EFFECTIVENESS OF COGNITIVELY GUIDED INSTRUCTIONAL STRATEGY ON MATHEMATICS ANXIETY AND ACHIEVEMENT IN MATHEMATICS OF UPPER PRIMARY SCHOOL STUDENTS

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Thesis
Submitted for the degree of

DOCTOR OF PHILOSOPHY IN EDUCATION

DEPARTMENT OF EDUCATION
UNIVERSITY OF CALICUT
2015

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Certificate

I, **Dr. M. N. MOHAMEDUNNI ALIAS MUSTHAFA,** do hereby certify that this thesis entitled **EFFECTIVENESS OF COGNITIVELY GUIDED INSTRUCTIONAL STRATEGY ON MATHEMATICS ANXIETY AND ACHIEVEMENT IN MATHEMATICS OF UPPER PRIMARY SCHOOL STUDENTS** is a record of bonafide study and research carried out by **SUNITHA. T.P**, under my supervision and guidance and that it has not been previously formed the basis for the award of any other Degree, Diploma, title or recognition.

The thesis is revised as per the modifications and recommendations reported by the adjudicators and re-submitted.

Place: Calicut University **Dr. M.N. MOHAMEDUNNI ALIAS MUSTHAFA**
Date: (*Supervising teacher*)

DECLARATION

I, **SUNITHA T.P.,** do here by declare that this thesis, entitled **EFFECTIVENESS OF COGNITIVELY GUIDED INSTRUCTIONAL STRATEGY ON MATHEMATICS ANXIETY AND ACHIEVEMENT IN MATHEMATICS OF UPPER PRIMARY SCHOOL STUDENTS** is an original work done by me under the supervision of **Dr. M.N. Mohamedunni Alias Musthafa,** Associate Professor, Department of Education, Central University of Kerala (On lien, Assistant Professor, Department of Education, University of Calicut) for the award of Degree of Doctor of Philosophy in the faculty of Education. I also declare that this thesis or any part of it has not been submitted by me for the award of any other Degree, Diploma, title or recognition before.

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Acknowledgement

The investigator expresses her deepest sense of gratitude and indebtedness to her Supervising Teacher, ***Dr. M. N. Mohamedunni Alias Musthafa***, Associate Professor, Department of Education, Central University of Kerala (Assistant Professor on lien, Department of Education, University of Calicut), for his constant support, encouragement and enduring patience throughout the investigation. He has always been a source of inspiration and without his timely guidance and expertise the study would not have been completed successfully.

The investigator would like to acknowledge her profound gratitude to **Dr. K. Abdul Gafoor**, Head of the Department of Education, University of Calicut and **Dr. P.K. Aruna** and **Dr. K.P. Meera**, former Heads of the Department of Education, University of Calicut for providing the facilities and for their support, encouragement and whole hearted co-operation. The investigator also extends her sincere thanks to **Dr. P. Usha**, Associate Professor, Department of Education and all other faculty members of the Department for their valuable suggestions and kind support.

The investigator acknowledges her sincere thanks to **Dr. A. Hameed,** Assistant Professor, Department of Education, University of Calicut for giving permission to adopt Verbal Group Test of Intelligence (Kumar, Hameed & Prasanna, 1997) for the study.

The investigator extends her heartfelt thanks to the Students, concerned Teachers and Heads of GMHSS, Calicut University and AUPS, Velimukku for their whole hearted co-operation. The investigator is also thankful to all the Heads of institutions, Teachers and Students of various schools for their co-operation during the survey.

The investigator is deeply grateful to all experts and teachers who extended their valuable suggestions at the time of preparation and validation of tools as well as in various stages of the study.

The investigator expresses her heartfelt gratitude to all research scholars of Department of Education who had contributed directly or indirectly in varying degrees to the successful completion of the study and naming a few will be injustice.

The investigator extends her love towards all her friends without whose loving support, care and encouragement the study would not have been completed successfully.

There are a few persons who are like pillars of life. This study is one of the fruits of the love, care and never ending support extended by them and pains taken by them. The investigator would like to remember her family, with deepest of love.

SUNITHA T.P.

CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

Chapter I

INTRODUCTION

- *Need and Significance of the Study*
- *Statement of the Problem*
- *Definition of Key Terms*
- *Variables of the Study*
- *Objectives of the Study*
- *Hypotheses of the study*
- *Methodology*
- *Scope and Limitations of the Study*
- *Organization of the Report*

Individual and societal expectations on transfer of knowledge, skills and values gained from the school to real life are foundations of the very existence of schools. Whatever students learn, in educational institutions, is useful only when they can apply the same in the everyday life. Whatever is taught in the school, it is assumed that children will use that knowledge, skills, attitudes and information to solve problems of life after completing their formal education. The different disciplines of the school curriculum are arranged and sequenced to attain this envisioning ultimately. In this aspect, each discipline has its own significant role to play. Mathematical thinking is a fundamental part of human thought and logic, and integral instrument to attempts at understanding the world and ourselves. In almost every domain of life, whether it is, simple day to day work or more complicated and long term dealings or sophisticated technology having direct or indirect relation to the life of the common man, the knowledge of Mathematics is quite essential.

Considering the societal perspective and significance, mathematical competence is both an essential component of the preparation of an informed citizenry and a requisite for the education of personnel required by industry, technology, engineering and science. This emphasises mathematical literacy as a crucial attribute of individuals living more effective lives as constructive, concerned and reflective citizens. Mathematical literacy includes basic computational skills, quantitative reasoning, spatial ability etc. Mathematical literacy or numeracy is vital to the life opportunities and achievements of each individual. In addition, Mathematics provides an effective way of building mental discipline and encourages logical reasoning and mental rigor. That is why the study of Mathematics occupies a central place in the school programmes of all countries.

Mathematics has a transversal nature as it is applied in various fields and disciplines providing vital underpinning of the knowledge economy. Mathematics is the language of Science. Mathematics concepts and procedures are essential in technology, physical sciences, engineering, financial services, business, and many areas of Information and Communication Technology (ICT). It is of much importance in medicine, biology, many of social sciences and even in music and art. Mathematics forms the basis of most scientific and industrial research and development and many complex systems and structures in the modern world can only be understood by applying mathematical concepts and methodologies.

The complexity of technology often requires quite sophisticated mathematical concepts and procedures when compared to the aforementioned mathematical literacy. The value of mathematical education and the power of Mathematics in the modern world arise from the cumulative nature of mathematical knowledge. A small collection of simple facts combined with simple theory is used to build layer upon layer of even more sophisticated mathematical knowledge. The essence of mathematical learning is the process of understanding each new layer of knowledge and thoroughly mastering that knowledge in order to be able to understand the successive layers in a hierarchical form.

Mathematics introduces children to concepts, skills and thinking strategies that are essential in everyday life and support learning across the curriculum. It helps children make sense of the numbers, patterns and shapes they see in the world around them, offers ways of handling data in an increasingly digital world and makes a crucial contribution to their development as successful learners. Children feel delighted in using Mathematics to solve a problem, especially when it leads them to an unexpected discovery or new physical and cognitive connections. As their confidence grows, they look for patterns, use logical reasoning, suggest solutions and try out different approaches to problem solving.

Mathematics offers children a powerful way of communication. They learn to explore and explain their ideas using symbols, diagrams and spoken and written language. They start to discover how Mathematics has developed over time and contribute to our economy, society and culture. Studying Mathematics stimulates curiosity, fosters creativity and equips children with the skills they need in life beyond school. Many everyday transactions and real-life problems, and most forms of employment, require confidence and competence in a range of basic mathematical skills and knowledge – such as measurement, manipulating shapes, organizing space, handling money, recording and interpreting numerical and graphical data, and using ICT.

Need and Significance of the Study

Mathematics is a highly structured body of knowledge. So success in Mathematics depends on systematic, cumulative learning and each new skill needs to be built on solid foundation laid at earlier stages. So Mathematics teaching-learning at the primary level of schooling is of so much importance. Foundations for the learning of various branches of Mathematics are laid at primary level of education. At this level students learn numbers and number systems, basic operations on numbers which are the basics of Arithmetic. Students are taught concepts related to lines, shapes, area and volume which form the preliminaries of Geometry. They also learn about equations and number sentences by the end of upper primary level which are the basic concepts of Algebra.

Moreover, childhood is a period of rapid change and studies show that foundations of attitudes are formed early. According to Newstead (1998), age 9 to 11 is a critical stage for the development of attitudes and emotional reactions towards Mathematics. Although attitudes may deepen or change throughout school age, negative attitudes and anxieties once formed are difficult to change and may continue to adult life and it may have far reaching consequences.

The overall performance in Mathematics and Mathematics learning outcomes depends on a wide range of factors related to the psycho-social conditions of the learner, school experiences of the child, factors related to the teacher and so on. Even then, the mindset of the individual learner and the subsequent habit formation in the learner are worthwhile. These factors in a configured manner result into the general habit in learner which is manifested in the form of some kind of phobia or high rigor as the case may be in dealing with Mathematics or situations related to Mathematics. The above mentioned negative form of behavior is described as Mathematics Anxiety by some researchers.

Mathematics Anxiety is a phenomenon that is very often considered when examining student's problems in Mathematics. Ashcraft (2002) suggests that highly anxious math students will avoid situations in which they have to perform mathematical equations. Math avoidance results in less competency, exposure and math practice, leaving students more anxious and mathematically unprepared to achieve. Adverse effects of Mathematics Anxiety as reported by various researchers are inability to do Mathematics related activities, decline in Mathematics achievement, low grades in Mathematics, avoidance of Mathematics courses, limitations in selecting subjects for higher studies and future careers, poor Mathematics performance in exams and the negative feelings of guilt and shame.

Although there are many reasons for the development of Mathematics Anxiety, like societal, educational and environmental factors, innate characteristics of Mathematics, usually Mathematics Anxiety stems from unpleasant experiences related to Mathematics teaching and learning. That means Mathematics Anxiety is a composite product of class room experiences and teacher factors. Recent works on classroom and school effects have suggested that teacher effects account for a large part of variation in Mathematics achievement of students.

Therefore it is very essential that the curricular experiences be provided in a sequentially arranged, cognitively and chronologically optimized manner. Mathematics instruction is most effective when it is based on individual differences of the students. Successful differentiation and individualization of Mathematics teaching depends greatly on teacher's knowledge of student's mathematical thinking. There are a few instructional strategies to foster mathematical thinking and mathematics achievement based on this principle, especially in the research realm of western countries. Cognitively Guided Instruction is an approach based on this principle. It leads to student centered learning as teachers focus on what students know and help them build future understanding based on present knowledge.

Cognitively Guided Instruction is not a traditional primary school Mathematics programme. It is an approach to teaching Mathematics rather than a curriculum program. It's a tenet of Cognitively Guided Instruction that there is no one way to implement the approach and that teacher's professional judgment is central to making decisions about how to use information about children's thinking. It provides a basis for identifying what is difficult and what is easy for students to comprehend in their study of Mathematics. It also provides a way for dealing with the common errors students make while learning. The emphasis is on what children can do, rather than on what they cannot do, which leads to a very different approach regarding incorrect answers. With the Cognitively Guided Instruction approach, teachers focus on what students know and help them build future understanding based on present knowledge.

Review of the research on Cognitively Guided Instruction shows that it has significant effect on student achievement. In the initial experimental study on teachers (Carpenter, Fennema, Peterson, Chiang & Loef, 1989) found that Cognitively Guided Instruction classes had significantly higher levels of achievement in problem solving than control classes had. Although there was significantly less emphasis on number skills in Cognitively Guided Instruction classes, there was no difference between the groups in achievement on the test of number skills.

Villasenor and Kepner (1993) found that urban students in Cognitively Guided Instruction classes performed significantly higher than a matched sample of students in traditional classes. Further effectiveness of Cognitively Guided Instruction with students from typically under achieving groups can be found in Carey, Fennema, Carpenter and Franke (1995) and Peterson, Fennema and Carpenter, (1991). A study conducted by Promising Practices Network concluded that Cognitively Guided Instruction Students score higher on complex addition and subtraction problems.

Since 1997, a lot had changed in Kerala education system with introduction of process oriented activity based approach and continuous and comprehensive evaluation in the school curriculum. Kerala Curriculum Framework (2007) mentioned the Mathematics fear factor among learners and suggestions were made to overcome this particularly at upper primary level. Constructivist approach integrated with critical pedagogy and issue based approach in text books were implemented and are in effect. Learning is more child-centered and related to real life situations. But the present system of mathematical instruction, though a system of reformations has been brought about as a result of shift in curricular approach, is not satisfactory in terms of achievement and developing problem solving competencies. Joyful learning of Mathematics is over considered, mean while the conceptualization and sequencing of Mathematics thinking is under considered. There is dearth of effective curriculum programmes and instructional strategies which simultaneously reduce anxiety among learners and ensure achievement in what is expected from Mathematics learning. Hence there is need for developing an instructional strategy based on Cognitively Guided Instruction for teaching Mathematics at upper primary level which is effective enough to reduce Mathematics Anxiety and ensures better Achievement in Mathematics of students.

This research effort is intended to develop such an instructional strategy and to test its effectiveness in terms of reduction in Mathematics Anxiety and increase in Achievement in Mathematics.

Statement of the Problem

The present study is to develop an instructional strategy based on Cognitively Guided Instruction for teaching mathematical concepts at the upper primary level and to study the effectiveness of the developed instructional strategy in reducing Mathematics Anxiety and in enhancing Achievement in Mathematics of students. So the study is entitled as **EFFECTIVENESS OF COGNITIVELY GUIDED INSTRUCTIONAL STRATEGY ON MATHEMATICS ANXIETY AND ACHIEVEMENT IN MATHEMATICS OF UPPER PRIMARY SCHOOL STUDENTS**.

Definition of Key Terms

Effectiveness

Effectiveness is the capability to produce empirically demonstrated effects on the learner. According to Guralnik (1975), effectiveness means 'producing a desired effect'.

In the present study effectiveness refers to the change brought about in the learner at upper primary level by the treatment of Cognitively Guided Instructional Strategy over Existing method of teaching as evidenced from the significant difference in the mean scores of Mathematics Anxiety and Achievement in Mathematics between students who are taught Mathematics through Cognitively Guided Instructional Strategy and Existing method of teaching.

Cognitively Guided Instructional Strategy

Cognitively Guided Instruction is "a program based on an integrated program of research on (a) the development of student's mathematical thinking; (b) instruction that influences that development; (c) teacher's knowledge and believes that influence their instructional practice, and (d) the way that teacher's knowledge, believes, and practices are influenced by their understanding of student's mathematical thinking" (Carpenter, Fennema, Franke, Levi, Empson, 1999).

Cognitively Guided Instructional Strategy is operationally defined as the three phased instructional strategy, designed and developed by the investigator, based on Cognitively Guided Instruction to impart Mathematics concepts at upper primary level.

Mathematics Anxiety

Mathematics Anxiety is defined as "a feeling of tension, apprehension, or fear that interferes with math performance" (Ashcraft, 2002).

In the present study, Mathematics Anxiety is defined as an intrinsic fear a learner at upper primary level experiences in Mathematics related situations which interferes with performance in Mathematics related academic and daily life activities measured in terms of response to statements in a Likert type scale prepared and standardized for upper primary school students of Kerala.

Achievement in Mathematics

According to Good (1973), achievement is accomplishment or proficiency of performance in a given skill or body of knowledge.

In the present study, Achievement in Mathematics refers to the tangible accomplishment or proficiency of performance in Mathematics as measured by a test of Achievement in Mathematics prepared and standardized for upper primary school students of Kerala.

Upper Primary School Students

Upper primary school students are students studying in standard V, VI and VII classes of any school recognized by the Government of Kerala.

In the present study, the students of standard VI are taken as representatives of the three standards of upper primary education.

Variables of the Study

Independent Variable

The independent variable selected for the study is Instructional strategy. It has two levels, Cognitively Guided Instructional Strategy and Existing method of teaching.

Dependent Variables

The following variables are selected as dependent variables for the present study.

- Mathematics Anxiety
- Achievement in Mathematics

The dependent variable Achievement in Mathematics was further divided into:

- Achievement in Mathematics (Lower order objectives)
- Achievement in Mathematics (Higher order objectives)

Control Variables

The variables controlled in the present study are as follows.

- Pre- Achievement in Mathematics
- Verbal Intelligence
- Non-verbal Intelligence

Criterion Variable

The criterion variable selected for the preliminary survey is Mathematics Anxiety

Classificatory Variables

Gender and Grade are the two classificatory variables selected for the preliminary survey.

Objectives of the Study

1. To identify the existing level of Mathematics Anxiety of upper primary school students
2. To compare the existing level of Mathematics Anxiety of different subgroups of upper primary school students based on
    i. Gender (Boys/Girls)
    ii. Grade (Standard V/Standard VI/Standard VII)
3. To develop an instructional strategy based on Cognitively Guided Instruction for teaching Mathematics at upper primary level
4. To find out the effectiveness of Cognitively Guided Instructional Strategy in reducing Mathematics Anxiety of upper primary school students for Total sample and subsamples based on Gender
5. To find out the effectiveness of Cognitively Guided Instructional Strategy in enhancing Achievement in Mathematics (Total, Lower order objectives, Higher order objectives) of upper primary school students for Total sample and subsamples based on Gender
6. To compare the effectiveness of Cognitively Guided Instructional Strategy and Existing method of teaching in reducing Mathematics Anxiety of upper primary school students for Total sample and subsamples based on Gender
7. To compare the effectiveness of Cognitively Guided Instructional Strategy and Existing method of teaching in enhancing Achievement in Mathematics (Total, Lower order objectives, Higher order objectives) of upper primary school students for Total sample and subsamples based on Gender

Hypotheses of the study

1. There is no significant difference in the existing level of Mathematics Anxiety of different subgroups of upper primary school students based on
   i. Gender (Boys/ Girls)
   ii. Grade (Standard V/Standard VI/Standard VII)
2. There is no significant difference in the mean pretest score of Mathematics Anxiety between experimental and control groups for
   a) Total sample
   b) Subsample Boys
   c) Subsample Girls
3. There is no significant difference in the mean pretest score of Achievement in Mathematics (Total) between experimental and control groups for
   a) Total sample
   b) Subsample Boys
   c) Subsample Girls
4. There is no significant difference in the mean pretest score of Achievement in Mathematics (Lower order objectives) between experimental and control groups for
   a) Total sample
   b) Subsample Boys
   c) Subsample Girls
5. There is no significant difference in the mean pretest score of Achievement in Mathematics (Higher order objectives) between experimental and control groups for
   a) Total sample
   b) Subsample Boys
   c) Subsample Girls

6. There is significant difference between the mean pretest and posttest scores of Mathematics Anxiety of the experimental group for
   a) Total sample
   b) Subsample Boys
   c) Subsample Girls
7. There is significant difference between the mean pretest and posttest scores of Achievement in Mathematics (Total) of the experimental group for
   a) Total sample
   b) Subsample Boys
   c) Subsample Girls
8. There is significant difference between the mean pretest and posttest scores of Achievement in Mathematics (Lower order objectives) of the experimental group for
   a) Total sample
   b) Subsample Boys
   c) Subsample Girls
9. There is significant difference between the mean pretest and posttest scores of Achievement in Mathematics (Higher order objectives) of the experimental group for
   a) Total sample
   b) Subsample Boys
   c) Subsample Girls
10. There is significant difference in the mean posttest score of Mathematics Anxiety between experimental and control groups for
    a) Total sample
    b) Subsample Boys
    c) Subsample Girls

11. There is significant difference in the mean posttest score of Achievement in Mathematics (Total) between experimental and control groups for
    a) Total sample
    b) Subsample Boys
    c) Subsample Girls
12. There is significant difference in the mean posttest score of Achievement in Mathematics (Lower order objectives) between experimental and control groups for
    a) Total sample
    b) Subsample Boys
    c) Subsample Girls
13. There is significant difference in the mean posttest score of Achievement in Mathematics (Higher order objectives) between experimental and control groups for
    a) Total sample
    b) Subsample Boys
    c) Subsample Girls
14. There is significant difference in the mean change score of Mathematics Anxiety between experimental and control groups for
    a) Total sample
    b) Subsample Boys
    c) Subsample Girls
15. There is significant difference in the mean gain score of Achievement in Mathematics (Total) between experimental and control groups for
    a) Total sample
    b) Subsample Boys
    c) Subsample Girls

16. There is significant difference in the mean gain score of Achievement in Mathematics (Lower order objectives) between experimental and control groups for
    a) Total sample
    b) Subsample Boys
    c) Subsample Girls
17. There is significant difference in the mean gain score of Achievement in Mathematics (Higher order objectives) between experimental and control groups for
    a) Total sample
    b) Subsample Boys
    c) Subsample Girls
18. There is significant difference in the adjusted mean score of Mathematics Anxiety between experimental and control groups by considering Pre- Achievement in Mathematics, Verbal Intelligence and Non-verbal Intelligence as covariates for
    a) Total sample
    b) Subsample Boys
    c) Subsample Girls
19. There is significant difference in the adjusted mean score of Achievement in Mathematics (Total) between experimental and control groups by considering Pre- Achievement in Mathematics, Verbal Intelligence and Non-verbal Intelligence as covariates for
    a) Total sample
    b) Subsample Boys
    c) Subsample Girls

20. There is significant difference in the adjusted mean score of Achievement in Mathematics (Lower order objectives) between experimental and control groups by considering Pre- Achievement in Mathematics, Verbal Intelligence and Non-verbal Intelligence as covariates for
    a) Total sample
    b) Subsample Boys
    c) Subsample Girls
21. There is significant difference in the adjusted mean score of Achievement in Mathematics (Higher order objectives) between experimental and control groups by considering Pre- Achievement in Mathematics, Verbal Intelligence and Non-verbal Intelligence as covariates for
    a) Total sample
    b) Subsample Boys
    c) Subsample Girls

Methodology

A brief description of the procedure adopted to realize the objectives of the study are presented in this section.

The study consists of a preliminary survey and experimental study. The preliminary survey was conducted to identify the existing level of Mathematics Anxiety of upper primary students and to study whether upper primary students belonging to subgroups based on Gender and Grade differ significantly in terms of Mathematics Anxiety. For this, data was collected from students studying in standard V, VI and VII. An instructional strategy based on Cognitively Guided Instruction was developed, implemented and tested for its effectiveness. To test the effectiveness in terms of Mathematics Anxiety and Achievement in Mathematics Anxiety, quasi experimental method was employed. The design selected for the study was pretest – posttest non equivalent groups design.

Sample Selected for the Study

The population of the study was upper primary school students of Kerala. The preliminary survey was conducted among upper primary students of Palakkad and Malappuram districts. The sample consisted of 400 upper primary students drawn using stratified random sampling from seven randomly selected schools of Palakkad and Malappuram districts. For experimental study, four intact class divisions of standard VI were selected randomly from two different schools selected conveniently from Malappuram district. In each school there was one experimental and control class each. The total sample for the experiment consisted of 128 upper primary school students.

Tools and Materials Used for Data Collection

The following tools and materials were employed to collect data for the present study.

- Mathematics Anxiety Scale (Musthafa & Sunitha, 2012)
- Lesson Transcripts based on Cognitively Guided Instructional Strategy (Musthafa & Sunitha, 2013)
- Lesson Transcripts on Existing method of teaching (Musthafa& Sunitha, 2013)
- Test of Achievement in Mathematics (Musthafa & Sunitha, 2013)
- Verbal Group Test of Intelligence (Kumar, Hameed & Prasanna, 1997)
- Standard Progressive Matrices Test (Raven, 1958)

Statistical Techniques Employed

Following are the major statistical techniques used to analyse the data collected from preliminary survey and experimental study.

The data collected from preliminary survey was analysed using the following statistical techniques.

- Basic descriptive statistics
- Test of significance of difference between mean scores of two independent groups
- ANOVA

The statistical techniques used to analyse the data collected from the experimental study are as follows.

- Basic descriptive statistics
- Standardized skewness and kurtosis
- Correlation coefficient
- Test of significance of difference between mean scores of
  - Two independent groups
  - Two dependent groups
- Analysis of Covariance (ANCOVA)
- Bonferroni's Test of Post hoc Comparison
- Effect size (Cohen's *d* and Partial Eta Squared)

Scope and Limitations of the Study

The present study aims to develop an instructional strategy based on Cognitively Guided Instruction approach to Mathematics instruction and to test its effectiveness in terms of reducing Mathematics Anxiety and enhancing Achievement in Mathematics of upper primary school students. The effectiveness of the developed instructional strategy in enhancing Achievement in lower order and higher order objectives of Mathematics instruction is also tested. In addition, the study investigates the existing level of Mathematics Anxiety of upper primary school students through a preliminary survey. The gender differences and grade differences in the level of Mathematics Anxiety of upper primary school students is also studied.

Before finalizing the variable under consideration a thorough review on the theoretical framework and observation of other researchers pertaining to this area were done effectively. This gives a sound theoretical basis for Mathematics Anxiety and Cognitively Guided Instruction in this study.

The instructional strategy was developed adhering to the norms and procedures derived by the investigator through literature review and also in consultation with experts in the field.

Upper primary school students from two different schools of Malappuam district of Kerala constituted the sample for the experimental study. However, the investigator hopes that the results of the study will be generalisable to upper primary school students of Kerala. Even though the schools selected are in close proximity, the two schools differ in terms of type of management, school environment and family background of students. Students from both the schools were included in experimental as well as control groups and were taught in their own classes without disturbing the order of functioning of the school.

As part of the study, in addition to Cognitively Guided Instructional Strategy and lesson transcripts based on the strategy, Mathematics Anxiety Scale for upper primary school students was developed and standardised using appropriate item analysis techniques and component analysis. The scale was standardised on a large representative sample of upper primary school students. It will be useful for future researches related to Mathematics Anxiety.

Standardised tools were used for collecting relevant data and utmost care has been taken in administration of the tools. The collected data was analysed using appropriate statistical techniques. Even though the students were not assigned randomly to experimental and control groups, the initial differences if any between the groups in terms of previous knowledge, verbal intelligence and nonverbal intelligence were statistically controlled using analysis of covariance. These ensure the validity of results of the study.

The researcher adopted sequential and systematic procedures for experimentation by eliminating the effect of extraneous variables to the maximum extent possible. The effect of the developed instructional strategy was compared with that of the existing method of teaching in terms of reducing Mathematics Anxiety and enhancing Achievement in Mathematics using adequate and appropriate statistical procedures. Hence the investigator hopes that the result evolved out of this research attempt is highly valid and generalisable.

Malappuram revenue district was the actual field of experiment and the investigator delimited the sample to the schools of Malappuram district. However, for the preliminary survey the investigator planned to include schools from four districts. Due to time constraints the sample for the preliminary survey was selected from only two districts of the state. This forms a limitation of the study.

The sample selected for the experiment consisted of Malayalam medium students only. The developed Cognitively Guided Instructional Strategy calls for sharing of different solution strategies by students and discussions of the strategies. So mother tongue was selected as the medium of instruction. However, the teachers can accommodate students with different abilities and limited language skills in the class room with carefully chosen learning experiences as reported by various researchers related to Cognitively Guided Instruction.

Among various affective and cognitive variables related to Mathematics teaching and learning only Mathematics Anxiety and Achievement in Mathematics were selected for the present study as felt most relevant by the investigator. The study focused on ways and means of reducing Mathematics Anxiety and enhancing Achievement in Mathematics.

The investigator could have attempted a longer intervention using Cognitively Guided Instruction as reported effective in various studies, but owing to practical reasons only two units of standard VI mathematics content were selected for intervention.

In spite of the limitations mentioned above, the investigator hopes that the present study will yield valuable contributions to the theory and practice of education, especially to the mathematics education at primary level.

Organization of the Report

The report of the study is organized in six chapters. The details incorporated in each chapter are as follows.

Chapter I presents a brief introduction of the problem, need and significance of the study, statement of the problem, definition of key terms used in the title, variables of the study, objectives set for the study and the hypotheses formulated, a brief description of methodology, scope and limitations of the study.

Chapter II presents the theoretical overview of the variables in the present study.

Chapter III presents the different studies reviewed and observations of other researchers related to the variables: Mathematics Anxiety and Cognitively Guided Instruction. Trends of research related to the variables are also presented.

Chapter IV includes the methodology of the study in detail. It comprises detailed description of design, sample, methods and materials of data collection, data collection procedure and statistical techniques used for analysis of collected data.

Chapter V deals with the statistical analysis of the data, interpretations and discussions of results.

Chapter VI contains summary of the study, major findings, tenability of hypotheses and conclusion derived. It also presents a detailed description of educational implications of the study and suggestions for further research.

Chapter II

THEORETICAL OVERVIEW

- *Theoretical Overview of Mathematics Anxiety*
- *Theoretical Overview of Cognitively Guided Instruction*
- *Theoretical Overview of Instructional Strategy*

THEORETICAL OVERVIEW

A thorough analysis of the theoretical background of the various concepts and variables related to the study helps to get a meaningful and deeper insight for designing the study.

This chapter has been devoted for presenting theoretical overview of Mathematics Anxiety, Cognitively Guided Instruction and Instructional strategy and these are presented under the following headings.

- Theoretical Overview of Mathematics Anxiety
- Theoretical Overview of Cognitively Guided Instruction
- Theoretical Overview of Instructional Strategy

Theoretical Overview of Mathematics Anxiety

Mathematics Anxiety- Conceptual framework

Mathematics anxiety is an intense emotional feeling of anxiety that people have about their ability to understand and do mathematics. People who suffer from mathematics anxiety feel that they are incapable of doing activities and classes that involve mathematics. Some math anxious people even have a fear of mathematics; it's called 'math phobia'. "Mathematics anxiety is an emotional rather than intellectual problem. As it interferes with a person's mathematics learning ability, it becomes an intellectual problem".

Researchers' interest in mathematics anxiety started in the early 1950s with the observations of mathematics teachers. In 1957, Dreger and Aiken introduced mathematics anxiety as a new term to describe students' attitudinal difficulties with Mathematics (Baloglu and Zelhart, 2007).

Different researchers had defined mathematics anxiety in a variety of ways. Some of the definitions are as follows:

According to Dreger and Aiken (1957) mathematics anxiety "is the presence of a syndrome of emotional reactions to arithmetic and mathematics".

Richardson and Suinn (1972) defined mathematics anxiety as "feelings of tension and anxiety that interfere with the manipulation of numbers and the solving of mathematical problems".

Tobias and Weissbrod (1980) describe math anxiety as "the panic, helplessness, paralysis, and mental disorganization that arises among some people when they are required to solve a mathematical problem".

Suinn, Taylor and Edwards (1988) defined mathematics anxiety as "feelings of tension and anxiety that interfere with the manipulation of numbers and the solving of mathematical problems in a wide variety of ordinary life and academic situations".

According to Ashcraft (2002) mathematics anxiety is "a feeling of tension, apprehension, or fear that interferes with Math performance".

Brady and Bowd (2005) defined mathematics anxiety as a combination of "debilitating test stress, low self confidence, fear of failure, and negative attitudes toward mathematics learning".

Mathematics anxiety has psychological as well as physical symptoms. Some of the psychological symptoms of mathematics anxiety are panic or fear, worry and apprehension, desire to flee the situation or avoid it altogether, a feeling of helplessness or inability to cope, mental disorganization, incoherent thinking, inability to recall material studied etc. Some of the physical symptoms of mathematics anxiety are queasy stomach, clammy hands and feet, increased or irregular heartbeat, muscle tension, feeling faint, shortness of breath etc.

Where Does Mathematics Anxiety Come From?

There are many reasons for development of mathematics anxiety in a student.

Mathematics Anxiety can be related to:

1) Attitudes of parents, teachers or other people in the learning environment.
2) Impact of some specific incident in a Student's mathematics history, which was frightening or embarrassing.
3) Teaching techniques which emphasize-time limits, the right answer, speed in getting the answer, competition among students, working in isolation, memorization rather than understanding.
4) Student attitudes like distrust of intuition or ability, negative self-talk, giving up before beginning, depression and feelings of failure, expectations of divine intervention.
5) Nature of mathematics itself, which requires students to think clearly, cleanly and often abstractly.
6) Mishandling of any of the mathematics disabilities like
    a) Difficulty with basic mathematics facts and memory.
    b) Weakness in doing calculations.
    c) Inability to apply mathematics concepts.
    d) Struggles with visual and spatial relationship.
7) A mathematics disability like dyscalculia or weak learning styles.

Although there are many reasons for mathematics anxiety, usually mathematics anxiety stems from unpleasant experiences in mathematics. According to Greenwood (1984), "evidence suggests that mathematics anxiety results more from the way the subject is presented than from the subject itself". Unfortunately, mathematics anxiety is often due to poor teaching and poor experiences in Mathematics.

Three practices that are a regular part of the mathematics class room and cause great anxiety in many students are imposed authority, public exposure and time deadlines.

Theories related to mathematics anxiety

Traditional Arousal theory

The traditional arousal theorists state that there exists an optimal level of arousal around the middle of the arousal dimension. This idea is graphically represented as an inverted U-curve depicting a curvilinear relationship between anxiety and performance. Thus this arousal theory indicates that some anxiety is beneficial to performance, but after a certain point it undermines performance (Ma, 1999).

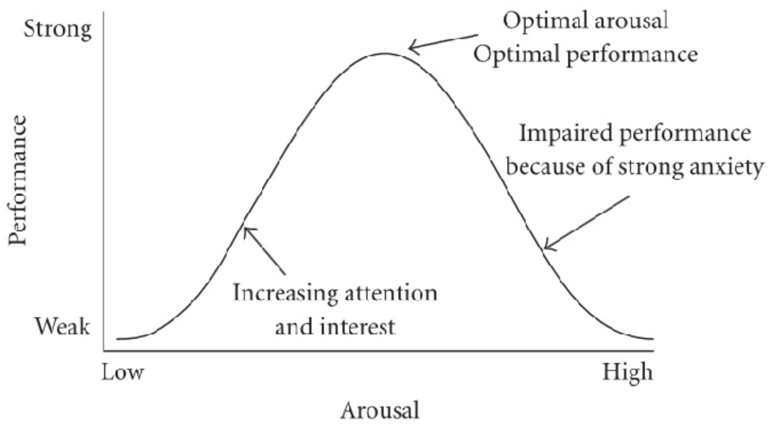


Figure 1. Inverted U curve

Several researchers have noted the nonlinear relationship between anxiety and mathematics achievement. Munz and Smouse's (1968) inverted U curvilinear hypothesis "implies that there is a degree of arousal which is optimal for performing a given task." According to this model, moderately anxious individuals perform better than "nonaffecteds" or "high affecteds". (Bessant, 1995)

Two factor theory of test anxiety

Liebert and Morris (1967) were the first to propose a two factor model of test anxiety that distinguished between an affective 'emotionality' and a cognitive 'worry' dimension of test anxiety.

Affective test anxiety: refers to the emotionality component of anxiety displayed through feelings of nervousness, tension, dread, fear and unpleasant physiological reactions to testing situations.

Cognitive anxiety: refers to the worry component of anxiety, which is often displayed through negative expectations, preoccupation with and deprecatory thoughts about an anxiety causing situation.

This two factor model that taps both affective and cognitive dimensions has also been found to be relevant to math anxiety. However, the pattern of associations between the dimensions of math anxiety and mathematics performance appears to differ from that for test anxiety and performance i.e., where as the cognitive worry factor of general test anxiety is reported to correlate negatively with test performance, for measures of math anxiety it is the affective factor that correlates negatively with math performance (Ho et al., 2000).

Wigfield and Meece (1988) claims that the negative affective reactions component of math anxiety may be debilitating, while the cognitive component may actually have some positive motivational consequences for the amount of efforts students put into mathematics and thus for mathematics performance. Depending on the individual and the task a moderate amount of anxiety may then actually facilitate performance. Beyond a certain point, however anxiety becomes debilitating in terms of performance; particularly in the case of higher mental activities and conceptual processes. Thus although mathematics anxiety may in some cases have positive effects, it is perhaps more important for educationalists to focus on its possible negative consequences for performance (Newstead, 1998).

Linear Relationship between Mathematics Anxiety and Performance

Most researchers however start with the linear notion that anxiety seriously impairs performance. Specifically, a higher level of anxiety is associated with a lower level of achievement. This negative relationship has been displayed across several age populations. Mathematics anxiety is negatively correlated with Mathematics performance among adults in general and college students in particular. This negative relationship also appears at the elementary and secondary school levels. Hembree (1990) reported an average negative correlation for school students and concluded that mathematics anxiety seriously constraints performance in mathematical tasks and that reduction in anxiety is consistently associated with improvement in achievement (Ma, 1999).

Studies show that the theoretical explanation of the negative relationship has roots in the theory of test anxiety. Many researchers view mathematics anxiety as a subject specific manifestation of test anxiety. Theoretical models of test anxiety are presumed to support math anxiety as well (Ho et al., 2000).

Two theoretical models of test anxiety have been influential in the research on mathematics anxiety.

Interference model

Based on the work of Liebert and Morris (1967); Mandler & Sarason (1952) and Wine (1971) researchers have described mathematics anxiety as a disturbance of the recall of prior mathematics knowledge and experience. Consequently, a high level of anxiety causes a low level of achievement (Ma, 1999).

Deficit model

Tobias (1985) regarded mathematics anxiety as the remembrance of poor mathematics performance in the past and believed that poor performance causes high anxiety. According to this model, a student's low level of math achievement is attributed to poor study habits and test taking skills instead of to mathematics anxiety (Ma, 1999). Within this model math anxiety does not cause poor performance, the reverse is true; an awareness of poor past performance causes mathematics anxiety.

Consequences of Mathematics Anxiety

Some of the consequences that result from being mathematics anxious as opposed to mathematic-confident include

A) The fear to perform tasks that are mathematically related to real life incidents.
B) Avoidance of mathematics classes
C) Belief that it is alright to fail or dislike mathematics
D) Feelings of physical illness, faintness, fear or panic.
E) An inability to perform in a test or test-like situations,
F) The utilization of tutoring sessions that provide little success

(Vinson, Haynes, Sloan and Gresham, 1997)

Many researchers have reported the consequences of being math anxious including the inability to do mathematics, the decline in mathematics achievement, the avoidance of mathematics courses, the limitation in selecting college courses and future careers, and the negative feelings of guilt and shame (Ma, 1999). The consequences also include avoidance of mathematics (Hembree, 1990), distress (Tobias, 1978; Buxton, 1981) and interference with conceptual thinking and memory processes (Skemp, 1986).

According to Tobias (1985), millions of adults are blocked from professional and personal opportunities because they fear or perform poorly in mathematics. For many, these negative experiences remain throughout their adult lives. “Mathematics anxiety paralyses a child’s capacity to learn mathematics even though the intellectual capability is there”. Overcoming mathematics anxiety is necessary for being successful in mathematics and in life.

Relationship between Mathematics Anxiety and Mathematics Achievement

The relationship between mathematics anxiety and mathematics achievement can change dramatically for students with different social and academic background characteristics. The social and academic characteristics of students appear to be the key to unfolding this achievement-anxiety dynamic. When student characteristics are diverse and unique, so are the relationships. Mathematics anxiety can facilitate or debilitate or can be unassociated with mathematics performance (Ma, 1999).

While it is agreed that anxiety can have a motivational role and therefore a positive effect on performance(Wigfield & Meece,1988), it is also agreed that the higher mental processes such as problem solving and divergent thinking which are required for mathematics will be negatively influenced by mathematics anxiety (Newstead,1998).

Teacher Influences in Mathematics Anxiety

A negative attitude towards mathematics is a growing barrier for many children to mathematics (Ashcraft, 2002; Popham, 2008; Rameau and Louime, 2007). The child’s educational context at home and at school can affect this attitude (Scarpello, 2007). The children begin to construct the foundations for future mathematical concepts during the first few months of life (Geist, 2001). Before a child can add or even count, they must construct ideas about mathematics that cannot be directly taught. Many of these ideas are constructed through interaction with the surrounding environment and the adults in the environment. Ideas that will support formal mathematics latter in life such as order and sequence, seriation, comparisons, classification, addition and other more advanced mathematical skills have their genesis before the age of 5. As children enter formal schooling, the constructive process sometimes takes a turn for the worse (Geist, 2010). Studies have shown that at this time in children's learning of mathematics, text books take over the process of teaching and the focus shifts from construction of concepts using children's own mathematical thinking to teacher imposed methods of getting the correct answer. Teachers begin to focus on repetition and speed or 'timed tests' as important tool for improving mathematical prowess and skill which can undermine the child's natural thinking process and lead to a negative attitude toward mathematics. Children begin to associate mathematics with boring work that does not relate to their everyday life. Instead of helping children develop fluency at computation and become more efficient at problem solving, the policies have produced students who rely more on rote memorization and have increased the level of anxiety in young children.

Mathematics anxiety is a learned emotional response that usually comes from negative experiences in working with teachers, tutors, classmates, parents or siblings (Harding & Terrell, 2006). Goulding, Rowland and Barber (2002) suggest that there are linkages between a teacher's lack of subject knowledge and ability to effectively plan teaching material. These findings suggest that teachers who do not have a sufficient background in mathematics may struggle with the development of comprehensive lesson plans for their students. Moreover, Jackson and Leffingwell (1999) found that teacher is a prime determinant of mathematics anxiety and it is usually evident early on in the primary grades. Many teachers who have mathematics anxiety themselves inadvertently pass it on to their student. They have found that teachers' behaviours like negative speech, insufficient feedback, ignoring students or disappointing them may cause mathematics anxiety in a period starting from kindergarten to college. It was found by Johnson, Smith and Carinci (2010) that a number of studies had theorized that elementary school children do not develop mathematics anxiety independently but learn math anxious behaviours from teachers. According to Furner and Berman (2003), teachers who have negative feelings toward mathematics do not feel confident in teaching the subject, use poor instructional techniques, or are insensitive to students' needs, can foster a dislike for mathematics and feelings of mathematics anxiety in their students.

Mathematics is often taught as if all the students are not just similar, but identical in terms of ability, preferred learning styles, and pace of working (Boaler, 1997). Every child learns differently. They also respond differently to different instructional approaches (Leedy, LaLonde and Runk, 2003). Methods that emphasize the primacy of correct answers over concept development, competition and speed over understanding and rote repetition over critical thinking will exacerbate the problem. Research has shown that these methods inherently create anxiety among children.

So overcoming mathematics anxiety involves re-examining the methods of teaching mathematics in the classrooms. There are strategies that can reduce mathematics anxiety of students.

Strategies for Reducing or Overcoming Mathematics Anxiety of Students

Teachers have a major role in helping their children to reduce or overcome mathematics anxiety. They have to ensure students understand the mathematics being presented to them. According to Furner and Berman (2003), teachers benefit children most when they encourage them to share their thinking process and justify their answers out loud or in writing as they perform mathematics operations. With less emphasis on right or wrong and more emphasis on process teachers can help to alleviate students' anxiety about mathematics. National Council of Teachers of Mathematics (NCTM) suggestions for teachers seeking to prevent mathematics anxiety include:

- Accommodating for different learning styles
- Creating a variety of testing environments
- Designing positive experiences in mathematics classes
- Refraining from tying self esteem to success in math
- Emphasizing that everyone makes mistakes in mathematics
- Making math relevant
- Letting students have some input into their own evaluations
- Allowing for different social approaches to learn mathematics
- Emphasizing the importance of original, quality thinking rather than rote manipulation of formulae

Cruikshank and Sheffield, 1992 (as cited in Johnson, Smith and Carinci, 2010) suggested that in order to establish a positive classroom climate for teaching mathematics teachers should: show that they like mathematics; make mathematics enjoyable; show the use of mathematics in careers and everyday life; adapt instruction according to students' interests; establish short term attainable goals; provide successful activities; and use meaningful methods so that mathematics makes sense.

So it is important that teachers make efforts towards selecting teaching methods that cater to the needs of individual child and creating a student friendly atmosphere in the classroom.

Some of the strategies that help in alleviating mathematics anxiety are

Visual Learning

Visual learning is a proven teaching method in which ideas, concepts, data and other information are associated with images and represented graphically. Visual learning when combined with technology, enable students clarify thoughts, organize and analyze information, think critically and integrate new knowledge by visually seeing how items can be grouped and organized. Working visually inspires students to tap into their own creativity, to clarify their thoughts, reinforce understanding, integrate new knowledge and identify misconceptions. With visual learning, students use manipulatives, diagram and plots to display large amounts of information in ways that are easy to understand and help reveal relationship and patterns.

Techniques Used in Visual Learning

Some of the techniques used in visual learning to enhance thinking and learning skills are;

Webs: Webs are visual maps that show how different categories of information relate to one another. They provide structure for ideas and give students a flexible framework for organizing and prioritizing information. Typically, major topics or central concepts are at the centre of the web. Links from the centre connect supporting details or ideas with core concept or topic. Webbing is an effective technique to use in small group settings. As students work cooperatively, they can build collaborative webs incorporating the thoughts and contributions of each group member.

Idea Maps: Idea map connects key words, symbols, colours and graphics to form non-linear networks of potential ideas and thoughts. Idea maps help in writing assignments, in projects or presentations. This visual learning technique stimulates students to generate ideas, follow them through and develop their thoughts visually. Idea maps help students brainstorm, solve problems and plan their work.

Concept Maps: Two or more concepts are linked by words that describe their relationship, i.e., graphic illustrations of the relationships between information. Concept maps encourage understanding by helping students organize and enhance their knowledge on any topic. They help students learn new information by integrating each new idea into their existing body of knowledge. Concept maps are ideal for measuring the growth of student learning. As students create concept maps, they reiterate ideas using their own words. Misdirected links or wrong connections alert educators to what students do not understand, providing an accurate, objective way to evaluate areas in which students do not yet grasp concepts fully.

Plots, Graphs and Charts: Plots, Graphs and Charts are great ways for the student to visualize the data. As students explore the way data moves through various plot types, they discover meaning from the visual representation. Some of the various plots are Venn diagrams, Pie graph, and Vertical Bar Graph. Venn Diagrams are a powerful way to describe and compare attributes by separating objects into groups based on their characteristics. Venn plots show relationships between mathematical sets or can be used to identify the commonalities and differences between things, ideas or physical attributes. Pie graphs are used to graphically represent the distribution of the entire set of data. Patterns can be easily identified, as well as the values that have the largest or smallest representations. Pie graphs can be used to illustrate percentages of a whole or to numerically represent a category of facts. Vertical bar graphs are used to represent a range of data for one variable. These are ideal for comparison activities.

Accepting different approaches to problem solving

Students who suffer from mathematics anxiety are very uncomfortable with problem solving. Often this is because they are certain, there is one right way, and they just don't have it. Mathematics is usually taught as a right and wrong subject and as if getting the right answer is paramount. Additionally, the subject is often taught as if there is only a right way to solve a problem and any other approaches would be wrong, even if students get right answer through another approach. When learning understanding the concepts should be paramount. But with a right or wrong approach to teaching mathematics, students are encouraged not to try, not to experiment, not to find algorithms that work for them, and not to take risks.

So mathematics anxiety can be reduced by helping the students solve problems. Teachers can show them different approaches. It can be very helpful to encourage students to talk his way through a problem, even if it's very round about. Teachers should try not to rush, or guide. Let students feel that there is no one way to get to the answer. And that the most direct way isn't the only way or even the best way. Understanding the best way comes from having taken the long way around for most of us. Teachers can replace anxiety with greater comfort, simply by replacing the attitude and experience of problem solving.

Teaching taking into consideration different learning styles of students

The theory of Multiple Intelligence addresses the different learning styles. Lessons are to be presented for visual/spatial, logical/mathematical, musical, body/kinesthetic, interpersonal and intrapersonal and verbal/linguistic learners. Everyone is capable of learning but may learn in different ways. Therefore, lessons must be presented in a variety of ways. For example, different ways to teach a new concept can be through play acting, co-operative groups, visual aids, hands on activities and technology. As a result once young children take mathematics as fun, they will enjoy it and mathematics could remain with them throughout the rest of their lives.

Relating mathematics concepts to everyday life

Students today need practical mathematics. Therefore mathematics needs to be relevant to their everyday lives. Students enjoy experimenting. To learn mathematics, students must be engaged in exploring, conjecturing and thinking rather than, engaged only in rote learning of rules and procedures. Studies have shown students learn best when they are active rather than passive learners (Spikell, 1993). Students should be given examples that are relevant outside the classroom. According to Brady and Bowd (2005) it is important for students to make connections to real world applications in order to foster understanding and engagement in mathematics. Helping students see how mathematics is used in their lives can reduce anxiety.

Creating a non threatening learning environment

Creating a comfortable, calm, non-threatening learning environment in the mathematics classroom helps. To develop a positive class room culture conductive to enabling all students to learn important mathematics: select an activity that students could relate to; use many strategies to include all learners and to promote equity; provide support to students whenever they need it (Roddick and spitzer, 2010). Teachers should demonstrate caring for students' feelings and learning. Encourage students to ask questions and be willing to answer any and all that arise. Active learners ask critical questions and some teachers may find these questions annoying or difficult to answer and respond with hostility and contempt. Better teachers respond eagerly to these questions and use them to help the students to deepen their understanding by examining alternative methods. Then students can choose for themselves which method they prefer. This process can result in meaningful class discussions. Handling incorrect responses positively is important for encouraging student involvement and to enhance confidence. Teachers should never make a student feel 'stupid' deliberately or unintentionally. They should not prejudge a student's ability or make assumptions about a student's motivation, without exploring the background of the student. Teachers have to make efforts to become comfortable with each individual student and to show compassion.

Teaching for understanding

Teachers should teach for understanding, not just replication of the procedure demonstrated. Encourage students to maximize their ability to learn and not to give up. Teachers should worry more about student understanding than the quota of material to be covered for the day. Every student should not be expected to learn the first time itself when something is taught. Students need time to internalize what is being taught. Understanding mathematics is critical. So teachers can emphasize the importance of original thinking rather than rote learning of formulae and procedures.

Avoiding negative experiences in mathematics classroom

Students' prior negative experiences in mathematics class when learning mathematics are often transferred and cause a lack of understanding of mathematics. Mathematics must be looked up in a positive light to reduce anxiety. Avoid forcing anxious students into intimidating circumstances, such as working problems on the board or being singled out to answer a question in class. Provide students alternative ways of participating in class until their confidence level improves. It is important to note that unlike general anxiety mathematics anxiety can be traced back to some specific previous educational experiences. So it is necessary to avoid negative experiences related to mathematics teaching and learning.

Theoretical Overview of Cognitively Guided Instruction

Cognitively Guided Instruction

Cognitively Guided Instruction (CGI) is an alternative way to teach and learn mathematics from an early age where students start with concrete demonstration of what story problems are demanding and eventually work towards abstract representation by inventing their own algorithms to solve story problems. It was developed by Thomas Carpenter, Elizabeth Fennema, Penelope Peterson, Megan Loef Franke and Linda Levi. Instead of memorizing number facts, students construct their knowledge in any way possible because all methods of findings solutions are accepted and critiqued until the desired final answers are correct. Essentially "Children are not shown how to solve problems, instead each child solves them in any way that he or she can, and then shows how the problem was solved with peers and teachers" (Secada, Fennema & Adajian, 1995).

Cognitively Guided Instruction is a style of teaching based on years of research showing that people learn beginning mathematical concepts linearly. i.e., there are clear stages that are passed through in a particular order. It leads to student centered learning and stimulates discussion about multiple approaches to solve the same problem (Ruppert, 2010). Cognitively Guided Instruction focuses on the learning process and teaching great problem solving skills, instead of trying to memorize facts.

Definition of cognitively guided instruction

Cognitively Guided Instruction is "a program based on an integrated program of research on

a) The development of students' mathematical thinking.
b) Instruction that influences that development.
c) Teacher's knowledge and believes that influence their instructional practices, and
d) The way that teacher's knowledge, believes and practices are influenced by their understanding of students' mathematical thinking" (Carpenter, Fennemma, Franke, Levi, Empson, 1999)

Features of cognitively guided instruction classroom

It's not easy to describe a typical Cognitively Guided Instruction class room because each one is unique and can appear to be quite different from other Cognitively Guided Instruction classrooms. In some classes whole group instruction is used. In others children spend most of their time working in learning centers. In some classes, children create many of the problems to be solved. In spite of the apparent diversity, there are similarities that can be seen across most Cognitively Guided Instruction classrooms. The similarities or features are:

Basing the curriculum on problem solving

In Cognitively Guided Instruction classes, all learning activities require problems solving. Children learn concepts and computation skills as they solve a variety of mathematics problems often set in story contexts. Sometimes problems are set in other formats like writing number sentences that equal a certain number, finding several ways to add 2 or 3 digit numbers, or discussing a mathematical concept like odd or even numbers. The critical consideration is that each child is actively involved in deciding how best to resolve a mathematical situation.

Unlike the traditional instruction in which the content to be learned is clearly sequenced (addition before subtraction, etc.) and where children learn skills before they use them to solve problems, the curriculum in Cognitively Guided Instruction classes is integrated. For e.g.: children do not learn number facts as isolated bits of instruction. Rather they learn them as they repeatedly solve problems, so that they begin to see relationships between various facts. In summary, children in Cognitively Guided Instruction classes learn mathematics with understanding through problem solving. Both word problems and symbolic problems are vehicles through which children learn mathematical concepts and skills. Although teachers choose problems so that they will enhance children's development, in most cases, teachers do not provide explicit instruction on problem solving strategies, which becomes more efficient and abstract over time. Skills and number facts are learned in the process of problem solving and are thus learned with understanding rather than learned as isolated pieces of information.

Communicating about problem solving

Closely integrated with problem solving is communicating about one's thinking. This communication usually takes the form of talking, writing or drawing pictures about how problems have been solved, and it serves a variety of purposes. It encourages children to think about or reflect on what they had done. It encourages understanding, because in order to be able to report they have to understand what they had done. It also enables the teacher to assess a child's thinking while at the same time allowing other children to hear a variety of strategies. In Cognitively Guided Instruction classes, children operate at many different levels because children have the latitude to use a strategy that makes sense to them at the time. There is no prevalent strategy that all children use at a particular point in time. The variety of strategies in use at any given time gives children the opportunity to learn more advanced strategies by listening to and interacting with other students who are using them. Children sharing strategies enable other children because they are listening carefully. If they are ready for it- and they have to be cognitively ready for that strategy – it might work for them.

Creating a climate for communication

Initially reporting how a problem has been solved is not easy, but it becomes easier as children have many experiences on reporting their strategies. Children are continually asked to report their thinking, and their peers are expected to listen to and value each other's thinking. Gradually, children come to recognize that their thinking is important, and they come to value the process of doing mathematics.

Closely related to the idea of valuing each child's thinking is the growing realization that there is no one best or "right" way to solve any problem. Any strategy that works and can be explained is important and correct. When a teacher expects and values a diversity of solution strategies, children realize that multiple strategies are not only acceptable but desirable. Thus no one's solution strategy is any better than anyone else's, and each child's thinking becomes important to everyone.

Teaching for understanding

Because understanding is synonymous with seeing relationships, emphasizing relationships help to develop understanding. No one can give knowledge to anyone else. Each individual must develop understanding by constructing relationships. This does not mean that a teacher can never tell children anything; sometimes the best way to construct a relationship is to have someone else point it out. However, even when children are told something, in order to understand they must be able to comprehend the relationship. Learning number facts is made much easier by understanding that these facts are related in specific ways and that there are principles governing these relationships. The basic principle that children should be encouraged to observe as early as possible is that number facts are related and these relationships can be used to simplify the process of solving problems. Thus teachers ask those questions designed to focus students' attention on these relationships.

Not only there are relationships between number facts, there are relationships between solution strategies such as direct modeling, counting and using grouping by ten to solve problems. When children experience many solution strategies, they come to see how strategies are related. Children mature in their use of strategies when they see the relationships between less mature and more mature strategies. And teachers play a vital role in helping children to see these relationships.

The Role of the Teacher

A Cognitively Guided Instruction teachers' role is active. They have to upgrade their understanding of how each child thinks, select activities that will engage all the children in problem solving and enable their mathematical knowledge to grow, and create a learning environment where all children are able to communicate about their thinking and feel good about them in relation to mathematics.

Understanding students' mathematical thinking

The frame work of children's thinking provides a basis for understanding critical components of almost all children's thinking. Although it appears complex at first, its coherence becomes more and more visible as a Cognitively Guided Instruction classroom develops. Rather than having to remember unrelated details, each child's thinking can be understood in relation to the framework. The framework provides a basis for understanding why a child is able to solve certain problems and not able to solve others. The path of development of ideas becomes visible, so it is possible to predict how children's thinking will grow.

Planning for instruction

In Cognitively Guided Instruction classes, decisions about what to teach and when to teach it are based on what children understand. Instruction is based on what children understand and can learn. Teachers plan instruction keeping this idea in mind.

Using knowledge of children's thinking

Using knowledge of children's thinking is not easy. Cognitively Guided Instruction teachers continuously grow in their abilities to use their children's knowledge to select problems, to question children in a way that both eliciting their thinking and helps them in problem solving and to understand their children's thinking. All this information helps the teachers to structure the mathematical learning events so that the children develop their mathematical knowledge. In a very general term, Cognitively Guided Instruction teachers understand the way children think, understand what makes problems easier or more difficult to solve, and then make decisions that enable children to engage in successful problem solving with problems that are neither too easy nor too difficult.

Encouraging children's mathematical development

Cognitively Guided Instruction teachers provide problem solving experiences that enable each child's knowledge to grow. Ideas that are important for children to learn are not ignored, nor taught incidentally. Problem Solving experiences are chosen in which the ideas to be learned can be explored.

Through sensitive questioning, children can be encouraged to focus on and discuss the selected ideas; thus their mathematical knowledge grows and develops.

Children choose strategies to solve problems for a variety of reasons, and they can be encouraged to move to more mature solution strategies. Consciously selecting problems to be solved, asking children to solve problems in more than one way, being sure that children hear solution strategies that are different from the ones they used, and discussing how various solution strategies are alike or different are just a few ways that children can be encouraged to develop their problem solving skills.

Although teacher's primary responsibility is not to demonstrate a prescribed sequence of procedures, teachers do play a critical role in their students' learning. A few of such strategies are listed below.

1. Listening to children to figure out what they understand
2. Selecting and adapting problems so that the problems connect to and extend the knowledge that the children have already acquired
3. Supporting children's learning by introducing appropriate symbols and ways of organizing and representing children's ideas
4. Providing a forum and active listening support for children to discuss alternative ways of thinking about problems and the concepts they embody

While not offering prescriptions about how and what to teach, CGI provide a great deal of support to help teachers to:

a) Understand their students' thinking
b) Select and sequence appropriate problems
c) Introduce notation to represent students' strategies, and
d) Engage students in productive discussion

Learning to listen to students

Listening is a teaching practice that can profoundly influence what students learn and how they see themselves as mathematical thinkers. The teacher's listening teaches students to pay attention to and value their own ideas and the ideas of others.

This image of teaching is different from the one that many teachers of mathematics hold. All teachers ask questions and listen to students' answers, but the listening is aimed at assessing whether students got what the teacher had explained rather than uncovering their understanding of the content. Listening with the intention to hear what a student has to say without imposing one's own way of thinking is a significant challenge. It can be hard for a teacher to listen without correcting or providing hints to a child who is hesitating or struggling and to know what questions to ask next when a child uses an unfamiliar strategy.

Developing the ability to listen to children's thinking and use it to guide instruction takes time. There are several interrelated skills that make up this ability, which cannot be learned all at once or in a short professional development session.

Some of the most important teaching skills include:

- Posing problems for children to solve using their own strategies
- Choosing or writing problems that elicit a variety of valid strategies and insights
- Adjusting problem difficulty so that children can use what they understand to solve problems
- Sequencing problems and number choices in developmentally appropriate ways
- Asking probing questions to clarify and extend children's thinking

- Conducting discussions of students' strategies so that students can make new mathematical connections
- Identifying the important mathematics in children's thinking

A focus on posing problems and asking students how they solved them is a natural place to start. These two skills alone can help teachers to find out a great deal about what students understand and at the same time lead to more understanding for students.

Theoretical Overview of Instructional Strategy

Concept, Meaning and Definition

Teaching strategy seeks to establish the relationship between teaching and learning in view of achieving the objectives. It is a generalized plan for a lesson which includes structure, desired learner behaviour in terms of goals of instruction and an outline of planned tactics necessary to implement the strategy. A tactics of teaching is a unit of teacher behaviour which is helpful for achieving instructional objectives. Different types of tactics can be used in the same teaching strategy.

It is possible to develop appropriate teaching strategies for a given instructional objective, for a given group of learners and for known conditions under which the group has to learn. The specific and reproducible strategies can be developed by using available gadgets, equipments and materials.

Teaching strategy is a means to achieve the instructional objective. Different teaching strategies can be used to achieve different objectives of cognitive, affective and psychomotor domains. All teaching strategies are helpful in achieving cognitive objectives. But low order cognitive objectives (knowledge, comprehension and application) can be achieved by lecture, low order affective objectives (receiving, responding and valuing) can be achieved by all teaching strategies. Low and high order of psychomotor objectives can be achieved by lesson demonstration, practical tutorials and independent study.

Selection of an appropriate teaching strategy is very much a matter of teacher's effectiveness. There is a great importance for the interaction between student ability and teaching strategy. The teaching strategies are not equally effective for each learner. In selecting teaching strategies main emphasis is given to achieve some learning objective rather than student interest. The learning objectives and learning conditions are the main criteria for choosing appropriate teaching strategies.

Definition of Instructional Strategy

Stones and Morris (1977) defined instructional strategies as a "generalized plan for a lesson which includes structure, desired learner behaviour in terms of goals of instruction and an outline of planned tactics necessary to implement the strategy".

Functions of an Instructional Strategy

Dick and Carey (1996) use the term instructional strategy to describe the process of sequencing and organizing content, specifying learning activities, and deciding how to deliver the content and activities.

An instructional strategy can perform several functions.

- It can be used as a prescription to develop instructional materials
- It can be used as a set of criteria to evaluate the existing materials.
- It can be used as a set of criteria and prescription to revise existing materials.
- It can be used as a frame work based on which to plan class lecture notes, interactive group exercises, and homework assignments.

Essentials of an Instructional Strategy

Creating an instructional strategy involves taking all the information accumulated to this point and generating an effective plan for presenting instruction to learners. Creating a strategy is not the same as actually developing instructional materials. The purpose of creating the strategy before developing the materials themselves is to outline how the instructional activities relate to the accomplishment of the objectives (Gagne, 1988). This will provide a clear plan for subsequent development. Dick and Carey (1996) describe four elements of an instructional strategy.

Element 1: Content Sequence and Clustering

Content Sequence

The first step in developing an instructional strategy is deciding on a teaching sequence and grouping of contents. Whether to develop a lesson, a course or an entire curriculum, decisions must be made regarding the sequencing of objectives. The best way to determine the sequence is to refer to instructional analysis. Generally begin with the lower level subordinate skills on the left and work way up through the hierarchy until the main goal step is reached. It's not a good idea to present information about a skill until the information on all related subordinate skills have been presented. Work from bottom to top and left to right till all of the skills are covered.

Clustering Instruction

The next important consideration is how to group instructional activities. It is to be decided whether to present information to accomplish one objective at a time, or cluster several related objectives. Dick and Carey (1996) recommend taking the following factors into consideration when determining how much or how little instruction to present at any given time.

1. The age level of learners
2. The complexity of the material
3. The type of learning taking place.
4. Whether the activity can be varied, thereby focusing attention on the task.
5. The amount of time required to include all the events in the instructional strategy for each cluster of content presented.

Element 2: Learning Components

The next element in an instructional strategy is a description of the learning components for a set of instructional materials. Here Dick and Carey (1996) mention Gagne's nine events of instruction, which is a set of external teaching activities that support the internal processes of leaning.

In order for instruction to bring about effective learning, it must be made to influence the internal processes of learning. Gagne believes that instruction is a deliberately arranged set of external events designed to support internal learning processes". The kinds of processing presumed to occur during any single act of learning are summarized by Gagne as follows.

Attention

Determines the extent and nature of reception of incoming stimulation.

Selective Perception (or pattern cognition)

Transforms this stimulation into the form of object features, for storage in short term memory.

Rehearsal

Maintains and renews the items stored in short term memory.

Semantic encoding

Prepares information for long term storage.

Retrieval, including search

Returns stored information to the working memory or to a response generator.

Response organization

Selects and organizes performance.

Feedback

Provides the learner with information about performances and sets in motion the process of reinforcement.

Executive control processes

Select and activate cognitive strategies; these modify any or all of the previously listed internal processes.

Gagne's events of instruction are designed to help learners get from where they are to where the teacher wants them to be.

The nine events of instruction are:

1. Gaining attention
2. Informing learner of objectives
3. Stimulating recall of prior learning.
4. Presenting the stimulus materials.
5. Providing learning guidance
6. Eliciting the performance
7. Providing feedback about performance correctness
8. Assessing the performance
9. Enhancing retention and transfer.

Each of these events may not be provided for every lesson. Sometimes one or more of the events may already be obvious to the learner and may not be needed.

Element 3: Student Groupings

The next element of an instructional strategy is how students will be grouped during instruction. The main things to consider are whether there are any requirements for social interaction explicit in the statement of the objective, in the performance environment, in the specific learning components being planned, or in personal views of the teacher.

Element 4: Selection of Media and Delivery Systems

Once decisions have been made about content sequencing and clustering, and the learning components have been planned, it is time to turn to select a delivery system for overall instructional system, along with media that will be used to present the information in the instruction.

Overall delivery system includes everything necessary to allow a particular instructional system to operate as it was intended and where it was intended. Some examples are:

- Classroom delivery
- Lecture
- Correspondence
- Video tape
- Video conference
- Computer based delivery
- Web based delivery

Once delivery system is chosen, various media can then be chosen to deliver the information and events of instruction. Media constitutes the physical elements in the learning environment. With which learners interact in order to learn something. The choice of media is done as part of the instructional strategy.

Procedure for Development of an Instructional Strategy

Dick and Carey (1996) suggest a sequence while creating instructional strategy.

This process has 5 steps

1. Sequence and cluster objectives
2. Plan pre-instructional assessment and follow through activities for the unit.
3. Plan the content presentation and student participation sections for each objectives or cluster of objectives.
4. Assign objectives to lesson and estimate time required for each.
5. Review the strategy to consolidate media selections and confirm or select a delivery system.

The first two steps relate to the overall unit of instruction and not to the individual objectives within the lesson.

Sequence and cluster objectives

Consider both the sequence and the size of cluster that are appropriate for the attention span of students and the time available for each session. Indicate the clusters and then the objectives to be taught within each cluster. For designing a short lesson only one cluster is needed. However, a teacher may still have small groupings of objectives that he/she want to divide up with review and/or practice activities.

Plan pre-instructional, assessment, and follow through activities for the unit

During this step, the decisions about student grouping and media selection are to be taken. This step gives indication with regards to pre instructional activities, assessment and follow through activities in narrative form using the following headings.

Pre-instructional activities

a) Motivation: ways of maintaining attention
b) Objectives
c) Student groupings and media selection (for pre instructional activities)

Assessment

a) Pretest
b) Practice tests
c) Post test
d) Student groupings and media selection (for assessment activities)

Follow through activities

a) Memory aid - that will be developed to facilitate retention of information and skills
b) Transfer - special factors to be employed to facilitate performance transfer
c) Student groups and media selection (for follow through activities)

Next two steps relate to individual objectives or clusters of objectives within the unit of instruction.

Plan the content presentations and student participation sections for each objectives or cluster of objectives.

First list the objectives and then two sections.

Content presentation

a) Content: Content for each objective

b) Examples: also non examples

c) Student grouping and media selection – for this activity

Student Participation

a) Practice items – practice exercises

b) Feed back – for practice exercises

c) Student groupings and media selection

Assign objectives to lessons and estimate time required for each

Review sequence and clusters of objectives along with the pre-instructional activities, assessment, content presentation, student participation, and student groupings and media selections. Using all these information, along with the time frame for overall instructional unit, assign objectives to individual lessons. In a large unit of instruction the first lesson generally contains pre-instructional activities, while the last generally contains the assessment and/or follow through activities. There must be time for presentations, review and participation activities. This process can be performed for extended instructional units or for semester long planning.

Review the strategy to consolidate media selections and confirm or select a delivery system

In this final step review the instructional strategy to consolidate media selections and to make sure that they are compatible with delivery system. Look over all selections to see if there are patterns on common media prescriptions across the objectives. Then see if these patterns fit with the chosen delivery system.

The planning of an instructional strategy is an important part of the instructional design process. The best lesson designs will demonstrate knowledge about the learners, the task reflected in the objectives and the effectiveness of teaching strategies.

Validation of an Instructional Strategy

The broad steps of validating the effectiveness of an instructional strategy are:

1. Develop the Instructional Strategy
2. Develop and select instructional materials
3. Design and conduct formative evaluation of instruction
4. Design and conduct summative evaluations of instructions.

Develop the instructional strategy

Going through five steps of development of an instructional strategy develop the instructional strategy. The strategy will be based on current theories of learning and results of learning research, the characteristics of the medium that will be used to deliver the instruction, content to be taught, and the characteristics of the learners who will receive the instruction. These features are used to develop or select materials or to develop a strategy for interactive classroom instruction.

Develop and select the instructional materials

In this step, the instructional strategy will be used to produce instruction. This typically includes a learner's manual, instructional materials, and tests. (The terms instructional materials include all forms of instruction such as instructor's guides, student modules, overhead transparencies, videotapes, computer based multimedia formats, and web pages for distance learning). The decision to develop original materials will depend on the type of leaning to be taught, availability of existing relevant materials, and developmental resources available.

Design and conduct formative evaluation of instruction

Following the completion of a draft of the instruction, a series of evaluation is conducted to collect data that are used to identify how to improve the instruction. The three types of formative evaluation are referred to as one-one evaluation, small group evaluation and field evaluation. Each type of evaluation provides the designer with a different type of information that can be used to improve the instruction. Data from the formative evaluation are summarized and interpreted to attempt to identify difficulties experienced by learners in achieving the objectives and relate these difficulties to specific deficiencies in the instruction. Data from a formative evaluation are not simply used to revise instruction itself, but are used to re examine the validity of the instructional analysis and the assumptions about the entry behaviours and characteristics of learners. It is necessary to re examine statements of performance objectives and test items in the light of collected data. The instructional strategy is reviewed and finally all this is incorporated into revisions of the instruction to make it a more effective instructional tool.

Design and conduct summative evaluation

Although summative evaluation is the culminating evaluation of the effectiveness of instruction, it is generally, not a part of the design process. It is an evaluation of the absolute and/or relative value or worth of the instruction and occurs only after the instruction has been formatively evaluated and sufficiently revised to meet the standards of the designer. Since the summative evaluation usually does not involve the designer of the instruction but instead involves an independent evaluator, this component is not considered as an integral part of the instructional design process.

Conclusion

The theoretical overview helped the investigator to understand the construct Mathematical Anxiety in detail, to get acquainted with the nuances of Cognitively Guided Instruction and to get a clear idea about the development and validation of an instructional strategy. An analysis of the strategies for reducing mathematics anxiety and the features of the Cognitively Guided Instruction classroom reveal that it theoretically holds the potential to reduce the mathematics anxiety of students. In Cognitively Guided Instruction, for better instruction, maintaining a non threatening environment is necessary and teachers are required to teach for understanding and create a climate for communication. These are also essential requirements for reduction of mathematics anxiety of students.

Chapter III

REVIEW OF RELATED LITERATURE

- *Studies Related to Mathematics Anxiety*
- *Studies Related to Cognitively Guided Instruction*

REVIEW OF RELATED STUDIES

Review of related studies is an important part of research. For any worthwhile study an adequate familiarity with studies which have already been conducted in the selected area is necessary. Review helps the researcher to gather up to date information regarding what has already been done in the area of study. It helps to avoid duplication of research, to identify gaps in research in the selected area and to derive helpful suggestions.

This chapter has been devoted for presenting survey of studies related to mathematics anxiety and cognitively guided instruction. It also includes trend of research in mathematics anxiety as well as cognitively guided instruction. These are presented under the following headings.

- Studies Related to Mathematics Anxiety
- Studies Related to Cognitively Guided Instruction

Studies Related to Mathematics Anxiety

Following are the studies related to mathematics anxiety reviewed by the investigator. These studies were helpful in various stages of the present study. The studies were thoroughly analysed and a trend of research in mathematics anxiety was also prepared.

Daneshamooz, Alamolhodaei and Darvishian (2012) conducted a quasi experimental research to investigate the effect of mathematics anxiety and working memory capacity on mathematical performance of three groups of college students with three different learning methods, co-operative method, e-learning method and traditional method. Significant negative correlation between mathematics anxiety and mathematical performance and positive correlation between mathematical performance and working memory capacity were found. It was also found that students in the cooperative learning groups had significantly higher achievement scores than students in the other groups. A significant interaction effect of working memory capacity and mathematics anxiety on mathematical performance based on students' learning method was also found. The study revealed that with controlling the effect of mathematics anxiety, working memory capacity had significantly more effect on mathematical problem solving of students who studied their lessons in e-learning method than other groups.

Devine, Fawcett, Szucs and Dowker (2012) studied the gender differences in Mathematics anxiety and the relation to mathematics performance while controlling for test anxiety on 433 British secondary school children in school years 7, 8 and 10. No gender differences emerged for mathematics performance but levels of mathematics anxiety and test anxiety were higher for girls than boys. Girls and boys showed a positive correlation between mathematics anxiety and test anxiety and a negative correlation between mathematics anxiety and mathematics performance. Test anxiety was also found to be negatively correlated with mathematics performance, but this relationship was found to be stronger for girls than for boys. When test anxiety was controlled, the negative correlation between mathematics anxiety and performance remained for girls only. Regression analyses revealed that mathematics anxiety was a significant predictor of performance for girls but not for boys.

Hlalele (2012) conducted a study on 403 learners of mathematics in 18 rural high schools in the Free State Province of South Africa. It was found that all learners sometimes, often or always experience mathematics anxiety in academic settings. No participants indicated that they never experience mathematics anxiety in academic settings.

Ko and Yi (2011) developed and validated a Mathematics Anxiety Scale for Students (MASS). The final version of the scale consisted of 65 items that measure four domains of mathematics anxiety viz., nature of mathematics, learning strategy, test/performance and environment. This scale was administered to a nationally representative sample of 2,339 Korean middle school and high school students to validate the scale. Psychometric properties including descriptive statistics, reliability measures, factorial structure and correlations with external criteria were examined to provide validity evidence of the final scale.

Lyons and Beilock (2011) used functional magnetic resonance imaging to separate neural activity during the anticipation of doing mathematics from activity during mathematics performance itself. Subjects were 32 right handed university students. For higher but not lower math anxious individuals, it was found that increased activity in front-o-parietal regions when simply anticipating doing mathematics mitigated mathematics specific performance deficits. It was found that individual difference in how mathematics-anxious individuals recruit cognitive control resources during mathematics performance predict the extent of their mathematics deficits. This suggested that educational interventions emphasizing control of negative emotional responses to mathematics stimuli will be most effective in increasing mathematics competency rather than merely giving additional mathematics training.

Bekdemir (2010) conducted a study to examine whether negative mathematics classroom experiences affect mathematics anxiety in 167 pre-service teachers in a university in Turkey. Mixed – method explanatory approach was employed. The findings revealed that many pre- service teachers have mathematics anxiety and that the negative mathematics classroom experiences have a direct influence on mathematics anxiety in pre- service teachers. It was also found that mathematics anxiety is substantially caused by the teacher's behaviour and teaching approach. The percentage of students who had negative experience was found to go up with the transition from the elementary and junior high school to high school level.

Cavanagh and Sparrow (2010a) conducted a study to develop a construct model of mathematics anxiety. The study examined the possible causes or determinants of mathematics anxiety followed by clarification of the construct using a four-function model of construct specifications which lead to operational definition of the construct. The study proposed a eight domain situational model of mathematics anxiety.

Cavanagh and Sparrow (2010b) in their study attempted to measure mathematics anxiety based on situational model of mathematics anxiety. Two forms of a questionnaire were constructed. Data were collected from 50 primary school students of age 5 to 7. The Rasch Rating Model was used for scaling. The empirical results were used to refine the situational model of mathematics anxiety.

In their study Erden and Akgul (2010) examined the predictive power of mathematics anxiety and perceived social support from teacher for mathematics achievement of primary school students. The sample consisted of 292 students of seventh and eighth grades. Independent samples t-test, Pearson's Correlation Coefficient and Multiple Regression analysis were employed. The results of the study revealed that an increase in mathematics anxiety reduces mathematics achievement but perceived teacher supports results in an increase in mathematics achievement for both boys and girls. It also revealed that mathematics anxiety and teacher support are significant predictors of students' mathematics achievement. In the case of boys, mathematics anxiety was more powerful predictor of mathematics achievement while it was teacher support for girls.

Johnson, Smith and Carinci (2010) conducted a longitudinal study of pre-service female teachers' mathematics anxiety and mathematics self concept. This triangulation study examined 102 female pre-service teachers of one University teacher training programme of United States over three periods of time: upon entering the pre-service teacher program, following completion of the program, and one year after completion of the program. Students who majored in mathematics or science, or who were earning their single subject credential in mathematics or science were excluded from the study. Separate one-way repeated measure ANOVAs for self concept and mathematics anxiety revealed increase in self concept and decrease in mathematics anxiety and this positive changes were found to sustain apparently one year after graduation from the program.

Krinzinger, Kaufmann and Willmes (2009) conducted a study on mathematics anxiety and mathematics ability in early primary school years. The main objective of the study was to longitudinally investigate the relationship between calculation ability, self-reported evaluation of mathematics and mathematics anxiety in 140 primary school children between the end of first grade and middle of third grade. Structural equation modeling revealed a strong influence of calculation ability and mathematics anxiety on the evaluation of mathematics but no effect of mathematics anxiety on calculation ability or vice versa, contradicting with frequent clinical reports of mathematics anxiety even in very young mathematical learning disabled children.

Rubinsten and Tannock (2010) conducted a study on mathematics anxiety of 12 children with developmental dyscalculia and 11 typically-developing peers. Participants completed a novel priming task in which an arithmetic equation was preceded by one of four types of priming words (positive, neutral, negative or related to mathematics). Children were required to indicate whether the equation was true or false. Analyses of the data revealed that participants with developmental dyscalculia responded faster to targets that were preceded by both negative primes and mathematics related primes. A reversed pattern was present in the control group. The result suggested that low mathematics achievement due to developmental dyscalculia lead to mathematics anxiety. Further, arithmetic affective priming might be used as an indirect measure of mathematics anxiety.

Ayotola and Adedeji (2009) in their study examined the relationship between gender, age, general mental ability, anxiety, mathematics self efficacy and achievement in mathematics among senior secondary students in Oyo State, Nigeria. Stepwise multiple regression was used on the collected data from 1,099 students and the results showed that mathematics self efficacy is the best predictor of mathematics achievement followed by gender and mathematics anxiety. The contributions of age and mental ability to mathematics achievement were non-significant.

Farnsworth (2009) studied math performance as a function of mathematics anxiety and arousal performance theory. No relationship was found between mathematics anxiety and performance on a non-math task, but an inverse relationship was found between mathematics anxiety and performance on the mathematics portion of a working memory intensive math task. Mathematics anxiety was directly related to perfectionism and fear of negative evaluation. There was no relationship found between mathematics anxiety and processing speed, memory span, or selective attention. There was a significant effect of mathematics anxiety on working memory, but this effect was limited to a math intensive task wherein the low mathematics anxious group outperformed the moderate or high mathematics anxious groups.

Karimi and Venkatesan (2009) in their study examined the relationship between levels of mathematics anxiety, mathematics performance and academic hardiness among high school students and also examined the effects of gender. Participants were 284 students of eighth grade, selected randomly from 9 high schools in Karnataka State. Pearson correlation analysis and two independent sample t-tests revealed that mathematics anxiety has significant negative correlation with mathematics performance, but no significant correlation was detected with academic hardiness. Significant gender difference was found in mathematics anxiety but not in mathematics performance and academic hardiness.

Yüksel-Şahin (2008) investigated whether students' mathematics anxiety differed significantly according to a group of variables. Participants were 249 fourth and fifth graders of Turkey. Independent sample t-test, one-way ANOVA and Scheffe test revealed that students' mathematics anxiety differed significantly according to gender, liking for mathematics class, liking for mathematics teacher and achievement level in mathematics. It was also found that female students had higher levels of mathematics anxiety than their male peers. Students who liked their mathematics class and who liked their mathematics teacher had reported significantly lower mathematics anxiety. Results showed that students who were more successful in mathematics had lower degree of mathematics anxiety. But students' mathematics anxiety was not found to differ significantly according to their grade level and their gender stereotypes regarding success in mathematics.

Zakaria and Nordin (2008) studied the effects of mathematics anxiety on matriculation students as related to motivation and achievement. The study revealed that the mean achievement scores and motivation scores of low, moderate and high anxiety groups were significantly different. A low but significant negative correlation between mathematics anxiety and achievement and a strong significant negative correlation between mathematics anxiety and motivation were found. The study also revealed a significant positive correlation between motivation and achievement.

Anderson (2007) conducted an online survey to assess student anxiety and attitude response to six different mathematical problems. Sample consisted of 43 students from grades 4, 5 and 6. The six mathematics problems varied in type between traditional leveled tasks in the form of basic mathematical operations and rich tasks. Basic operations varied amongst three levels of difficulty and rich tasks varied amongst three degrees of complexity of context. A weak relationship was found between mathematics anxiety and attitude to the six problems presented. Some differences were observed between boys and girls for responses to rich tasks. Differences in both attitude and anxiety responses were found due to a variation of problem difficulty for traditional basic operations.

Ashcraft and Krause (2007) conducted a study on working memory, math performance and mathematics anxiety. The study showed how performance on a standardized achievement test varies as a function of mathematics anxiety, and that mathematics anxiety compromises the functioning of working memory. The study commented on developmental and educational factors related to mathematics and working memory, and on factors that might contribute to the development of mathematics anxiety.

Medeiros and Leclercq (2007) used an electroencephalograph (EEG) machine to measure the cortical activity of 6 volunteer undergraduate students while each memorized and recalled lists of both scientific and common mathematics words. A paired sample t-test showed that there was no significant difference in average cortical activity. It also showed that students who had high cortical activity when exposed to scientific terms also had high cortical activity when exposed to common terms.

Nasser and Birenbaum (2005) found that the correlation of mathematics anxiety and achievement is significant for Arab students and is not significant for Jewish students. For the whole sample the effects of mathematics anxiety on mathematics achievement was found to be not significant.

Sebastian (2005) conducted a study of some psychological variables discriminating between under and over achievers in mathematics among secondary school pupils of Kerala. A significant low negative relationship was found between mathematics anxiety and achievement in mathematics. Results revealed that the selected predictor psychological variables including mathematics anxiety are capable of classifying pupils as under normal and over achievers in mathematics.

Ma and Xu (2004) conducted a longitudinal panel analysis to determine the causal ordering between mathematics anxiety and mathematics achievement. Results of structural equation modeling revealed that prior low mathematics achievement was significantly related to later high mathematics anxiety but prior high mathematics anxiety not related to low mathematics achievement, across the entire junior and senior high school. Mathematics achievement was more reliably stable from year to year than mathematics anxiety. Statistically significant gender differences were found in the causal ordering of mathematics anxiety and mathematics achievement. Prior low mathematics achievement was significantly related to later high mathematics anxiety for boys across the entire junior and senior high school but for girls at critical transition points only. Mathematics anxiety was more reliably stable from year to year among girls than among boys.

In the study conducted by Tapia and Marsh (2004) on the effects of mathematics anxiety and gender on attitudes toward mathematics using a sample of 134 students enrolled in mathematics class in a state university. The results of multivariate factorial model revealed that gender had no effect on attitudes towards mathematics, and gender and mathematics anxiety had no influence on attitudes toward mathematics. An overall significant effect of mathematics anxiety on self confidence, enjoyment and motivation with large effect size was found. Students with no mathematics anxiety scored significantly higher in enjoyment than students with high mathematics anxiety. Students with little or no mathematics anxiety scored significantly higher than students with some or high mathematics anxiety in measures of self confidence and motivation. Students with some mathematics anxiety scored significantly higher in motivation than those with high mathematics anxiety.

Uusimaki and Kidman (2004) in their study tested an intervention model than can be used to challenge mathematics anxiety amongst primary pre-service teacher education students. In the three phased intervention model, mathematics anxious participants engage in collaborative teamwork, specifically chosen mathematical activities, personal written reflections, and with innovative computer mediated software programs. It was found that the intervention model reduce mathematics anxiety, enhance the repertoires of mathematical subject knowledge, and a sense of identity as future primary mathematics teachers.

Woodard (2004) examined the effects of mathematics anxiety on post secondary developmental mathematics students as related to achievement, gender and age. The study was conducted on a sample of 125 developmental mathematics students. A significant negative relationship was found between mathematics achievement and mathematics anxiety. The results indicated that female mathematics students are significantly more mathematics anxious than male students. No significant age difference was found in mathematics anxiety.

Cates and Rhymer (2003) investigated the relationship between mathematics anxiety, fluency, and error rates in basic mathematical operations among college students. Sample consisted of 52 students. Results suggested that the higher mathematics anxiety group had significantly lower fluency levels across all mathematical operations tests. No significant differences were found in error rates between higher and lower mathematics anxiety groups, which suggested that mathematics anxiety is more related to higher levels of learning than to the initial acquisition stage of learning.

Sherman and Wither (2003) conducted a longitudinal study of the relationship between mathematics anxiety and mathematics achievement. The technique of cross lagged panel analysis was employed. Observation of a cohort of 66 students was made twice a year over a period of five years as they progressed from school year 6 to year 10. The results revealed a negative correlation between mathematics anxiety and mathematics achievement. The data did not support the hypothesis that mathematics anxiety causes a lack of mathematical achievement, but supported the hypothesis that either the lack of mathematical achievement causes mathematical anxiety, or there is a third factor which causes both.

Ho, *et al*. (2000) studied the cognitive and affective dimensions of mathematics anxiety across samples of sixth grade students from China, Taiwan and the United States consisting of 671 students. The study compared the dimensions, levels, and relationship with mathematics achievement of mathematics anxiety. The results of confirmatory factor analyses were found to support the theoretical distinction between affective and cognitive dimensions of mathematics anxiety in all three national samples. The analyses of structural equation models provided evidence for the differential predictive validity of the affective and cognitive dimensions of mathematics anxiety. The study showed that the affective factor of mathematics anxiety is consistently related to mathematics achievement in the negative direction for all three national samples. Gender- nation interactions were also found to be significant for both dimensions.

Kazelskis, *et al.* (2000) used correlational and confirmatory factor analytic techniques to examine the relationship between mathematics anxiety and test anxiety. The sample consisted of 321 university students. The results of the study did not provide strong support for a clear distinction between measures of mathematics anxiety and test anxiety.

Ma (1999) in a Meta analysis of the relationship between mathematics anxiety and achievement in mathematics among elementary and secondary school students examined 26 studies. The common population correlation for the relationship was found to be significant. A series of general linear models indicated that the relationship was consistent across gender groups, grade level groups, ethnic groups, instruments measuring anxiety, and years of publication. It was also found that researchers using standardised achievement tests tended to report a relationship of significantly smaller magnitude than researchers using mathematics teachers' grades and researcher made achievement tests. Published studies tended to indicate a significantly smaller magnitude of the relationship than unpublished studies. No significant interaction effects were found among key variables such as gender, grade and ethnicity.

Newstead (1998) studied mathematics anxiety among 9 to 11 year old children. Mathematics anxiety of pupils taught in a traditional manner was compared with that of pupils taught in an alternative approach called Calculator Aware Number (CAN) curriculum emphasizing problem solving and discussion of pupil's own informal strategies. Sample included 246 primary school students. The results revealed that mathematics anxiety is multidimensional. It was also found that students who were exposed to traditional approach reported more mathematics anxiety than those who were exposed to the alternative approach, particularly with regard to social, public aspects of doing mathematics.

Bessant (1995) conducted a study on factors associated with types of mathematics anxiety in 173 university students. The interrelatedness of various types of mathematics anxiety with attitudes toward mathematics, learning preferences, study motives, and strategies was studied. Factor analysis of the Mathematics Anxiety Rating Scale identified six factors. Correlation analysis indicated complex interaction patterns between attitudes toward mathematics and the six factors, depending on the overall level of anxiety experienced. Variation in orientation to learning was also found to be significantly related to specific types of anxiety, attitudes, and instructional factors.

Gierl and Bisanz (1995) evaluated students in Grades 3 and 6 on measures of mathematics anxiety, School Test Anxiety, and Attitudes towards Mathematics. The sample consisted of 95 students in a public school system, 47 students from Grade 3 and 48 students from Grade 6. Results revealed two distinct forms of mathematics anxiety: test and problem solving anxiety. Mathematics test anxiety was found to increase with age when compared to mathematics problem solving anxiety. This indicated that children become more anxious about mathematics test situations as they progress through school. It was also found that mathematics test anxiety was related, but not identical, to school test anxiety, and students in both grades were less anxious about mathematics tests than about academic testing generally. Older students tended to show more positive attitudes toward mathematics than did younger students. The relations between these attitudes and the two forms of mathematics anxiety changed between Grades 3 and 6.

Malini (1995) conducted a study to investigate the gender differences in certain psychological variables of the mathematical domain at secondary school level. No significant relationship was found between gender and mathematics anxiety. A low negative correlation was found between mathematics anxiety and mathematics achievement and the gender difference in the relationship was not significant.

Sobha (1995) found that mathematics anxiety discriminate significantly between high, average and low mathematically able pupils.

Roy and Roy (1994) studied the interaction effects of mathematics performance, anxiety and achievement in mathematics and found that there is significant interaction effect of both the variables on mathematics achievement.

Jameela (1993) studied the gender difference in the relationship between mathematics anxiety and achievement in mathematics. No gender difference was found in mathematics anxiety and the variables were found to be negatively correlated.

Krishnakumar (1993) studied the effect of self concept and mathematics anxiety on achievement in mathematics of secondary school pupils of Kerala. Significant difference was found in the mean achievement scores of high, average and low mathematics anxiety groups. A low negative correlation between Achievement in Mathematics and Mathematics Anxiety was also found.

Coleman (1991) investigated the prevalence and intensity of mathematics anxiety among college students enrolled in mathematics education and English courses. No gender difference was found in mathematics anxiety and results indicated that factors other than mathematics anxiety should be considered to explain differences in male and female enrolment in certain mathematics courses. Negative correlation was found between mathematics anxiety and mathematics achievement.

Hadfield, Martin and Wooden (1992) conducted a study on a sample of 358 middle school students and found that mathematics anxiety and mathematics achievement are negatively related.

Mancini (1992) examined the relationship between mathematics anxiety, personality type, sex, age and prior mathematics course. No significant relationships were found between any of the variables studied.

Flessati and Jamieson (1991) investigated gender differences in mathematics anxiety and gender related response bias in mathematics anxiety using a sample of 60 male and 90 female undergraduates aged 19 to 49 years. Regardless of whether students were male or female, more negative mathematics experiences were reported by students with higher mathematics anxiety scores. It was revealed that the two findings that females are more self-critical of mathematics anxiety in them and are more self critical of their performance in mathematics could explain gender difference in mathematics anxiety.

Lupkowski and Schumacker (1991) studied mathematics anxiety among talented students. The participants were 66 students attending the Texas Academy of Mathematics and Science in an early entrance to college program for talented students. Results indicated that these talented students were less math anxious than most unselected college students. But they were found to be more math anxious than a group of college students majoring in physics. No relationship between level of mathematics anxiety and grades or mathematics and Scholastic Aptitude Test- Mathematics scores was found for the group of talented students. Higher verbal scores and higher grades were found to be associated with lower levels of mathematics anxiety for males. These relationships were not found to be evident for females.

Miller (1991) conducted a study to find out the relationship of mathematics anxiety to gender and mathematics achievement. Results did not confirm that mathematics anxiety is correlated with gender and mathematics achievement.

Green (1990) studied test anxiety, mathematics anxiety and teacher comments in relation to achievement in remedial mathematics and found that test anxiety has a greater effect on mathematics achievement of students than mathematics anxiety.

In a study by Hembree (1990), results of 151 studies were integrated by Meta analysis to scrutinize the construct mathematics anxiety. The study revealed that mathematics anxiety is related to poor performance on mathematics achievement tests and is bound directly to avoidance of the subject. It also showed that variables which exhibit differential mathematics anxiety levels include ability, school grade level, and under graduate fields of study, with pre-service arithmetic teachers especially prone to mathematics anxiety. It also revealed that females display higher levels of mathematics anxiety than males. However, mathematics anxiety was found to link more strongly with poor performance and avoidance of mathematics in pre college males than females.

Hunsley and Flessati (1990) studied gender effect in mathematics anxiety and the findings revealed that mathematics anxiety is not truly a gender related phenomenon, but rather due to poor mathematical preparation.

Lewellyn (1990) investigated gender differences in mathematics achievement, and mathematics anxiety. Sample consisted of 241 adolescents in grades 7, 8 and 9. Even though females outperformed males in mathematics achievement, no gender difference was found in mathematics anxiety.

Meece, Wigfield and Eccles (1990) as part of a two year longitudinal research project studied 250 students of grades seven through nine. Structural modeling procedures were used to assess the influence of past math grades, math ability perceptions, performance expectancies, and value perceptions on the level of mathematics anxiety of the students. A second set of analysis examined the relative influence of these performance, self perception and affect variables on students' subsequent grades and course enrollment intentions in mathematics. The findings indicated that mathematics anxiety was most directly related to students' math ability perceptions, performance expectancies, and value perceptions. Students' performance expectancies predicted subsequent mathematics grades, where as their value perceptions predicted course enrollment intentions. Mathematics anxiety was not found to have significant direct effects on either grades or intentions.

Wigfield and Meece (1988) conducted a study on mathematics anxiety in elementary and secondary school students. Confirmatory factor analysis of the obtained data revealed two components of mathematics anxiety, a negative affective reactions component and a cognitive component. It was also found that the affective component of mathematics anxiety related more strongly and negatively to children's ability perceptions, performance perceptions and mathematics performance. But the worry component related more strongly and positively to the importance that children attach to mathematics and their reported actual effort in mathematics. Girls were found to report stronger affective reactions to mathematics. Ninth grade students reported experiencing the most worry about mathematics and sixth graders the least.

Mevarech and Ben-Artzi (1987) in their study examined the effects of Computer Assisted Instruction (CAI) with fixed and adaptive feedback on children's mathematics anxiety and achievement. Multivariate and Univariate analyses of covariance on data collected from 245 sixth grade students revealed significant differences between CAI and non CAI treatments on six factors of Mathematics Anxiety. No significant differences were found between the two CAI treatments on any variable.

Clute (1984) studied the relationship of anxiety, teaching method and their interaction to mathematics achievement. Direct instruction discovery and direct instruction expository strategies were employed on 81 students in different sections of a survey course in college mathematics at two colleges. It was found that students with a high level of mathematics anxiety had significantly lower achievement than students with a low level of anxiety. It was also found that students with high anxiety benefited more from expository approach and students with low anxiety benefited more from discovery approach. It was also revealed that if the desired outcome is correct answers to high level questions, a discovery method may benefit students at all levels of anxiety.

Sepie and Keeling (1978) divided a sample of 246 eleven and twelve years old children, belonging to a school in New Zealand, into groups of over-achievers, achievers and under achievers in mathematics using regression equation based on the relationship between Otis I.Q. and mathematics achievement and employing the cut off procedure recommended by Thorndike. Analysis of Variance was used to compare the performances of the three groups on measures of general anxiety, test anxiety and mathematics anxiety. The results revealed that under achievers in mathematics are clearly differentiated from their achieving and over achieving peers in mathematics-specific anxiety than in either general or test anxiety.

Mathematics Anxiety- Research Trend

Mathematics learning and factors affecting mathematics learning including Mathematics Anxiety is a well analysed area in India as well as abroad. Many case studies, surveys, experimental studies, longitudinal and cross sectional studies had been conducted related to mathematics anxiety on a variety of samples, using a variety of methodologies and utilizing various techniques of analysis. Quantitative, qualitative and triangulation studies were located which had studied mathematics anxiety in relation to variables like mathematics achievement, self concept, test anxiety, general anxiety, gender, age, mental ability, various teaching methods etc. Some studies tried to explore the reasons and consequences of mathematics anxiety while some others tried to clarify and define the construct. A number of studies were related to development of instruments for measuring mathematics anxiety.

With regard to the research on mathematics anxiety as related to teaching methods, some methods like Direct Instruction Expository (Clute, 1984), Computer Assisted Instruction (Mevarech & Ben-Artzi, 1987), Co-operative method (Daneshamooz, Alamolhodaei & Darvishian, 2012) were found beneficial for improving achievement of mathematically anxious students. An intervention model developed by Uusimaki and Kidman (2004) was found effective for reducing mathematics anxiety of primary pre-service teachers. The investigator was able to locate only one teaching approach helpful in reducing mathematics anxiety of primary students, namely Calculator Aware Number Curriculum (Newstead, 1998). The research trend analysed in this specific area support the research intension of the investigator to develop some form of instructional strategy to reduce Mathematics Anxiety.

Studies Related to Cognitively Guided Instruction

Guerrero (2014) examined teacher and administrator perspectives with regard to the adoption and implementation of Cognitively Guided Instruction at three elementary schools. A holistic exploratory case study analysis was conducted. Participants were elementary mathematics teachers representing grades one to six, school principals and one district office representative.

Classroom observations, teacher interviews, administrator interviews and a review of documents and materials related to Cognitively Guided Instruction were conducted. The data from these three sources were triangulated and analysed for emerging categories and subcategories. The findings of the study indicated few differences between the three school sites with regards to their adoption and implementation. Teachers' and administrators' perceptions of the adoption and implementation were found to be generally positive.

Moscardini (2014) carried out a study in Scotland which involved introducing the principles of Cognitively Guided Instruction to 21 mainstream elementary teachers. The study explored how these teachers used this knowledge to support all learners. The study was a qualitative one designed over three phases to support a comparison of pre- and post- intervention measures. Data from final interviews showed that all the participating teachers considered themselves to be more knowledgeable about children's mathematical thinking. A shift away from the transmission of knowledge and procedures and towards encouraging pupils to make connections in their mathematical thinking was found.

Hankes, Skoning, Fast and Mason (2013) conducted a three year research study among Native American students identified as learning disabled. Methods used were problems based, consistent with those of Cognitively Guided Instruction and were culturally relevant. Participants were teachers in special education and inclusive education classrooms of grades kindergarten through 12. It was found that the target students had significant learning gains.

Hendricks (2013) conducted a quasi-experimental study to measure the impact of Cognitively Guided Instruction on Criterion Referenced Competency Tests (CRCT) achievement scores of 104 students who had been administered the test from 2007 to 2010. The experimental group consisted of 53 students and control group consisted of 51 students. Using ANCOVA, the results revealed that a significant difference exist between mathematics scores of the experimental group and control group. Cognitively Guided Instruction was found to be instrumental in improving instruction and improving mathematics understanding. It was also found that as the dynamics of classroom social communication changes, children learn to think and act mathematically.

Spilde (2013) studied the effect of using a sequence of representations to solve word problems on students' scores on pre-post assessments and daily problem solving. Mixed methods were employed to collect data. One group pre-test post-test design was used. Nineteen students ranging in age from 6 to 8 years participated. It was found that students' problem solving abilities increased, students internalized the solution strategy process and students worked more independently on problems as their problem solving abilities increased. The triangulated results of the study showed that students solve Cognitively Guided Instruction style word problems correctly, with understanding at a high complexity level, and co-operatively with developed independence. It was also found that students increased the complexity of solutions used to solve problems and decreased the rate of guessing in answers to word problems.

Christenson and Wager (2012) reported that to provide guidelines for differentiated instruction in mathematics, staff from the Madison Metropolitan school district in Wisconsin created a pedagogical framework for teaching called "Balanced Mathematics". The framework was based on Cognitively Guided Instruction, algebraic thinking and NCTM standards. It has four components. The teachers in the district were introduced to the framework through an instructional guidebook that contains many classroom resources, such as instructional organizers and sample activities and assessments.

Medrano (2012) studied the effect of Cognitively Guided Instruction on primary school students' mathematics achievement, problem solving abilities and teacher questioning. Participants were second, third and fourth grade students of four elementary schools and nine teachers of these grades. Mixed method approach was used. Predominant strategy used by students to approach word problems was found to be direct modeling. It was found that third and fourth grade students demonstrated better achievement outcomes than regression prediction but not second grade students. It was also found that students did not understand questions being asked in many of the story problems and students had many misconceptions despite being asked many higher level questions.

Dowdy (2011) conducted a case study of 5 second grade teachers in two schools of one Southern California school district where Cognitively Guided Instruction was implemented in 2005 district wide for all elementary students. A qualitative analysis of observations, interviews, rubrics and district professional development records was done. It was found that teachers use Cognitively Guided Instruction in varying degrees. All observed teachers demonstrated most elements of quality Cognitively Guided Instruction.

Prusaczyk and Baker (2011) conducted a case study of a partnership of Southern Illinois University-Carbondale (SIUC) with twelve rural schools with high percentage of students in poverty. Participants were forty five teachers. Each one of them was given mathematics anxiety counseling and Cognitively Guided Instruction was used to enhance teachers' mathematical knowledge and ability to apply discipline-particular teaching approaches. Analysis of various data collected during four years revealed significant reduction in the mathematics anxiety of teachers and significant increase in Algebraic reasoning. No significant change in number operations was found. It was also found that students of the participant teachers have made gains in achievement.

Helding (2010) conducted a study to develop a measurement instrument for student knowledge within educational interventions. The construct underlying the measurement instrument corresponded with student knowledge in Cognitively Guided Instruction contexts. Item types and content arrangement were according to Guttman pattern, and administered to kindergarten and first grade students with clinical interviews. In the IRT modeling of student responses and items, one dimension was ultimately extracted.

Moscardini (2010) conducted a study on a group of 24 children in 3 Scottish primary schools for pupils with moderate learning difficulties. This study showed how the pupils responded to word problems following their teachers' introduction to the principles of Cognitively Guided Instruction. The study found that the pupils were able to develop their understanding of Mathematics concepts through actively engaging in word problems without prior explicit instruction and with minimal teacher adjustments. The pupils' conceptual understandings demonstrated by their solution strategies within Cognitively Guided Instruction activities were not found consistent with classroom records of assessment.

Franke, Webb, Chan, Ing, Freund and Battey (2009) examined the classrooms of 3 teachers who had engaged in algebraic reasoning professional development. It was found that after the initial "How did you get that?" question a great deal of variability existed among teachers' questions and students' responses.

Musanti, Celedon-Pattichis and Marshall (2009) conducted a case study to investigate a professional development initiative in which a first-grade bilingual teacher was engaged in learning and teaching Cognitively Guided Instruction. The study explored the impact of classroom based professional development on a teacher's understanding of teaching mathematics to Latin/o students and issues of language and culture with which the teacher grappled while engaged in reflecting on students' mathematical thinking. The findings showed that ongoing reflection, collegial conversation, and analysis of students' work enhanced teacher's understandings of students' mathematical learning, and of practices that provide students opportunities to solve contextualized mathematics problems, to communicate their solutions, and to represent their thinking.

Jacobs and Ambrose (2008) studied teacher-student conversations in problem solving interviews in which a third grade teacher worked one-one with a child. After analyzing videotaped problem solving interviews conducted by 65 teachers while 231 children solving 1018 story problems, eight categories of teacher moves that, when timed properly, were productive in advancing mathematical conversations were found.

Lawson and Ramsey (2008) conducted a study to determine teachers' perceptions concerning the use of Cognitively Guided Instruction in mathematics instruction. Participants were five teachers and two administrators who had attended professional development in Cognitively Guided Instruction. A Likert type survey was employed to collect data and percentage analysis was done for each survey item. The findings suggested that over all the teachers and administrators perceived Cognitively Guided Instruction training as beneficial and that improvements were made in student achievement. The results revealed that teachers intended to continue use of Cognitively Guided Instruction approach in their classrooms.

Empson, Junk, Dominguez and Turner (2006) analyzed children's coordination of number of people sharing and number of things being shared in their solutions to equal sharing problems and also to what extent this coordination was multiplicative. In the study children's solutions for equal sharing problems in which the quantities had a common factor was documented. Data consisted of problem solving interviews with students in first, third and fourth grades (n=12). Two major categories of strategies were found and it was found that problems that included number combinations with common factors elicited a wider range of whole-number knowledge and operations in children's strategies.

Fast (2005) attempted to determine if children in Zimbabwe, a developing country with cultures and educational experiences very different from those in the United States, could also potentially benefit from Cognitively Guided Instruction. Thirty five second grade Zimbabwean students' mathematics problem solving attempts were assessed using the 14 Cognitively Guided Instruction problem types. It was found that their solution strategies were consistent with findings of previous research. Most of the students were at the direct modeling stage in their development and they had difficulty in solving more complex problems. Results suggested that Cognitively Guided Instruction offer considerable benefits for elementary school children in Zimbabwe.

Empson (2003) conducted an analysis of two low performing students' experiences in a first grade classroom oriented toward teaching for understanding. Combining constructs from interactional sociolinguistics and developmental task analysis, the nature of these students' participation in classroom discourse about fractions was investigated. Pre- and post instruction interviews documenting learning and analysis of classroom interactions suggested mechanisms of that learning. It was proposed that three main factors account for these two students' success: use of tasks that elicited the students' prior understanding, creation of a variety of participant frameworks in which students were treated as mathematically competent, and frequency of opportunities for identity-enhancing interactions.

Waxman and Tellez (2002) in their study synthesized research from 1990 to 2002 on effective teaching for English Language Learners (ELL), focusing on instructional strategies and methods found to have most educational benefit to ELLs. The final synthesis consisted of 34 articles. Seven teaching practices were found to be effective in improving education of ELLs. It was found that Cognitively Guided Instruction has several positive components that can improve the education of ELLs.

Bowman, Bright and Vacc (2000) examined changes in 16 teachers' beliefs about teaching and learning across a five year Cognitively Guided Instruction project. Beliefs scale was administered six times during the project and repeated measures analysis of variance and nonlinear regression analysis were done. It was found that during the initial year of implementation of Cognitively Guided Instruction, teachers' beliefs declined and by the end of the second year teachers' beliefs were found to recover to the same level evidenced immediately after the initial workshops. Little change was found in total scale and subscale scores after the second implementation year. The results revealed that long term, intensive support is needed by teachers to continue using Cognitively Guided Instruction approach in their mathematics instruction.

Bright, Vacc and Bowman (2000) conducted a case study of a third grade teacher across four years of implementation of Cognitively Guided Instruction. Data included annual interviews, written reflections of the teacher on instructional issues and observations of mathematics instruction of the teacher. It was found that the beliefs of the teacher shifted toward a constructivist view and remained stable throughout the project. By the end, the teacher was able to see student-student interaction as critical to development of mathematical thinking, view students' struggles with mathematics ideas as desirable, help students to reflect, make explicit decisions about when children would share solutions and focus questions to help children to see mathematical structures.

Carpenter and Levi (2000) conducted a series of two studies in the context of Cognitively Guided Instruction to understand how to provide support for children to reflect on their procedures in order to form generalizations from them and construct notations for representing their procedures and generalizations abstractly. In the first study, a group of eight students in a combination first and second grade class were taught eight lessons. It was found that some first and second grade children could deal successfully with a variety of true or false number sentences. The following year a case study of a combination class of grade first and second consisting of 20 students was conducted. The results were found to be consistent with the results of first study. The two studies revealed that students in the primary grades are able to engage in formulating, representing, and justifying conjectures even though their justification might not always be sufficient to validate all of the conjectures they are capable of identifying.

Vacc, Bowman and Bright (2000) conducted case studies of two teachers at their first year of teaching who had joined a five year Cognitively Guided Instruction project. Changes were documented in the areas of discourse, children's thinking and instructional planning through analysis of transcribed annual interviews, teachers' written responses to a variety of instruments, and classroom observations with post- observation interviews. Results revealed that by the end of the project, one teacher provided students with opportunities to solve a variety of problems but did not use what students shared to make instructional decisions. But the other teacher was found to make instructional decisions based on the knowledge about individual child's mathematical thinking. Significant difference was also found between the belief scale scores of the teachers.

Clements, Swaminathan, Hannibal and Sarama (1999) investigated the criteria that preschool children use to distinguish members of a class of shapes from other figures. Individual clinical interviews of 97 children of ages 3 to 6 emphasizing identification and descriptions of shapes and reasons for these identifications were conducted. It was found that young children initially form schemes on the basis of feature analysis of visual forms. It was also found that while these schemas are developing, children continue to rely primarily on visual matching to distinguish shapes. Results also revealed that children are capable of recognizing components and simple properties of familiar shapes.

Empson (1999) conducted a study to explore children's fraction learning in a first grade classroom in which the teacher elicited and built on children's informal knowledge of fractions. Sample consisted of 19 children. Pre tests and post tests indicated that children's understanding of fractions had advanced. The results suggested that how children think about fractions is influenced not only by how their own knowledge is structured, but also by how the context for thinking about and discussing fractions is structured.

Vacc and Bright (1999) studied elementary pre-service teachers' changing beliefs and instructional use of children's mathematical thinking. 34 participants were introduced to Cognitively Guided Instruction as part of a mathematics method course. Belief-scale scores indicated that significant changes in teachers' beliefs and perceptions about mathematics instruction occurred across the two year long sequence of professional course work and student teaching during their under graduate program. But it was found that their use of knowledge of children's mathematical thinking during instructional planning and teaching was limited.

Battista, Clements, Arnoff, Battista and Borrow (1998) examined in detail students' structuring and enumeration of two-dimensional rectangular arrays of squares. Twelve second graders were interviewed and research indicated that many students do not recognize the row-by-column structure assumed in such arrays. Various levels of sophistication in students' structuring of the arrays were found.

Bowman, Bright and Vacc (1998) in their study examined changes in 20 elementary teachers' beliefs about teaching and learning that occurred during the first two years of a five year implementation of Cognitively Guided Instruction as the basis of mathematics instruction. To assess changes in teachers' beliefs about teaching and learning mathematics, Cognitively Guided Instruction beliefs scale was administered before and after each of the four workshops. Results indicated that during the first year, teachers' beliefs declined, despite receiving extensive support. It took two years of implementation for teachers' beliefs to recover to the same level evidenced immediately after the initial workshops.

Bright, Bowman and Vacc (1998) conducted a study to examine the influence of teachers' frameworks for human development, curriculum and mathematics on their interpretations of children's mathematical thinking. The teachers in the study were 20 elementary teachers who were participating in a profession development project to help them implement Cognitively Guided Instruction. Data on teacher beliefs, interpretations of children's solutions to Mathematics problems and instructional decision making were collected. Five frameworks were identified viz., developmental, taxonomic, problem solving, curriculum, deficiency. Results suggested that teachers focus most frequently and very consistently on the curriculum framework. It was also found that the increasing importance of the developmental framework was due to the increased attention paid by the teachers to the different kinds of solutions strategies used by students.

Carpenter, Franke, Jacobs, Fennema and Empson (1998) conducted a three years longitudinal study to investigate the development of 32 students' understanding of multi-digit number concepts and operations in Grades 1-3. Students were individually interviewed five times on a variety of tasks involving base-ten number concepts and addition and subtraction problems. The study proved that children can invent strategies for adding and subtracting and illustrated both what that invention affords and the role that different concepts may play in that invention. About 90 percent of the students were found to use invented strategies. Students who used invented strategies before they learned standard algorithms demonstrated better knowledge of base-ten number concepts and were more successful in extending, their knowledge to situations than were students who initially learned standard algorithms.

Fennema, Carpenter, Jacobs, Franke and Levi (1998) investigated gender differences in problem solving and computational strategies used by 44 boys and 38 girls as they progressed from grades 1 to 3. The children were individually interviewed five times. In each interview, they solved tasks involving basic number operations and their application to more complex problems. No gender differences were found in solving number fact, addition or subtraction, or nonroutine problems throughout the three years of the study. Each year, there were strong and consistent gender differences in the strategies used to solve problems, with girls tending to use more concrete strategies like modeling and counting and boys tending to use more abstract strategies that reflected conceptual understanding. At the end of the third grade, girls were found to use more standard logarithms than boys. On the problems that required flexibility in extending one's procedures, boys were found to be more successful than girls.

Franke, Carpenter, Fennema, Ansell and Behrend (1998) investigated changes over four years of three elementary teachers participating in Cognitively Guided Instruction professional development. Interviews and observations indicated that Cognitively Guided Instruction allowed teachers to engage in ongoing practical inquiry directed at understanding their students' thinking.

Hankes (1998) examined whether teaching methods employed in Cognitively Guided Instruction were compatible with the teaching methods of Native American Pedagogy. A kindergarten teacher implemented Cognitively Guided Instruction after participating in two 30-hour Cognitively Guided Instruction workshops. The results of a nine item test showed that the students demonstrated remarkable problem solving ability, indicating that Cognitively Guided Instruction is a culturally compatible way of teaching mathematics to Native American children.

Vacc, Bright and Bowman (1998) in their study examined changes in 19 teachers' beliefs across the first two years of a professional development program in Cognitively Guided Instruction. The study involved five teams of mathematics teachers and teacher educators. Participants responded to three sets of open ended questions. It was found that participants changed their beliefs in three areas: teachers' view of children, teacher and student roles, and skill acquisition and problem solving. The changes were found to vary by category and grade level.

Bowman, Bright and Vacc (1997) studied teachers' beliefs and their implementations of children's problem solving performance across the first year of implementation of Cognitively Guided Instruction. Sample consisted of 21 female teachers in grade 5. A transcript analysis of a dialogue between a first grade teacher and three students, a 48 item Beliefs Scale and two general items were completed by the teachers before each of the two workshops. Results of analysis of pre-post responses revealed that teachers' beliefs changed significantly in ways that were consistent with Cognitively Guided Instruction tenets. Evidence cited by the teachers to support their assessment of students' thinking also changed consistently with the implementation of Cognitively Guided Instruction. It was found that complex relations exist between these two kinds of changes.

Battista and Clements (1996) examined various conceptual structures that students construct in enumerating three dimensional cube array and the mental operations that underlie these constructions. 45 third and 78 fifth graders were interviewed and observed before and after a teaching experiment on volume. Results showed that students' initial conception of a three dimensional rectangular array of cubes was an uncoordinated set of faces. It was also found that as students became capable of coordinating views, they see array as space filling and strive to restructure it as such. Those who complete a global restructuring of the array use laying strategies. Those in transition use local piece to piece restructuring strategies. These findings suggested that many students are unable to enumerate the cubes in a three dimensional array because they cannot coordinate the separate views of the array and integrate them to construct one coherent mental model.

Fennema, Carpenter, Franke, Levi, Jacobs and Empson (1996) conducted a longitudinal study to examine changes in the beliefs and instruction of 21 primary grade teachers over a four year period in which the teachers participated in a Cognitively Guided Instruction teacher development program. It was found that there were fundamental changes in the beliefs and instruction of the teachers. The gain in their students' concepts and problem solving performance was found to be directly related to changes in teachers' instruction.

Melton (1996) studied the change in black students' performance when they worked with partners they selected. Participants were students of a fourth grade teacher. Using Cognitively Guided Instruction principles, the teacher observed students and adapted teaching method. Then a survey was conducted and the results revealed that the partnership was successful.

Knapp and Peterson (1995) conducted a study on teachers' interpretations of Cognitively Guided Instruction. Twenty primary teachers were interviewed who, three of four years earlier, had participated in in-service workshop on Cognitively Guided Instruction. Three patterns of use of Cognitively Guided Instruction were found. These patterns were found to be related to the meanings teachers constructed for Cognitively Guided Instruction itself.

Behrend (1994) examined the problem solving processes of five second and third-grade students identified as learning disabled. Children's independent and assisted problem solving abilities were assessed based on Cognitively Guided Instruction framework. Individual interviews and small group sessions were conducted. It was found that, given the opportunity, these students were capable of sharing their strategies, listening to other children's strategies, comparing the strategies, justifying their thinking and helping each other to understand word problems. They were also capable of generating and generalizing their own problem solving strategies and did not need to be taught specific strategies.

Bright and Vacc (1994) as part of a project conducted a study to examine the effect of inclusion of Cognitively Guided Instruction in a mathematics methods course on the teaching performance of undergraduate pre service teachers. The sample consisted of 68 pre-service teachers at the University of North Carolina. The experimental group consisting of 34 students was given instruction on Cognitively Guided Instruction in their methods course and the control group was not. The beliefs survey revealed that pre-service teachers in both groups changed their beliefs to a more constructivist orientation during the program. It was found that Cognitively Guided Instruction pre-service teachers taught for meaningful understanding of mathematics concepts by the students but control pre-service teachers wanted students to reflect the mathematics understanding of the teacher. The study also suggested that it is possible to teach pre-service teachers to use Cognitively Guided Instruction.

Lehrer and Jacobson (1994) conducted a three year longitudinal study of the development of children's thinking about shapes; measurement, depiction and visualization. Based on the findings of the study conducted on first, second and third graders an experimental Cognitively Guided Instruction curriculum for teaching geometry was developed. After a series of workshops and a year of instruction using this curriculum, significant change in the beliefs of teachers about the teaching and learning of geometry was found. At the end of the year it was found that Cognitively Guided Instruction Geometry group showed large differences in conceptions of Geometry.

Schmitz (1994) conducted a study to increase middle-level teaching teams understanding of cognitively guided instructional strategies or brain-based learning theories and to promote the incorporation of these into the teaching of cross-curriculum thematic units. Twelve staff development modules based on a new perspective of learning were developed and implemented. Analysis of the survey and interview data revealed that middle level educators who were consistently involved in staff development sessions discussed the meaning of cognitive instruction, implemented more strategies within their classroom, and demonstrated understanding of cognitively guided instructional strategies' relationships to curriculum integration.

Steinberg, Carpenter and Fennema (1994) conducted case study of a fourth grade teacher and 21 students of the teacher. The teacher taught mathematics using Cognitively Guided Instruction approach. Nine students randomly selected and were documented regularly. Observations, interviews and student assessments were collected. Four phases of teacher change were identified and teacher change was found to reflect in children's solution strategies. Results also suggested that it is possible to start implementing Cognitively Guided Instruction in fourth grade also.

Fennema, Franke, Carpenter and Carey (1993) conducted a longitudinal case study of one first grade teacher over a period of four years. The study was to understand how knowledge of children's thinking in mathematics was used by the teacher to make instructional decisions. It was found that children in the Cognitively Guided Instruction classroom learned mathematics to a level that exceeds what is recommended by the NCTM standards.

Villasenor and Kepner (1993) compared the problem solving and computational skills of first grade students whose teachers had participated in staff development programme to learn to teach using a Cognitively Guided Instruction framework to that of first grade students whose teachers had not. It was found that students in experimental classes performed significantly better in solving word problems and completing number facts.

Knapp and Peterson (1991) conducted a study to examine teachers' ideas of Cognitively Guided Instruction intervention four years later. The participants were 20 teachers who had participated in month-long workshops on Cognitively Guided Instruction as part of a large scale study. Ten of the teachers had participated in the experimental group and another 10 in control group in the larger study. Interview results revealed that their use of Cognitively Guided Instruction to teach mathematics varied widely from occasionally or supplementarily to mainly or solely. Three patterns of change in Cognitively Guided Instruction use were found. These patterns of change were found related to the meanings that teachers had constructed for Cognitively Guided Instruction.

Carpenter, Fennema, Peterson, Chiang and Loef (1989) studied teachers' use of knowledge from research on children's mathematical thinking and how their students' achievement is influenced as a result. Twenty first grade teachers, assigned randomly to an experimental treatment, participated in a month long

Cognitively Guided Instruction workshop in which they studied a research based analysis of children's development of problem solving skills in addition and subtraction. Other 20 first grade teachers were assigned randomly to a control group. Although differences in student achievement were modest, the differences found consistently favoured the Cognitively Guided Instruction treatment group.

Peterson, Carpenter and Fennema (1989) in their study examined the relationship of teachers' knowledge of students' knowledge to teachers' mathematics instruction and to students' mathematics problem solving. Twenty first grade teachers participated in a four week workshop in which they were given knowledge on children's mathematics learning. Observations, interviews and questionnaires were employed. Correlation analyses showed significant positive relationships between teachers' knowledge of students' knowledge and mathematics problem solving achievement of students. Case analyses of knowledge and behaviour of the most effective teacher and the least effective teacher were found to support these conclusions.

Peterson, Fennema, Carpenter, Franke and Loef (1989) examined relationships among first grade teachers' pedagogical content beliefs, teachers' pedagogical content knowledge, and students' achievement in mathematics. Sample consisted of 39 teachers. Results indicated significant positive relationships among teachers' beliefs, teachers' knowledge, and students' problem solving achievement. Compared to teachers with a less cognitively based perspective, teachers with a more cognitively based perspective were found to make extensive use of word problems in introducing and teaching addition and subtraction. Cognitively based teachers showed greater knowledge of word problem types, children's problem solving strategies and their children scored higher on word Problem Solving Achievement.

Carpenter and Moser (1984) studied children's solutions to simple addition and subtraction word problems in a three year longitudinal study that followed 88 children from grades 1 through 3. Clinical interviews were used to identify the processes that children used. The results revealed that the children were able to solve the problems using a variety of modeling and counting strategies even before they received formal instruction in arithmetic. It was found that the invented strategies were continued to be used after several years of formal instruction. Four levels of problem solving ability were found.

Cognitively Guided Instruction- Research Trend

Review of the studies related to Cognitively Guided Instruction revealed that it is an emerging area of research. Most of the previous studies have investigated whether the Cognitively Guided Instruction knowledge shared in workshops had an impact on teachers and on students. The studies have used a variety of methodologies to study teachers including precise observations of teaching, paper and pencil assessments, individual interviews, and in depth case studies. Mixed methodology was also used. To assess children's thinking, standardized tests, self developed paper and pencil tests and individual interviews have been used. The majority of the studies have been concerned with the learning and attitudes, problem solving strategies etc. of primary school students and with the thinking and instruction of their teachers. But studies have also been conducted on different samples such as students with learning disabilities, Native American, Black, Latin/o students and pre service teachers.

Researches on Cognitively Guided Instruction gave evidence for its significant effect on student achievement. It was also found to be effective for improving problem solving ability, number skills etc. Its positive effects for special education students are also found.

The review revealed gaps in Cognitively Guided Instruction related research. Majority of the earlier related studies were carried out by its programme developers themselves. Only a small number of studies had been conducted by persons other than Cognitively Guided Instruction programme developers. Only a few studies had evaluated Cognitively Guided Instruction in terms of students' mathematical performance. Most of the studies were carried out in United States of America. Investigator was able to locate only a small number of studies related to implementation of Cognitively Guided Instruction in other countries and was not able to locate any related study conducted in India.

As noted earlier, most of the studies reviewed relate Cognitively Guided Instruction to learning and attitudes of students and thinking and instruction of teachers. Only one study was located related to mathematics anxiety. In this particular study, it was used to enhance teachers' mathematical knowledge and counseling was used to reduce their mathematics anxiety. No study was found to study the effect of Cognitively Guided Instruction on mathematics anxiety of students.

Conclusion

A thorough analysis of studies related to Mathematics Anxiety, Cognitively Guided Instruction was done. It helped to clarify the design of the study and to justify the selection of the research area. From the review it can be seen that study related to Cognitively Guided Instruction is a novel one in India and the investigator was not able to locate studies on teaching methods reducing mathematics anxiety of primary students also. The investigator hopes that the present study will be a worthwhile research contribution as the investigator had made an extensive survey of the studies related to mathematics anxiety and Cognitively Guided Instruction, and was able to identify the gap in this area of research.

Chapter IV

METHODOLOGY

- *Preliminary Survey*
  - *Variables in Preliminary Survey*
  - *Design of the Preliminary Survey*
  - *Sample selected for the Preliminary Survey*
- *Experiment*
  - *Variables in the Experiment*
  - *Design of the Experiment*
  - *Sample Selected for the Experiment*
  - *Tools and Materials Used in the Experiment*
- *Statistical Techniques Employed in the Study*

METHODOLOGY

The methodology adopted for the present study is detailed in this chapter. The study mainly intended to develop an instructional strategy based on Cognitively Guided Instruction to teach Mathematics at upper primary level and to study the effectiveness of the instructional strategy in terms of Mathematics Anxiety and Achievement in Mathematics of the selected students. As a first step to have a conceptual reality of Mathematics Anxiety of upper primary school children, a preliminary survey was carried out. After this the investigator proceeded to design and develop the instructional strategy and the effectiveness of the strategy was tested from the result of the experiment. A detailed description of variables, design, sample, tools and materials used, data collection procedure and statistical techniques is presented in this chapter.

The main part of the present study is development of an instructional strategy based on Cognitively Guided Instruction and testing its effectiveness in terms of Mathematics Anxiety and Achievement in Mathematics of upper primary school students. Before going to the actual experimentation, a preliminary survey was conducted to find out the level of Mathematics Anxiety of upper primary school students. The procedure adopted in the study is presented in two major sections.

Preliminary Survey

The objectives of the preliminary survey were to find out the existing level of Mathematics Anxiety of upper primary school students and to compare Mathematics Anxiety of different subgroups of students based on Gender and Grade.

The preliminary survey was conducted with the intention to select sample for the experiment. That is, to decide based on the existing level of Mathematics Anxiety of upper primary students which standard to select for the intervention using Cognitively Guided Instructional Strategy.

Variables in Preliminary Survey

For this phase of the study a single criterion variable and two classificatory variables were selected. The criterion variable selected is Mathematics Anxiety and classificatory variables are Gender and Grade.

Design of the Preliminary Survey

In this first phase of the study, for identifying the existing level of Mathematics Anxiety of upper primary school students and to study whether there exist any significant difference in the existing level of Mathematics Anxiety of students belonging to different subgroups based on Gender and Grade, data were collected using survey method. The data were collected from four schools of Palakkad district and three schools of Malappuram district giving due representation to Gender and Grade.

Sample selected for the Preliminary Survey

For preliminary survey a sample of 400 upper primary school students were selected from Palakkad and Malappuram districts using stratified random sampling technique. The sample was selected giving due representation to factors like Gender and Grade. The breakup of the sample selected for preliminary survey is given in Table 1.

Table 1
Breakup of the Sample Selected for Preliminary Survey

Classificatory Variable	Subgroups	Number of Students	Total
Gender	Boys	232	400
	Girls	168	
Grade	Standard V	102	400
	Standard VI	178	
	Standard VII	120	

Tools Used for the Preliminary Survey

Mathematics Anxiety Scale (Musthafa & Sunitha, 2012) developed and standardised by the investigator with the help of supervising teacher was used to collect data in the preliminary survey phase. The detailed description of the steps involved in the development and standardisation of the tool is presented in the experimental phase of the present study.

The statistical techniques employed are presented in the section, Statistical Techniques employed for the study.

Experiment

The experiment was carried out to study the effectiveness of the developed Cognitively Guided Instructional Strategy in terms of Mathematics Anxiety and Achievement in Mathematics of upper primary school students.

Variables in the Experiment

The experimental phase of the present study was designed with incorporating independent variable, dependent variables and control variables.

Independent variable

The independent variable selected for the experiment is Instructional strategy and the two levels of Instructional strategy are Cognitively Guided Instructional Strategy and Existing method of teaching.

Cognitively Guided Instructional Strategy is the instructional strategy developed based on Cognitively Guided Instruction to impart mathematics concepts at upper primary level.

Existing method of teaching refers to the method of teaching adopted by upper primary school teachers for transacting the curriculum implemented by Government of Kerala in the upper primary schools of Kerala from the year 2009- 2010 onwards.

Dependent variables

The two main dependent variables of the study are Mathematics Anxiety and Achievement in Mathematics. The variable Achievement in Mathematics was subdivided into Achievement in Mathematics (Lower order objectives) and Achievement in Mathematics (Higher order objectives).

Control variables

The control variables selected for the study are Pre- Achievement in Mathematics, Verbal Intelligence and Non-verbal Intelligence. Pre- Achievement in Mathematics refers to the previous knowledge of the students in the Mathematics topics selected for experiment. These variables were statistically controlled using ANCOVA. Since both the experimental and control groups were instructed by the investigator, the teacher factor is considered constant.

Design of the Experiment

In this second phase of the study, data were collected using quasi experimental method. For this, pretest - posttest non equivalent groups design was adopted. Four intact classes of standard VI were selected from two different schools. In both the selected schools, one intact class was assigned to experimental group and another intact class was assigned to control group.

Hence there were one experimental class and one control class in both the schools. Pretests were administered to both experimental and control groups. The experimental group was taught using Cognitively Guided Instructional Strategy and control group was taught using Existing method of teaching Mathematics at upper primary level. Then the posttests were administered to both experimental and control groups. Then the effectiveness of Cognitively Guided Instructional Strategy was tested by employing appropriate statistical techniques.

Experimental design

To test the effectiveness of Cognitively Guided Instructional Strategy in reducing Mathematics Anxiety and enhancing Achievement in Mathematics of upper primary school students, pretest- posttest non equivalent groups design was used. The layout of the design is as follows.

O_1 X_{CGIS} O_2

O_3 X_{EMT} O_4

In the layout of the design O_1 and O_3 refer to pretests on Achievement in Mathematics, Verbal Intelligence, Non-verbal Intelligence and Mathematics Anxiety. O_2 and O_4 are posttests on Mathematics Anxiety and Achievement in Mathematics. X_{CGIS} is the experimental treatment using Cognitively Guided Instructional Strategy and X_{EMT} is the control treatment using Existing method of teaching Mathematics.

Sample Selected for the Experiment

The sample for the experiment was selected from two schools of Malappuram revenue district of Kerala state. From each school two intact classes of standard VI were selected and one class was randomly assigned to experimental group and one class to control group. The final sample for the experiment consisted of 128 standard VI students, out of which 66 students belonged to experimental group and 62 students belonged to control group. The breakup of sample selected for the experiment is presented in Table 2.

Table 2

Breakup of the Sample Selected for Experiment

Group	Name of School	Number of Students		Total
		Boys	Girls	
Experimental Group	GMHSS, CU Campus	18	17	35
	AUPS, Velimukku	20	11	31
Control Group	GMHSS, CU Campus	17	13	30
	AUPS, Velimukku	15	17	32
Grand Total		70	58	128

Tools and Materials Used in the Experiment

The following tools and materials were used for collecting data in the experimental phase of present study.

- Mathematics Anxiety Scale (Musthafa & Sunitha, 2012)
- Lesson Transcripts based on Cognitively Guided Instructional Strategy (Musthafa & Sunitha, 2013)
- Lesson Transcripts on Existing method of teaching (Musthafa& Sunitha, 2013)
- Test of Achievement in Mathematics (Musthafa & Sunitha, 2013)
- Verbal Group Test of Intelligence (Kumar, Hameed & Prasanna, 1997)
- Standard Progressive Matrices Test (Raven, 1958)

Detailed description of each tool and material is presented in the following sections.

Mathematics Anxiety Scale (Musthafa & Sunitha, 2012).

Mathematics Anxiety Scale was developed and standardized by the investigator along with supervising teacher to measure Mathematics Anxiety of upper primary school students of Kerala. This test was used in the preliminary survey to estimate the existing level of Mathematics Anxiety of upper primary school students and in the experiment as pretest and posttest to collect data on Mathematics Anxiety. The procedures adopted in the development and standardization of the scale is detailed in the following sections.

Planning and preparation of Mathematics Anxiety Scale.

The investigator thoroughly reviewed the literature related to Mathematics Anxiety in order to clarify the construct. Various researchers have defined Mathematics Anxiety in different ways and there are many theories related to Mathematics Anxiety. But the investigator was not able to find a commonly accepted construct model. However, based on theories related to Mathematics Anxiety and the implications of the theories for teachers, two basic assumptions were made to develop Mathematics Anxiety Scale. 1) Mathematics Anxiety and Achievement are linearly related, 2) Mathematics Anxiety interferes with Achievement in Mathematics. That is, a high level of Mathematics anxiety causes a low level of achievement.

Then various tools used to measure the variable were studied to find out whether it has a uni–dimensional structure or multi- dimensional structure and studies related to development of tools for measuring the variable were also reviewed. But the investigator was not able to reach a conclusion as the dimensions reported varied from a single factor to many factors and using the same tool different factors were identified by different researchers. For example:

Bai, Wang, Pan and Frey (2009) reported Negative and Positive factors; Bessant (1995) found six factors namely, General evaluation anxiety, Mathematics test anxiety, Passive observation anxiety, Performance anxiety, Problem solving anxiety and Every day numerical anxiety; Wigfield and Meece (1988) identified two factors, Concerns about doing well in math and Strong negative reactions to math. So different factors reported were listed and were examined for meaning and its corresponding theoretical perspectives. After many discussions with supervising teacher and experts in the field 11 possible components were shortlisted.

The possible components finalized were Problem solving anxiety, Application anxiety, Performance anxiety, Worries about learning Mathematics, Negative affect towards Mathematics, Test/ Evaluation anxiety, Apprehension of Mathematics courses and lessons, Social or public aspects of doing Mathematics, Anxiety due to nature of Mathematics, Self efficiency for Mathematics and Physical arousal in Mathematics situations. Based on these, items were written to prepare the draft form of Mathematics Anxiety Scale.

The draft Mathematics Anxiety Scale consisted of 88 statements pertaining to the 11 possible components. The distribution of statements in the draft Mathematics Anxiety Scale is presented in Table 3.

Table 3

Distribution of Statements in Draft Mathematics Anxiety Scale

Sl No.	Possible Components	Serial Number of Statements
1	Problem solving anxiety	1,4,**7**,**10**,13,16,19,**22**
2	Application anxiety	2,5,**8**,11,**14**,**17**,20,**23**
3	Performance anxiety	3,6,9,12,15,18,**21**,24
4	Worries about learning Mathematics	25,**27**,29,31,33,35,37,39
5	Negative affects towards Mathematics	26,28,30,32,**34**,**36**,**38**,**40**
6	Test/ Evaluation anxiety	41,43,45,47,49,51,53,55
7	Apprehension of Mathematics courses and lessons	**42**,**44**,46,48,50,52,54,56
8	Social or public aspects of doing Mathematics	57,**59**,61,63,65,67,69,71
9	Anxiety due to nature of Mathematics	58,60,62,64,66,68,70,**72**
10	Self efficiency for Mathematics	73,75,77,79,**81**,**83**,85,87
11	Physical arousal in Mathematics situations	74,76,78,80,82,84,86,**88**

The draft scale consisted of 68 favourable statements and 20 unfavourable statements. The serial numbers of unfavourable statements are given in bold face.

A copy of the Malayalam and English versions of the draft scale are given as Appendix A1 and Appendix A2 respectively.

Item analysis

The draft scale was administered to a random sample of 400 upper primary school students. Out of these 370 sheets were selected randomly for item analysis. Total score of the scale is the sum of item scores. The scores were arranged in descending order and the highest 100 and lowest 100 were selected to form upper group and lower group respectively. Then t values were calculated for each item. Items with t values greater than 2.58 were selected for the final test.

The details of item analysis of draft Mathematics Anxiety Scale is presented in Table 4.

Table 4

Details of the Item Analysis of draft Mathematics Anxiety Scale

Sl No.	t value	Sl No.	t value
1	8.204	45	11.372
2	3.985	46	10.435
3	7.877	47	12.696
4	7.676	48	10.893
5	8.519	49	8.652
6	6.902	50	12.525
7	1.251*	51	13.703
8	0.783*	52	12.746
9	11.815	53	11.096
10	2.280*	54	12.366
11	3.645	55	6.379
12	12.358	56	13.069
13	10.938	57	12.309
14	3.828	58	5.680
15	10.244	59	5.994
16	11.327	60	11.407
17	5.577	61	11.589
18	6.727	62	9.845
19	10.842	63	8.032
20	8.775	64	12.305
21	6.589	65	12.574
22	2.030*	66	8.778
23	4.068	67	8.319

Sl No.	t value	Sl No.	t value
24	6.299	68	9.283
25	11.114	69	11.516
26	10.339	70	0.090*
27	3.287	71	10.287
28	7.900	72	7.164
29	12.154	73	10.123
30	13.214	74	10.978
31	8.767	75	12.384
32	13.614	76	8.698
33	6.743	77	8.904
34	6.250	78	12.190
35	14.740	79	10.600
36	6.463	80	8.165
37	9.424	81	0.696*
38	8.844	82	10.486
39	12.097	83	5.778
40	3.134	84	10.261
41	12.284	85	13.296
42	8.604	86	9.905
43	9.450	87	5.630
44	6.880	88	4.651

* indicates t values of deleted items

After item analysis only five items were deleted from the draft scale.

Finalisation of the scale.

Factor structure of the scale was studied using Principal component analysis (N= 534), after removing the five items from draft scale. In this analysis all the items loaded into a single factor and items with factor loading greater than .30 were retained in the scale. Hence another 14 items were discarded from the draft scale (Serial no. 2, 11, 14, 17, 23, 27, 34, 36, 40, 58, 59, 83, 87, and 88).

The details of factor loading of the items are given as Appendix A3.

The final form of the scale consisted of 68 statements. 63 statements are favourable and five statements (Sl no. 14, 26, 29, 31, 56 in final scale) are unfavourable.

Administration and scoring procedure of Mathematics Anxiety Scale.

To record the response of the students, space is provided in the scale itself against each statement considering the age group of students. The purpose of the scale is detailed to the students and specific instructions regarding the recording of responses are given. Statements are read out loudly and clarifications are made wherever necessary so that all students are able to respond. Uniformity is maintained in clarifications. It takes less than one hour for the students to complete the scale.

Each statement in Mathematics Anxiety Scale has five response category Always, Frequently, Sometimes, Rarely and Never and scores 5, 4, 3, 2 and 1 respectively are assigned for favourable items. Unfavourable statements are reversely scored. The sum of scores of all statements gives the total score of the scale and is treated as the Mathematics Anxiety score of the subject. The maximum possible score is 340 and minimum score is 68.

Validity of Mathematics Anxiety Scale.

The statements in the scale appear to measure Mathematics Anxiety of subjects as confirmed by experts, so the scale has face validity. The items of the scale were prepared on the basis of different components of Mathematics

Anxiety identified by various researchers. The construct validity of the scale was further established by correlating the scale with school achievement of students (Aggregate grade points of second terminal Mathematics examination, converted into z scores) and also correlating with Test of Achievement in Mathematics prepared and standardized for the present study. The validity coefficients (N=58) thus obtained are -.64 and -.66 respectively, suggesting negative relationship between Mathematics Anxiety and Achievement in Mathematics. Since all the items of the scale loaded into a single factor with factor loadings ranging from .31 to .65, the scale has factorial validity. Hence the scale is a valid tool to measure Mathematics Anxiety.

Reliability of Mathematics Anxiety Scale.

Reliability of the scale over time was established by test- retest method. The final scale was administered twice to a sample of 58 students within an interval of three weeks. The two sets of scores thus obtained were correlated and the obtained reliability coefficient is .75. The internal consistency of the scale was established by calculating Cronbach's alpha. The obtained Cronbach's alpha of the scale is .97 suggesting very high internal consistency of the scale.

Hence Mathematics Anxiety Scale is a valid and reliable tool with good psychometric properties to measure Mathematics Anxiety of upper primary school students.

A copy of the Malayalam and English versions of the final Scale are given as Appendix A4 and Appendix A5 respectively.

Design and Development of Cognitively Guided Instructional Strategy

After carefully reviewing the studies related to Mathematics Anxiety, strategies that facilitate reduction in Mathematics Anxiety, various factors that contribute to learning of Mathematics with understanding and the theoretical underpinnings of Cognitively Guided Instruction the investigator with the help of the supervising teacher designed an instructional strategy based on Cognitively Guided Instruction. The details of designing and development of the strategy are presented in the following sections.

Designing of Cognitively Guided Instructional Strategy

Careful examination of the features of a Cognitively Guided Instruction class room, role of the teacher in instruction and various studies related to implementation of Cognitively Guided Instruction provided the insight required to design the strategy. Three books related to Cognitively Guided Instruction research (Carpenter, Fennema, Franke, Levi & Empson, 1999; Carpenter, Franke & Levi, 2003; Empson & Levi, 2011) were the basic resources.

The important features of a Cognitively Guided Instruction class room are:

1. Students learn various Mathematics concepts and computation skills as they solve a variety of problems related to real life situations.
2. Closely integrated with problem solving is communicating about problem solving. It is important that students communicate about their thinking through talking, writing or drawing pictures about how problems have been solved.
3. As students are asked to report their thinking and their peers are expected to listen to and value each others' thinking, it is necessary to create and maintain a non threatening environment in the class room.
4. Teaching is about helping students to understand concepts by helping them to see the relationships. Students develop understanding as they share and discuss various strategies of solving a problem.

The role of the teacher includes:

1. Listening to children to figure out what they understand
2. Selecting and adapting problems so that the problems connect to and extend the knowledge that the children have already acquired
3. Supporting children's learning by introducing appropriate symbols and ways of organizing and representing children's ideas
4. Providing a forum and active listening support for children to discuss alternative ways of thinking about problems and the concepts they embody

The content of the Mathematics text books of standard V, standard VI and standard VII were analysed thoroughly. Discussions were done with supervising teacher and teachers at upper primary level of schooling. Systematic organization of the knowledge acquired from these discussions, content analysis, review related to development and validation of instructional strategy and aforementioned principles of Cognitively Guided Instruction helped the investigator to design Cognitively Guided Instructional Strategy.

Cognitively Guided Instructional Strategy

The Cognitively Guided Instructional Strategy developed by the investigator is a three phased strategy. The different phases of the strategy are detailed below.

Phase 1: Presentation of the Problem

Phase 2: Finding Solution to the Problem

Phase 3: Discussion of the Solution Strategies

Step1: Sharing of Solution Strategies

Step 2: Justification of Solution Strategies

Step 3: Analysis of Solution Strategies

Phase 1: Presentation of the Problem

In this phase teacher presents the content area briefly or conduct a small discussion of the concepts related to the topic. Then presents a problem to students, which they are required to solve based on their understanding. Usually the problems are word problems related to real life situations

Phase 2: Finding Solution to the Problem

In this phase, students solve the problem individually or in small groups as decided by the teacher. For small group activities challenging problems are given and for individual activities relatively less challenging problems are given. Teacher monitors the procedures and gives necessary guidance based on understanding of students without emphasizing a particular procedure to solve the problem. Teacher asks questions related to the problem in order to understand the thinking of students or to understand what they are doing or to help students to discover their mistakes. Teacher helps the students to solve the problem using a procedure they understand and multiple ways to solve a problem are encouraged. Those students who solve the problem more quickly than others are asked to try to solve the problem in one more way.

Phase 3: Discussion of Solution Strategies

In this phase the problem solving procedure adopted by students are discussed and consolidated. Teacher ensures that whole class is involved in the process. This phase has three steps.

Step 1: Sharing of Solution Strategies

The first step involves presentation of different solution strategies adopted by students to solve the particular problem. If the problems were solved in groups, one student from a group presents the strategy. If the problem was solved individually, teacher selects students to present solution strategies. Importance is given to sharing of a number of valid solution strategies.

Step 2: Justification of Solution Strategies

In this step teacher asks those students who have presented their strategies probing questions regarding their solution strategies like "can you tell me what you were thinking?", "why did you start from this number?" and may continue based on the answers of the student in a non threatening way. This is done mainly for helping other children to understand the strategy so that they can use it if they understood it clearly. Teacher questioning helps students to understand their mistakes or make them reflect on their own solution strategies. Teacher also helps to clarify the strategies by writing the steps on the black board as they describe.

Step 3: Analysis of Solution Strategies

The various valid solution strategies are compared or made clearer through discussion as required to consolidate the lesson.

Development of Cognitively Guided Instructional Strategy

After designing the strategy various teaching learning materials were prepared based on the Mathematics topics of standard VI selected for the experiment.

Selection of topics for the experiment

After consulting with experts in the field and analyzing the Mathematics text book prescribed for standard VI, two units were selected for experimentation. The selected topics were Volume of Rectangular Prisms and Decimal Numbers. In the unit related to Volume students are required to carry out basic mathematics operations on large numbers and it also involves conversion of metric units. In the unit Decimal numbers they learn to add, subtract, multiply and divide decimal numbers. So these topics are challenging for students.

Lesson transcripts based on Cognitively Guided Instructional Strategy

The selected units were divided into small topics based on the concepts to prepare lesson plans. Objectives were assigned and activities were selected for each lesson and learning materials were prepared.

The lesson frame includes descriptions of objectives assigned for each lesson, concepts related to the topic, learning materials and previous knowledge relevant to the lesson, activities in the three phases and follow up activities of the lesson.

Based on the designed Cognitively Guided Instructional Strategy, 20 lesson transcripts were prepared. Each lesson is of 40 minutes duration. Out of these lessons, 10 lessons are on the unit Volume and the remaining 10 are on the unit Decimal Numbers. The lesson transcripts were examined by selected teachers and experts.

The Malayalam and English versions of lesson transcripts are given as Appendix B1 and Appendix B2 respectively.

Lesson Transcripts on Existing Method of Teaching

The Existing method of teaching Mathematics at upper primary schools of Kerala is based on constructivist approach and is integrated with Critical pedagogy. Various strategies like whole class instruction, demonstration, and group activities are used by teachers to transact the curriculum.

The investigator consulted upper primary Mathematics teachers and based on the text book and teachers' handbook prepared lesson plans for Existing method of teaching. The concerned teachers of the four class divisions of standard VI selected for the experimentation were also consulted.

The lesson frame for Existing method of teaching includes descriptions of issue domain related to the topic, theme, learning objectives, concepts/ ideas, previous knowledge, resources required for the lesson, product of the lesson, values and attitudes developed through the lesson, and activities related to preparation, exploration and consolidation or application. It also includes follow up activities for the lesson.

Based on the Existing method of teaching, 20 lesson plans were prepared on the same topics selected for the experimentation. Time duration of each lesson is 40 minutes.

Malayalam and English versions of a model lesson plan on Existing method of teaching is given as Appendix C1 and Appendix C2 respectively.

Test of Achievement in Mathematics (Musthafa & Sunitha, 2013)

To measure Achievement in Mathematics of standard VI students belonging to experimental and control groups, Test of Achievement in Mathematics was developed and standardized by the investigator along with supervising teacher. This test was used as both pretest and posttest for the experiment to collect data on Achievement in Mathematics. This has been prepared on the Mathematics topics of standard VI selected for the experiment namely, Volume and Decimal Numbers. The details of the procedures adopted in the test construction and standardization are presented in the following sections.

Planning of Test of Achievement in Mathematics.

After analyzing the topics and consulting with supervising teacher and experts in the field it was decided to construct a test consisting of objective type items on the selected topics based on Revised Bloom's Taxonomy of

Educational Objectives (Anderson, Krathwohl & Bloom, 2001). The Mathematics text books and teacher's hand book for standard VI for the academic year 2013- 2014 was thoroughly analysed and utilized several resources available for constructing the test.

Preparation of Test of Achievement in Mathematics.

The items were prepared on the basis of Revised Bloom's Taxonomy of Educational Objectives (Anderson, Krathwohl & Bloom, 2001) which has two dimensions: Knowledge dimension and Cognitive process dimension.

The Knowledge dimension consists of Factual knowledge, Conceptual Knowledge, Procedural Knowledge and Metacognitive Knowledge. The Knowledge dimension deal with the subject matter content that the learners may be expected to acquire or construct. These categories range from concrete to abstract. The Cognitive process dimension consists of six major categories. They are Remember, Understand, Apply, Analyze, Evaluate and Create. These categories range from lower order thinking skills to higher order thinking skills.

Items were prepared under the six categories of cognitive processes and factual knowledge, conceptual knowledge and procedural knowledge only under the knowledge dimension. Objective type items with four alternatives were prepared for Remember, Understand, Apply, Analyze and Evaluate categories and supply type items were prepared for Create category. The items were written based on the blue print prepared. Blue print was prepared for a maximum score of 40.

Preparation of blue print for Test of Achievement in Mathematics.

In order to be conclusive to the accepted principles of test construction, items were prepared in such a way that they belong to predetermined objectives in desirable proportions. For this a design was prepared giving due weightage to instructional objectives and content.

Weightage to instructional objectives.

In the present study, objectives are based on Revised Bloom's taxonomy of educational objectives. There are two dimensions in this, knowledge dimension and cognitive process dimension. Only factual knowledge, conceptual knowledge and procedural knowledge are considered for item preparation as metacognitive knowledge is beyond consideration of the present study. The knowledge dimension was not given any specific weightage but inclusion of the above mentioned categories were ensured. The weightage given to different categories are presented in Table 5.

Table 5

Weightage Given to Instructional Objectives

Objectives	Score	Percentage
Remember	6	15
Understand	9	22.5
Apply	15	37.5
Analyze	4	10
Evaluate	4	10
Create	2	5
Total	40	100

Weightage to content.

The weightage given in the test to topics selected for the study are given in Table 6.

Table 6

Weightage Given to Content

Content	Score	Percentage
Volume	18	45
Decimal Numbers	22	55
Total	40	100

Weightage to form of questions.

Objective type test items were selected to measure all categories of cognitive processes and the selected categories of knowledge domain as objective type items ensure validity, reliability and objectivity. Multiple choice test items were prepared for all the categories except for the category Create. For measuring this cognitive process supply type test items were prepared where students are required to write the answer for the question, as it is difficult to measure the category using multiple choice test items.

Blue print of Test of Achievement in Mathematics.

The detailed blue print of the final Test of Achievement in Mathematics displaying the number of questions and scores corresponding to the selected content and instructional objectives is presented in Table 7.

Table 7

Blue Print of the Test of Achievement in Mathematics (Final)

Objectives / Content	Remember	Understand	Apply	Analyze	Evaluate	Create	Total
Volume	2	4	7	2	2	1	18
Decimal Numbers	4	5	8	2	2	1	22
Total	6	9	15	4	4	2	40

Note: Since all items are objective type, number in the cells correspond both to score and number of questions

Item writing

According to the blue print several items were prepared pertaining to the specified objectives and concepts in the topics selected for the study. Several resources like subject books, resource books, Mathematics text books of NCERT containing the concepts and other available achievement tests were consulted for writing the items. After consultation with supervising teacher and subject experts, 66 multiple choice test items with four alternatives and four supply type test items were included in the draft test.

The scoring key was prepared and since there are only objective type test items in the test, a score of *one* was given to each correct answer and *zero* to each incorrect answer.

Copies of the Malayalam and English versions of draft Test of Achievement in Mathematics are attached as Appendix D1 and Appendix D2 respectively. One copy each of the scoring key and response sheet of draft test is attached as Appendix D3 and Appendix D4 respectively.

Item Analysis

The draft test was administered to a random sample of 126 standard VI students and the response sheets were scored according to the prepared scoring key. Item analysis was carried out using the procedure suggested by Ebel (1972). The scores of students were arranged in descending order and then highest 34 and lowest 34 were selected to form upper group and lower group respectively. In order to select items for the final test, discriminating power and difficulty index were calculated for each item.

The discriminating power (Dp) was calculated using the formula, (U-L)/ N and difficulty index was calculated using the formula, (U+L)/2N. U and L refer to number of correct responses in the upper group and lower group respectively and N is the number of participants in any of the two groups. Here N is 34.

Selection of items

Selection of items for the final test was done on the basis of difficulty index and discriminating power of each item. Items having difficulty index between .25 and .70 and discriminating power greater than .30 were selected. But some items satisfying these criteria were not selected in order to match the items with blue print. In such cases, items with better discriminating were selected. Thus 40 items were selected for the final test.

Difficulty index and discriminating power of each item along with item number in the draft test are presented in Table 8.

Table 8

Details of Item Analysis of Test of Achievement in Mathematics

Item no.	U	L	Di	Dp	Remarks
1	27	18	0.66	0.27	Rejected
2	29	16	0.66	0.38	Not selected
3	25	16	0.60	0.27	Rejected
4	22	7	0.43	0.44	Selected
5	13	8	0.31	0.15	Rejected
6	21	4	0.37	0.50	Selected
7	18	5	0.34	0.38	Selected
8	14	6	0.29	0.24	Rejected
9	14	3	0.25	0.32	Selected
10	18	6	0.35	0.35	Selected
11	6	4	0.15	0.06	Rejected
12	22	6	0.41	0.47	Selected
13	30	4	0.50	0.77	Selected
14	7	5	0.18	0.06	Rejected
15	24	9	0.49	0.44	Not selected
16	8	6	0.21	0.06	Rejected
17	24	3	0.40	0.62	Selected

Item no.	U	L	Di	Dp	Remarks
18	33	14	0.69	0.56	Selected
19	28	12	0.59	0.47	Selected
20	32	15	0.69	0.50	Selected
21	20	3	0.34	0.50	Selected
22	17	7	0.35	0.29	Rejected
23	33	2	0.52	0.92	Selected
24	21	11	0.47	0.29	Rejected
25	25	13	0.56	0.35	Not selected
26	25	7	0.47	0.53	Selected
27	33	16	0.72	0.50	Selected
28	28	13	0.60	0.44	Not selected
29	12	7	0.28	0.15	Rejected
30	20	8	0.41	0.35	Rejected
31	25	13	0.56	0.35	Selected
32	30	11	0.60	0.56	Selected
33	18	3	0.31	0.44	Selected
34	19	2	0.31	0.50	Selected
35	17	5	0.32	0.35	Selected
36	12	3	0.22	0.27	Rejected
37	16	0	0.24	0.47	Selected
38	25	11	0.53	0.42	Selected
39	30	9	0.57	0.62	Selected
40	13	11	0.35	0.06	Rejected
41	14	3	0.25	0.32	Selected
42	19	2	0.31	0.50	Selected
43	14	11	0.37	0.09	Rejected
44	10	8	0.27	0.06	Rejected
45	10	5	0.22	0.15	Rejected
46	14	4	0.27	0.29	Rejected
47	18	7	0.37	0.32	Selected

Item no.	U	L	Di	Dp	Remarks
48	17	6	0.34	0.32	Selected
49	4	3	0.10	0.03	Rejected
50	22	6	0.41	0.47	Selected
51	19	7	0.38	0.35	Selected
52	20	6	0.38	0.41	Selected
53	7	6	0.19	0.03	Rejected
54	7	2	0.13	0.15	Rejected
55	11	10	0.31	0.03	Rejected
56	25	14	0.57	0.32	Selected
57	18	7	0.37	0.32	Selected
58	20	4	0.35	0.47	Selected
59	24	5	0.43	0.56	Selected
60	3	2	0.07	0.03	Rejected
61	21	7	0.41	0.42	Selected
62	16	5	0.31	0. 32	Selected
63	17	5	0.32	0.35	Selected
64	5	0	0.07	0.15	Rejected
65	9	6	0.22	0.09	Rejected
66	15	3	0.27	0.35	Selected
67	21	1	0.32	0.59	Selected
68	17	1	0.27	0.47	Selected
69	5	0	0.07	0.15	Rejected
70	9	0	0.13	0.27	Rejected

Final form of Test of Achievement in Mathematics

The final test consisted of 40 objective type items. Among these, 38 items were multiple choice items with four alternatives and two were supply type items. The objective wise distribution of items in the final test is presented in Table 9

Table 9

Distribution of Items in Test of Achievement in Mathematics - Final

Objectives	Content	Item number
Remember	Volume	1, 2
	Decimal numbers	3, 4, 5, 6
Understand	Volume	8, 13,14, 15
	Decimal numbers	7, 9, 10, 11, 12
Apply	Volume	21, 22, 23, 24, 28, 29, 30
	Decimal numbers	16, 17, 18, 19, 20, 25, 26, 27
Analyze	Volume	31, 32
	Decimal numbers	33, 34
Evaluate	Volume	35,38
	Decimal numbers	36,37
Create	Volume	40
	Decimal numbers	39

Administration and scoring procedure of Test of Achievement in Mathematics.

The students taking the test are required to record their answers in the response sheets provided separately, as per instructions provided in the question booklet. Additional instructions are provided by the investigator as and where necessary. Uniformity is maintained in instructions and administration procedures. It takes one hour and twenty minutes for students to complete the test.

There are a total of 40 items in the test. Since the test consists of objective type items only, each correct answer yields *one* score and incorrect answer yields *zero* score. Sum of scores of all items gives the total score of the test and is treated as the Achievement in Mathematics (Total) of a student. Sum of scores of items pertaining to the lower order objectives namely, Remember, Understand and Apply is treated as the Achievement in Mathematics (Lower order objectives) of a student. The sum of scores of items pertaining to the higher order objectives namely, Analyze, Evaluate and Create is taken as the Achievement in Mathematics (Higher order objectives) of a student. Minimum possible score for the total test as well as the components is *zero*. Maximum possible score for Achievement in Mathematics (Total), Achievement in Mathematics (Lower order objectives) and Achievement in Mathematics (Higher order objectives) are 40, 30 and 10 respectively.

Validity of the test.

The test was constructed with adequate coverage of the content and proper weightage to instructional objectives and the items were prepared and selected with the help of experts in the field. Thus the investigator could ensure content validity. The items were based on Mathematics selected topics of standard VI and the test appears to measure Achievement in Mathematics of standard VI students as confirmed by experts. So the test has face validity. Criterion related validity was established by correlating the test scores of final test with that of school achievement in Mathematics. The aggregate grade point secured by students (N=59) in second terminal mathematical examination was taken as school achievement in Mathematics score. Both the scores were converted in to z scores before correlation. The obtained validity coefficient is .77. Hence the test is having substantial level of criterion validity.

Reliability of the test

Reliability of the test was established using test-retest method. The test was administered to a sample of 54 students and after a period of three weeks the same test was administered to the same sample. The reliability coefficient thus obtained is .79.

Hence the developed Test of Achievement in Mathematics is a reliable and valid tool to measure Achievement in Mathematics of standard VI students.

Copies of the Malayalam and English versions of final Test of Achievement in Mathematics are attached as Appendix D5 and Appendix D6 respectively. One copy each of the scoring key and response sheet of final test is attached as Appendix D7 and Appendix D8 respectively.

Verbal Group Test of Intelligence (Kumar, Hameed & Prasanna, 1997)

The verbal intelligence of students belonging to experimental and control groups was measured using Verbal Group Test of Intelligence (Kumar, Hameed & Prasanna, 1997). The test consists of a total of 100 items subdivided into five subtests. Each subtest consists of 20 multiple choice items. Verbal Analogy, Verbal Classification, Numerical Reasoning, Verbal Reasoning and Comprehension are the five components of the test. The test is suitable to measure Verbal Intelligence of subjects belonging to the age group 10 to 15 and the duration of the test is one hour. The test is in Malayalam. Maximum possible score is *100* and minimum score is *zero*. The total score obtained by a student in this test is treated as the Verbal intelligence score of that student.

As reported by the test constructors, criterion related validity coefficients varied from .40 to .66 and split half reliability coefficients varied from .47 to .82. Internal structure of the test examined and reported in the form of inter correlation matrix.

In the present study the internal consistency of the test established by calculating Cronbach's alpha for the whole test and subtests (N=128). The obtained alpha for the test is .80. The obtained coefficients for the subtests are: Verbal Analogy .71, Verbal Classification .60, Numerical Reasoning .67, Verbal Reasoning .62 and Comprehension .69. Hence the test is reliable and valid tool to measure Verbal Intelligence of students.

A copy of the response sheet of Verbal Group Test of Intelligence is given as Appendix E

Standard Progressive Matrices Test (Raven, 1958)

To measure the Non-verbal Intelligence of students, Standard Progressive Matrices Test (Raven, 1958) was used. This is a nonverbal test consisting of five subtests (A, B, C, D and E). In each subtest there are 12 items and in each item a part of the given geometrical design is missing. The person taking the test has to select the one that most logically fits the missing part from six or eight options provided. Maximum possible score is 60 and score of a person taking the test is the total number of items answered correctly. The total score obtained by a student in this test is treated as Non-verbal Intelligence score.

As reported by Raven, the validity estimated varied from .50 to .80 and the reliability coefficients of the test varied from .80 to .90.

In the present study, internal consistency of the test was established by calculating Cronbach's alpha and the obtained alpha (N= 128) for the total test is .94. The calculated alpha for the subtests A, B, C, D and E are .88, .84, .82, .83 and .75 respectively. It is a reliable and valid tool, well established to measure Non-verbal Intelligence.

A copy of the response sheet of Standard Progressive Matrices Test is given as Appendix F

Statistical Techniques Employed in the Study

The following statistical techniques were used in the present study to analyse the collected data.

Basic Descriptive Statistics

To examine the nature of distribution of variables for the selected sample in preliminary survey as well as experiment, preliminary analysis was done. For this mean, median, mode, standard deviation, skewness and kurtosis corresponding to each variable were calculated for total sample and relevant subsamples.

Standardised Skewness and Kurtosis

Standardised skewness and kurtosis were calculated as indices of normality of data. These indices are obtained by dividing the values of skewness and kurtosis by their respective standard errors. The following criteria were used to determine the normality of data. For small samples ($n<50$) if the absolute values of the indices are greater than 1.96, then the distribution of the sample is not normal ($p<.05$). For medium sized samples ($50<n<300$) if the absolute values of theses indices are greater than 3.29, then the distribution of the sample is not normal ($p<.05$). For sample sizes greater than 300, absolute values of skewness and kurtosis are considered without considering their standardized values. If either the absolute skewness value is greater than 2 or the absolute value of kurtosis is greater than 4, then the distribution is not normal (Kim, 2013).

Correlation Coefficient

To find out the reliability and validity of tools Pearson's product moment coefficient of correlation was used.

Tests of Significance of Difference between Means

To compare the mean Mathematics Anxiety scores of boys and girls among the upper primary school students selected for the preliminary survey and to compare the mean pretest scores, mean posttest scores and mean gain scores of experimental and control groups, two tailed test of significance of difference between means of two independent samples was used. To compare the mean pretest and mean posttest scores of experimental group, two tailed test of significance of difference between means of two dependent samples was used.

Analysis of Variance (ANOVA)

To test whether upper primary school students differ significantly in their mean Mathematics Anxiety scores based on grade, one way Analysis of Variance was used.

Analysis of Covariance (ANCOVA)

Since the experiment was carried out using non-equated intact class groups, to statistically control for the initial differences between experimental and control groups, if any in terms of Pre- Achievement in Mathematics, Verbal Intelligence and Non-verbal Intelligence, one -way ANCOVA was used. This helped in better comparison of the two groups to study the relative effectiveness of Cognitively Guided Instructional Strategy in terms of Mathematics Anxiety and Achievement in Mathematics.

Bonferroni's Test of Post- Hoc Comparison

To compare the adjusted mean scores of Mathematics Anxiety and Achievement in Mathematics of experimental and control groups after ANCOVA, Bonferroni's test of post-hoc comparison was used.

Effect size

To measure the magnitude of the difference between the experimental and control groups effect size was used. Effect sizes provide magnitude of the reported effects in a standardized metric which is independent of the scale that was used to measure the dependent variables (Lakens, 2013). They help in quantifying the relative effectiveness of a particular intervention (Coe, 2002).

To report the relative effectiveness of Cognitively Guided Instructional Strategy two different measures of effect size were used. For independent sample *t* tests, Cohen's *d* and for ANCOVA Partial eta squared (η_p^2) for group differences were reported.

Cohen's *d* is the standardized mean difference between two independent samples and is calculated using the following formula.

$$\text{Cohen's d} = \frac{\overline{X}_1 - \overline{X}_2}{\sqrt{\frac{(n_1 - 1)SD_1^{\,2} + (n_2 - 1)SD_2^{\,2}}{n_1 + n_2 - 2}}}$$

In this formula, numerator is the difference between means of experimental and control groups and denominator is pooled standard deviation.

To interpret this effect size the bench mark proposed by Cohen (1988) is: 0. 2 indicate small effect, 0.5 indicate medium effect and 0.8 indicate large effect.

Partial eta squared ($\eta_p^{\,2}$) is the effect size related to ANCOVA and is the ratio between sum squares of the effect and the total of sum of squares of effect and sum of squares of the error associated with the effect (Lakens, 2013). It is calculated using the formula:

$$\eta_p^{\,2} = \frac{\boldsymbol{SS}\ effect}{\boldsymbol{SS}\ effect + \boldsymbol{SS}\ error}$$

In this formula, SS_{effect} is the sum of squares of effect and SS_{error} is the sum of squares of error. Since the interpretation of Partial eta squared in terms of bench marks is not feasible in designs containing covariates, it was reported to substantiate the results of ANCOVA.

The data and results of analysis done by employing the above mentioned statistical techniques (manually or using SPSS for windows version 20 as appropriate) are presented in chapter V.

The whole procedure adopted in the study is summarized and presented in the following chart given as Figure 2.

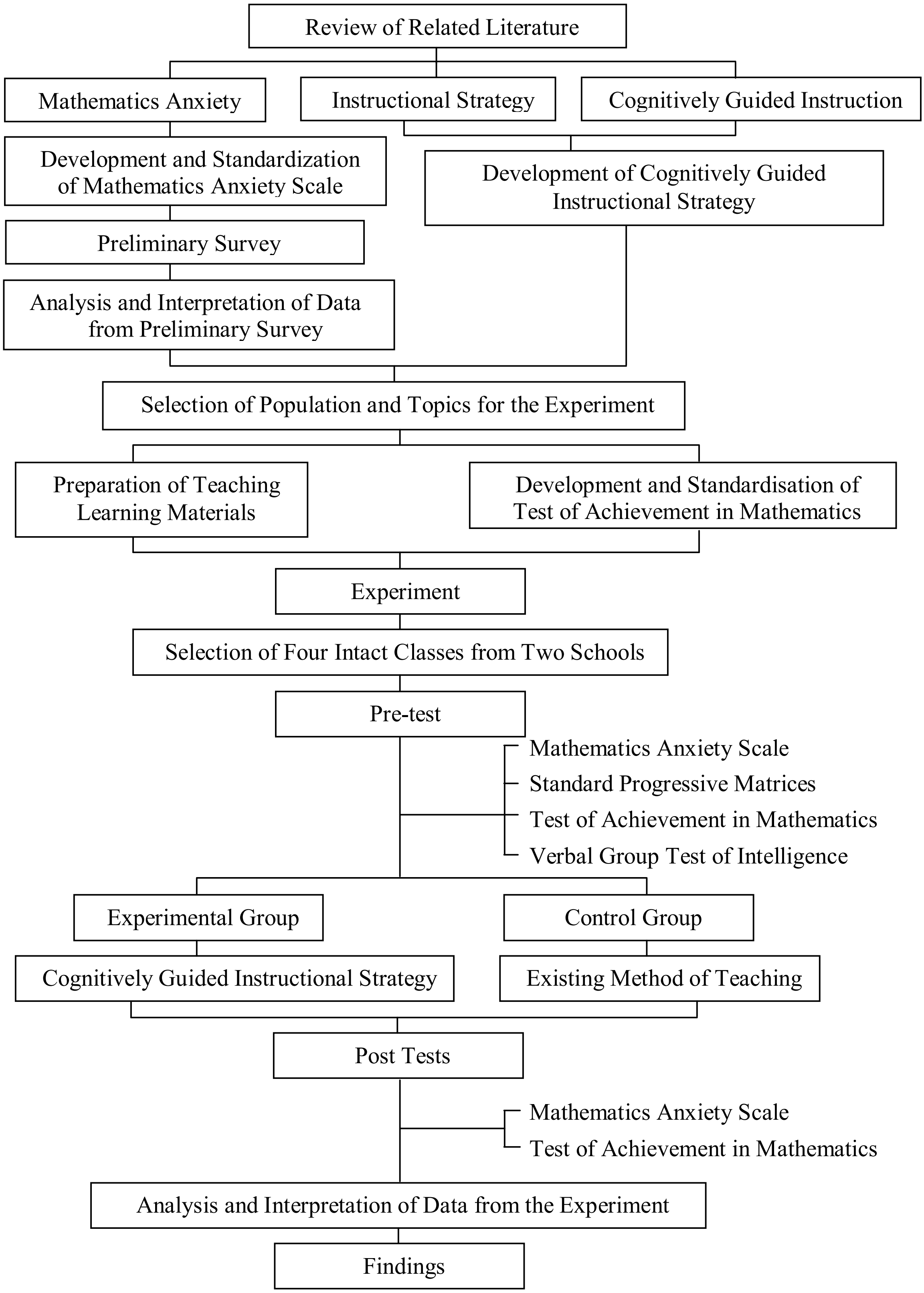


Figure 2. Summary of procedures adopted in the study

Chapter V

ANALYSIS AND INTERPRETATION OF DATA

- *Analysis of Data from Preliminary Survey*
- *Analysis of Data from Experiment*
  - *Important Statistical Constants of the variables*
  - *Mean Difference Analysis*
  - *Analysis of Covariance of the Dependent Variables*

ANALYSIS AND INTERPRETATION OF DATA

The purpose of the present study was to design and develop an instructional strategy based on Cognitively Guided Instruction and to test its effectiveness specifically on Mathematics Anxiety and Achievement in Mathematics of upper primary school students. The study was carried out in two phases. A preliminary survey was conducted in the first phase and the implementation of the experiment was done in the second phase. The experimental group was taught through Cognitively Guided Instructional Strategy and the control group was taught through Existing method of teaching. The data collected from preliminary survey was analyzed using the statistical techniques namely, test of significance of difference between means and Analysis of Variance. The data from the experiment were analyzed using the test of significance of difference between means followed by calculation of effect size (Cohen's *d*) and one- way Analysis of Covariance by considering Pre-Achievement in Mathematics, Verbal Intelligence and Non-verbal Intelligence as covariates followed by its effect size (Partial eta squared).

The results obtained from the analysis have been presented in two parts. In the first part, analysis of the data collected from preliminary survey and in the second part, analysis of the data from experiment is presented.

Analysis of data from the preliminary survey is described under the following headings.

- Estimation of the existing level of Mathematics Anxiety of upper primary school students
- Comparison of Mathematics Anxiety of different subgroups of upper primary school students

- Comparison of mean scores of Mathematics Anxiety of upper primary school students belonging to subgroups based on Gender
- Comparison of mean scores of Mathematics Anxiety of upper primary school students belonging to subgroups based on Grade

Analysis of data from experiment consists of the following major headings.

- Important Statistical Constants of the variables
  - Pretest scores of the variables for the experimental group
  - Pretest scores of the variables for the control group
  - Posttest scores of the variables for the experimental group
  - Posttest scores of the variables for the control group
- Mean Difference Analysis
  - Comparison of mean pretest scores of Mathematics Anxiety and Achievement in Mathematics of experimental and control groups
  - Comparison of mean pretest and posttest scores of Mathematics Anxiety and Achievement in Mathematics of experimental group
  - Comparison of mean posttest scores of Mathematics Anxiety and Achievement in Mathematics of experimental and control groups
  - Comparison of mean change scores of Mathematics Anxiety and comparison of mean gain scores of Achievement in Mathematics of experimental and control groups
- Analysis of Covariance of the Dependent Variables
  - Comparison of the adjusted mean scores of Mathematics Anxiety of experimental and control groups by considering Pre- Achievement in Mathematics, Verbal Intelligence and Non-verbal Intelligence as covariates

- Comparison of the adjusted mean scores of Achievement in Mathematics of experimental and control groups by considering Pre- Achievement in Mathematics, Verbal Intelligence and Non-verbal Intelligence as covariates

Objectives of the Study

1. To identify the existing level of Mathematics Anxiety of upper primary school students
2. To compare the existing level of Mathematics Anxiety of different subgroups of upper primary school students based on
   a) Gender (Boys/Girls)
   b) Grade (Standard V/Standard VI/Standard VII)
3. To develop an instructional strategy based on Cognitively Guided Instruction for teaching Mathematics at upper primary level
4. To find out the effectiveness of Cognitively Guided Instructional Strategy in reducing Mathematics Anxiety of upper primary school students for Total sample and subsamples based on Gender
5. To find out the effectiveness of Cognitively Guided Instructional Strategy in enhancing Achievement in Mathematics (Total, Lower order objectives, Higher order objectives) of upper primary school students for Total sample and subsamples based on Gender
6. To compare the effectiveness of Cognitively Guided Instructional Strategy and Existing method of teaching in reducing Mathematics Anxiety of upper primary school students for Total sample and subsamples based on Gender
7. To compare the effectiveness of Cognitively Guided Instructional Strategy and Existing method of teaching in enhancing Achievement in Mathematics (Total, Lower order objectives, Higher order objectives) of upper primary school students for Total sample and subsamples based on Gender

Hypotheses of the study

1. There is no significant difference in the existing level of Mathematics Anxiety of different subgroups of upper primary school students based on
   a) Gender (Boys/ Girls)
   b) Grade (Standard V/Standard VI/Standard VII)
2. There is no significant difference in the mean pretest score of Mathematics Anxiety between experimental and control groups for
   a) Total sample
   b) Subsample Boys
   c) Subsample Girls
3. There is no significant difference in the mean pretest score of Achievement in Mathematics (Total) between experimental and control groups for
   a) Total sample
   b) Subsample Boys
   c) Subsample Girls
4. There is no significant difference in the mean pretest score of Achievement in Mathematics (Lower order objectives) between experimental and control groups for
   a) Total sample
   b) Subsample Boys
   c) Subsample Girls
5. There is no significant difference in the mean pretest score of Achievement in Mathematics (Higher order objectives) between experimental and control groups for
   a) Total sample
   b) Subsample Boys
   c) Subsample Girls

6. There is significant difference between the mean pretest and posttest scores of Mathematics Anxiety of the experimental group for
   a) Total sample
   b) Subsample Boys
   c) Subsample Girls
7. There is significant difference between the mean pretest and posttest scores of Achievement in Mathematics (Total) of the experimental group for
   a) Total sample
   b) Subsample Boys
   c) Subsample Girls
8. There is significant difference between the mean pretest and posttest scores of Achievement in Mathematics (Lower order objectives) of the experimental group for
   a) Total sample
   b) Subsample Boys
   c) Subsample Girls
9. There is significant difference between the mean pretest and posttest scores of Achievement in Mathematics (Higher order objectives) of the experimental group for
   a) Total sample
   b) Subsample Boys
   c) Subsample Girls
10. There is significant difference in the mean posttest score of Mathematics Anxiety between experimental and control groups for
   a) Total sample
   b) Subsample Boys
   c) Subsample Girls

11. There is significant difference in the mean posttest score of Achievement in Mathematics (Total) between experimental and control groups for
    a) Total sample
    b) Subsample Boys
    c) Subsample Girls
12. There is significant difference in the mean posttest score of Achievement in Mathematics (Lower order objectives) between experimental and control groups for
    a) Total sample
    b) Subsample Boys
    c) Subsample Girls
13. There is significant difference in the mean posttest score of Achievement in Mathematics (Higher order objectives) between experimental and control groups for
    a) Total sample
    b) Subsample Boys
    c) Subsample Girls
14. There is significant difference in the mean change score of Mathematics Anxiety between experimental and control groups for
    a) Total sample
    b) Subsample Boys
    c) Subsample Girls
15. There is significant difference in the mean gain score of Achievement in Mathematics (Total) between experimental and control groups for
    a) Total sample
    b) Subsample Boys
    c) Subsample Girls

16. There is significant difference in the mean gain score of Achievement in Mathematics (Lower order objectives) between experimental and control groups for
    a) Total sample
    b) Subsample Boys
    c) Subsample Girls
17. There is significant difference in the mean gain score of Achievement in Mathematics (Higher order objectives) between experimental and control groups for
    a) Total sample
    b) Subsample Boys
    c) Subsample Girls
18. There is significant difference in the adjusted mean score of Mathematics Anxiety between experimental and control groups by considering Pre- Achievement in Mathematics, Verbal Intelligence and Non-verbal Intelligence as covariates for
    a) Total sample
    b) Subsample Boys
    c) Subsample Girls
19. There is significant difference in the adjusted mean score of Achievement in Mathematics (Total) between experimental and control groups by considering Pre- Achievement in Mathematics, Verbal Intelligence and Non-verbal Intelligence as covariates for
    a) Total sample
    b) Subsample Boys
    c) Subsample Girls

20. There is significant difference in the adjusted mean score of Achievement in Mathematics (Lower order objectives) between experimental and control groups by considering Pre- Achievement in Mathematics, Verbal Intelligence and Non-verbal Intelligence as covariates for
    a) Total sample
    b) Subsample Boys
    c) Subsample Girls
21. There is significant difference in the adjusted mean score of Achievement in Mathematics (Higher order objectives) between experimental and control groups by considering Pre- Achievement in Mathematics, Verbal Intelligence and Non-verbal Intelligence as covariates for
    a) Total sample
    b) Subsample Boys
    c) Subsample Girls

Analysis of Data from Preliminary Survey

Estimation of the Existing Level of Mathematics Anxiety of Upper Primary School Students

The existing level of Mathematics Anxiety of upper primary students for Total sample and subsamples based on Gender and Grade are presented in this section. The statistical constants namely mean, median, mode, skewness and kurtosis of Mathematics Anxiety for total sample and subsamples based on Gender and Grade were calculated. For checking the normality of the distribution of scores, the ratio between skewness (Sk) and its standard error (SE_{Sk}) and the ratio between kurtosis (Ku) and its standard error (SE_{Ku}) were calculated and interpreted as per criteria given in Kim (2013). These ratios were not calculated for total sample as the sample size is greater than 300 and the absolute values of skewness and kurtosis were utilized for determining normality. The calculated statistical constants are given in Table 10.

Table 10

Statistical Constants of Mathematics Anxiety Scores of Upper Primary School Students

Group		N	Mean	Median	Mode	SD	Sk	SE_{Sk}	Sk/ SE_{Sk}	Ku	SE_{Ku}	Ku/ SE_{Ku}
Total		400	157.63	155.50	158	43.96	0.30	-	-	-0.40	-	-
Gender	Boys	232	158.84	153.00	158	43.51	0.29	0.16	1.81	-0.28	0.32	0.88
	Girls	168	154.90	157.00	159	44.35	0.30	0.19	1.58	-0.56	0.37	1.51
Grade	Std V	102	154.82	155.50	166	48.56	0.43	0.24	1.79	-0.35	0.47	0.75
	Std VI	178	155.09	153.00	158	36.72	0.27	0.18	1.50	-0.32	0.36	0.89
	Std VII	120	163.79	159.50	157	49.18	0.11	0.22	0.50	-0.81	0.44	1.84

Table 10 reveals that for all the groups, the calculated values of mean, median and mode are almost equal. The standard deviations of the groups indicate that the scores are dispersed from central value to a great extent. This shows that there is great deal of individual differences within the groups.

For all the groups the indices of skewness are positive indicating positively skewed distribution of Mathematics Anxiety. For all the groups the indices of kurtosis are negative indicating platykurtic distribution of Mathematics Anxiety scores. However, the absolute values of ratio between skewness and its standard error (Sk/SE_{Sk}) and the ratio between kurtosis and its standard error (Ku/SE_{Ku}) were found to be less than 3.29 for subsamples based on Gender and Grade. This shows that the scores are normally distributed ($p>.05$) for all these groups. For Total sample, the absolute value of skewness was found to be less than 2 and the absolute value of kurtosis was found to be less than 4 indicating the normality of distribution. Hence it can be concluded that the distribution of Mathematics Anxiety is normal for all the groups. So it is possible to employ parametric tests on this data.

To collect data on Mathematics Anxiety, Mathematics Anxiety Scale (Musthafa & Sunitha, 2012) was used. The scale has a minimum possible score of 68 and a maximum possible score of 340. The scale average value is 204. The results reveal that the existing levels of Mathematics Anxiety of all the groups are less than the scale average value.

Regarding the mean Mathematics Anxiety scores of subsample Boys and subsample Girls, it can be seen from Table 10 that the mean score of Mathematics Anxiety of Boys (158.84) is slightly higher than that of Girls (154.90). This shows that Boys have reported higher level of Mathematics Anxiety than Girls.

From Table 10, it can be seen that the mean score of Mathematics Anxiety of standard VI students (155.09) is slightly higher than that of standard V students (154.82). Similarly, the mean score of standard VII students (163.79) is higher than that of standard VI students. It is evident that the level of Mathematics Anxiety of students tends to increase with Grade.

Comparison of Mathematics Anxiety of Different Subgroups of Upper Primary School Students

The mean scores of Mathematics Anxiety of upper primary school students belonging to different subgroups based on Gender and Grade were compared using test of significance of difference between means for large independent samples. The details are given in the following sections.

Comparison of mean scores of Mathematics Anxiety of upper primary school students belonging to subgroups based on Gender.

To test whether subsample Boys and subsample Girls differ in terms of mean Mathematics Anxiety score, test of significance of difference between means was utilized. The means and standard deviations of the scores were subjected to mean difference analysis. The levels of significance were fixed at .05 and .01. The details of the test are given in Table 11.

Table 11

Results of Test of Significance of Difference in Mean Scores of Mathematics Anxiety of Upper Primary School Students Based on Gender

Variable	Boys			Girls			t
	N_1	M_1	SD_1	N_2	M_2	SD_2	
Mathematics Anxiety	232	158.84	43.51	168	154.90	44.35	0.88

From Table 11, it is clear that the obtained t value 0.88 is less than the table value 1.96 at .05 level of significance. Hence it can be inferred that there is no significant difference in the mean scores of Mathematics Anxiety of Boys and Girls at .05 level of significance. This shows that Boys and Girls have same level of Mathematics Anxiety at upper primary level of schooling.

Comparison of mean scores of Mathematics Anxiety of upper primary school students belonging to subgroups based on Grade.

To test whether students from standard V, VI and VII differ significantly in terms of mean Mathematics Anxiety scores, analysis of variance was used. The significance of difference between mean Mathematics Anxiety scores of these groups was found out by calculating F ratio using ANOVA. The results are presented in Table 12.

Table 12

Results of Analysis of Variance of Mathematics Anxiety Scores of Upper Primary School Students Based on Grade

Source of Variance	Sum of Squares	df	Mean Squares	F	Level of Significance
Within Groups	6507.80	2	3253.90		
Between Groups	764631.18	397	1926.02	1.69	.186
Total	771138.98	399			

From Table 12, it is clear that the obtained F (2,397) = 1.69, p =.186 is below the table value 3.02 for .05 level of significance. Hence it can be inferred that there is no significant difference in the mean scores of Mathematics Anxiety of students studying in different Grades of upper primary at .05level of significance. This shows that the students from different Grades of upper primary level have almost the same level of Mathematics Anxiety.

Discussion

The following inferences can be made from the analysis of data obtained from the preliminary survey on the level of Mathematics Anxiety of upper primary school students.

The mean Mathematics Anxiety scores of all the groups of upper primary students are less than the scale average value 204. The high values of standard deviation of Mathematics Anxiety scores show that there is great deal of individual differences within the groups.

The mean scores indicate that Boys have higher Mathematics Anxiety than Girls, but the test of significance of difference between means reveals that the difference found is not statistically significant. This shows that there is no Gender difference with respect to mean Mathematics Anxiety scores of upper primary school students. The result reveals that level of Mathematics Anxiety of upper primary school students do not differ significantly with Gender.

Students belonging to standard VI have reported higher Mathematics Anxiety than students of standard V. Standard VII students have reported higher Mathematics Anxiety than standard VI students. However, the calculated F ratio using ANOVA indicates that the mean difference among the groups is not significant. Thus the results indicate that the level of Mathematics Anxiety of upper primary school students do not differ significantly with Grade. Hence it is justifiable to consider standard VI students as representatives of upper primary school students while considering level of Mathematics Anxiety.

Analysis of Data from Experiment

Statistical Constants of the Variables

To identify the basic properties of distributions of the dependent variables and the covariates preliminary analysis was done. Mean, Median, Mode, Standard Deviation, Skewness and Kurtosis of the pretest and post test scores of the dependent variables Mathematics Anxiety, Achievement in Mathematics (Total, Lower order objectives, Higher order objectives) and those of the pretest scores of covariates Verbal Intelligence and Non-verbal Intelligence were computed separately for experimental and control groups (Total sample, subsample Boys and subsample Girls).

To collect data on Mathematics Anxiety, Mathematics Anxiety Scale (Musthafa & Sunitha, 2012) was used. The possible maximum and minimum scores of Mathematics Anxiety are 340 and 68 respectively.

To collect data on Achievement in Mathematics, Test of Achievement in Mathematics (Musthafa & Sunitha, 2013) was used. Sum of scores of items pertaining to the lower order objectives namely, Remember, Understand and Apply is treated as the Achievement in Mathematics (Lower order objectives) of a student. The sum of scores of items pertaining to the higher order objectives namely, Analyze, Evaluate and Create is taken as the Achievement in Mathematics (Higher order objectives) of a student. Minimum possible score for the total test as well as the components is *zero*. Maximum possible score for Achievement in Mathematics (Total), Achievement in Mathematics (Lower order objectives) and Achievement in Mathematics (Higher order objectives) are 40, 30 and 10 respectively.

The Verbal Intelligence of upper primary school students belonging to experimental and control groups were measured using Verbal Group Test of Intelligence (Kumar, Hameed & Prasanna, 1997). To measure the Non-verbal

Intelligence of upper primary school students, Standard Progressive Matrices Test (Raven, 1958) was used. The maximum possible scores of Verbal Intelligence and Non-verbal Intelligence are 100 and 60 respectively. The minimum possible score of these two variables is *zero*.

The ratio between skewness (Sk) and its standard error (SE_{Sk}) and the ratio between kurtosis (Ku) and its standard error (SE_{Ku}) were calculated and interpreted as per criteria for normality of distribution given in Kim (2013). Normal P-P plots of the pretest scores of the variables were also utilized to check the normality of pretest scores of experimental group and control group.

Pretest scores of the variables for the experimental group.

The statistical constants of the pretest scores of the variables Mathematics Anxiety, Achievement in Mathematics (Total, Lower order objectives, Higher order objectives), Verbal Intelligence and Non-verbal Intelligence of experimental group for Total sample, subsample Boys and subsample Girls are presented in Table 13, Table 14 and Table 15 respectively.

Table 13

Statistical Constants of the Pretest Scores of the Variables for the Experimental Group- Total Sample

Variables		Mean	Median	Mode	SD	Sk	Sk/ SE_{Sk}	Ku	Ku/ SE_{Ku}
Mathematics Anxiety		148.39	144.50	119	41.11	0.28	0.93	-0.84	-1.45
Achievement in Mathematics	Lower order objectives	5.05	5.00	5	2.28	0.41	1.37	-0.47	-0.81
	Higher order objectives	0.70	1.00	0	0.72	0.53	1.77	-0.91	-1.57
	Total	5.74	5.50	5	2.68	0.46	1.53	-0.34	-0.59
Verbal Intelligence		28.12	28.00	25	8.83	0.21	0.70	0.50	0.86
Non-verbal Intelligence		31.45	33.00	44	11.63	-0.53	-1.77	-0.65	-1.12

N=66. SE_{sk}=.30. SE_{Ku}=.58.

Table 13 shows that the values of mean, median and mode of the pretest scores of the variables for Total sample of upper primary school students in the experimental group are almost similar except for Mathematics Anxiety and Non-verbal Intelligence for which the value of mode differed from mean and median. The standard deviation of Mathematics Anxiety indicates that the scores are very much dispersed from the central value. The standard deviations of Verbal Intelligence and Non-verbal Intelligence reveal that the scores are somewhat dispersed from the central value. For Non-verbal Intelligence, the distribution is negatively skewed and for the remaining variables the distributions are positively skewed. The distributions of the variables are platykurtic except for the variable Verbal Intelligence, distribution of which is leptokurtic. The absolute values of the ratio between skewness and its standard error and the ratio between kurtosis and its standard error are less than 3.29 for all the variables. The results indicate that the distribution of the variables are normally distributed (p>.05).

Table 14

Statistical Constants of the Pretest Scores of the Variables for the Experimental Group - Subsample Boys

Variables		Mean	Median	Mode	SD	Sk	Sk/ SE_{Sk}	Ku	Ku/ SE_{Ku}
Mathematics Anxiety		150.95	147.50	111	44.10	0.11	0.29	-1.26	-1.68
Achievement in Mathematics	Lower order objectives	4.87	5.00	5	2.00	0.21	0.55	-0.44	-0.59
	Higher order objectives	0.71	1.00	0	0.73	0.52	1.37	-0.93	-1.24
	Total	5.58	5.00	5	2.34	0.27	0.71	-0.72	-0.96
Verbal Intelligence		28.39	29.00	25	8.83	0.29	0.76	1.52	2.03*
Non-verbal Intelligence		30.95	33.00	33	11.62	-0.40	-1.05	-0.44	0.59

N= 38 SE_{sk}=.38 SE_{Ku}=.75 *$p < .05$

Table 14 reveals that the values of mean, median and mode of pretest scores of all the variables except Mathematics Anxiety are almost similar for the experimental group subsample Boys. For Mathematics Anxiety, the value of mode is less than mean and median. The standard deviation of Mathematics Anxiety indicates that the scores are very much dispersed from the central value. The values of standard deviation of Verbal Intelligence and Non-verbal Intelligence show that the scores are somewhat dispersed from the central value. The indices of skewness show that the distribution of Non-verbal Intelligence is negatively skewed and the distributions of the remaining variables are positively skewed. The distribution of Non-verbal Intelligence is platykurtic and those of the remaining variables are leptokurtic. The absolute values of the ratio between skewness and its standard error and the ratio between kurtosis and its standard error for all the variables except for Verbal Intelligence are less than 1.96. The results indicate that all the variables other than Verbal Intelligence are normally distributed ($p>.05$) and distribution of Verbal Intelligence is not normal ($p<.05$).

Table 15

Statistical Constants of the Pretest Scores of the Variables for the Experimental Group - Subsample Girls

Variables		Mean	Median	Mode	SD	Sk	Sk/ SE_{Sk}	Ku	Ku/ SE_{Ku}
Mathematics Anxiety		144.93	142.50	144	37.18	0.57	1.30	0.36	0.42
Achievement in Mathematics	Lower order objectives	5.29	5.00	5	2.62	0.42	0.95	-0.82	-0.95
	Higher order objectives	0.68	1.00	0	0.72	0.58	1.32	-0.81	-0.94
	Total	5.96	6.00	4	3.11	0.47	1.07	-0.48	-0.56
Verbal Intelligence		27.75	27.00	27	8.96	0.13	0.30	-0.59	-0.69
Non-verbal Intelligence		32.14	34.50	44	11.84	-0.74	-1.68	-0.74	-0.86

N= 28 SE_{sk}=.44 SE_{Ku}=.86

It is evident from Table 15 that the mean, median and mode are almost similar for the pretest scores of all variables except Non-verbal Intelligence for experimental group subsample Girls. For Non-verbal Intelligence, the value of mode is greater than those of mean and median. The value of standard deviation of Mathematics Anxiety shows that the scores are very much dispersed from the central value. The standard deviations of Verbal Intelligence and Non-verbal Intelligence indicate that the scores are somewhat dispersed from the central value. The indices of skewness show that the distribution of Non-verbal Intelligence is negatively skewed and the distributions of the remaining variables are positively skewed. The distribution of Mathematics Anxiety is leptokurtic and those of the remaining variables are platykurtic. The absolute values of ratio between skewness and its standard error and the ratio between kurtosis and its standard error for all the variables are less than 1.96. The results indicate that all the variables are normally distributed ($p>.05$).

The P-P plots of the pretest scores of the variables of the experimental group for the Total sample are presented as Figure 3. It can be seen from the figure that there are only slight deviations of observed cumulative probability from diagonals in each of the P-P plots. This indicates that all distributions approximated to normality.

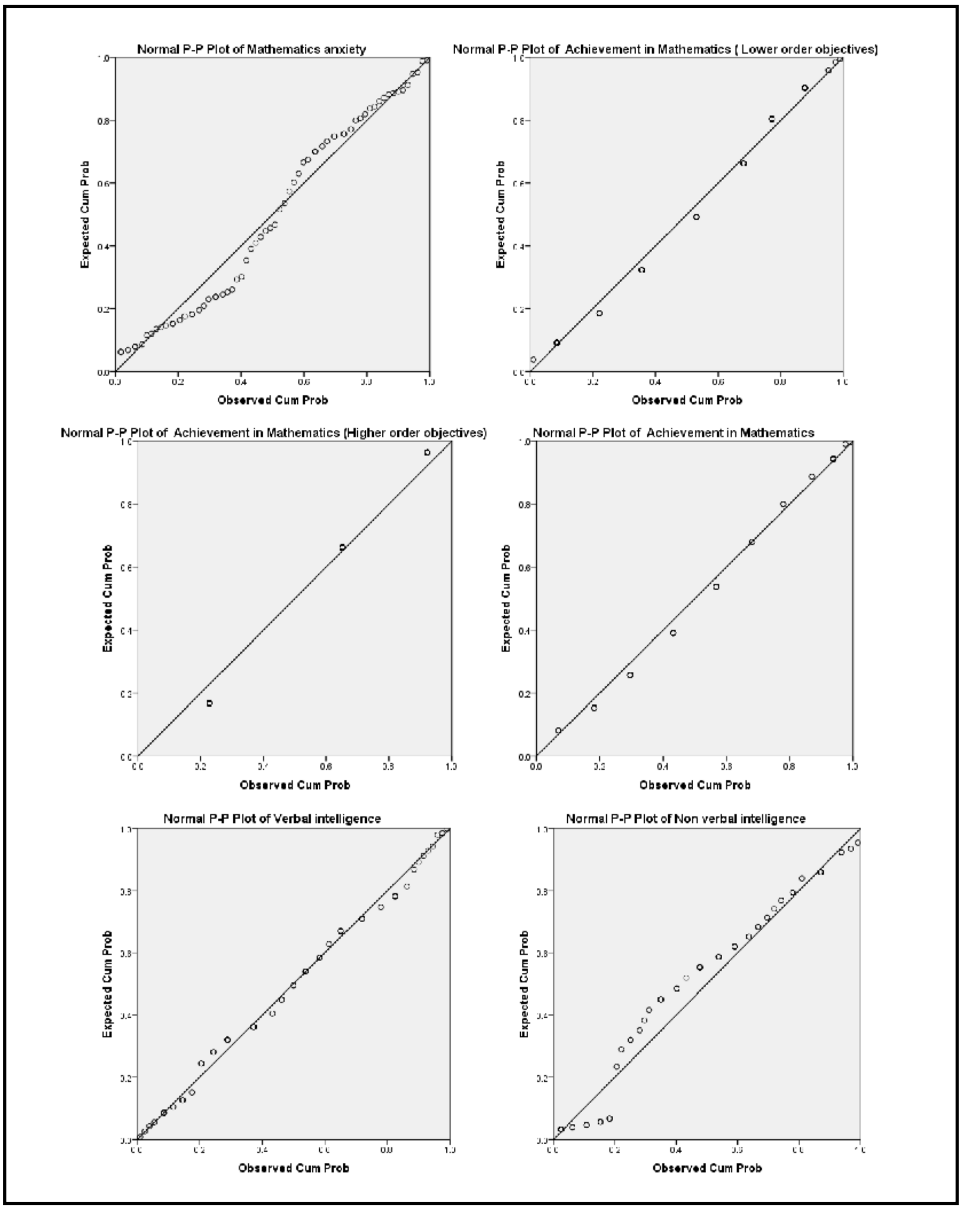


Figure 3. The P-P plots of the pretest scores of the variables for the experimental group

Pretest scores of the variables for the control group.

The Statistical Constants of the pretest scores of the variables Mathematics Anxiety, Achievement in Mathematics (Total, Lower order objectives, Higher order objectives), Verbal Intelligence and Non-verbal Intelligence of control group for Total sample, subsample Boys and subsample Girls are presented in Table 16, Table 17 and Table 18 respectively.

Table 16

Statistical Constants of the Pretest Scores of the Variables for the Control Group -Total sample

Variables		Mean	Median	Mode	SD	Sk	Sk/ SE_{Sk}	Ku	Ku/ SE_{Ku}
Mathematics Anxiety		154.55	159.00	205	42.90	-0.14	-0.47	-0.78	-1.30
Achievement in Mathematics	Lower order objectives	6.06	6.00	7	2.18	0.17	0.57	-0.22	-0.37
	Higher order objectives	0.76	1.00	0	0.86	0.97	3.23	0.26	0.43
	Total	6.84	7.00	7	2.78	0.38	1.27	-0.03	-0.05
Verbal Intelligence		32.89	32.50	34	9.86	0.53	1.77	0.33	0.55
Non-verbal Intelligence		29.68	29.50	30	10.09	0.22	0.73	-0.51	-0.85

N=62 SE_{sk}=.30 SE_{Ku}=.60

Table 16 shows that the mean, median and mode of the pretest scores of the variables for control group Total sample are almost similar except for Mathematics Anxiety. For Mathematics Anxiety, the value of mode is larger than the values of mean and median. The standard deviation of Mathematics Anxiety indicates that the scores are very much dispersed from the central value. The standard deviations of Verbal Intelligence and Non-verbal Intelligence reveal that the scores are somewhat dispersed from the central value. For Mathematics Anxiety, the distribution is negatively skewed and for the remaining variables the distributions are positively skewed. The distributions of the variables are platykurtic except for the variables Achievement in Mathematics (Higher order objectives) and Verbal Intelligence the distributions of which are leptokurtic. The absolute values of the ratio between skewness and its standard error and the ratio between kurtosis and its standard error are less than 3.29 for all the variables. It indicates that the distribution of the variables are normally distributed ($p>.05$).

Table 17

Statistical Constants of the Pretest Scores of the Variables for the Control Group -Subsample Boys

Variables		Mean	Median	Mode	SD	Sk	Sk/ SE_{Sk}	Ku	Ku/ SE_{Ku}
Mathematics Anxiety		161.47	163.00	150	35.16	-0.45	-1.10	-0.02	-0.03
Achievement in Mathematics	Lower order objectives	5.47	5.00	4	1.95	-0.05	-0.12	-0.49	-0.61
	Higher order objectives	0.50	0.00	0	0.76	1.63	3.98*	2.61	3.22*
	Total	6.00	5.50	7	2.51	0.62	1.51	0.69	0.85
Verbal Intelligence		31.56	31.50	28	7.11	0.16	0.39	-1.13	-1.39
Non-verbal Intelligence		26.94	26.50	24	7.61	-0.10	-0.24	-0.99	-1.22

N=32 SE_{Sk}=.41 SE_{Ku}=.81
*$p < .05$

Table 17 reveals that the mean, median and mode of the pretest scores of the variables for control group Boys sample are almost similar except for Mathematics Anxiety. For Mathematics Anxiety, the value of mode is less than the values of mean and median. The standard deviation of Mathematics Anxiety indicates that the scores are very much dispersed from the central value. The standard deviations of Verbal Intelligence and Non-verbal Intelligence reveal that the scores are somewhat dispersed from the central value. For Mathematics Anxiety, Achievement in Mathematics (Lower order objectives) and Non-verbal Intelligence the distribution of scores are negatively skewed and for the remaining variables the distributions are positively skewed. The distributions of the variables are platykurtic except for the variables Achievement in Mathematics (Higher order objectives) and Achievement in Mathematics (Total) the distributions of which are leptokurtic. The absolute values of the ratio between skewness and its standard error and the ratio between kurtosis and its standard error are less than 1.96 for all variables other than Achievement in Mathematics (Higher order objectives). It indicates that the distribution of the variable Achievement in Mathematics (Higher order objectives) is not normal ($p<.05$) and the distributions of the remaining variables are normally distributed ($p>.05$).

Table 18

Statistical Constants of the Pretest Scores of the Variables for the Control Group - Subsample Girls

Variables		Mean	Median	Mode	SD	Sk	Sk/ SE_{Sk}	Ku	Ku/ SE_{Ku}
Mathematics Anxiety		147.17	141.50	201	49.40	0.22	0.51	-1.07	-1.29
Achievement in Mathematics	Lower order objectives	6.70	6.50	6	2.26	0.13	0.30	-0.30	-0.36
	Higher order objectives	1.03	1.00	1	0.89	0.56	1.30	-0.27	-0.33
	Total	7.73	8.00	9	2.82	0.10	0.23	0.06	0.07
Verbal Intelligence		34.30	33.50	26	12.10	0.35	0.81	-0.32	-0.39
Non-verbal Intelligence		32.60	31.00	30	11.62	-0.12	-0.28	-0.83	-1.00

N=30 SE_{Sk}=.43 SE_{Ku}=.83

It is clear from Table 18 that the mean, median and mode of the pretest scores of the variables for control group Girls sample are almost equal except for Mathematics Anxiety and Verbal Intelligence. For Mathematics Anxiety and Verbal Intelligence, the value of mode differed from those of mean and median. The standard deviation of Mathematics Anxiety indicates that the scores are very much dispersed from the central value. The standard deviations of Verbal Intelligence and Non-verbal Intelligence reveal that the scores are somewhat dispersed from the central value. For all the variables, distributions of scores are positively skewed except for Non-verbal Intelligence the distribution of which is negatively skewed. The distributions of the variables are platykurtic except for the variable Achievement in Mathematics (Total) the distribution of which is leptokurtic. The absolute values of the ratio between skewness and its standard error and the ratio between kurtosis and its standard error are less than 1.96 for all the variables. It indicates that the distributions of all the variables are normally distributed (p>.05).

The P-P plots of the pretest scores of the variables of the control group for the Total sample are presented as Figure 4. It is evident from the P-P plots of the variables that there are only slight deviations of observed cumulative probability from the diagonals. Hence it is clear that distributions of all the variables approximated to normality.

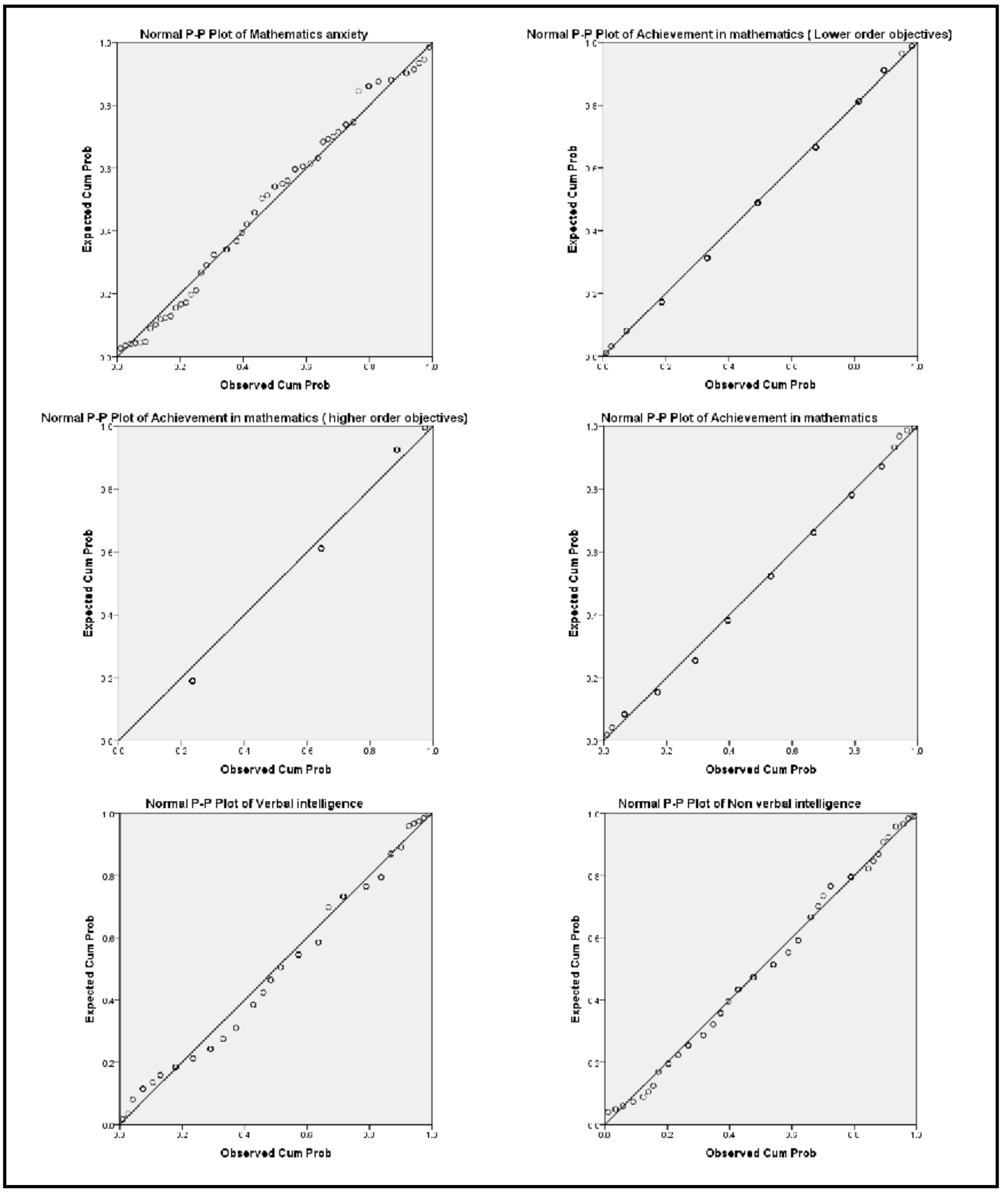


Figure 4. The P-P plots of the pretest scores of the variables for the control group

Posttest scores of the variables for the experimental group.

The Statistical Constants of the posttest scores of the dependent variables Mathematics Anxiety and Achievement in Mathematics (Total, Lower order objectives, Higher order objectives) of experimental group for Total sample, subsample Boys and subsample Girls are presented in Table 19, Table 20 and Table 21 respectively.

Table 19

Statistical Constants of the Posttest Scores of the Variables for the Experimental Group -Total sample

Variables		Mean	Median	Mode	SD	Sk	Sk/ SE_{Sk}	Ku	Ku/ SE_{Ku}
Mathematics Anxiety		137.17	133.00	110	38.33	0.48	1.6	-0.43	-0.74
Achievement in Mathematics	Lower order objectives	13.64	13.00	13	5.77	0.71	2.37	0.17	0.29
	Higher order objectives	3.74	3.50	3	1.89	0.60	2.00	0.16	0.28
	Total	17.38	16.00	15	7.06	0.75	2.5	0.38	0.66

N=66 SE_{Sk}=.30 SE_{Ku}=.5.

Table19 reveals that the mean, median and mode of the posttest scores of the variables for experimental group Total sample are almost same except for Mathematics Anxiety. For Mathematics Anxiety, value of mode is smaller than those of mean and median. The standard deviation of Mathematics Anxiety indicates that the scores are very much dispersed from the central value. The standard deviations of Achievement in Mathematics (Lower order objectives, Total) reveal that the scores are somewhat dispersed from the central value. For all the variables, the distributions are positively skewed. The distribution of scores of the variable Mathematics Anxiety is platykurtic and distributions of scores of Achievement in Mathematics (Total, Lower order objectives, Higher order objectives) are leptokurtic. The absolute values of the ratio between skewness and its standard error and the ratio between kurtosis and its standard error are less than 3.29 for all the variables. It indicates that the distributions of the variables are normally distributed (p>.05).

Table 20

Statistical Constants of the Posttest Scores of the Variables for the Experimental Group - Subsample Boys

Variables		Mean	Median	Mode	SD	Sk	Sk/ SE_{Sk}	Ku	Ku/ SE_{Ku}
Mathematics Anxiety		136.95	134.00	118	41.46	0.52	1.36	-0.41	-0.55
Achievement in Mathematics	Lower order objectives	12.76	12.00	11	5.37	0.99	2.61*	0.45	0.6
	Higher order objectives	3.55	3.00	3	1.57	0.27	0.71	-0.73	-0.97
	Total	16.32	14.50	14	6.31	0.87	2.29*	0.22	0.29

N= 38 SE_{sk}=.38 SE_{Ku}=.75
*p< .05

From Table 20 it is clear that the mean, median and mode of the posttest scores of the variables for experimental group subsample Boys are almost similar except for Mathematics Anxiety. For Mathematics Anxiety, the value of mode is smaller than those of mean and median. The standard deviation of Mathematics Anxiety indicates that the scores are very much dispersed from the central value. The standard deviations of Achievement in Mathematics (Lower order objectives, Total) reveal that the scores are somewhat dispersed from the central value. For all the variables, the distributions are positively skewed. The distributions of the variables Mathematics Anxiety and Achievement in Mathematics (Higher order objectives) are platykurtic and those of Achievement in Mathematics (Lower order objectives, Total) are leptokurtic. The absolute values of the ratio between skewness and its standard error and the ratio between kurtosis and its standard error are less than 1.96 for Mathematics Anxiety and Achievement in Mathematics (Higher order objectives) indicating that the distributions are normally distributed (p>.05). For Achievement in Mathematics (Lower order objectives, Total) the ratios are greater than 1.96 showing that the distributions are not normally distributed (p<.05).

Table 21

Statistical Constants of the Posttest Scores of the Variables for the Experimental Group - Subsample Girls

Variables		Mean	Median	Mode	SD	Sk	Sk/ SE_{Sk}	Ku	Ku/ SE_{Ku}
Mathematics Anxiety		137.46	130.00	110	34.37	0.43	0.98	-0.61	-0.71
Achievement in Mathematics	Lower order objectives	14.82	14.50	13	6.14	0.40	0.91	0.32	0.37
	Higher order objectives	4.00	4.00	4	2.26	0.56	1.27	-0.17	-0.20
	Total	18.82	18.50	16	7.86	0.54	1.23	0.41	0.48

N= 28 SE_{sk}=.44 SE_{Ku}=.86

Table 21 shows that the mean, median and mode of the posttest scores of the variables for experimental group subsample Girls are similar except for Mathematics Anxiety. For Mathematics Anxiety, the value of mode is smaller than those of mean and median. The standard deviation of Mathematics Anxiety indicates that the scores are very much dispersed from the central value. The standard deviations of Achievement in Mathematics (Lower order objectives, Total) reveal that the scores are somewhat dispersed from the central value. The distributions are positively skewed for all the variables. The distributions of scores of Mathematics Anxiety and Achievement in Mathematics (Higher order objectives) are platykurtic and those of Achievement in Mathematics (Lower order objectives, Total) are leptokurtic. The absolute values of the ratio between skewness and its standard error and the ratio between kurtosis and its standard error are less than 1.96 for all the variables. It indicates that the distributions of the variables are normally distributed (p>.05).

Posttest scores of the variables for the control group

The Statistical Constants of the posttest scores of the dependent variables Mathematics Anxiety and Achievement in Mathematics (Total, Lower order objectives, Higher order objectives) of the control group for Total sample, subsample Boys and subsample Girls are presented in Table 22, Table 23 and Table 24 respectively.

Table 22

Statistical Constants of the Posttest Scores of the Variables for the Control Group- Total sample

Variables		Mean	Median	Mode	SD	Sk	Sk/ SE_{Sk}	Ku	Ku/ SE_{Ku}
Mathematics Anxiety		160.02	169.00	212	49.40	-0.19	-0.63	-1.18	-1.97
Achievement in Mathematics	Lower order objectives	11.45	11.00	8	5.40	0.73	2.43	0.10	0.17
	Higher order objectives	2.53	2.00	2	1.82	0.82	2.73	0.23	0.38
	Total	13.98	12.00	11	6.72	0.94	3.13	0.32	0.53

N=62 SE_{sk}=.30 SE_{Ku}=.60

Table 22 reveals that the mean, median and mode of the posttest scores of the variables for control group Total sample are similar except for Mathematics Anxiety. For Mathematics Anxiety, the value of mode is greater than the values of mean and median. The standard deviation of Mathematics Anxiety indicates that the scores are very much dispersed from the central value. The standard deviations of Achievement in Mathematics (Lower order objectives, Total) reveal that the scores are somewhat dispersed from the central value. The distributions are positively skewed for all the variables except Mathematics Anxiety the distribution of which is negatively skewed. The distribution of the variable Mathematics Anxiety is platykurtic and distributions of Achievement in Mathematics (Total, Lower order objectives, Higher order objectives) are leptokurtic. The absolute values of the ratio between skewness and its standard error and the ratio between kurtosis and its standard error are less than 3.29 for all the variables. It indicates that the distributions of the variables are normally distributed (p>.05).

Table 23

Statistical Constants of the Posttest Scores of the Variables for the Control Group - Subsample Boys

Variables		Mean	Median	Mode	SD	Sk	Sk/ SE_{Sk}	Ku	Ku/ SE_{Ku}
Mathematics Anxiety		172.47	182.50	186	45.15	-0.47	-1.15	-0.56	-0.69
Achievement in Mathematics	Lower order objectives	10.38	9.50	10	5.41	1.30	3.17*	1.71	2.11*
	Higher order objectives	2.03	2.00	1	1.58	0.95	2.31*	0.36	0.44
	Total	12.41	11.00	11	6.41	1.59	3.88*	2.47	3.05*

N=32 SE_{sk}=.41 SE_{Ku}=.81
*p< .05

From Table 23 it is clear that the mean, median and mode of the posttest scores of the variables for control group subsample Boys are similar for all the variables. The standard deviation of Mathematics Anxiety indicates that the scores are very much dispersed from the central value. The standard deviations of Achievement in Mathematics (Lower order objectives, Total) reveal that the scores are somewhat dispersed from the central value. For Mathematics Anxiety, the distribution is negatively skewed and for Achievement in Mathematics (Total, Lower order objectives, Higher order objectives) the distributions are positively skewed. The distribution of the variable Mathematics Anxiety is platykurtic and distributions of Achievement in Mathematics (Lower order objectives, Higher order objectives, Total) are leptokurtic. The absolute values of the ratio between skewness and its standard error and the ratio between kurtosis and its standard error are less than 1.96 for Mathematics Anxiety indicating that the distribution is normally distributed ($p>.05$). For the variables, Achievement in Mathematics (Total, Lower order objectives, Higher order objectives), the ratios are greater than 1.96 showing that the distributions are not normally distributed ($p<.05$).

Table 24

Statistical Constants of the Posttest Scores of the Variables for the Control Group - Subsample Girls

Variables		Mean	Median	Mode	SD	Sk	Sk/ SE_{Sk}	Ku	Ku/ SE_{Ku}
Mathematics Anxiety		146.73	133.50	72	50.99	0.16	0.37	-1.40	-1.69
Achievement in Mathematics	Lower Order Objectives	12.60	13.00	13	5.22	0.27	0.63	-0.44	-0.53
	Higher Order Objectives	3.07	2.50	2	1.93	0.64	1.49	0.05	0.06
	Total	15.67	14.00	14	6.73	0.49	1.14	-0.26	-0.31

N=30 SE_{sk}=.43 SE_{Ku}=.83

Table 24 shows that the mean, median and mode of the posttest scores of the variables for control group subsample Girls are similar except for Mathematics Anxiety. For Mathematics Anxiety, the value of mode is smaller than those of mean and median. The standard deviation of Mathematics Anxiety indicates that the scores are very much dispersed from the central value. The standard deviations of Achievement in Mathematics (Lower order objectives, Total) reveal that the scores are somewhat dispersed from the central value. The distributions are positively skewed for all the variables. The distributions of scores of all the variables are platykurtic except for Achievement in Mathematics (Higher order objectives) the distribution of which is leptokurtic. The absolute values of the ratio between skewness and its standard error and the ratio between kurtosis and its standard error are less than 1.96 for all the variables. It indicates that the distributions of the variables are normally distributed ($p>.05$).

Discussion

The following inferences can be made from the observation of important statistical constants of pretest and posttest scores of the variables for experimental and control groups.

The statistical constants of the variables and normal P-P plots revealed that the distribution of scores follow normal distribution. Hence it is possible to carry out parametric testing on the data.

The mean Mathematics Anxiety pretest scores of experimental and control groups are 148.39 and 154.55 respectively. These mean scores approximate the mean Mathematics Anxiety score (155.09) for standard VI students of the preliminary survey. Further, Boys belonging to experimental as well as control groups have reported higher Mathematics Anxiety than Girls. This result is also consistent with preliminary survey result. Hence it can be concluded that the sample selected for the experiment is a representative sample of standard VI students in terms of Mathematics Anxiety level.

Mean Difference Analysis

Difference in mean pretest scores of the dependent variables between the experimental and control groups, mean difference in pretest and post test scores of experimental group, difference in mean post test scores of the variables for experimental and control groups and difference in mean gain scores between the experimental and control groups were investigated before controlling the effects of the covariates. The comparisons were done using mean difference analysis and levels of significance were fixed at .05 and .01.

Comparison of mean pretest scores of Mathematics Anxiety and Achievement in Mathematics of experimental and control groups.

The comparisons of mean performance of the students belonging to experimental and control groups on Mathematics Anxiety and Achievement in Mathematics pretests were done to compare the status of the groups on these variables, prior to the intervention.

Comparison of mean pretest scores of Mathematics Anxiety of experimental and control groups for total sample and subsamples based on Gender.

To compare the pre experimental status of experimental and control groups with respect to the dependent variable Mathematics Anxiety, test of significance of difference between means of two independent groups was utilized. To check whether there was any statistically significant difference between mean Mathematics Anxiety scores of the groups prior to the experiment, mean pretest scores of the two groups were calculated and these values were subjected to test of significance of difference between means. The data and results of the test of significance of difference between means for Total sample, subsample Boys and subsample Girls are given in the following sections.

Comparison of mean pretest scores of Mathematics Anxiety of experimental and control groups for total sample.

To compare the pre experimental status on Mathematics Anxiety of upper primary school students belonging experimental and control groups, the means and standard deviations of pretest scores of Mathematics Anxiety of the two groups were subjected to test of significance of difference between means. The details of *t* test for Total sample are presented in Table 25.

Table 25

Results of Test of Significance of Difference in Mean Pretest Scores of Mathematics Anxiety between Experimental and Control Groups- Total sample

Variable	Experimental Group			Control Group			t
	N_1	M_1	SD_1	N_2	M_2	SD_2	
Mathematics Anxiety	66	148.39	41.11	62	154.55	42.90	0.83

It is clear from Table 25 that the calculated t value is less than the table value 1.98 for df 126. So there is no statistically significant difference in the mean pretest score of Mathematics Anxiety of experimental and control groups. This shows that the pre experimental Mathematics Anxiety status of upper primary school students in experimental and control groups is same. Hence the two groups are comparable in terms of level of Mathematics Anxiety for Total sample.

The mean pretest scores of Mathematics Anxiety of experimental group and control group for Total sample are represented graphically in Figure 5.

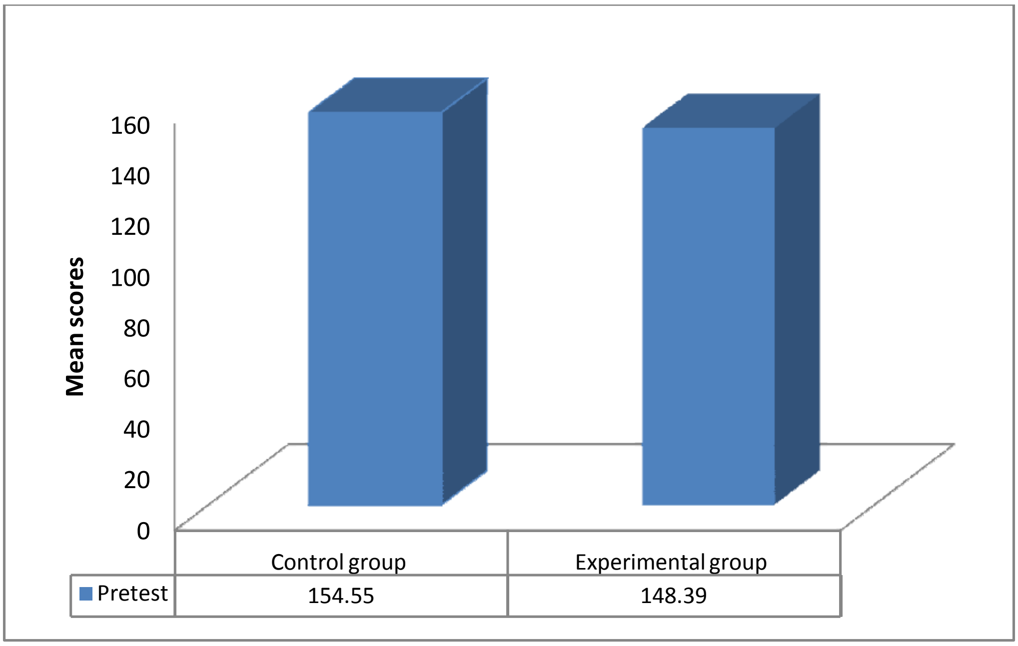


Figure 5. Mean pretest scores of Mathematics Anxiety of experimental and control groups –Total sample

The graphical representation of mean pretest scores of Mathematics Anxiety of experimental and control groups shows that the mean performance of upper primary school students in the two groups are almost equal for Total sample. This supports the result of mean difference analysis.

Comparison of mean pretest scores of Mathematics Anxiety of experimental and control groups for subsample boys.

The means and standard deviations of pretest scores of Mathematics Anxiety of Boys belonging to experimental and control groups were subjected to test of significance of difference between means, to compare the pre experimental status on Mathematics Anxiety of the two groups. The data and results of *t* test for subsample Boys are presented in Table 26.

Table 26

Results of Test of Significance of Difference in Mean Pretest Scores of Mathematics Anxiety between Experimental and Control Groups- Subsample Boys

Variable	Experimental Group			Control Group			t
	N_1	M_1	SD_1	N_2	M_2	SD_2	
Mathematics Anxiety	38	150.95	44.10	32	161.47	35.16	1.11

Table 26 shows that the calculated t value is less than the table value 2.0 for df 68 at .05 level of significance. So there is no statistically significant difference in the mean pretest scores of Mathematics Anxiety of upper primary school students belonging to experimental and control groups. This shows that the pre experimental Mathematics Anxiety status of boy students in experimental and control groups is same. Hence the two groups are comparable in terms of level of Mathematics Anxiety for subsample Boys.

The mean pretest scores of Mathematics Anxiety for subsample Boys are presented graphically in Figure 6.

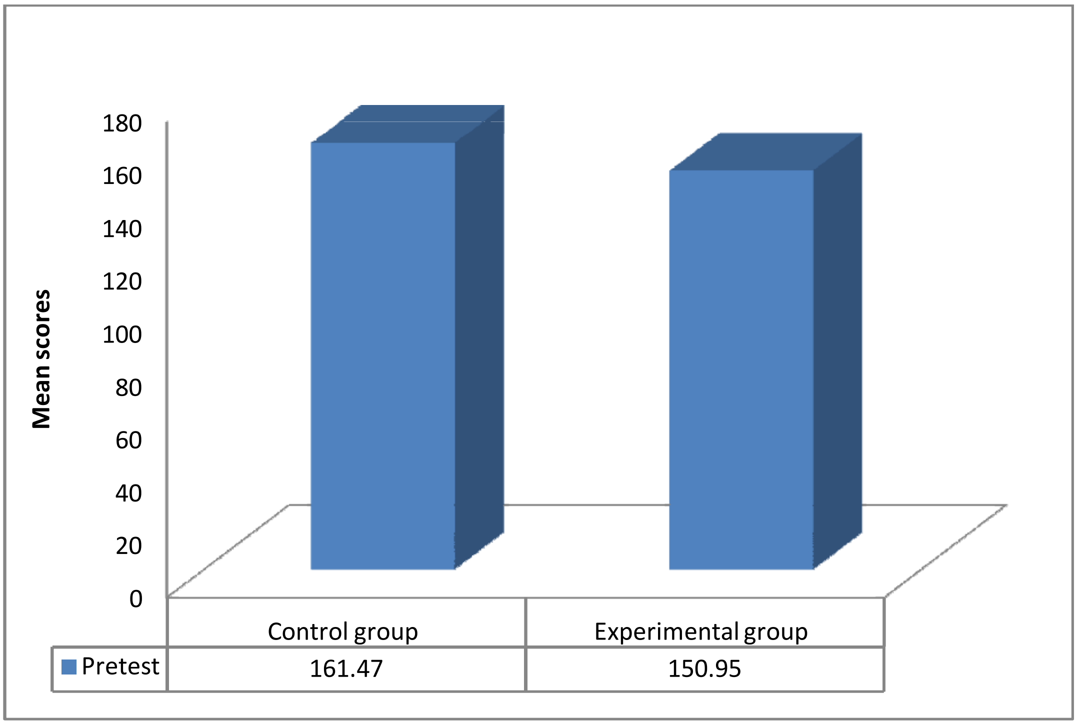


Figure 6. Mean pretest scores of Mathematics Anxiety of experimental and control groups –Subsample Boys

The graphical representation of mean pretest scores of Mathematics Anxiety of experimental and control groups shows that the pre experimental status of Boys belonging to the two groups is almost the same with respect to Mathematics Anxiety. Hence the result of *t* test is supported by the graphical representation also.

Comparison of mean pretest scores of Mathematics Anxiety of experimental and control groups for subsample girls.

To compare the pre experimental status of Girls in experimental and control groups with regard to Mathematics Anxiety, the means and standard deviations of the pretest scores were subjected to mean difference analysis. The details of the *t* test are presented in Table 27.

Table 27

Results of Test of Significance of Difference in Mean Pretest Scores of Mathematics Anxiety between Experimental and Control Groups- Subsample Girls

Variable	Experimental Group			Control Group			t
	N_1	M_1	SD_1	N_2	M_2	SD_2	
Mathematics Anxiety	28	144.93	37.18	30	147.17	49.40	0.19

Table 27 shows that experimental and control groups do not differ significantly in their mean pretest scores of Mathematics anxiety as the calculated t value is less than the tabled value 2.0 for df 56 at .05 level of significance. This indicates that the pre experimental Mathematics Anxiety status of Girls in the experimental and control groups are same. Hence the two groups are comparable with regard to Mathematics Anxiety for subsample Girls.

The mean pretest scores of Mathematics Anxiety of experimental and control groups for subsample Girls are graphically represented in Figure 7.

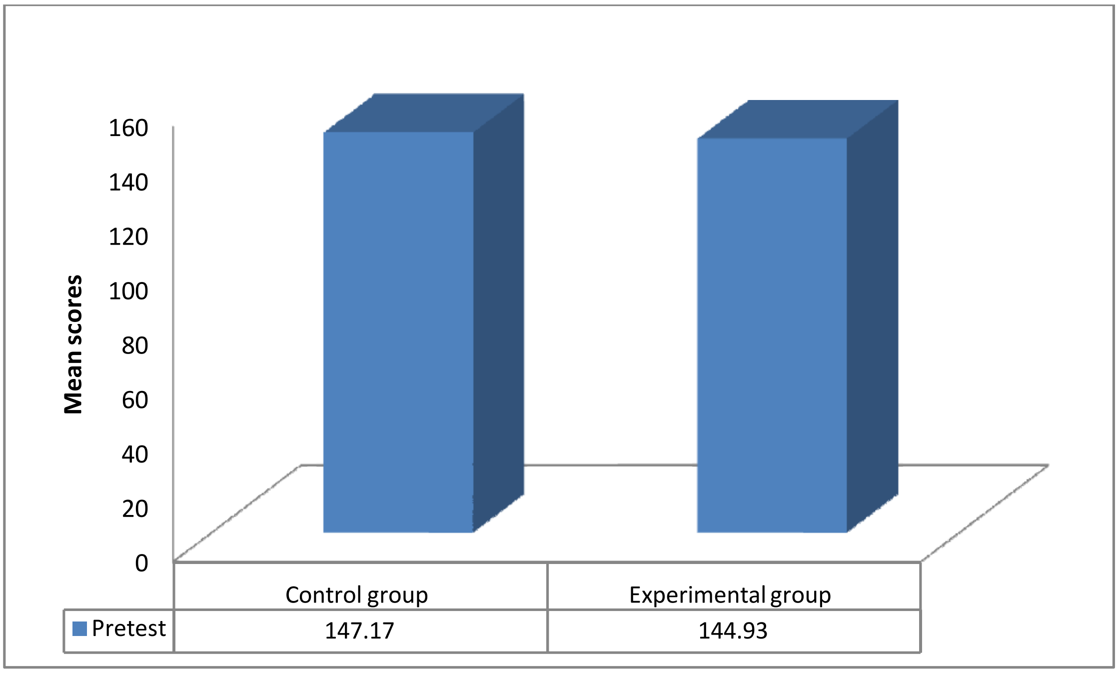


Figure 7. Mean pretest scores of Mathematics Anxiety of experimental and control groups –Subsample Girls

The graphical representation indicates that the mean pretest scores of Mathematics Anxiety of experimental and control groups are similar to certain extent for subsample Girls. Hence the graphical representation supports the result of mean difference analysis.

Comparison of mean pretest scores of Achievement in Mathematics (Total, Lower order objectives, Higher order objectives) of experimental and control groups for total sample and subsamples based on Gender.

To compare the pre experimental status of experimental and control groups with respect to the dependent variable Achievement in Mathematics (Total, Lower order objectives, Higher order objectives), test of significance of difference between means of two independent groups was utilized. To check whether there was any statistically significant difference between mean Achievement in Mathematics (Total, Lower order objectives, Higher order objectives) scores of the two groups prior to the experiment, mean pretest scores of the two groups were calculated and subjected to test of significance of difference between means. The data and results of the test of significance of difference between means for Total sample, subsample Boys and subsample Girls are given in the following sections.

Comparison of mean pretest scores of Achievement in Mathematics (Total, Lower order objectives, Higher order objectives) of experimental and control groups for total sample.

To compare the pre experimental status of upper primary school students belonging to experimental and control groups on Achievement in Mathematics (Total, Lower order objectives, Higher order objectives), the means and standard deviations of pretest scores of the two groups were subjected to test of significance of difference between means.

The details of *t* test for Total sample are presented in Table 28.

Table 28

Results of Test of Significance of Difference in Mean Pretest Scores of Achievement in Mathematics between Experimental and Control Groups- Total sample

Variable		Experimental Group			Control Group			t
		N_1	M_1	SD_1	N_2	M_2	SD_2	
Achievement in Mathematics	Lower order objectives	66	5.05	2.28	62	6.06	2.18	2.58*
	Higher order objectives	66	0.70	0.72	62	0.76	0.86	0.44
	Total	66	5.74	2.68	62	6.84	2.78	2.27*

* $p<.05$

Table 28 shows that the calculated t value for the variable Achievement in Mathematics (Higher order objectives) is less than the tabled value 1.98 for df 126 at .05 level of significance. So experimental and control groups do not differ significantly in terms of Achievement in Mathematics (Higher order objectives) prior to the intervention. The calculated t values for the variables Achievement in Mathematics (Lower order objectives) and Achievement in Mathematics (Total) are greater than the tabled value 1.98 for df 126 at .05 level of significance. This shows that the experimental and control groups differ significantly in terms of Achievement in Mathematics (Lower order objectives) and Achievement in Mathematics (Total). Moreover, it can be seen from the means that control group is significantly superior to experimental group in Achievement in Mathematics (Lower order objectives) and Achievement in Mathematics (Total).

The mean pretest scores of Achievement in Mathematics (Total, Lower order objectives, Higher order objectives) for Total sample are presented graphically in Figure 8.

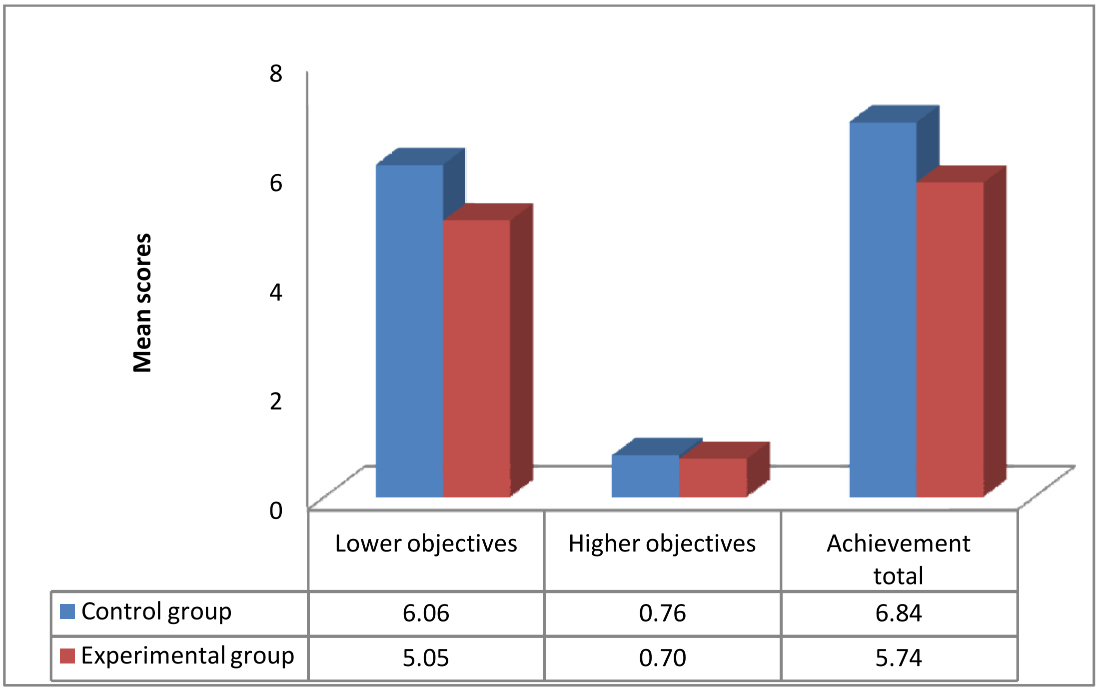


Figure 8. Mean pretest scores of Achievement in Mathematics (Total, Lower order objectives, Higher order objectives) of experimental and control groups-Total sample

The graphical representation shows that mean Achievement in Mathematics (Higher order objectives) of experimental and control groups prior to the experiment are similar, but the difference in Achievement in Mathematics (Total) and Achievement in Mathematics (Lower order objectives) of the two groups prior to the experiment are evident. The results of mean difference analysis are supported by the graphical representation also.

Comparison of mean pretest scores of Achievement in Mathematics (Total, Lower order objectives, Higher order objectives) of experimental and control groups for subsample boys.

The means and standard deviations of the pretest scores of Achievement in Mathematics (Total, Lower order objectives, Higher order objectives) of Boys belonging to experimental and control groups were subjected to test of significance of difference between means, to compare the pre experimental status of experimental and control groups on these variables.

The data and results of the *t* test for subsample Boys are presented in Table 29.

Table 29

Results of Test of Significance of Difference in Mean Pretest Scores of Achievement in Mathematics between Experimental and Control Groups-Subsample Boys

Variable		Experimental Group			Control Group			t
		N_1	M_1	SD_1	N_2	M_2	SD_2	
Achievement in Mathematics	Lower order objectives	38	4.87	2.00	32	5.47	1.95	1.26
	Higher order objectives	38	0.71	0.73	32	0.50	0.76	1.18
	Total	38	5.58	2.34	32	6.00	2.51	0.72

It is clear from Table 29 that the calculated t value is less than the table value 2.0 for df 68 at .05 level of significance. So experimental and control groups do not differ significantly in the mean pretest scores of Achievement in Mathematics (Total, Lower order objectives, Higher order objectives). This shows that the pre experimental Achievement status in Mathematics of Boy students in the two groups is same. Hence the two groups are comparable in terms of level of Achievement in Mathematics for Boys subsample.

The mean pretest scores of Achievement in Mathematics (Total, Lower order objectives, Higher order objectives) of boy students belonging to experimental and control groups are presented graphically in Figure 9.

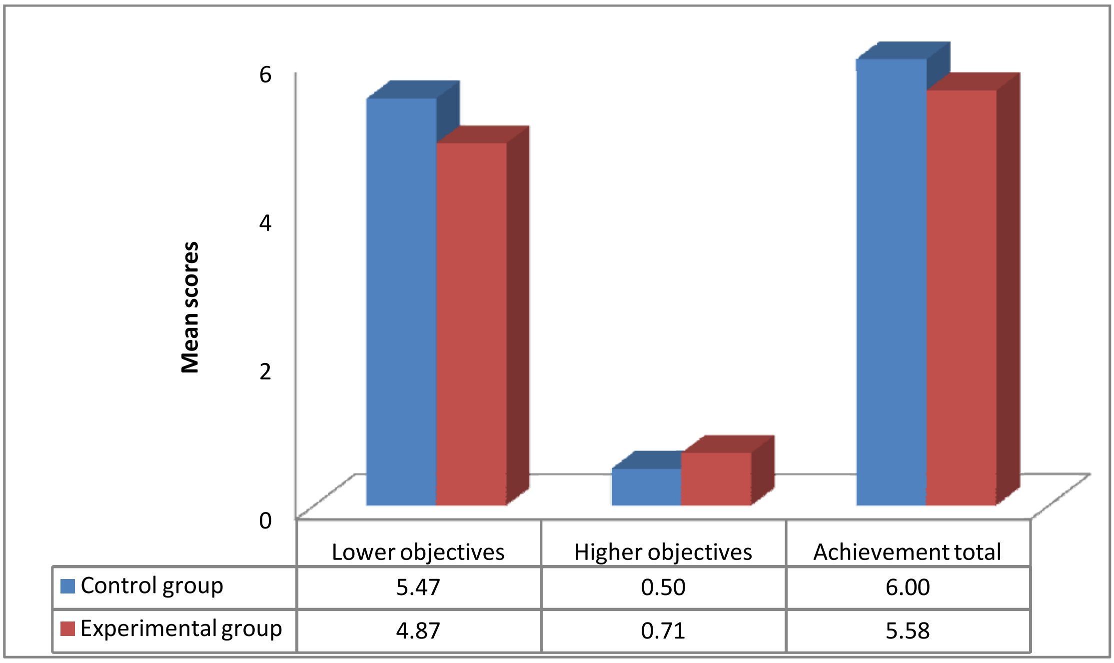


Figure 9. Mean pretest scores of Achievement in Mathematics (Total, Lower order objectives, Higher order objectives) of experimental and control groups-subsample boys

The graphical representation shows that the mean Achievement in Mathematics of Boys belonging to experimental and control groups are similar to certain extent prior to the intervention. Hence the results of mean difference analysis are supported by the graphical representation also.

Comparison of mean pretest scores of Achievement in Mathematics (Total, Lower order objectives, Higher order objectives) of experimental and control groups for subsample girls.

To compare the pre experimental Achievement status in Mathematics of Girl students belonging to experimental and control groups, the means and standard deviations of Achievement in Mathematics (Total, Lower order objectives, Higher order objectives) were subjected to test of significance of difference between means. The data and results of the *t* tests are given in Table 30.

Table 30

Results of Test of Significance of Difference in Mean Pretest Scores of Achievement in Mathematics between Experimental and Control Groups-Subsample Girls

Variable		Experimental Group			Control Group			t
		N_1	M_1	SD_1	N_2	M_2	SD_2	
Achievement in Mathematics	Lower order objectives	28	5.29	2.62	30	6.70	2.26	2.20*
	Higher order objectives	28	0.68	0.72	30	1.03	0.89	1.66
	Total	28	5.96	3.11	30	7.73	2.82	2.27*

*$p< .05$

It is clear from Table 30 that the calculated t value for the variable Achievement in Mathematics (Higher order objectives) is less than the table value 2.0 for df 56 at .05 level of significance, but the calculated t values for the remaining two variables are greater than the table value 2.0 for df 56 at .05 level of significance. So there is no significant difference in the mean pretest scores of Achievement in Mathematics (Higher order objectives) of experimental and control groups for Girls subsample. At the same time, the two groups differ significantly in mean pretest scores of Achievement in Mathematics (Lower order objectives) and Achievement in Mathematics (Total). Hence the two groups are comparable in the level of Achievement in Mathematics (Higher order objectives) for Girls subsample. Moreover, it can be seen from the means that the control group is significantly superior to experimental group in Achievement in Mathematics (Lower order objectives) and for Achievement in Mathematics (Total).

The mean pretest scores of the variables for Girls belonging to experimental and control groups are presented graphically in Figure 10.

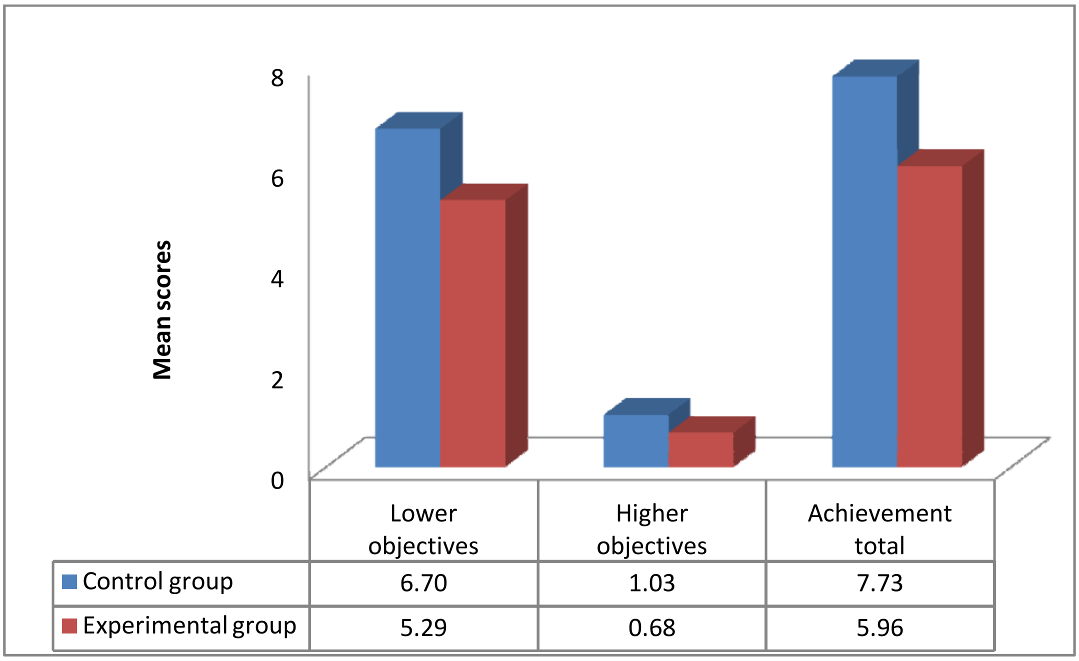


Figure 10. Mean pretest scores of Achievement in Mathematics (Total, Lower order objectives, Higher order objectives) of experimental and control groups-Subsample Girls

Figure 10 shows that the performance of girl upper primary school students belonging to experimental and control groups on Achievement in Mathematics (Higher order objectives) prior to the intervention is similar, but the performances on Achievement in Mathematics (Lower order objectives) and Achievement in Mathematics (Total) prior to the intervention are not similar. The results of mean difference analysis are supported by the graphical representation also.

Discussion

The mean difference analysis of pretest scores of Mathematics Anxiety and Achievement in Mathematics (Total, Lower order objectives, Higher order objectives) of experimental and control groups show the following results.

The experimental and control groups do not differ significantly in the pre experimental status of Mathematics Anxiety and Achievement in Mathematics

(Higher order objectives) for Total sample, subsample Boys and subsample Girls. Similarly, the two groups do not differ significantly in the pre experimental status of Achievement in Mathematics (Total, Lower order objectives) for subsample for Boys. Hence the experimental and control groups are comparable with regard to aforementioned variables for the particular samples.

The experimental and control groups differ significantly in the pre experimental status of Achievement in Mathematics (Total, Lower order objectives) for Total sample and subsample Girls. So the two groups are not comparable in terms of these two variables for Total sample and subsample Girls. This necessitates Analysis of Covariance of the variables for deriving conclusions.

Comparison of mean pretest and posttest scores of Mathematics Anxiety and Achievement in Mathematics of experimental group

The experimental group was taught Mathematics through Cognitively Guided Instructional Strategy and the control group was taught through Existing method of teaching Mathematics. To test the effectiveness of Cognitively Guided Instructional Strategy in reducing Mathematics Anxiety and enhancing Achievement in Mathematics of upper primary school students, the mean scores before and after intervention of the students belonging to Total, Boys and Girls samples in the experimental group were compared.

Comparison of mean pretest scores and mean post test scores of Mathematics Anxiety of experimental group for total sample and subsamples based on Gender.

To test whether there exist any significant difference between the mean pretest and posttest scores of Mathematics Anxiety of total, boys and girls upper primary school students belonging to the experimental group, paired *t* test was used. The means and standard deviations of pretest and posttest scores were subjected to test of significance of difference between two correlated means for Total sample, subsample Boys and subsample Girls. The details are presented in the following sections.

Comparison of mean pretest and mean posttest scores of Mathematics Anxiety of experimental group for total sample.

To compare the mean performance of Total sample of upper primary school students in the experimental group on pretest and posttest of Mathematics Anxiety, the means and standard deviations were subjected to paired *t* test.

The result of paired *t* test for Total sample is given in Table 31

Table 31

Results of Test of Significance of Difference in Mean Pretest Scores and Mean Posttest Scores of Mathematics Anxiety of Experimental Group- Total sample

Variable	N	Experimental Group				r	t
		Posttest		Pretest			
		M_1	SD_1	M_2	SD_2		
Mathematics Anxiety	66	137.17	38.33	148.39	41.11	.72	3.04**

** $p < .01$

From Table 31 it is evident that the calculated t value is greater than the table value 2.65 for df 65 at .01 level of significance. So there is significant difference between mean pretest and mean post scores of Mathematics Anxiety of upper primary school students in the experimental group. The mean posttest score is significantly smaller than the mean pretest score of Mathematics Anxiety. The correlation coefficient indicates that there is high positive correlation between pretest and posttest scores. Hence Cognitively Guided Instructional Strategy is effective in reducing Mathematics Anxiety of Total sample of upper primary school students belonging to the experimental group.

The mean pretest and posttest scores on Mathematics Anxiety for Total sample in the experimental group are presented graphically in Figure 11.

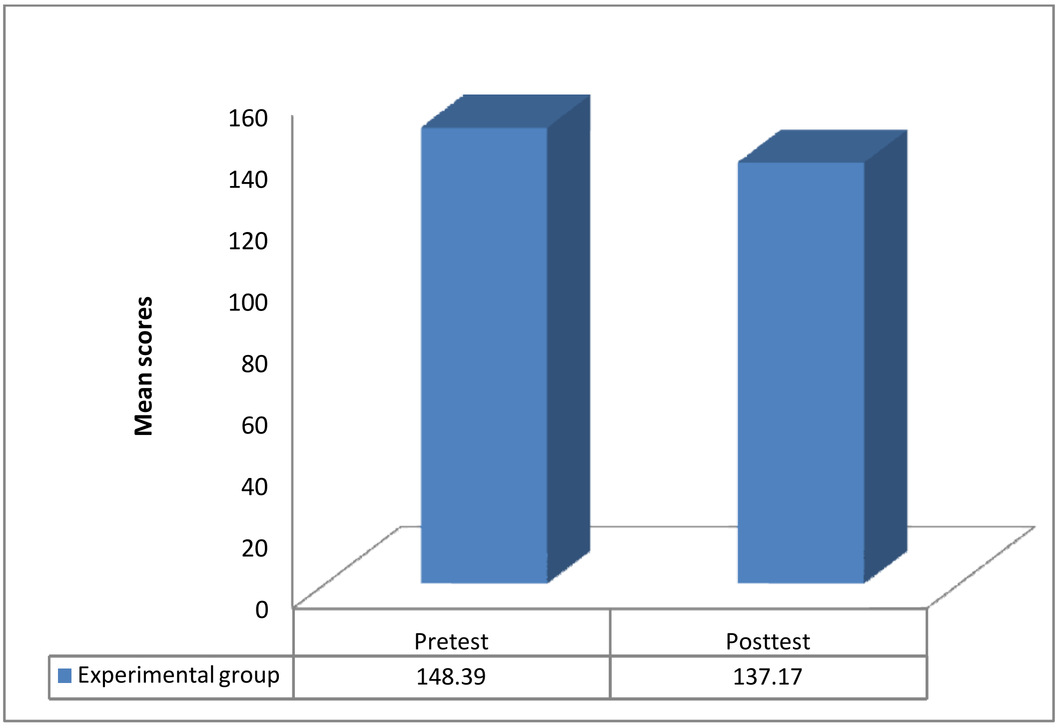


Figure 11. Mean pretest and posttest scores of Mathematics Anxiety of experimental group- Total Sample

The graphical representation of mean pretest and posttest on Mathematics Anxiety of experimental group indicates that the performances of upper primary school students in the two tests are not similar and the mean posttest score is smaller than the mean pretest score. Hence the results of mean difference analysis are supported by the graphical representation also.

Comparison of mean pretest and mean posttest scores of Mathematics Anxiety of experimental group for subsample boys.

To compare the mean performance of Boys in the experimental group on pretest and posttest of Mathematics Anxiety, the means and standard deviations were subjected to paired *t* test.

The details of paired *t* test for subsample Boys is given in Table 32.

Table 32

Results of Test of Significance of Difference in Mean Pretest Scores and Mean Posttest Scores of Mathematics Anxiety of Experimental Group- Subsample Boys

Variable	N	Experimental Group				r	t
		Posttest		Pretest			
		M_1	SD_1	M_2	SD_2		
Mathematics Anxiety	38	136.95	41.46	150.95	44.10	.67	2.58*

*p < .05

Table 32 shows that the calculated t value is greater than the table value 2.02 for df 37 at .05 level of significance. Hence there is significant difference between means of pretest and posttest Mathematics Anxiety scores of boy upper primary school students in the experimental group. The mean posttest score is significantly smaller than the mean pretest score. The calculated correlation coefficient shows that there is substantial positive relationship between pretest and posttest Mathematics Anxiety scores. So it is clear that Cognitively Guided Instructional Strategy is effective in reducing Mathematics Anxiety of subsample Boys in the experimental group.

The mean pretest and posttest scores of Mathematics Anxiety for subsample Boys are presented graphically in Figure12.

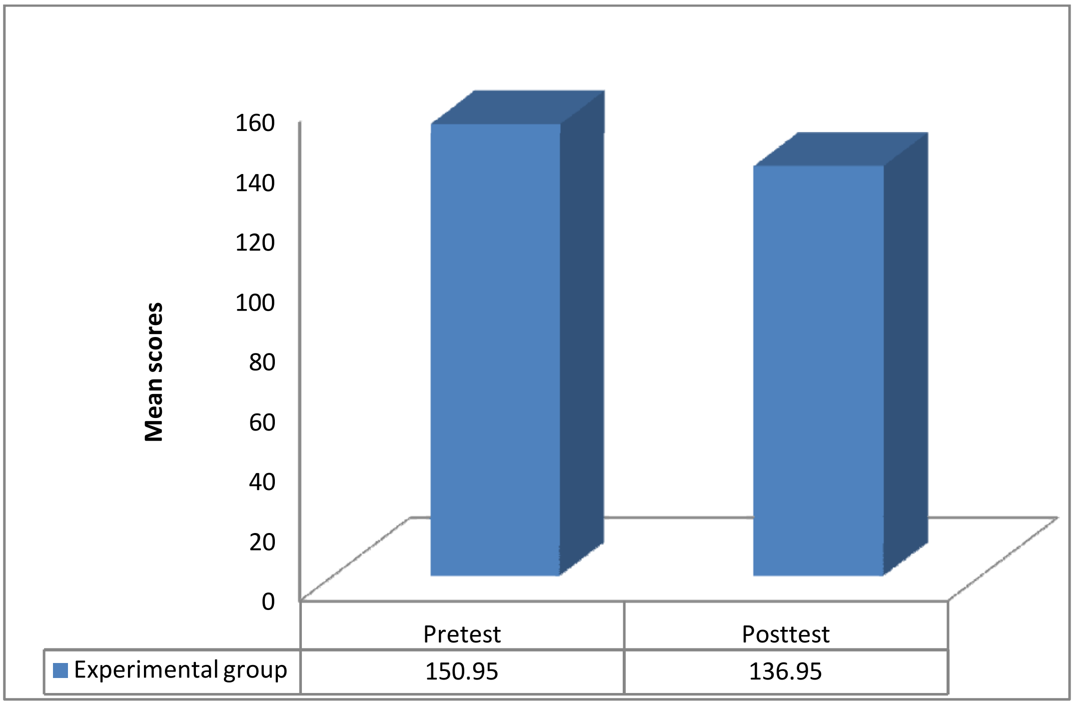


Figure 12. Mean pretest and posttest scores of Mathematics Anxiety of experimental group-Subsample Boys

It is clear from Figure12 that the mean performance of Boys belonging to experimental group in pretest and posttest of Mathematics Anxiety is not similar, as the mean posttest score is smaller than mean pretest score of Mathematics Anxiety. Hence the results of mean difference analysis are supported by the graphical representation also.

Comparison of mean pretest and mean posttest scores of Mathematics Anxiety of experimental group for subsample girls.

To compare the mean performance of Girls belonging to the experimental group in pretest and posttest of Mathematics Anxiety, paired *t* test was used.

The details of test of significance of difference between mean pretest and mean posttest scores of Mathematics Anxiety for Girls subsample are given in Table 33.

Table 33

Results of Test of Significance of Difference in Mean Pretest Scores and Mean Posttest Scores of Mathematics Anxiety of Experimental Group- Subsample Girls

Variable	N	Experimental Group				r	t
		Posttest		Pretest			
		M_1	SD_1	M_2	SD_2		
Mathematics Anxiety	28	137.46	34.37	144.93	37.18	.77	1.60

The results given in Table 33 reveal that there is no significant difference in the mean pretest and mean posttest scores of Mathematics Anxiety of Girls in the experimental group as the calculated t value is smaller than the table value 2.05 for df 27 at .05 level of significance. The correlation coefficient obtained indicates high positive relationship between pretest and posttest scores. Even though the mean posttest score is smaller than the mean pretest score, the difference is not significant enough to attribute it to the effect of Cognitively Guided Instructional Strategy. Hence further analysis is necessary for deriving conclusion.

The mean pretest and posttest scores of Mathematics Anxiety of Girls in the experimental group are presented graphically in Figure 13.

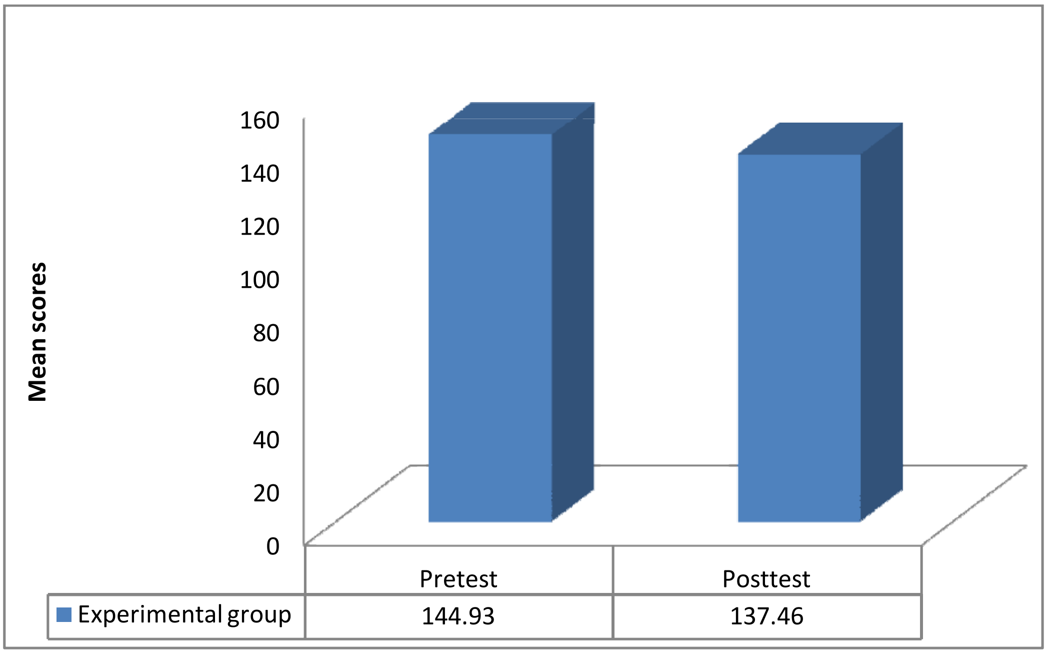


Figure 13. Mean pretest and posttest scores of Mathematics Anxiety of experimental group-subsample girls

The graphical representation as Figure 13 of mean pretest and posttest scores of Mathematics Anxiety of Girls shows that the mean performances of the students in the two tests are similar to certain extent, but mean posttest score is smaller than mean pretest score indicating reduction in Mathematics Anxiety. Hence the results of mean difference analysis are supported by the graphical representation also.

Comparison of mean pretest scores and mean post test scores of Achievement in Mathematics (Total, Lower order objectives, Higher order objectives) of experimental group for total sample and subsamples based on Gender.

To test whether there exist any significant difference between the mean pretest and posttest scores of Achievement in Mathematics (Total, Lower order objectives, Higher order objectives) of total, boys and girls upper primary school students belonging to the experimental group, paired *t* test was used. The means and standard deviations of pretest and posttest scores were subjected to test of significance of difference between two correlated means for Total sample, subsample Boys and subsample Girls. The details are presented in the following sections.

Comparison of mean pretest scores and mean posttest scores of Achievement in Mathematics (Total, Lower order objectives, Higher order objectives) of experimental group for total sample.

To compare the mean performance of Total sample of upper primary school students in the experimental group on pretest and posttest of Achievement in Mathematics (Total, Lower order objectives, Higher order objectives), paired *t* test was used.

The details of paired *t* test for Total sample are given in Table 34.

Table 34

Results of Test of Significance of Difference in Mean Pretest Scores and Mean Posttest Scores of Achievement in Mathematics of Experimental Group- Total sample

Variable		N	Experimental Group				r	t
			Posttest		Pretest			
			M_1	SD_1	M_2	SD_2		
Achievement in Mathematics	Lower order objectives	66	13.64	5.76	5.05	2.28	.54	14.21**
	Higher order objectives	66	3.74	1.89	0.70	0.72	.48	14.83**
	Total	66	17.38	7.06	5.74	2.68	.56	15.81**

$^{**}p < .01$

Table 34 shows that the calculated t values for Achievement in Mathematics (Total, Lower order objectives, Higher order objectives) are greater than the table value 2.65 for df 65 at .01 level of significance. So there is significant difference between pretest and posttest means of all the variables for Total sample of upper primary school students in the experimental group. The posttest mean is significantly greater than the pretest mean for all the variables and the correlation coefficients indicate that there is substantial positive relationship between pretest and posttest scores of all the variables. This shows that Cognitively Guided Instructional Strategy is effective in enhancing Achievement in Mathematics (Total, Lower order objectives, Higher order objectives) of upper primary school students.

The pretest and posttest means of Achievement in Mathematics (Total, Lower order objectives, Higher order objectives) for Total sample are presented graphically in Figure 14.

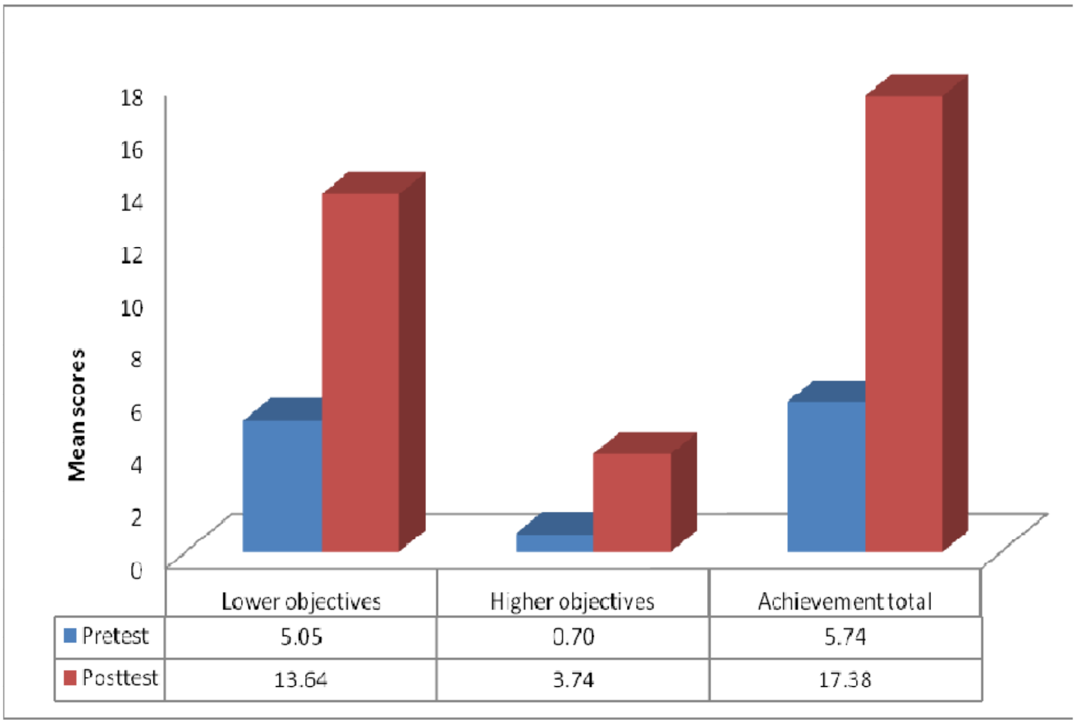


Figure14. Mean pretest and posttest scores of Achievement in Mathematics (Total, Lower order objectives, Higher order objectives) of experimental group-Total sample

The graphical representation in Figure 14 shows that the performances of upper primary school students in the two tests are not similar for all the variables. The posttest mean is greater than pretest mean for all the three variables and the difference is evident in the graphical representation. So it supports the results of mean difference analysis.

Comparison of mean pretest scores and mean posttest scores of Achievement in Mathematics (Total, Lower order objectives, Higher order objectives) of experimental group for subsample boys.

To compare the mean performance of subsample Boys in the experimental group on pretest and posttest of Achievement in Mathematics (Total, Lower order objectives, Higher order objectives), paired *t* test was used. The means and standard deviations of pretest and posttest were subjected to mean difference analysis and the calculated t values were tested for significance.

The details of paired *t* tests for Boys subsample are presented in Table 35.

Table 35

Results of Test of Significance of Difference in Mean Pretest Scores and Mean Posttest Scores of Achievement in Mathematics of Experimental Group-Subsample Boys

Variable		N	Experimental Group				r	t
			Posttest		Pretest			
			M_1	SD_1	M_2	SD_2		
Achievement in Mathematics	Lower order objectives	38	12.76	5.37	4.87	2.00	.44	10.09**
	Higher order objectives	38	3.55	1.57	0.71	0.73	.45	12.47**
	Total	38	16.32	6.31	5.58	2.34	.46	11.73**

$^{**}p < .01$

It is clear from Table 35 that calculated t values for Achievement in Mathematics (Total, Lower order objectives, Higher order objectives) are greater than the tabled value 2.71 for df 37 at .01 level of significance. So there is significant difference between pretest and posttest means of all the variables for subsample Boys in the experimental group. The posttest mean is significantly greater than the pretest mean for all the variables. The correlation coefficients calculated indicate that there is substantial positive relationship between pretest and posttest scores of all the three variables. This shows that Cognitively Guided Instructional Strategy is effective in enhancing Achievement in Mathematics (Total, Lower order objectives, Higher order objectives) of boys upper primary school students.

The means of pretest and posttest scores of the variables for subsample Boys are presented graphically in Figure 15.

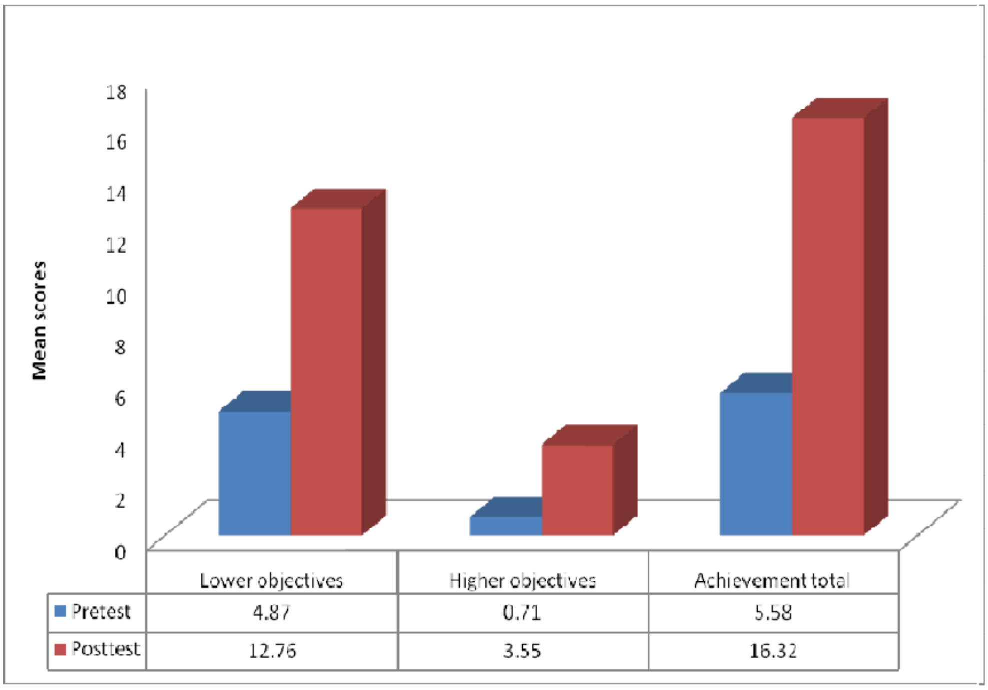


Figure15. Mean pretest and posttest scores of Achievement in Mathematics (Total, Lower order objectives, Higher order objectives) of experimental group-Subsample Boys

The graphical representation in Figure 15 of pretest and posttest means of Achievement in Mathematics (Total, Lower order objectives, Higher order objectives) of boys upper primary school students in the experimental group shows that the performance of the students in the two tests are not similar. For all the three variables the posttest mean is greater than pretest mean and the difference is clear in the graphical representation. So it supports the results of mean difference analysis.

Comparison of mean pretest scores and mean post test scores of Achievement in Mathematics (Total, Lower order objectives, Higher order objectives) of experimental group for subsample girls.

To compare the mean performance of girl upper primary school students in the experimental group on pretest and posttest of Achievement in Mathematics (Total, Lower order objectives, Higher order objectives), paired *t* test was used.

The data and results of comparisons of pretest and posttest means for subsample Girls are given in Table 36.

Table 36

Results of Test of Significance of Difference in Mean Pretest Scores and Mean Posttest Scores of Achievement in Mathematics of Experimental Group-Subsample Girls

Variable		N	Experimental Group				r	t
			Posttest		Pretest			
			M_1	SD_1	M_2	SD_2		
Achievement in Mathematics	Lower order objectives	28	14.82	6.14	5.29	2.62	.62	10.18**
	Higher order objectives	28	4.00	2.26	0.68	0.72	.54	8.95**
	Total	28	18.82	7.86	5.96	3.11	.65	10.79**

**$p < .01$

It is clear from Table 36 that there is significant difference between pretest and post test means of Achievement in Mathematics (Total, Lower order objectives, Higher order objectives) for subsample Girls in the experimental group as the calculated t values are greater than table value 2.77 for df 27 at .01 level of significance. The post test mean is significantly greater than pretest mean for all the three variables. The obtained correlation coefficients indicate that there is high positive relationship between pretest and posttest scores of the variables Achievement in Mathematics (Total, Lower order objectives) and there is substantial positive relationship between the pretest and posttest scores of Achievement in Mathematics (Higher order objectives). Hence Cognitively Guided Instructional Strategy is effective in enhancing the level of Achievement in Mathematics (Total, Lower order objectives, Higher order objectives) of girl upper primary school students.

The pretest and posttest means of Achievement in Mathematics for Girls in the experimental group are presented graphically in Figure 16.

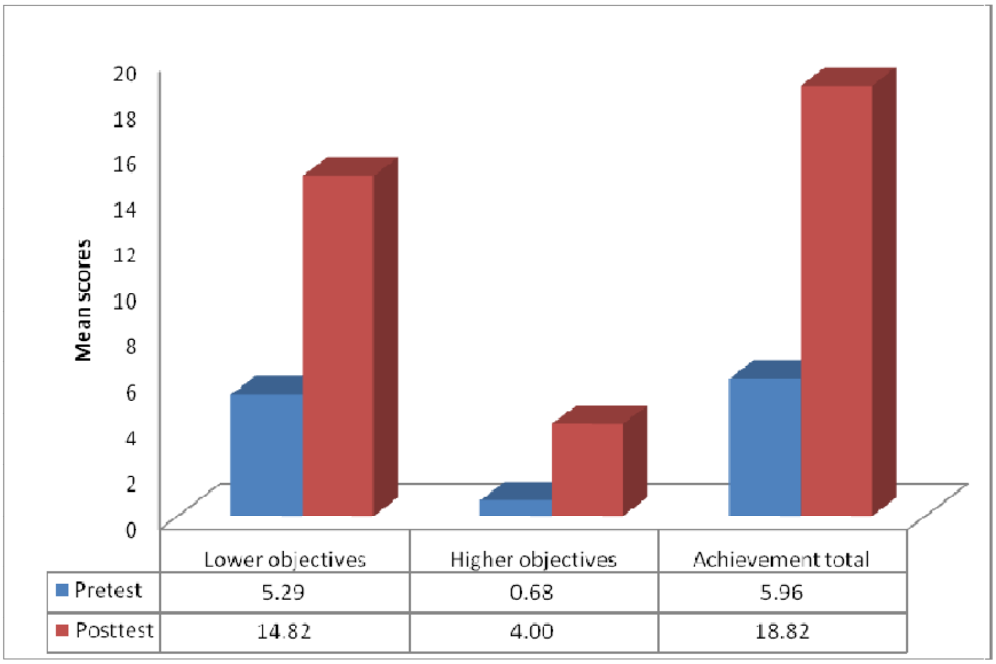


Figure16. Mean pretest and posttest scores of Achievement in Mathematics (Total, Lower order objectives, Higher order objectives) of experimental group-Subsample Girls

Figure 16 shows that the mean performance of Girls students in pretests and posttests of the three variables are not similar. For all the three variables posttest mean is greater than pretest mean. Hence the results of mean difference analysis are clearly supported by the graphical representation.

Discussion

The mean difference analysis of pretest and posttest scores of Mathematics Anxiety and Achievement in Mathematics of upper primary school students in the experimental group revealed the following results.

There is significant difference between mean pretest and posttest scores of Mathematics Anxiety for Total sample and subsample Boys. Hence Cognitively Guided Instructional Strategy is effective in reducing the Mathematics Anxiety level of Total sample and subsample Boys. Effectiveness of Cognitively Guided Instructional Strategy in reducing the Mathematics Anxiety level of Girls was not proved as the mean difference was not significant enough. However, the mean posttest score is smaller than mean pretest score indicating a reduction in Mathematics Anxiety of Girls. There is high positive correlation between pretest and posttest scores of Mathematics Anxiety.

The mean pretest and posttest scores of Achievement in Mathematics (Total, Lower order objectives, Higher order objectives) differ significantly for Total sample, subsample Boys and subsample Girls. Hence Cognitively Guided Instructional Strategy is effective in enhancing the level of Achievement in Mathematics for Total sample, subsample Boys and subsample Girls. The correlation coefficients show substantial to high positive relationship between pretest and posttest scores of Achievement in mathematics.

Comparison of mean posttest scores of Mathematics Anxiety and Achievement in Mathematics of experimental and control groups.

Comparisons of the mean posttest scores of Mathematics Anxiety and Achievement in Mathematics, of upper primary school students in experimental group taught through Cognitively Guided Instructional Strategy and control group taught through Existing method of teaching, were done to compare the effect of Cognitively Guided Instructional Strategy and Existing method of teaching on Mathematics Anxiety and Achievement in Mathematics.

Comparison of mean posttest scores of Mathematics Anxiety of experimental and control groups for Total sample and subsamples based on Gender.

Comparison of mean scores was carried out to test whether significant difference exist between mean scores of the experimental group and the control group in the dependent variable Mathematics Anxiety after the intervention. For comparison of posttest scores two tailed test of significance of difference between means was used. The means and standard deviations of posttest scores of Mathematics Anxiety of the two groups were subjected to mean difference analysis and the calculated t values were tested for significance. The data and results of *t* tests for Total sample, subsample Boys and subsample Girls are given in the following sections.

Comparison of mean posttest scores of Mathematics Anxiety of experimental and control groups for total sample.

To test whether there exist any significant difference in the Mathematics Anxiety level of upper primary school students in experimental and control groups after intervention, the posttest means on Mathematics Anxiety of experimental and control groups were compared. The means and standard deviations of the posttest scores were subjected to mean difference analysis and the calculated t value was tested for significance.

The details of the *t* test for Total sample are presented in Table 37.

Table 37

Results of Test of Significance of Difference in Mean Posttest Scores of Mathematics Anxiety between Experimental and Control Groups- Total sample

Variable	Experimental Group			Control Group			t
	N_1	M_1	SD_1	N_2	M_2	SD_2	
Mathematics Anxiety	66	137.17	38.33	62	160.02	49.40	2.91**

**$p < .01$

Table 37 shows that the calculated t value is greater than table value 2.62 for df 126 at .01 level of significance. So there is statistically significant difference between the mean posttest scores of Mathematics Anxiety of the experimental and control groups. The mean score of experimental group is significantly smaller than the mean score of control group. This indicates that Cognitively Guided Instructional Strategy is more effective than Existing method of teaching in reducing Mathematics Anxiety of Total sample of upper primary school students.

The mean posttest scores of Mathematics Anxiety for Total sample are presented graphically in Figure 17.

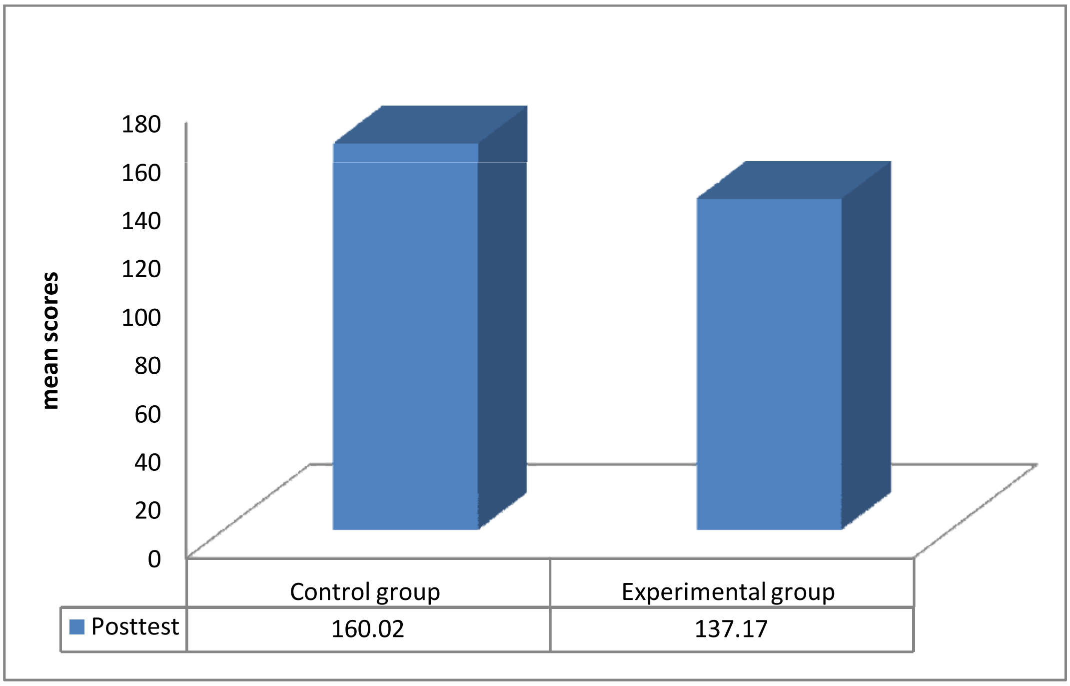


Figure17. Mean posttest scores of Mathematics Anxiety of experimental and control groups- Total Sample

It is clear from Figure 17 that the mean performance of the upper primary school students on Mathematics Anxiety is not similar for experimental and control groups. It indicates that students in the control group have reported more Mathematics Anxiety than students in the experimental group after the intervention. Hence the graphical representation supports the results of mean difference analysis for Total sample of upper primary school students in the experimental and control groups.

Comparison of mean posttest scores of Mathematics Anxiety of experimental and control groups for subsample boys.

To test whether there exist any significant difference in the mean Mathematics Anxiety level of Boys in experimental and control groups after intervention, the posttest means of Mathematics Anxiety of experimental and control groups were compared. The means and standard deviations of the posttest scores of the two groups were subjected to mean difference analysis. Then the calculated t value was tested for significance.

The data and results of the *t* test for subsample Boys are presented in Table 38.

Table 38

Results of Test of Significance of Difference in Mean Posttest Scores of Mathematics Anxiety between Experimental and Control Groups- Subsample Boys

Variable	Experimental Group			Control Group			t
	N_1	M_1	SD_1	N_2	M_2	SD_2	
Mathematics Anxiety	38	136.95	41.46	32	172.47	45.15	3.43**

$^{**}p < .01$

It is evident from Table 38 that experimental and control groups differ significantly in the mean posttest scores of Mathematics Anxiety as the calculated t value is greater than the table value 2.65 for df 68 at .01 level of significance. The mean score of the control group is significantly greater than the mean score of experimental group after the intervention. Hence the results show that for subsample Boys, Cognitively Guided Instructional Strategy is more effective in reducing the Mathematics Anxiety than Existing method of teaching.

The posttest Mathematics Anxiety mean scores for subsample Boys are presented graphically in Figure 18.

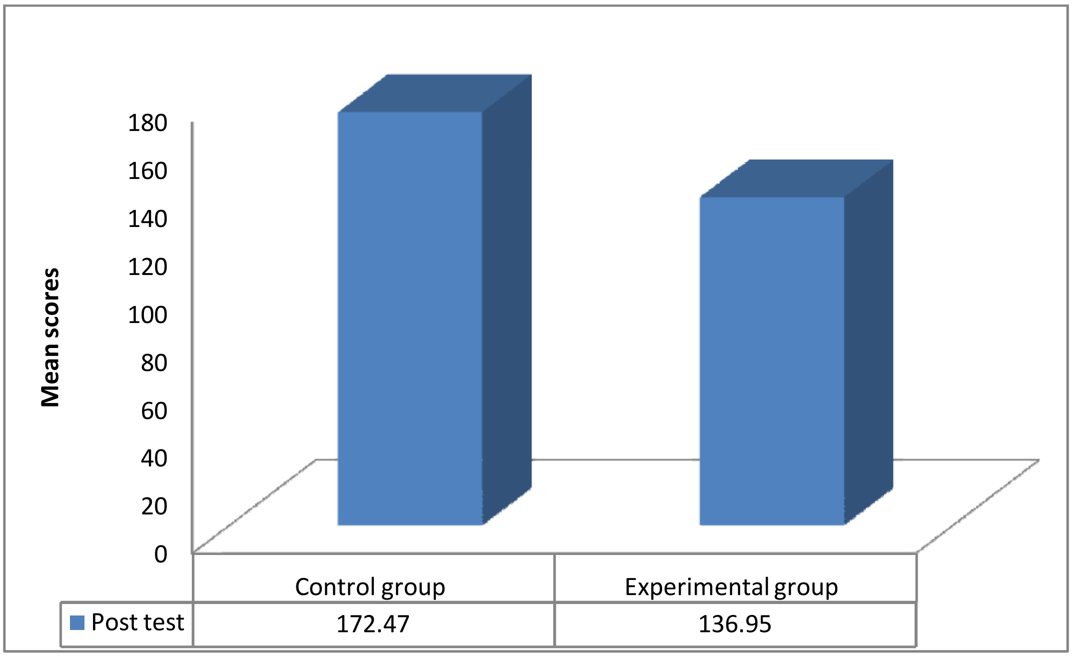


Figure 18. Mean posttest scores of Mathematics Anxiety of experimental and control groups- Subsample Boys

Figure 18 shows that the mean performance of Boys on the test is not similar for experimental and control groups and upper primary school students in the experimental group have less Mathematics Anxiety than students in the control group, after the intervention. Hence results of mean difference analysis are supported by the graphical observation for subsample Boys.

Comparison of mean posttest scores of Mathematics Anxiety of experimental and control groups for subsample girls.

To test whether there exist significant difference in the Mathematics Anxiety level of Girl students in experimental and control groups after intervention, the posttest means on Mathematics Anxiety of Girls belonging to experimental and control groups were compared. The means and standard deviations of the posttest scores were subjected to mean difference analysis and the calculated t value was tested for significance.

The details of the mean difference analysis for subsample Girls are presented in Table 39.

Table 39

Results of Test of Significance of Difference in Mean posttest Scores of Mathematics Anxiety between Experimental and Control Groups- Subsample Girls

Variable	Experimental Group			Control Group			t
	N_1	M_1	SD_1	N_2	M_2	SD_2	
Mathematics Anxiety	28	137.46	34.37	30	146.73	50.99	0.82

Table 39 indicates that the calculated t value is smaller than the table value 2.0 for df 56 at .05 level of significance. So there is no significant difference between mean posttest scores of Mathematics Anxiety of experimental and control groups. However, it can be seen that the low mean score of Mathematics Anxiety is associated with experimental after the intervention. But, the difference in the two groups cannot be attributed to treatment as the difference is not statistically significant.

The posttest mean scores for subsample Girls are presented graphically in Figure 19.

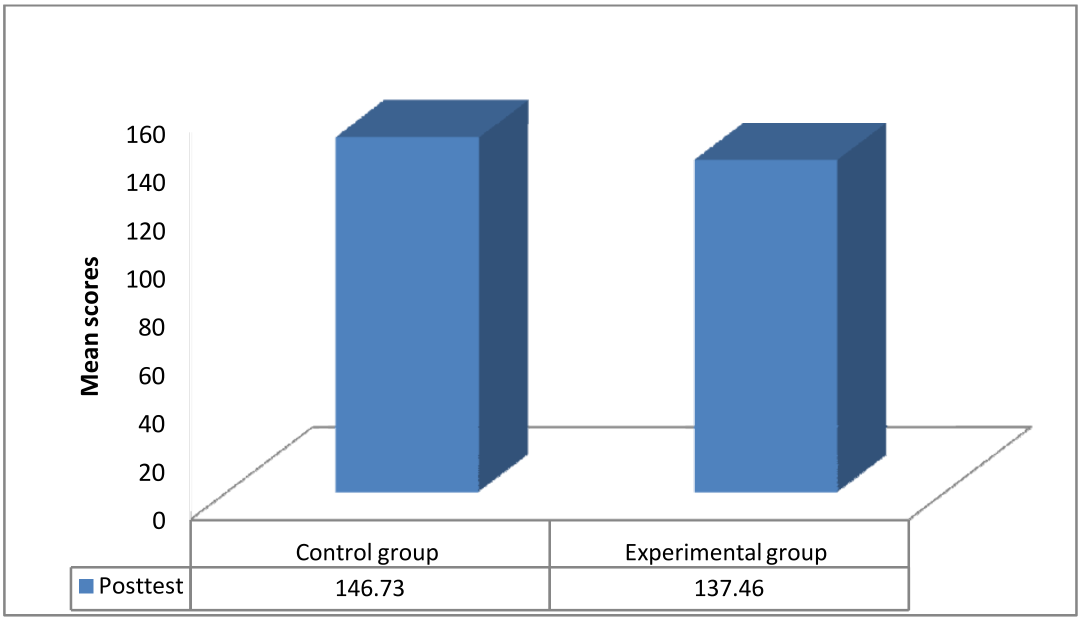


Figure19. Mean posttest scores of Mathematics Anxiety of experimental and control groups- Subsample Girls

Figure 19 shows that the performance of upper primary school students belonging to experimental and control groups are similar to certain extent and Girls in the experimental group have less Mathematics Anxiety than Girls in the control group. However, the difference is not evident. So the results of mean difference analysis are supported by the graphical representation also.

Comparison of mean post test scores of Achievement in Mathematics (Total, Lower order objectives, Higher order objectives) of experimental and control groups for Total sample and subsamples based on Gender.

Comparison of mean posttest scores was carried out to test whether significant difference exist between mean scores of the experimental group and the control group on Achievement in Mathematics (Total, Lower order objectives, Higher order objectives), after the intervention. For comparison of posttest scores two tailed test of significance of difference between means was used. The means and standard deviations of posttest scores of Achievement in Mathematics (Total, Lower order objectives, Higher order objectives) of the two groups were subjected to mean difference analysis and the calculated t values were tested for significance. The details of *t* tests for Total sample, subsample Boys and subsample Girls are given in the following sections.

Comparison of mean posttest scores of Achievement in Mathematics (Total, Lower order objectives, Higher order objectives) of experimental and control groups for total sample.

To test whether there exist any statistically significant difference in the mean Achievement in Mathematics (Total, Lower order objectives, Higher order objectives) of upper primary school students in experimental and control groups after intervention, the posttest mean scores of the two groups were compared. The means and standard deviations of the posttest scores for Total sample were subjected to mean difference analysis and the calculated t values were tested for significance.

The details of mean difference analysis for Total sample are given in Table 40.

Table 40

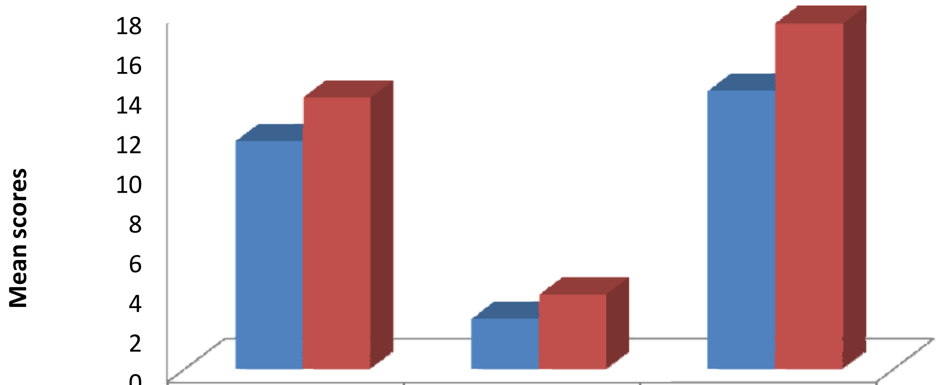
Results of Test of Significance of Difference in Mean Posttest Scores of Achievement in Mathematics between Experimental and Control Groups- Total sample

Variable		Experimental Group			Control Group			t
		N_1	M_1	SD_1	N_2	M_2	SD_2	
Achievement in Mathematics	Lower order objectives	66	13.64	5.76	62	11.45	5.40	2.21*
	Higher order objectives	66	3.74	1.89	62	2.53	1.82	3.69**
	Total	66	17.38	7.06	62	13.98	6.72	2.78**

*p< .05 **p< .01

Table 40 shows that there are significant differences in the mean posttest scores of the variable between experimental and control groups. The calculated t values for Achievement in Mathematics (Higher order objectives) and Achievement in Mathematics (Total) are greater than the table value 2.62 for df 126 at .01 level of significance and the t value for Achievement in Mathematics (Lower order objectives) is greater than table value 1.98 for df 126 at .05 level of significance. Hence experimental and control groups differ significantly in the mean Achievement in Mathematics after the intervention and higher mean values are seen to associate with experimental group. So Cognitively Guided Instructional Strategy is more effective in enhancing Achievement in Mathematics of upper primary school students than Existing method of teaching for Total sample.

The mean posttest scores of Achievement in Mathematics for Total sample are presented graphically in Figure 20.



	Lower objectives	Higher objectives	Achievement total
Control group	11.45	2.53	13.98
Experimental group	13.64	3.74	17.38

Figure 20. Mean posttest scores of Achievement in Mathematics (Total, Lower order objectives, Higher order objectives) of experimental and control groups- Total Sample

It is clear from Figure 20 that the performances on Achievement in Mathematics (Total, Lower order objectives, Higher order objectives) of upper primary school students belonging to experimental and control groups are not similar and the mean posttest scores of experimental group are greater than those of control group for Total sample. Hence the graphical representation supports the results of mean difference analysis.

Comparison of mean posttest scores of Achievement in Mathematics (Total, Lower order objectives, Higher order objectives) of experimental and control groups for subsample boys.

To test whether there exist any statistically significant difference in the mean Achievement in Mathematics (Total, Lower order objectives, Higher order objectives) of boy students in experimental and control groups after intervention, the posttest mean scores of the two groups were compared. The means and standard deviations of the posttest scores for subsample Boys were subjected to mean difference analysis and the calculated t values were tested for significance.

The details of mean difference analysis for Boys subsample are given in Table 41

Table 41

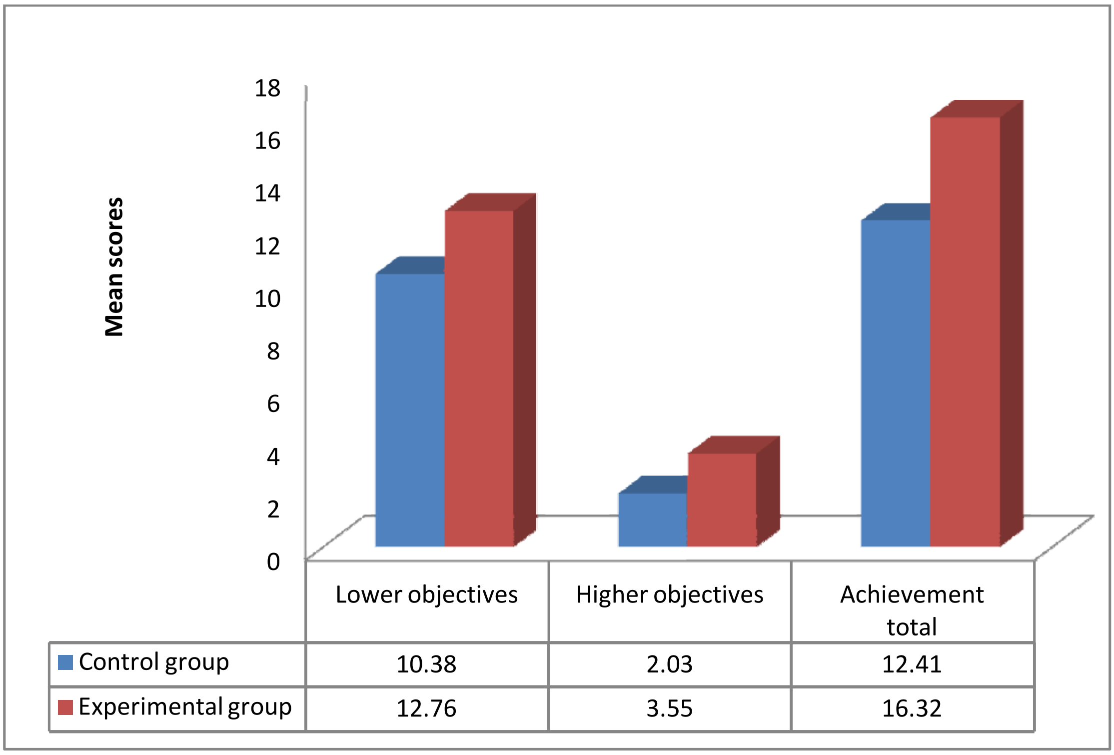
Results of Test of Significance of Difference in Mean Posttest Scores of Achievement in Mathematics between Experimental and Control Groups-Subsample Boys

Variable		Experimental Group			Control Group			t
		N_1	M_1	SD_1	N_2	M_2	SD_2	
Achievement in Mathematics	Lower order objectives	38	12.76	5.37	32	10.38	5.41	1.85
	Higher order objectives	38	3.55	1.57	32	2.03	1.58	4.03**
	Total	38	16.32	6.31	32	12.41	6.41	2.56*

*p< .05 ** p< .01

Table 41 indicates that the calculated t value for Achievement in Mathematics (Higher order objectives) is greater than the table value 2.65 for df 68 at .01 level of significance and that of Achievement in Mathematics (Total) is greater than the table value 2.0 for df 68 at .05 level of significance. Hence the experimental and control groups differ significantly in the mean scores of Achievement in Mathematics (Total, Higher order objectives) after the intervention. High mean scores are seen to associate with experimental group. So Cognitively Guided Instructional Strategy is more effective in enhancing these variables for Boys than Existing method of teaching. As the obtained t value for Achievement in Mathematics (Lower order objectives) is less than the table value 2.0 for df 68 at .05 level of significance, there is no significant difference in mean posttest scores of experimental and control groups. However, for this variable also higher mean is associated with experimental group.

The mean posttest score for subsample Boys are presented graphically in Figure 21.



	Lower objectives	Higher objectives	Achievement total
Control group	10.38	2.03	12.41
Experimental group	12.76	3.55	16.32

Figure 21. Mean posttest scores of Achievement in Mathematics (Total, Lower order objectives, Higher order objectives) of experimental and control groups-Subsample Boys

Figure 21 indicates that the mean performance of upper primary school students belonging to experimental and control groups on Achievement in Mathematics (Total, Higher order objectives) are not similar. But the mean performance of the students on Achievement in Mathematics (Lower order objectives) is similar to a certain extent. The graphical representation shows that students in the experimental group have scored more on these variables than students in the control group. Hence the graphical observation supports the results of mean difference analysis for subsample Boys.

Comparison of mean posttest scores of Achievement in Mathematics (Total, Lower order objectives, Higher order objectives) of experimental and control groups for subsample girls.

To test whether there exist statistically significant difference in the mean Achievement in Mathematics (Total, Lower order objectives, Higher order objectives) of Girls in experimental and control groups after intervention, the posttest mean scores of experimental and control groups were compared. The means and standard deviations of the posttest scores for subsample Girls were subjected to mean difference analysis and the calculated t values were tested for significance.

The details of *t* tests for subsample Girls are given in Table 42.

Table 42

Results of Test of Significance of Difference in Mean Posttest Scores of Achievement in Mathematics between Experimental and Control Groups-Subsample Girls

Variable		Experimental Group			Control Group			t
		N_1	M_1	SD_1	N_2	M_2	SD_2	
Achievement in Mathematics	Lower order objectives	28	14.82	6.14	30	12.60	5.22	1.49
	Higher order objectives	28	4.00	2.26	30	3.07	1.93	1.70
	Total	28	18.82	7.86	30	15.67	6.73	1.65

It is clear from Table 42 that the calculated t values are smaller than table value 2.0 for df 56 at .05 level of significance. So the experimental and control groups do not differ significantly in the mean posttest score of the variables. However, the higher mean scores are found to be associated with experimental group after the intervention. Since the mean differences in the posttest scores are not significant enough, any difference in the two groups cannot be attributed to intervention.

The mean posttest scores of Achievement in Mathematics for subsample Girls are presented graphically in Figure 22.

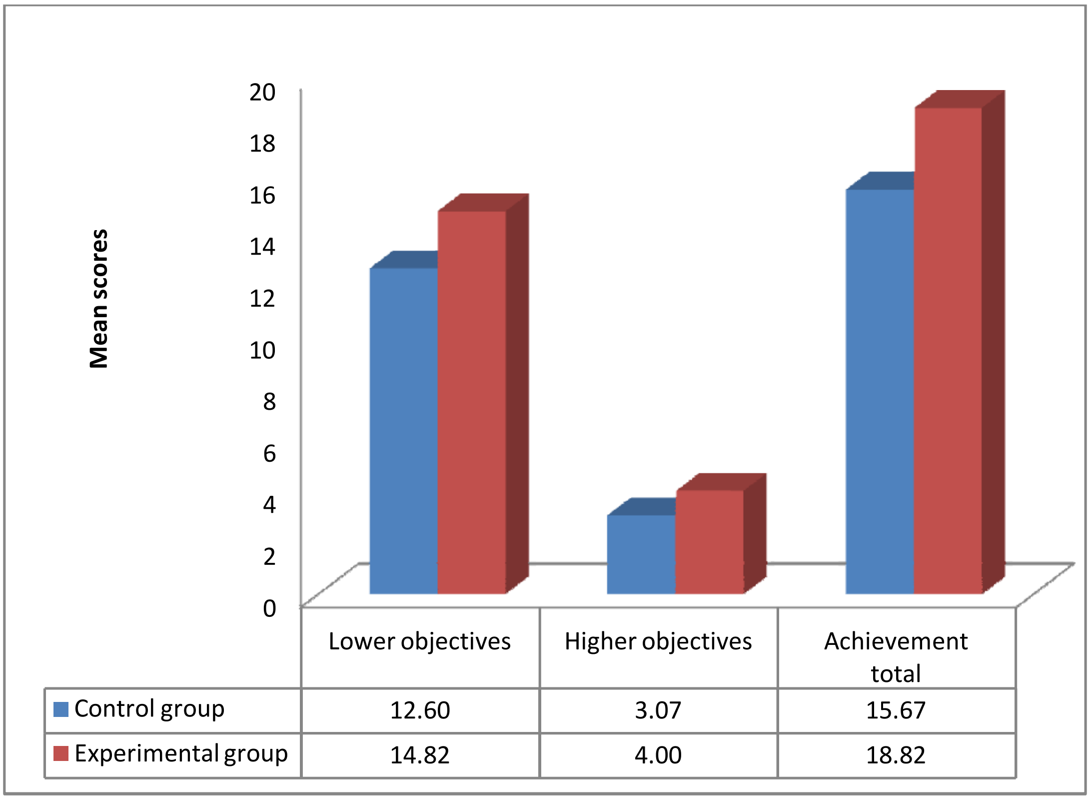


Figure 22. Mean posttest scores of Achievement in Mathematics (Total, Lower order objectives, Higher order objectives) of experimental and control groups-Subsample Girlss

Figure 22 indicates that the mean performance of girls belonging to experimental and control groups are similar to a certain extent for Achievement in Mathematics (Total, Lower order objectives, Higher order objectives) and the mean posttest scores of experimental group are greater than that of control group. Hence the results of *t* test are supported by the graphical representation.

Discussion

The comparison of mean posttest scores for Total sample, subsample Boys and subsample Girls show the following results.

There is significant difference between mean Mathematics anxiety posttest scores of experimental and control groups for Total sample and subsample Boys, but not for subsample Girls.

The mean Achievement in Mathematics (Total, Lower order, Higher order objectives) posttest scores differ significantly for Total sample but not for Girls subsample. Significant mean differences were found in Achievement in Mathematics (Total, Higher order objectives) posttest scores but not in Achievement in Mathematics (Lower order objectives) post test scores for Boys.

Hence Cognitively Guided Instructional Strategy was found to be effective than Existing method of teaching, in reducing the Mathematics Anxiety for Total sample and Boys subsample, in enhancing Achievement in Mathematics (Total, Lower order objectives, Higher order objectives) for Total sample and in enhancing Achievement in Mathematics (Total, Higher order objectives) for subsample Boys.

However, it is to be noted that significant pretest mean differences were found in Achievement in Mathematics (Total, Lower order objectives) of experimental and control groups for Total and Girls samples and also that higher means were associated with control group. After the intervention, these group differences for Girls were found to be not significant but the group differences for Total sample were still significant. Group differences in Achievement in Mathematics (Lower order objectives) for Boys and Girls samples were not significant even after intervention. But for all samples, high posttest mean scores in Achievement in Mathematics (Total, Lower order objectives, Higher order objectives) are associated with the experimental group, not with the control group.

Comparison of mean change scores of Mathematics Anxiety and comparison of mean gain scores of Achievement in Mathematics of experimental and control groups.

Since there are cases of initial differences in means being significant and these differences turning statistically not significant after intervention and vice versa, mean difference analysis of change scores was utilized for clarifying the results. The mean change scores of Mathematics Anxiety of experimental and control groups were compared to test the effectiveness of Cognitively Guided Instructional Strategy in reducing Mathematics Anxiety of upper primary school students. Similarly, to test the effectiveness of Cognitively Guided Instructional Strategy in enhancing Achievement in Mathematics of upper primary school students, mean gain scores of experimental and control groups on these variables were compared. Effect size was calculated wherever the mean difference between the groups was found statistically significant.

Comparison of mean change scores of Mathematics Anxiety of experimental and control groups for Total sample and subsamples based on Gender.

Comparison of mean scores was carried out to test whether significant difference exist between mean change scores of the experimental group and the control group for the dependent variable Mathematics Anxiety, using two tailed test of significance of difference between means. The means and standard deviations of change scores of Mathematics Anxiety of the two groups were subjected to mean difference analysis and the calculated t values were tested for significance. For significant mean differences, the magnitude of the effect was also found out using effect size measure for two independent groups. The data and results of *t* tests for Total sample, subsample Boys and subsample Girls are given in subsequent sections.

Comparison of mean change score of Mathematics Anxiety of experimental and control groups for total sample.

To study whether the experimental and control groups differ significantly in terms of the mean change score of Mathematics Anxiety, test of significance of difference between means was used. The details of *t* test and effect size for Total sample are given in Table 43.

Table 43

Results of Test of Significance of Difference in Mean Change Scores of Mathematics Anxiety between Experimental and Control Groups- Total sample

Variable	Experimental Group			Control Group			t	Effect size	Cohen's category
	N_1	M_1	SD_1	N_2	M_2	SD_2			
Mathematics Anxiety	66	-11.23	30.02	62	5.47	35.40	2.88**	0.51	Medium

**p< .01

It is clear from Table 43 that the calculated t value is greater than 2.62 for df 126 at .01 level of significance. So there is significant difference between mean change score on Mathematics Anxiety of experimental and control groups. The mean change score of experimental group is significantly smaller than that of control group. Hence Cognitively Guided Instructional Strategy is more effective in reducing Mathematics Anxiety of upper primary school students than Existing method of teaching.

Since the mean difference was found to be significant, effect size was calculated. The value of Cohen's *d* is 0.51, which is greater than 0.5, the limit set for medium effects in Cohen's category. It means that Cognitively Guided Instructional Strategy has a medium effect in reducing Mathematics Anxiety of Total sample of upper primary school students when compared to Existing method of teaching.

The mean change scores of experimental and control groups for Total sample are presented graphically in Figure 23.

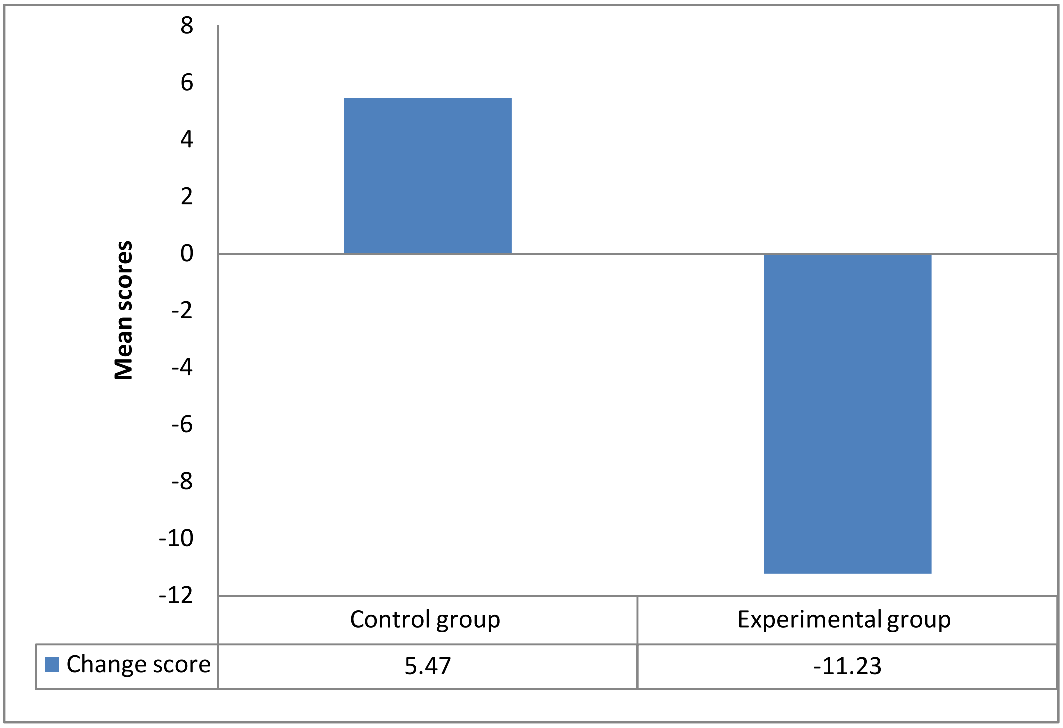


Figure 23. Mean change scores of Mathematics Anxiety of experimental and control groups- Total Sample

Figure 23 shows that the performance of the upper primary school students belonging to experimental and control groups are not similar and that there is reduction in Mathematics Anxiety of experimental group and gain in Mathematics Anxiety of control group, after the intervention. Hence the results of mean difference analysis are supported by the graphical representation.

Comparison of mean change scores of Mathematics Anxiety of experimental and control groups for subsample boys.

To study whether significant mean difference exist between change scores of Mathematics Anxiety of Boy students belonging to experimental and control groups, test of significance of difference between means was used. Effect size was also calculated. The details of mean difference analysis and effect size for subsample Boys are given in Table 44.

Table 44

Results of Test of Significance of Difference in Mean Change Scores of Mathematics Anxiety between Experimental and Control Groups - Subsample Boys

Variable	Experimental Group			Control Group			t	Effect size	Cohen's category
	N_1	M_1	SD_1	N_2	M_2	SD_2			
Mathematics Anxiety	38	-14.00	33.49	32	11.00	36.68	2.98**	0.72	Medium

**p< .01

It is clear from Table 44 that the calculated t value is greater than the table value 2.65 for df 68 at .01 level of significance. So experimental and control groups differ significantly in the mean change scores of Mathematics Anxiety for subsample Boys. The mean change score of experimental group is significantly smaller than that of control group. These results indicate that Cognitively Guided Instructional Strategy is more effective in reducing the Mathematics Anxiety of boy upper primary school students than Existing method of teaching.

As significant mean difference was found between the two groups, effect size was calculated to measure the magnitude of effect of intervention. The calculated value of Cohen's *d* 0.72 is greater than the limit set for medium effects in Cohen's category. This implies that Cognitively Guided Instructional Strategy has a medium effect in reducing the Mathematics Anxiety of Boys when compared to Existing method of teaching.

The mean change scores of experimental and control groups for Boys sample are presented graphically in Figure 24.

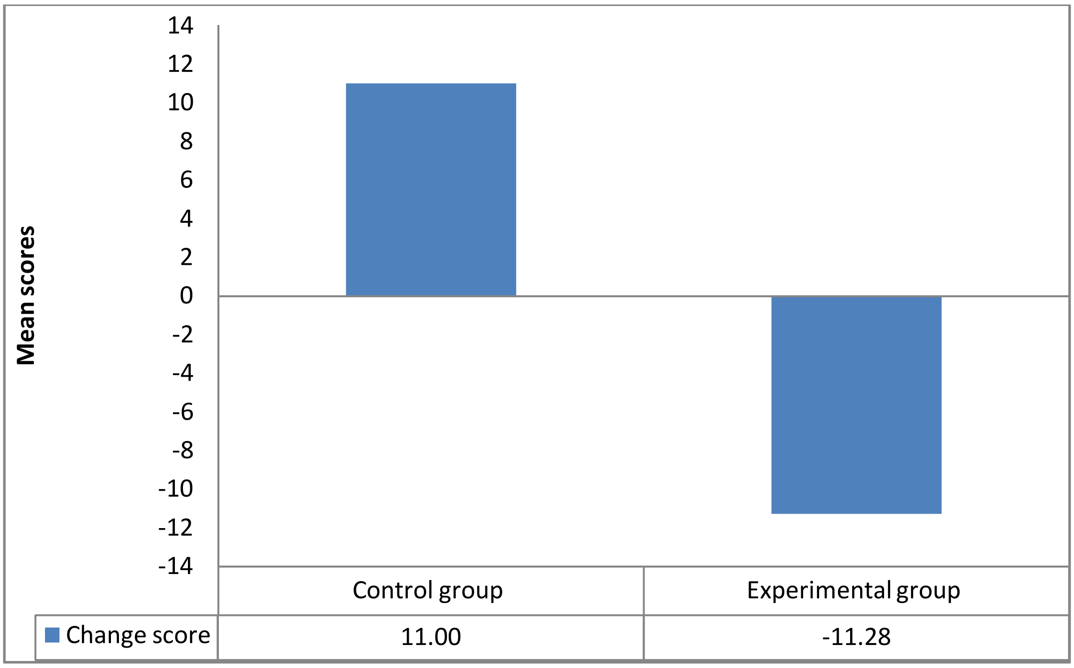


Figure 24. Mean change scores of Mathematics Anxiety of experimental and control groups- Subsample Boys

Figure 24 shows that the performance of boy upper primary school students belonging to experimental and control groups are not similar. It clearly reveals that there is reduction in Mathematics Anxiety of experimental group and gain in Mathematics Anxiety of control group. Hence the results of mean difference analysis are supported by the graphical representation.

Comparison of mean change scores of Mathematics Anxiety of experimental and control groups for subsample girls.

To study whether the experimental and control groups differ significantly in terms of the mean change scores of Mathematics Anxiety for subsample

Girls, test of significance of difference between means was used. The details of *t* test for Girls are given in Table 45.

Table 45

Results of Test of Significance of Difference in Mean Change Scores of Mathematics Anxiety between Experimental and Control groups- Subsample Girls

Variable	Experimental Group			Control Group			t
	N_1	M_1	SD_1	N_2	M_2	SD_2	
Mathematics Anxiety	28	-7.46	24.62	30	-0.43	33.57	0.90

Table 45 shows that there is no significant difference between mean change scores of Mathematics Anxiety of experimental and control groups as the calculated t value is less than the table value 2.0 for df 56 at .05 level of significance. Comparison of the mean values of change scores indicates that there is reduction in Mathematics Anxiety for both the groups. However, the change score of experimental group is smaller than the change score of control group. But the mean difference is not significant enough to attribute it to intervention. Since the mean difference between the two groups was not significant, effect size was not calculated for Girls subsample.

The mean change scores of Mathematics Anxiety of the two groups for subsample Girls are presented graphically in Figure 25.

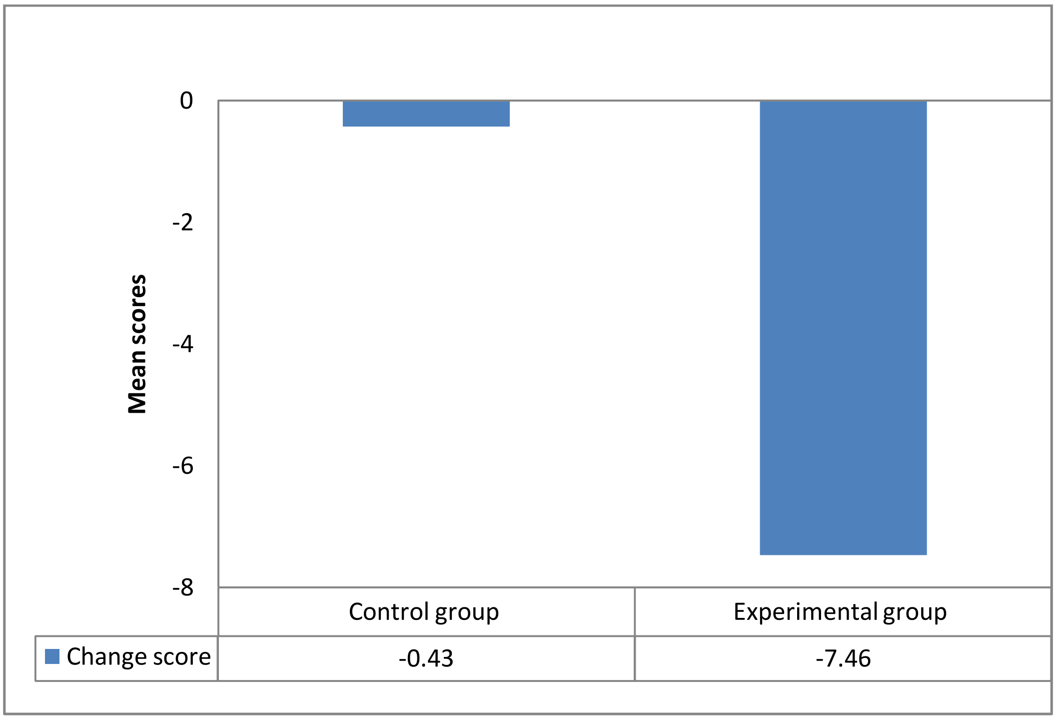


Figure 25. Mean change scores of Mathematics Anxiety of experimental and control groups- Subsample Girls

Figure 25 shows that there is reduction in Mathematics Anxiety for Girls belonging to experimental and control groups. The graphical representation shows that the performance of upper primary school students in the two groups is not similar, but significant mean difference was not found in mean difference analysis.

Comparison of gain scores of Achievement in Mathematics (Total, Lower order objectives, Higher order objectives) of experimental and control groups for Total sample and subsamples based on Gender.

Comparison of mean scores was carried out to test whether significant differences exist between mean gain scores of the experimental group and the control group for Achievement in Mathematics (Total, Lower order objectives, Higher order objectives) using two tailed test of significance of difference between means. The means and standard deviations of gain scores of Achievement in Mathematics (Total, Lower order objectives, Higher order objectives) of the two groups were subjected to mean difference analysis and the calculated t values were tested for significance. For significant mean differences, the magnitude of effect was also found out using effect size measure for two independent groups. The data and results of *t* tests for Total sample, subsample Boys and subsample Girls are given in the following sections.

Comparison of mean gain scores of Achievement in Mathematics (Total, Lower order objectives, Higher order objectives) of experimental and control groups for total sample.

To study whether the experimental and control groups differ significantly in terms of mean gain score of Achievement in Mathematics (Total, Lower order objectives, Higher order objectives) for Total sample, tests of significance of difference between means were used. The data and results of mean difference analysis and effect sizes are presented in Table 46.

Table 46

Results of Test of Significance of Difference in Mean Gain Scores of Achievement in Mathematics between Experimental and Control Groups- Total sample

Variable		Experimental Group			Control Group			t	Effect size	Cohen's category
		N_1	M_1	SD_1	N_2	M_2	SD_2			
Achievement in Mathematics	Lower order objectives	66	8.59	4.91	62	5.39	4.54	3.83**	0.68	Medium
	Higher order objectives	66	3.05	1.67	62	1.77	1.45	4.59**	0.82	Large
	Total	66	11.64	5.98	62	7.15	5.42	4.44**	0.79	Medium

**p< .01

Table 46 shows that the calculated t values are greater than the table value 2.62 for df 126 at .01 level of significance. So the experimental and control groups differ significantly in terms of mean gain scores of Achievement in Mathematics (Total, Lower order objectives, Higher order objectives) for Total sample. It is to be noted that the mean gain score of the experimental group is significantly greater than that of control group for all the three variables. Hence Cognitively Guided Instructional Strategy is more effective in enhancing Achievement in Mathematics of upper primary school students when compared to Existing method of teaching.

Effect size was calculated for all the three variables to measure the magnitude of effect as the mean differences were found significant for Total sample. The values of Cohen's *d* for Achievement in Mathematics (Total, Lower order objectives) are greater than 0.5. So the effect sizes come under the Cohen's category 'medium' and hence it can be inferred that Cognitively Guided Instructional Strategy has medium effect in enhancing these variables of upper primary school students when compared to Existing method of teaching. As the value of Cohen's *d* is greater than 0.8, Cognitively Guided Instructional Strategy has large effect in enhancing Achievement in Mathematics (Higher order objectives) of upper primary school students when compared to Existing method of teaching.

The mean gain scores of experimental and control groups for Total sample are presented graphically in Figure 26.

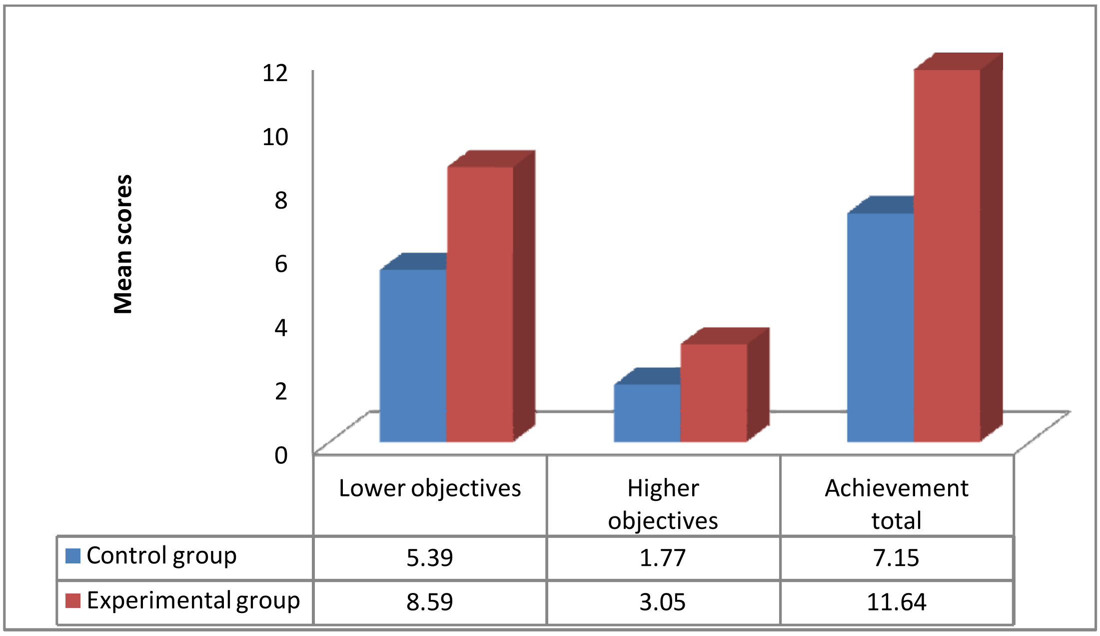


Figure 26. Mean gain scores of Achievement in Mathematics (Total, Lower order objectives, Higher order objectives) of experimental and control groups-Total Sample

It is clear from Figure 26 that the mean performance of upper primary school students belonging to experimental and control groups are not similar and the mean gain score of experimental group is greater than that of control group for all the three variables. Hence the results of mean difference analysis are supported by the graphical representation.

Comparison of mean gain scores of Achievement in Mathematics (Total, Lower order objectives, Higher order objectives) of experimental and control groups for subsample boys.

To study whether there is any statistically significant difference between mean gain scores of experimental and control groups for subsample Boys, test of significance of difference between means was used. Effect size was calculated for significant mean differences. The data and results of mean difference analysis are given in Table 47.

Table 47

Results of Test of Significance of Difference in Mean Gain Scores of Achievement in Mathematics between Experimental and Control Groups-Subsample Boys

Variable		Experimental Group			Control Group			t	Effect size	Cohen's category
		N_1	M_1	SD_1	N_2	M_2	SD_2			
Achievement in Mathematics	Lower order objectives	38	7.89	4.83	32	4.91	4.36	2.70**	0.65	Medium
	Higher order objectives	38	2.84	1.41	32	1.53	1.05	4.36**	1.04	Large
	Total	38	10.74	5.64	32	6.41	4.74	3.44**	0.83	Large

**p< .01

It is clear from Table 47 that experimental and control groups differ significantly in the mean gain scores of Achievement in Mathematics (Total, Lower order objectives, Higher order objectives) as the calculated t values are greater than the table value 2.65 for df 68 at .01 level of significance. Mean gain score of experimental group is significantly greater than the mean gain score of control group for all the three variables. Hence Cognitively Guided Instructional Strategy is more effective in enhancing Achievement in Mathematics of boy upper primary school students than Existing method of teaching.

Effect sizes were calculated to measure the magnitude of effect of Cognitively Guided Instructional Strategy. Cohen's *d* for Achievement in Mathematics (Lower order objectives) is greater than 0.5 and comes under Cohen's category 'medium'. Cohen's *d* for Achievement in Mathematics (Total, Higher order objectives) are greater than 0.8 and these come under the category 'large'. Hence Cognitively Guided Instructional Strategy has a medium effect in enhancing Achievement in Mathematics (Lower order objectives) and large effect in enhancing Achievement in Mathematics (Total, Higher order objectives) of upper primary school students when compared to Existing method of teaching.

The mean gain scores of experimental and control groups for subsample Boys are presented graphically in Figure 27.

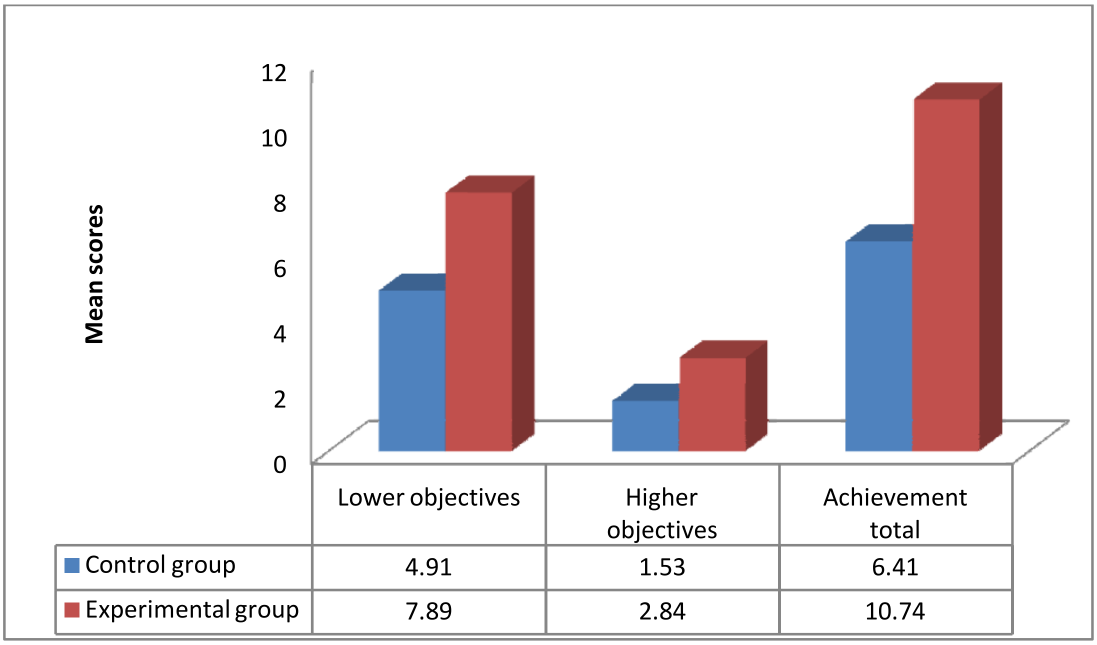


Figure 27. Mean gain scores of Achievement in Mathematics (Total, Lower order objectives, Higher order objectives) of experimental and control groups-Subsample Boys

It is clear from Figure 27 that the mean performances of boy upper primary school students belonging to experimental group and control group on Achievement in Mathematics (Total, Lower order objectives, Higher order objectives) are not similar and the mean gain score of experimental group is greater than the mean gain score of control group for these variables. Hence the results of mean difference analysis are supported by graphical representation.

Comparison of mean gain scores of Achievement in Mathematics (Total, Lower order objectives, Higher order objectives) of experimental and control groups for subsample girls.

To study whether experimental and control groups differ significantly in terms of mean gain scores of Achievement in Mathematics (Total, Lower order objectives, Higher order objectives), tests of significance of difference between means were used. The details of *t* test for subsample Girls are given in Table 48.

Table 48

Results of Test of Significance of Difference in Mean Gain Scores of Achievement in Mathematics between Experimental and Control Groups-Subsample Girls

Variable		Experimental Group			Control Group			t	Effect size	Cohen's category
		N_1	M_1	SD_1	N_2	M_2	SD_2			
Achievement in Mathematics	Lower order objectives	28	9.54	4.96	30	5.90	4.74	2.86**	0.75	Medium
	Higher order objectives	28	3.32	1.96	30	2.03	1.77	2.63*	0.69	Medium
	Total	28	12.86	6.31	30	7.93	6.05	3.04**	0.80	Large

*p< .05 **p< .01

Table 48 shows that the calculated t values for Achievement in Mathematics (Total, Lower order objectives) are greater than the table value 2.66 for df 56 at .01 level of significance and the calculated t value for Achievement in Mathematics (Higher order objectives) is greater than table value 2.0 for df 56 at .05 level of significance. So there exist significant difference between mean gain score of experimental and control groups for these variables. For all the three variables, the mean gain score of experimental group is significantly greater than the mean gain score of control group. Hence Cognitively Guided Instructional Strategy is more effective than Existing method of teaching in enhancing Achievement in Mathematics of girl upper primary school students.

Since the mean differences are significant, effect sizes were calculated. The calculated effect sizes for Achievement in Mathematics (Lower order objectives, Higher order objectives) are greater than 0.5 and that for Achievement in Mathematics (Total) is 0.80. So Cognitively Guided Instructional Strategy has medium effects in enhancing Achievement in Mathematics (Lower order objectives, Higher order objectives) and has large effect in enhancing Achievement in Mathematics (Total) for girl upper primary school students when compared to Existing method of teaching.

The mean gain scores of Achievement in Mathematics of the two groups for Girls subsample are presented graphically in Figure 28.

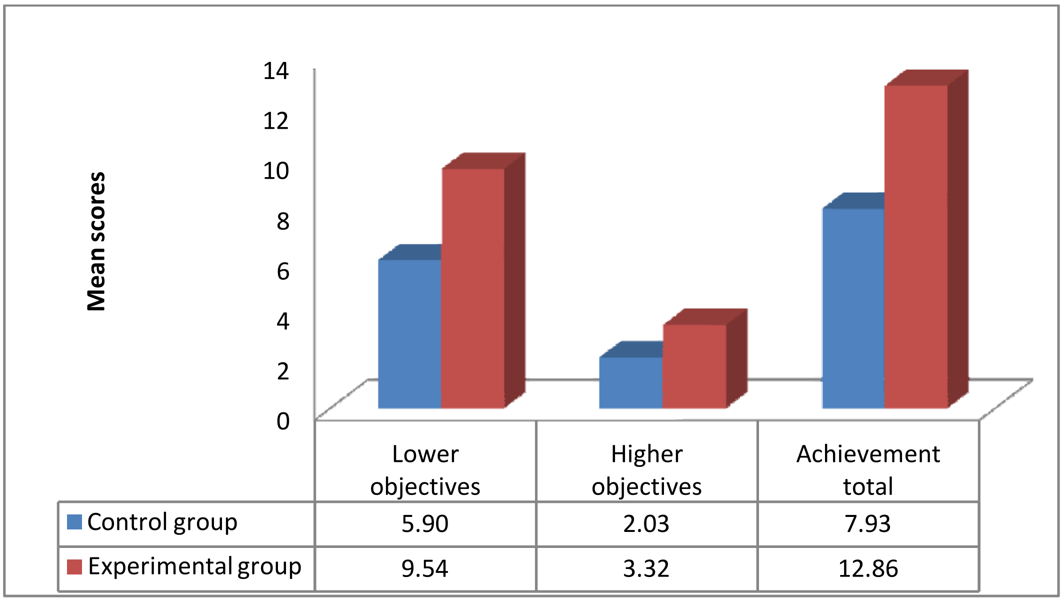


Figure 28. Mean gain scores of Achievement in Mathematics (Total, Lower order objectives, Higher order objectives) of experimental and control groups-Subsample Girls

Figure 28 shows that the performance of upper primary school students belonging to experimental and control groups are not similar and the mean gain score of experimental group is greater than that of control group for all these variables. Hence the results of mean difference analysis for subsample Girls are confirmed by the graphical representation.

Discussion

Comparisons of change scores of Mathematics Anxiety and gain scores of Achievement in Mathematics between experimental and control groups show the following results.

Significant mean difference exists between experimental and control groups on change scores of Mathematics Anxiety for Total and Boys samples and on Achievement in Mathematics (Total, Lower order objectives, Higher order objectives) for Total, Boys and Girls samples. Significant mean difference was not found in mean change scores of Mathematics Anxiety for subsample Girls.

Hence Cognitively Guided Instructional Strategy is better than Existing method of teaching in reducing Mathematics Anxiety of Total and Boys samples and in enhancing Achievement in Mathematics (Total, Lower order objectives, Higher order objectives) for Total sample and subsamples Boys and Girls.

For the variable Mathematics Anxiety, medium effects of Cognitively Guided Instructional Strategy were found for Total and Boys samples in comparison with Existing method of teaching. In the case of Achievement in Mathematics (Total), medium effects of Cognitively Guided Instructional Strategy were found for Total sample and large effects were found for Boys and Girls. For the variable Achievement in Mathematics (Lower order objectives), medium effects were found for all the three samples. For Achievement in

Mathematics (Higher order objectives) large effects of Cognitively Guided Instructional Strategy were found for Total and Boys samples and medium effect was found for Girls sample.

Analysis of Covariance (ANCOVA) of the Dependent Variables

The comparisons of pretest and posttest scores of experimental group using tests of significance of difference between two correlated means and comparisons of change scores of the experimental and control groups using tests of significance of difference between means, significant differences were found in the dependent variables for all the three samples except in Mathematics Anxiety for Girls subsample. Hence it can be tentatively concluded that Cognitively Guided Instructional Strategy is more effective than Existing method of teaching in enhancing Achievement in Mathematics (Total, Lower order objectives, Higher order objectives) for Total sample, subsample Boys and subsample Girls and in reducing Mathematics Anxiety for Total and Boys samples. However, it is noteworthy that non equivalent intact classes were selected for the experimental and control groups for the study and initial differences between the two groups prior to the intervention were found in Achievement in Mathematics (Total, Lower order objectives) for Total and Girls samples. Even though the gain score analysis yielded more clear results than posttest analysis, further analysis is needed before drawing conclusions regarding the effectiveness of Cognitively Guided Instructional Strategy. So the statistical technique of Analysis of Covariance (ANCOVA) was used.

By employing one-way ANCOVA, the investigator could further study the relative effectiveness of Cognitively Guided Instructional Strategy and Existing method of teaching with regard to Mathematics Anxiety and Achievement in Mathematics (Total, Lower order objectives, Higher order objectives) after controlling the individual and combined effect of the three covariates. To study whether the experimental and control groups differ significantly in mean posttest scores of Mathematics Anxiety and Achievement in Mathematics after controlling the effects of three covariates namely, Pre- Achievement in Mathematics, Verbal Intelligence and Non-verbal Intelligence, covariance analysis was used for Total sample and subsamples based on Gender. The independent variable of the study is instructional strategy and its two levels are Cognitively Guided Instructional Strategy and Existing method of teaching. So Cognitively Guided Instructional Strategy and Existing method of teaching were incorporated in the ANCOVA as the two levels of independent variable. Pretest scores of Achievement in Mathematics (Total), Verbal Intelligence and Non-verbal Intelligence were taken as the covariates. The posttest scores of Mathematics Anxiety and Achievement in Mathematics (Total, Lower order objectives, Higher order objectives) were considered as dependent variables.

Check for basic assumptions.

To ensure that the collected data can be subjected to ANCOVA, it was analyzed to check whether the data follow the basic assumptions or not. The dependent variables of the study Mathematics Anxiety and Achievement in Mathematics are on interval scale. The distributions of dependent variable scores follow normal distribution properties as evidenced from preliminary analysis. The observations under consideration are independent. Besides, the major assumptions of linear relationship between dependent variable and covariates and homogeneity of variances were checked and are presented in the following sections.

Linear relationship between the dependent variable and covariates

Scatter Plots were used to study the nature of the relationship between dependent variable and covariates. Scatter plots of the dependent variables, Mathematics Anxiety and Achievement in Mathematics (Total, Lower order objectives, Higher order objectives) against covariates Pre- Achievement in Mathematics, Verbal Intelligence and Non-verbal Intelligence, were generated.

The scatter plots of the dependent variables against the three covariates for Total sample, subsample Boys, and subsample Girls are given in Figure 29, Figure 30 and Figure 31 respectively.

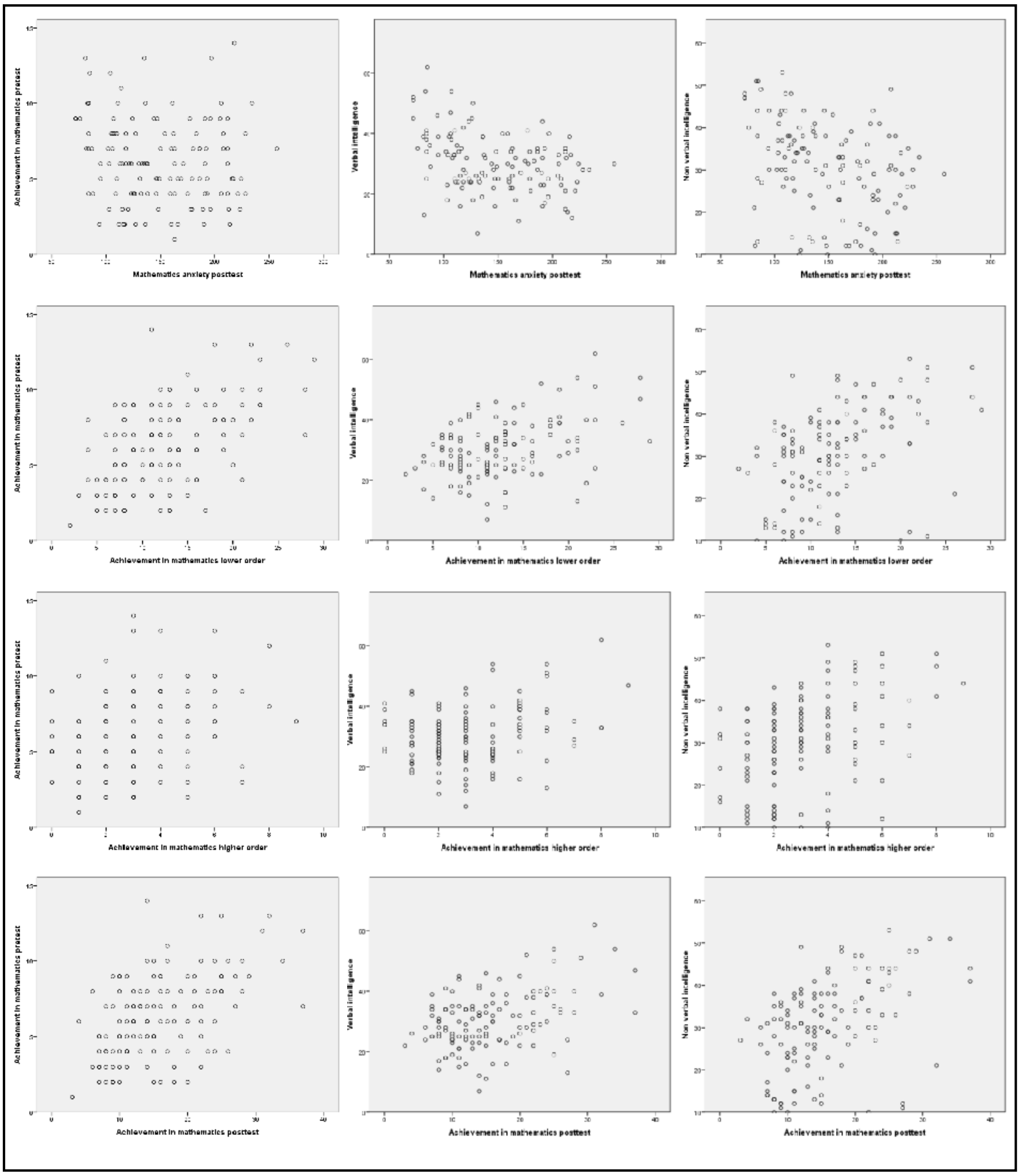


Figure 29. Scatter plots of the dependent variables against the three covariates – Total sample

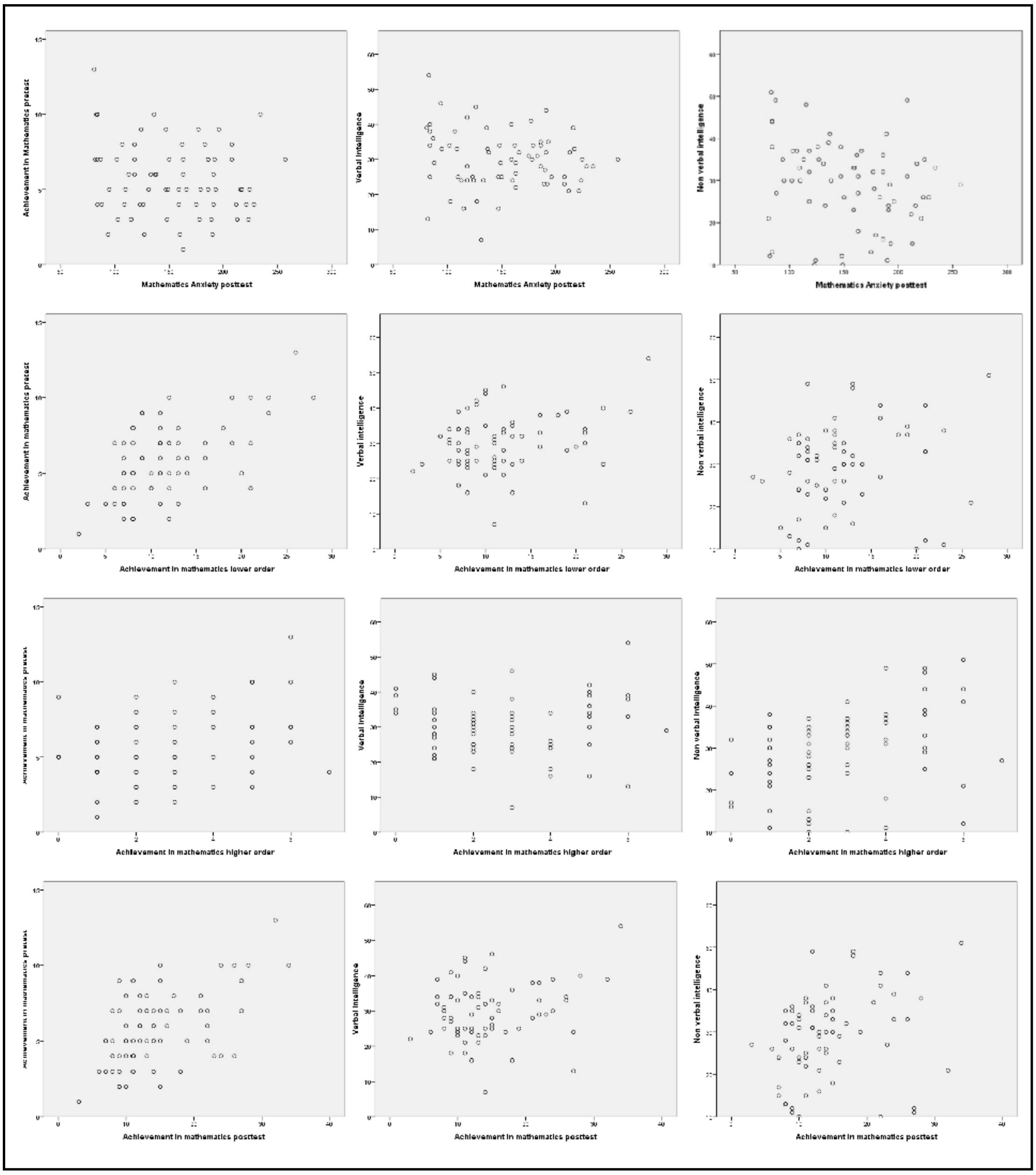


Figure 30. Scatter plots of the dependent variables against the three covariates – Subsample Boys

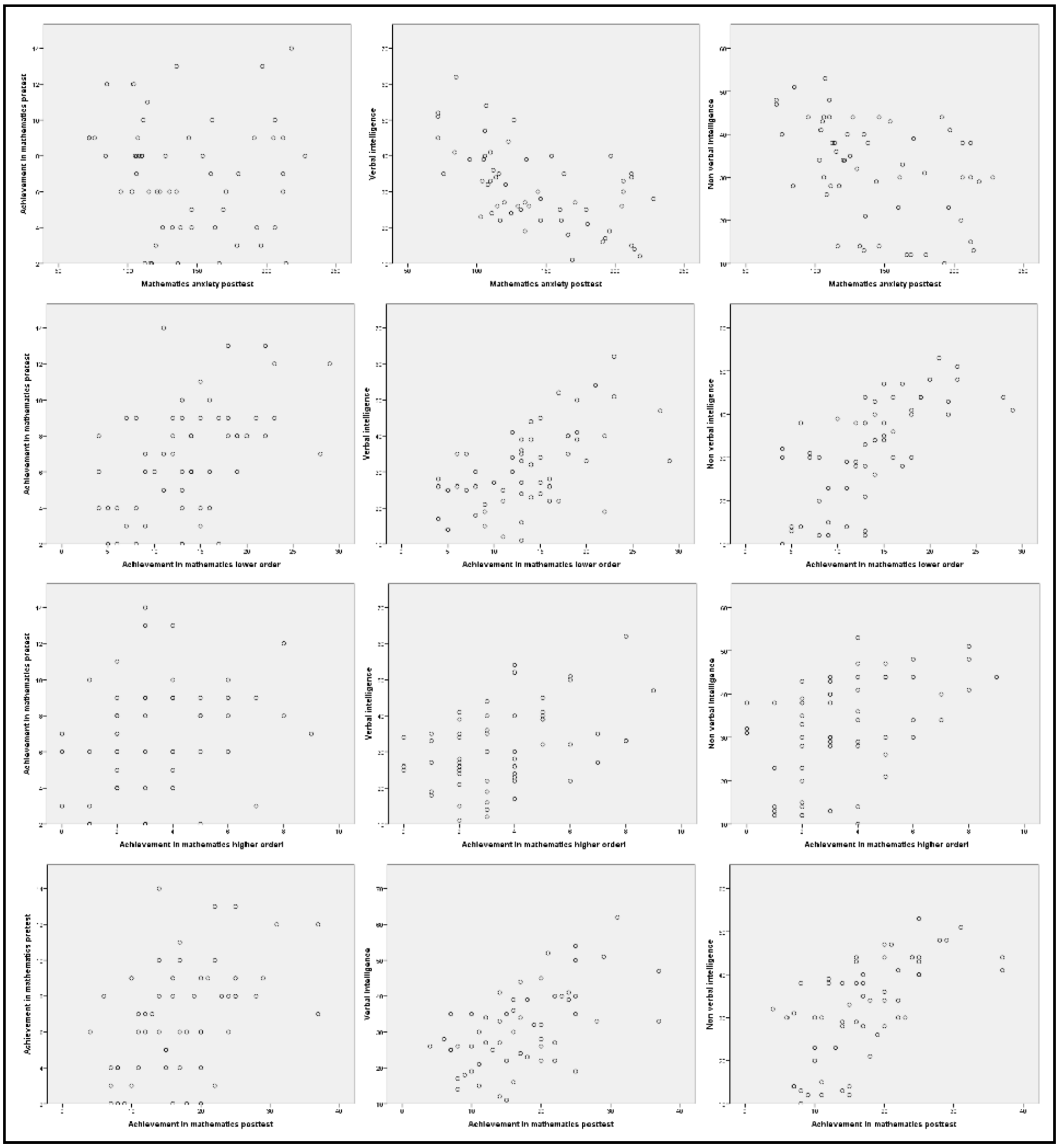


Figure 31. Scatter plots of the dependent variables against the three covariates – Subsample Girls

A visual observation of the Scatter Plots given in Figure 29, Figure 30 and Figure 31 revealed that there are linear relations between dependent variables and covariates for Total sample, subsample Boys and subsample Girls.

Homogeneity of variances

For testing the homogeneity of variances of two groups, Levene's test of equality of error variances was used. This tests the null hypothesis that the error variance of the dependent variable is equal across groups. Homogeneity of variance of experimental and control groups on dependent variables Mathematics Anxiety and Achievement in Mathematics (Total, Lower order objectives, Higher order objectives) were tested for Total sample, subsample Boys and subsample Girls. Results of Levene's tests for all the three samples are consolidated in Table 49.

Table 49

Results of Levene's Test for Mathematics Anxiety and Achievement in Mathematics- Total sample, Subsample Boys and Subsample Girls

Sample	Variable	Covariates	Levene's F	df_1	df_2	Significance level
Total	Mathematics Anxiety	Pre- Achievement in Mathematics	7.13	1	126	.009
		Verbal Intelligence	3.13	1	126	.079
		Non-verbal Intelligence	4.16	1	126	.044
		Combined	2.3	1	126	.126
	Achievement in Mathematics (Lower order objectives)	Pre- Achievement in Mathematics	1.68	1	12	.198
		Verbal Intelligence	2.81	1	126	.096
		Non-verbal Intelligence	1.21	1	126	.274
		Combined	3.80	1	126	.053
	Achievement in Mathematics (Higher order objectives)	Pre- Achievement in Mathematics	0.14	1	126	.713
		Verbal Intelligence	1.011	1	126	.315
		Non-verbal Intelligence	0.14	1	126	.708
		Combined	0.46	1	126	.497
	Achievement in Mathematics (Total)	Pre- Achievement in Mathematics	2.02	1	126	.157
		Verbal Intelligence	2.73	1	126	.101
		Non-verbal Intelligence	1.11	1	126	.294
		Combined	2.67	1	126	.105

Sample	Variable	Covariates	Levene's F	df_1	df_2	Significance level
Boys	Mathematics Anxiety	Pre- Achievement in Mathematics	0.00	1	68	.989
		Verbal Intelligence	0.03	1	68	.863
		Non-verbal Intelligence	0.06	1	68	.804
		Combined	0.024	1	68	.878
	Achievement in Mathematics (Lower order objectives)	Pre- Achievement in Mathematics	2.49	1	68	.119
		Verbal Intelligence	0.02	1	68	.894
		Non-verbal Intelligence	0.28	1	68	.602
		Combined	2.66	1	68	.108
	Achievement in Mathematics (Higher order objectives)	Pre- Achievement in Mathematics	0.31	1	68	.580
		Verbal Intelligence	0.32	1	68	.574
		Non-verbal Intelligence	0.02	1	68	.890
		Combined	0.01	1	68	.909
	Achievement in Mathematics (Total)	Pre- Achievement in Mathematics	4.94	1	68	.030
		Verbal Intelligence	0.17	1	68	.682
		Non-verbal Intelligence	0.39	1	68	.536
		Combined	4.53	1	68	.037
	Mathematics Anxiety	Pre- Achievement in Mathematics	10.26	1	56	.002
		Verbal Intelligence	4.96	1	56	.030
		Non-verbal Intelligence	6.04	1	56	.017
		Combined	4.94	1	56	.030
	Achievement in Mathematics (Lower order objectives)	Pre- Achievement in Mathematics	0.02	1	56	.886
		Verbal Intelligence	3.38	1	56	.071
		Non-verbal Intelligence	0.01	1	56	.918
		Combined	0.34	1	56	.560

Sample	Variable	Covariates	Levene's F	df_1	df_2	Significance level
Girls	Achievement in Mathematics (Higher order objectives)	Pre- Achievement in Mathematics	0.00	1	56	.985
		Verbal Intelligence	1.62	1	56	.209
		Non-verbal Intelligence	1.61	1	56	.210
		Combined	0.78	1	56	.381
	Achievement in Mathematics (Total)	Pre- Achievement in Mathematics	0.00	1	56	.994
		Verbal Intelligence	3.19	1	56	.080
		Non-verbal Intelligence	0.04	1	56	.844
		Combined	0.13	1	56	.716

Table 49 shows that the variances of experimental and control groups are almost equal. Hence the assumption of homogeneity of variance for ANCOVA is satisfied to a certain extent for the dependent variables in the case of Total sample, subsample Boys and subsample Girls.

The examination of the major assumptions revealed that the basic assumptions of ANCOVA are met to a satisfactory extent for Total sample, subsample Boys and subsample Girls. Hence the data can be subjected to ANCOVA. The details of covariance analysis of dependent variables are presented in the following sections.

Comparison of the adjusted mean scores of Mathematics Anxiety of experimental and control groups by considering Pre- Achievement in Mathematics, Verbal Intelligence and Non-verbal Intelligence as covariates for total sample and subsamples based on Gender.

To study whether there any significant difference exists between experimental and control groups in terms of Mathematics Anxiety after adjusting for the pre intervention differences if any, one-way ANCOVA was used. For each sample, four different ANCOVA were employed by taking covariates one at a time and in combination of three at a time. That is, one ANCOVA each by taking Pre-Achievement in Mathematics, Verbal Intelligence and Non-verbal Intelligence separately as covariate and one ANCOVA with combined effect of the three covariates. Every ANCOVA with significant F value was followed by Bonferroni's test of post hoc comparison. The details of covariance analysis of the dependent variable Mathematics Anxiety and effect size in terms of Partial eta squared for Total sample, subsample Boys and subsample Girls are presented in the following sections.

Comparison of the adjusted mean scores of Mathematics Anxiety of experimental and control groups by considering Pre- Achievement in Mathematics, Verbal Intelligence and Non-verbal Intelligence as covariates for total sample.

To study the relative effectiveness of Cognitively Guided Instructional Strategy and Existing method of teaching in reducing Mathematics Anxiety of upper primary school students, after adjusting for pretest differences if any, four ANCOVA were employed on Total sample. Linear adjustments were made in the posttest scores of Mathematics Anxiety for the individual as well as combined effect of the covariates namely, Pre- Achievement in Mathematics, Verbal Intelligence and Non-verbal Intelligence. For economy of presentation, the four ANCOVA are described in a single table.

The data and results of covariance analysis of Mathematics Anxiety for Total sample are presented in Table 50.

Table 50

Summary of Analysis of Covariance of Mathematics Anxiety- Total sample

		Covariates			
	Source of Variance	Pre-Achievement in Mathematics	Verbal Intelligence	Non-verbal Intelligence	Combined Effect
Sum of squares	Between groups	21775.57	32590.09	13302.75	27158.00
	Within groups	233188.25	194818.45	217384.56	189535.81
df	Between groups	1	1	1	1
	Within groups	125	125	125	123
Mean squares	Between groups	21775.57	32590.09	13302.75	27158.00
	Within groups	1865.51	1558.55	1739.08	1540.94
	Total	261030.97	261030.97	261030.97	261030.97
F		11.67	20.91	7.65	17.62
Level of Significance		.001	<.001	.007	<.001
Partial eta squared		.085	.143	.058	.125

Table 50 shows that the calculated F (1,125) = 11.67, p = .001, η_p^2 = .085; F(1,125) = 20.91, p <.001, η_p^2 = .143; F (1,125) = 7.65, p = .007, η_p^2 = .058 and F (1,123) = 17.62, p<.001, η_p^2 = .125 for the effect of Instructional strategy on Mathematics Anxiety after controlling the effects of Pre-Achievement in Mathematics, Verbal Intelligence, Non-verbal Intelligence and combined effect of the three covariates respectively, are significant at .01 level of significance. This indicates that there is significant difference between posttest scores of Mathematics Anxiety of experimental and control groups even after controlling the effects of covariates. Hence the difference in posttest scores of Mathematics Anxiety between experimental and control groups can be attributed to the influence of Instructional strategy. The values of Partial eta squared also substantiate the results.

Post hoc comparison of adjusted means on Mathematics Anxiety of experimental and control groups for total sample.

To find out whether experimental and control groups differ significantly in terms of adjusted mean posttest scores of Mathematics Anxiety, test of significance of difference between adjusted means was used with each ANCOVA. The details of post hoc comparison of adjusted mean scores of Mathematics Anxiety for Total sample are presented in Table 51.

Table 51

Data and results of Bonferroni's Test of Post Hoc Comparison between the Adjusted Means of Mathematics Anxiety- Total sample

Covariates	Experimental Group		Control Group		SE	t
	N	Adjusted Mean	N	Adjusted Mean		
Pre- Achievement in Mathematics	66	135.34	62	161.96	7.79	3.42**
Verbal Intelligence	66	132.27	62	165.23	7.21	4.57**
Non-verbal Intelligence	66	138.32	62	158.79	7.40	2.77**
Combined Effect	66	132.92	62	164.54	7.53	4.20**

**p<.01

Table 51 shows that the calculated t values are greater than 2.62, the table value at .01 level of significance. So there is significant difference between adjusted mean scores of Mathematics Anxiety of upper primary school students belonging to experimental and control groups. It is to be noted that low adjusted mean scores of Mathematics Anxiety are associated with experimental group. Hence Cognitively Guided Instructional Strategy is more effective in reducing the Mathematics Anxiety of upper primary school students than Existing method of teaching for Total sample.

Comparison of the adjusted mean scores of Mathematics Anxiety of experimental and control groups by considering Pre- Achievement in Mathematics, Verbal Intelligence and Non-verbal Intelligence as covariates for subsample boys.

To study the relative effectiveness of Cognitively Guided Instructional Strategy and Existing method of teaching in reducing Mathematics Anxiety of upper primary school students, after adjusting for pretest differences if any, four ANCOVA were employed on subsample Boys. Linear adjustments were made in the posttest scores of Mathematics Anxiety for the individual as well as combined effects of the covariates namely, Pre- Achievement in Mathematics, Verbal Intelligence and Non-verbal Intelligence. For economy of presentation, the four ANCOVA are described in a single table.

The data and results of covariance analysis on Mathematics Anxiety for subsample Boys are presented in Table 52.

Table 52

Summary of Analysis of Covariance of Mathematics Anxiety- Subsample Boys

		Covariates			
	Source of Variance	Pre-Achievement in Mathematics	Verbal Intelligence	Non-verbal Intelligence	Combined Effect
Sum of squares	Between groups	23954.23	25817.48	17894.98	22762.30
	Within groups	119859.83	120468.78	123558.32	115414.85
df	Between groups	1	1	1	1
	Within groups	67	67	67	65
Mean squares	Between groups	23954.23	25817.48	17894.98	22762.30
	Within groups	1788.95	1798.95	1844.15	1775.61
	Total	148720.59	148720.59	148720.59	148720.59
F		13.39	14.36	9.70	12.82
Level of Significance		<.001	<.001	.003	.001
Partial eta squared		.167	.177	.127	.165

Table 52 shows that the calculated F values for the effect of Instructional strategy on Mathematics Anxiety F (1,67) = 13.39, p< .001, η_p^2 = .167 ; F(1,67) = 14.36, p<.001, η_p^2 = .177; F(1,67) = 9.70, p = 9.70, η_p^2 = .127 and F(1,65) = 12.82, p= .001, η_p^2=.165 when adjustments are made for the effects of Pre Achievement, Verbal Intelligence, Non-verbal Intelligence and the combined effect of the covariates respectively, are greater than the table value for the specified degrees of freedom at .01 level of significance. Hence there is significant difference between Mathematics Anxiety posttest scores of experimental and control groups even after controlling the effects of the covariates. This suggests that the variation in Mathematics Anxiety of experimental and control groups can be attributed to the effect of Instructional strategy for subsample Boys. The values of Partial eta squared also substantiate the results.

Post hoc comparison of adjusted means on Mathematics Anxiety of experimental and control groups for subsample boys.

To compare the adjusted mean scores of Mathematics Anxiety of Boys belonging to experimental and control groups, tests of significance of difference between adjusted means were used with each ANCOVA.

The details of post hoc comparison of adjusted means on Mathematics Anxiety for subsample Boys are given in Table 53.

Table 53

Data and results of Bonferroni's Test of Post Hoc Comparison between the Adjusted Means of Mathematics Anxiety- Subsample Boys

Covariates	Experimental Group		Control Group		SE	t
	N	Adjusted Mean	N	Adjusted Mean		
Pre- Achievement in Mathematics	38	136.15	32	173.42	10.19	3.66**
Verbal Intelligence	38	135.22	32	174.52	10.37	3.79**
Non-verbal Intelligence	38	138.22	32	170.96	10.51	3.12**
Combined Effect	38	135.76	32	173.88	10.64	3.58**

** $p<.01$

It is clear from Table 53 that the calculated t values are greater than the limit set for significance at .01 level. So experimental and control groups differ significantly in terms of adjusted mean posttest scores of Mathematics Anxiety.

The results suggest significant advantage of Cognitively Guided Instructional Strategy in reducing Mathematics Anxiety of upper primary school students over Existing method of teaching as low adjusted mean scores are seen associated with experimental group.

Comparison of the adjusted mean scores of Mathematics Anxiety of experimental and control groups by considering Pre-Achievement in Mathematics, Verbal Intelligence and Non-verbal Intelligence as covariates for subsample girls.

To study the relative effectiveness of Cognitively Guided Instructional Strategy and Existing method of teaching in reducing Mathematics Anxiety of upper primary school students, after adjusting for pretest differences if any, four ANCOVA were employed on subsample Girls. Linear adjustments were made in the posttest scores of Mathematics Anxiety for the individual as well as combined effects of the covariates namely, Pre- Achievement in Mathematics, Verbal Intelligence and Non-verbal Intelligence. For economy of presentation, the four ANCOVA are described in a single table.

The data and results of covariance analysis on Mathematics Anxiety for subsample Girls are presented in Table 54.

Table 54

Summary of Analysis of Covariance of Mathematics Anxiety- Subsample Girls

		Covariates			
	Source of Variance	Pre-Achievement in Mathematics	Verbal Intelligence	Non-verbal Intelligence	Combined Effect
Sum of squares	Between groups	2056.40	9310.33	1462.63	6821.83
	Within groups	105687.92	62625.32	84736.09	62506.70
df	Between groups	1	1	1	1
	Within groups	55	55	55	53
Mean squares	Between groups	2056.40	9310.33	1462.63	6821.83
	Within groups	1921.60	1138.64	1540.66	1179.372
	Total	108523.12	108523.12	108523.12	108523.12
F		1.07	8.18	0.95	5.78
Level of Significance		.305	.006	.334	.020
Partial eta squared		.019	.129	.017	.098

It is clear from Table 54 that the obtained F value for the effect of Instructional strategy on Mathematics Anxiety after controlling the effect of Verbal Intelligence F (1, 55) = 8.18, p = .006, η_p^2 = .129 is significant at .01 level of significance and the F value after controlling the combined effect of the covariates F (1, 53) = 5.78, p = .020, η_p^2 = .098 is significant at .05 level of significance. However, F(1, 55) = 1.07, p = .305, η_p^2 = .019 and F (1, 55) = 0.95, p=.334, η_p^2 = .017, obtained after controlling the effects of Pre- Achievement in Mathematics and Non-verbal Intelligence respectively are not significant at .05 level of significance. The results suggest that there is significant difference between Mathematics Anxiety posttest scores of experimental and control groups when the individual effect of verbal intelligence and combined effect of covariates are controlled. So in these cases, there is significant effect of Instructional strategy on Mathematics Anxiety for Girls. But in the remaining two cases, the effect of Instructional strategy is not significant and difference between the two groups, if any, can be attributed to pretest difference. The values of partial eta squared also substantiate these results.

Post hoc comparison of adjusted means on Mathematics Anxiety of experimental and control groups for subsample girls.

To test whether the experimental group taught through Cognitively Guided Instructional Strategy and control group taught through Existing method of teaching differs in the adjusted mean posttest scores of Mathematics Anxiety for subsample Girls, test of significance of difference between adjusted means was used with each ANCOVA. The details of post hoc comparison of adjusted means for subsample Girls are given in Table 55.

Table 55

Data and results of Bonferroni's Test of Post Hoc Comparison between the Adjusted Means of Mathematics Anxiety- Subsample Girls

Covariates	Experimental Group		Control group		SE	t
	N	Adjusted Mean	N	Adjusted Mean		
Pre- Achievement in Mathematics	28	135.82	30	148.27	12.04	1.03
Verbal Intelligence	28	128.52	30	155.08	9.29	2.86**
Non-verbal Intelligence	28	137.06	30	147.11	10.32	0.97
Combined Effect	28	129.25	30	154.40	10.45	2.41*

* p<.05 ** p<.01

Table 55 shows that there is significant difference between adjusted mean scores of Mathematics Anxiety of experimental and control groups, after controlling the individual effect of Verbal Intelligence and the combined effect of the covariates at .01 and .05 levels respectively. Hence there is significant effect of Cognitively Guided Instructional Strategy on Mathematics Anxiety after controlling Verbal Intelligence and combined effect for girl upper primary school students. But the t values in the remaining two cases are not significant and hence the difference cannot be attributed to the effect of Instructional strategy.

Comparison of the adjusted mean scores of Achievement in Mathematics of experimental and control groups by considering Pre-Achievement in Mathematics, Verbal Intelligence and Non-verbal Intelligence as covariates for total sample and subsamples based on Gender.

To study whether there exist any significant difference between experimental and control groups in terms of Achievement in Mathematics (Total, Lower order objectives, Higher order objectives) after adjusting for the pre intervention differences if any, one-way ANCOVA was used. For each sample, four different ANCOVA were employed on each of the three variables by taking covariates one at a time and in combination of three at a time. That is, one ANCOVA each by taking Pre- Achievement in Mathematics, Verbal Intelligence and Non-verbal Intelligence separately as covariate and one ANCOVA with combined effect of the three covariates. Every ANCOVA with significant F value was followed by Bonferroni's test of post hoc comparison.

The details of covariance analysis on each of the dependent variables - Achievement in Mathematics (Total), Achievement in Mathematics (Lower order objectives) and Achievement in Mathematics (Higher order objectives) - for Total sample, subsample Boys and subsample Girls are presented in the following sections.

Comparison of the adjusted mean scores of Achievement in Mathematics (Total) of experimental and control groups by considering Pre- Achievement in Mathematics, Verbal Intelligence and Non-verbal Intelligence as covariates for total sample.

To study the relative effectiveness of Cognitively Guided Instructional Strategy and Existing method of teaching in enhancing Achievement in Mathematics (Total) of upper primary school students, after making linear adjustments in posttest scores for individual as well as combined effect of Pre-Achievement in Mathematics, Verbal Intelligence and Non-verbal Intelligence, four separate one-way ANCOVA were employed on Total sample. The details are presented in a single table.

The data and results of covariance analysis on Achievement in Mathematics (Total) for Total sample are given in Table 56.

Table 56

Summary of Analysis of Covariance of Achievement in Mathematics (Total) - Total Sample

		Covariates			
	Source of Variance	Pre-Achievement in Mathematics	Verbal Intelligence	Non-verbal Intelligence	Combined Effect
Sum of squares	Between groups	779.85	799.63	259.72	868.65
	Within groups	3882.45	4480.57	4634.46	2997.95
df	Between groups	1	1	1	1
	Within groups	125	125	125	123
Mean squares	Between groups	779.85	799.63	259.72	868.65
	Within groups	31.06	35.85	37.08	24.37
	Total	6362.97	6362.97	6362.97	6362.97
F		25.11	22.31	7.01	35.64
Level of Significance		<.001	<.001	.009	<.001
Partial eta squared		.167	.151	.053	.225

Table 56 shows that the calculated F values for the effect of Instructional strategy on Achievement in Mathematics (Total) are greater than the table value for specified degrees of freedom at.01 level of significance. That is, F (1, 125) = 25.11, p<.001, η_p^2 = .167; F (1, 125) = 22.31, p<.001, η_p^2 = .151; F (1, 125) =7.01, p = .009, η_p^2 = .053 and F (1,123) = 35.64, p<.001, η_p^2 = .225 obtained after controlling the effects of Pre- Achievement in Mathematics, Verbal

Intelligence , Non-verbal Intelligence and the combined effect of covariates respectively, are significant at .01 level. The results indicate that there is significant difference between posttest scores of Achievement in Mathematics (Total) of upper primary school students belonging to experimental and control groups after controlling individual as well as combined effect of the selected covariates. Hence the difference between the two groups can be attributed to the effect of Instructional strategy for Total sample. The values of Partial eta squared also substantiate the results.

Post hoc comparison of adjusted means on Achievement in Mathematics (Total) of experimental and control groups for total sample.

To compare the adjusted mean posttest scores of Achievement in Mathematics (Total) of experimental and control groups for Total sample, test of significance of difference between means was used with each ANCOVA.

The results of post hoc comparison of adjusted means on Achievement in Mathematics (Total) for Total sample are given in Table 57.

Table 57

Data and Results of Bonferroni's Test of Post Hoc Comparison between the Adjusted Means of Achievement in Mathematics (Total) - Total sample

Covariates	Experimental Group		Control Group		SE	t
	N	Adjusted Mean	N	Adjusted Mean		
Pre- Achievement in Mathematics	66	18.18	62	13.14	1.01	5.01**
Verbal Intelligence	66	18.24	62	13.07	1.09	4.72**
Non-verbal Intelligence	66	17.12	62	14.26	1.08	2.65**
Combined Effect	66	18.47	62	12.82	0.95	5.97**

** p<.01

Table 57 shows that the calculated t values are greater than the table value 2.62 at .01 level of significance. So there is significant difference between experimental and control groups in terms of adjusted mean scores of Achievement in Mathematics (Total) for Total sample. Moreover, higher adjusted mean posttest scores are associated with experimental group. Hence the results suggest that Cognitively Guided Instructional Strategy is more effective in enhancing Achievement in Mathematics (Total) of upper primary school students than Existing method of teaching.

Comparison of the adjusted mean scores of Achievement in Mathematics (Lower order objectives) of experimental and control groups by considering Pre- Achievement in Mathematics, Verbal Intelligence and Non-verbal Intelligence as covariates for total sample.

To study the relative effectiveness of Cognitively Guided Instructional Strategy and Existing method of teaching in enhancing Achievement in Mathematics (Lower order objectives) of upper primary school students, after making linear adjustments in posttest scores for individual as well as combined effect of Pre- Achievement in Mathematics, Verbal Intelligence and Non-verbal Intelligence, four separate one-way ANCOVA were employed on Total sample. The details are presented in a single table.

The data and results of covariance analysis on Achievement in Mathematics (Lower order objectives) for Total sample are given in Table 58.

Table 58

Summary of Analysis of Covariance of Achievement in Mathematics (Lower order objectives)- Total sample

		Covariates			
	Source of Variance	Pre-Achievement in Mathematics	Verbal Intelligence	Non-verbal Intelligence	Combined Effect
Sum of squares	Between groups	375.41	388.24	100.47	452.79
	Within groups	2584.78	2962.09	3145.45	2040.80
df	Between groups	1	1	1	1
	Within groups	125	125	125	123
Mean squares	Between groups	375.41	388.24	100.47	452.79
	Within groups	20.68	23.70	25.16	16.59
	Total	4081.22	4081.22	4081.22	4081.22
F		18.16	16.38	3.99	27.29
Level of Significance		<.001	<.001	.048	<.001
Partial eta squared		.127	.116	.031	.182

As per Table 58 the calculated F values for the effect of Instructional Strategy on Achievement in Mathematics (Lower order objectives) for Total sample, $F(1, 125) = 18.16$, $p<.001$, $\eta_p^2 = .127$; $F(1, 125) = 16.38$, $p<.001$, $\eta_p^2 = .116$; $F(1, 123) = 27.29$, $p<.001$, $\eta_p^2 =.182$ after controlling the effects of Pre- Achievement in Mathematics, Verbal Intelligence and the combined effect of covariates respectively, are greater than the table value at .01 level of significance. The calculated value, F (1,125) = 3.99, p = .048, η_p^2 = .031 after controlling Non-verbal Intelligence is greater than the table value for .05 level. Hence there is significant difference between posttest scores of Achievement in Mathematics (Lower order objectives) of experimental and control groups after controlling the individual as well as combined effect of the three covariates. This indicates that there is significant effect of Instructional Strategy on Achievement in Mathematics (Lower order objectives) for Total sample. These results are substantiated by the values of Partial eta squared also.

Post hoc comparison of adjusted means on Achievement in Mathematics (Lower order objectives) of experimental and control groups for total sample.

To compare the adjusted mean posttest scores of Achievement in Mathematics (Lower order objectives) of experimental and control groups for Total sample, test of significance of difference between means was used with each ANCOVA.

The results of post hoc comparison of adjusted means on Achievement in Mathematics (Lower order objectives) for Total sample are given in Table 59.

Table 59

Data and Results of Bonferroni's Test of Post Hoc Comparison between the Adjusted Means of Achievement in Mathematics (Lower order objectives)-Total Sample

Covariates	Experimental Group		Control Group		SE	t
	N	Adjusted Mean	N	Adjusted Mean		
Pre- Achievement in Mathematics	66	14.27	62	10.78	0.82	4.26**
Verbal Intelligence	66	14.32	62	10.72	0.89	4.05**
Non-verbal Intelligence	66	13.44	62	11.66	0.89	2.00*
Combined Effect	66	14.56	62	10.47	0.78	5.22**

* p<.05 ** p<.01

It is clear from Table 59 that the calculated t values for test of significance of difference between adjusted mean posttest scores of Achievement in Mathematics (Lower order objectives) are greater than the table value at .01 level of significance, after adjusting for the individual effects of Pre- Achievement in Mathematics and Verbal Intelligence and combined effect of the covariates. The calculated t value after adjusting for the individual effect of Non-verbal Intelligence is greater than the table value at .05 level of significance. Hence there is significant difference between adjusted mean scores of experimental and control groups. Since higher adjusted means are associated with experimental group, Cognitively Guided Instructional Strategy is more effective than Existing method of teaching in enhancing Achievement in Mathematics (Lower order objectives) for Total sample of upper primary school students. The values of Partial eta squared also substantiate these results.

Comparison of the adjusted mean scores of Achievement in Mathematics (Higher order objectives) of experimental and control groups by considering Pre- Achievement in Mathematics, Verbal Intelligence and Non-verbal Intelligence as covariates for total sample.

To study the relative effectiveness of Cognitively Guided Instructional Strategy and Existing method of teaching in enhancing Achievement in Mathematics (Higher order objectives) of upper primary school students, after making linear adjustments in posttest scores for individual as well as combined effect of Pre- Achievement in Mathematics, Verbal Intelligence and Non-verbal Intelligence, four separate one-way ANCOVA were employed on Total sample. The details are presented in a single table.

The data and results of covariance analysis on Achievement in Mathematics (Higher order objectives) for Total sample are given in Table 60.

Table 60

Summary of Analysis of Covariance of Achievement in Mathematics (Higher order objectives) - Total sample

		Covariates			
	Source of Variance	Pre-Achievement in Mathematics	Verbal Intelligence	Non-verbal Intelligence	Combined Effect
Sum of squares	Between groups	73.11	73.51	37.12	67.14
	Within groups	347.59	372.90	354.96	302.73
df	Between groups	1	1	1	1
	Within groups	125	125	125	123

		Covariates			
	Source of Variance	Pre-Achievement in Mathematics	Verbal Intelligence	Non-verbal Intelligence	Combined Effect
Mean squares	Between groups	73.11	73.51	37.12	67.14
	Within groups	2.78	2.98	2.84	2.46
	Total	480.88	480.88	480.88	480.88
F		26.29	24.64	13.07	27.28
Level of Significance		<.001	<.001	<.001	<.001
Partial eta squared		.174	.165	.095	.182

It is clear from Table 60 that the calculated F values for the effect of Instructional Strategy on Achievement in Mathematics (Higher order objectives) for Total sample, after controlling the individual as well as combined effect of the three covariates, are greater than the table value for specified degrees of freedom at .01 level of significance. Hence, $F(1,125) = 26.29$, $p<.001$, $\eta_p^2 = .174$; $F(1,125) = 24.64$, $p<.001$, $\eta_p^2 = .165$; $F(1,125) = 13.07$, $p<.001$, $\eta_p^2 = .095$ and $F(1,123) = 27.28$, $p<.001$, $\eta_p^2 = .182$ obtained after controlling the effects of Pre- Achievement in Mathematics, Verbal Intelligence, Non-verbal Intelligence and their combined effect respectively, are significant at .01 level of significance. So there is significant difference between posttest scores of Achievement in Mathematics (Higher order objectives) of experimental and control groups even after controlling the effects of covariates. This indicates significant effect of Instructional Strategy on Achievement in Mathematics (Higher order objectives) for Total sample. These results are substantiated by the values of Partial eta squared also.

Post hoc comparison of adjusted means on Achievement in Mathematics (Higher order objectives) of experimental and control groups for total sample.

To compare the adjusted mean posttest scores of Achievement in Mathematics (Higher order objectives) of experimental and control groups for Total sample, test of significance of difference between means was used with each ANCOVA.

The results of post hoc comparison of adjusted means on Achievement in Mathematics (Higher order objectives) for Total sample are given in Table 61.

Table 61

Data and Results of Bonferroni's Test of Post Hoc Comparison between the Adjusted Means of Achievement in Mathematics (Higher order objectives) - Total sample

Covariates	Experimental Group		Control Group		SE	t
	N	Adjusted Mean	N	Adjusted Mean		
Pre- Achievement in Mathematics	66	3.90	62	2.36	0.30	5.13**
Verbal Intelligence	66	3.92	62	2.35	0.32	4.91**
Non-verbal Intelligence	66	3.68	62	2.60	0.30	3.62**
Combined Effect	66	3.92	62	2.35	0.30	5.22**

** $p<.01$

Table 61 shows that the calculated t values are greater than the table value 2.62 at .01 level of significance. So there is significant difference between experimental and control groups in terms of adjusted mean scores of Achievement in Mathematics (Higher order objectives) for Total sample. Moreover, higher adjusted mean posttest scores are associated with experimental group. Hence the results suggest that Cognitively Guided Instructional Strategy is more effective in enhancing Achievement in Mathematics (Higher order objectives) of upper primary school students than Existing method of teaching.

Comparison of the adjusted mean scores of Achievement in Mathematics (Total) of experimental and control groups by considering Pre-Achievement in Mathematics, Verbal Intelligence and Non-verbal Intelligence as covariates for subsample boys.

To study the relative effectiveness of Cognitively Guided Instructional Strategy and Existing method of teaching in enhancing Achievement in Mathematics (Total) of upper primary school students, after making linear adjustments in posttest scores for individual as well as combined effect of Pre-Achievement in Mathematics, Verbal Intelligence and Non-verbal Intelligence, four separate one-way ANCOVA were employed on subsample Boys. The details are presented in a single table.

The data and results of covariance analysis on Achievement in Mathematics (Total) for subsample Boys are given in Table 62.

Table 62

Summary of Analysis of Covariance of Achievement in Mathematics (Total) – Subsample Boys

		Covariates			
	Source of Variance	Pre-Achievement in Mathematics	Verbal Intelligence	Non-verbal Intelligence	Combined Effect
Sum of squares	Between groups	361.82	362.98	186.11	356.85
	Within groups	1731.47	2498.11	2610.90	1662.17
df	Between groups	1	1	1	1
	Within groups	67	67	67	65
Mean squares	Between groups	361.82	362.98	186.11	356.85
	Within groups	25.84	37.29	38.97	25.57
	Total	3013.44	3013.44	3013.44	3013.44
F		14.00	9.74	4.78	13.96
Level of Significance		<.001	.003	.032	<.001
Partial eta squared		.173	.127	.067	.177

As per Table 62 the F values for the effect of Instructional Strategy on Achievement in Mathematics (Total) for subsample Boys, F (1, 67) = 14.00, p<.001, η_p^2 = .173; F (1, 67) = 9.74, p = .003, η_p^2 = .127 and F (1, 65) = 13.96, p<.001, η_p^2 = .177 obtained after controlling the effects of Pre- Achievement in Mathematics, Verbal Intelligence and combined effect of covariates respectively, are greater than the table value at .01 level of significance. The value, F(1, 67)= 4.78, p= .032, η_p^2 = .067 after controlling Non-verbal

Intelligence is greater than the table value for .05 level. Hence there is significant difference between posttest scores of Achievement in Mathematics (Total) of experimental and control groups after controlling the individual as well as combined effect of the three covariates. This indicates that there is significant effect of Instructional Strategy on Achievement in Mathematics (Total) for subsample Boys. The values of Partial eta squared also substantiate these results.

Post hoc comparison of adjusted means on Achievement in Mathematics (Total) of experimental and control groups for subsample boys.

To test whether the experimental group taught through Cognitively Guided Instructional Strategy and control group taught through Existing method of teaching differs in the adjusted mean posttest scores of Achievement in Mathematics (Total) for subsample Boys, test of significance of difference between adjusted means was used with each ANCOVA.

The details of post hoc comparison of adjusted mean posttest scores for subsample Boys are given in Table 63.

Table 63

Data and Results of Bonferroni's Test of Post Hoc Comparison between the Adjusted Means of Achievement in Mathematics (Total) - Subsample Boys

Covariates	Experimental Group		Control Group		SE	t
	N	Adjusted Mean	N	Adjusted Mean		
Pre-Achievement in Mathematics	38	16.62	32	12.04	1.22	3.74**
Verbal Intelligence	38	16.66	32	12.00	1.49	3.10**
Non-verbal Intelligence	38	16.06	32	12.72	1.53	2.19*
Combined Effect	38	16.71	32	11.94	1.28	3.74**

* p<.05 ** p<.01

It is clear from Table 63 that the calculated t values for test of significance of difference between adjusted mean posttest scores of Achievement in Mathematics (Total) are greater than the table value at .01 level of significance, after adjusting for the individual effects of Pre- Achievement in Mathematics and Verbal Intelligence and the combined effect of the covariates. The calculated t value after adjusting for the individual effect of Non-verbal Intelligence is greater than the table value at .05 level of significance. Hence there is significant difference between adjusted mean scores of experimental and control groups. Since higher adjusted means are associated with experimental group, Cognitively Guided Instructional Strategy is more effective than Existing method of teaching in enhancing Achievement in Mathematics (Total) of boy upper primary school students.

Comparison of the adjusted mean scores of Achievement in Mathematics (Lower order objectives) of experimental and control groups by considering Pre-Achievement in Mathematics, Verbal Intelligence and Non-verbal Intelligence as covariates for subsample boys.

To study the relative effectiveness of Cognitively Guided Instructional Strategy and Existing method of teaching in enhancing Achievement in Mathematics (Lower order objectives) of upper primary school students, after making linear adjustments in posttest scores for individual as well as combined effect of Pre- Achievement in Mathematics, Verbal Intelligence and Non-verbal Intelligence, four separate one-way ANCOVA were employed on subsample Boys. The details are presented in a single table.

The data and results of covariance analysis on Achievement in Mathematics (Lower order objectives) for subsample Boys are given in Table 64.

Table 64

Summary of Analysis of Covariance of Achievement in Mathematics (Lower order objectives) – Subsample Boys

		Covariates			
	Source of Variance	Pre-Achievement in Mathematics	Verbal Intelligence	Non-verbal Intelligence	Combined Effect
Sum of squares	Between groups	148.78	157.33	68.44	171.59
	Within groups	1293.96	1769.30	1918.78	1230.66
df	Between groups	1	1	1	1
	Within groups	67	67	67	65
Mean squares	Between groups	148.78	157.33	68.44	171.59
	Within groups	19.31	26.41	28.64	18.93
	Total	2073.44	2073.44	2073.44	2073.44
F		7.70	5.96	2.39	9.06
Level of Significance		.007	.017	.127	.004
Partial eta squared		.103	.082	.034	.122

Table 64 shows that the calculated F values for the effect of Instructional Strategy on Achievement in Mathematics (Lower order objectives) for subsample Boys, F (1, 67) = 7.70, p=.007, η_p^2 =.103 after controlling the effect of Pre- Achievement in Mathematics and F (1, 65) = 9.06, p=.004, η_p^2 = .122 after controlling the combined effect of covariates are significant at .01 level of significance. The obtained F value after controlling the effect of Verbal Intelligence, F (1, 67) = 5.96, p=.017, η_p^2 = .082 is significant at .05 level of significance. But the F value after controlling the effect of Non-verbal Intelligence, F (1, 67) = 2.39, p=.127, η_p^2 = .034 is not significant at .05 level of significance. The results suggest that there is significant difference between posttest scores of Achievement in Mathematics (Lower order objectives) of experimental and control groups even after controlling the effects of Pre-Achievement in Mathematics, Verbal Intelligence and combined effect of covariates. This indicates significant effect of Instructional Strategy on Achievement in Mathematics (Lower order objectives). But when only Non-verbal Intelligence is controlled, the difference between groups cannot be attributed to the effect of Instructional strategy. The values of Partial eta squared also substantiate these results.

Post hoc comparison of adjusted means on Achievement in Mathematics (Lower order objectives) of experimental and control groups for subsample boys.

To test whether the experimental group taught through Cognitively Guided Instructional Strategy and control group taught through Existing method of teaching differs in the adjusted mean posttest scores of Achievement in Mathematics (Lower order objectives) for subsample Boys, test of significance of difference between adjusted means was used with each ANCOVA.

The details of post hoc comparison of adjusted mean posttest scores for subsample Boys are given in Table 65.

Table 65

Data and Results of Bonferroni's Test of Post Hoc Comparison between the Adjusted Means of Achievement in Mathematics (Lower order objectives) - Subsample Boys

Covariates	Experimental Group		Control Group		SE	t
	N	Adjusted Mean	N	Adjusted Mean		
Pre- Achievement in Mathematics	38	13.01	32	10.08	1.06	2.78**
Verbal Intelligence	38	13.07	32	10.01	1.26	2.44*
Non-verbal Intelligence	38	12.60	32	10.57	1.31	1.55
Combined Effect	38	13.19	32	9.87	1.10	3.01**

* p<.05 ** p<.01

Table 65 shows that the calculated t values for test of significance of difference between adjusted mean posttest scores of Achievement in Mathematics (Lower order objectives) are greater than the table value at .01 level of significance, after adjusting for the individual effect of Pre-Achievement in Mathematics and the combined effect of the covariates. The calculated t value after adjusting for the individual effect of Verbal Intelligence is greater than the table value at .05 level of significance and the t value after controlling Non-verbal Intelligence is less than the table value at .05 level. Hence there is significant difference between adjusted mean scores of experimental and control groups after controlling Pre- Achievement in Mathematics, Verbal Intelligence and combined effect of covariates. Since higher adjusted means are associated with experimental groups in these cases, Cognitively Guided Instructional Strategy is more effective than Existing method of teaching in enhancing Achievement in Mathematics (Total) for subsample Boys. But it can be seen that, the experimental and control groups do not differ significantly in terms of Achievement in Mathematics (Lower order objectives) when the covariate Non-verbal Intelligence is controlled. So in this case, mean difference cannot be attributed to the influence of Instructional strategy.

Comparison of the adjusted mean scores of Achievement in Mathematics (Higher order objectives) of experimental and control groups by considering Pre- Achievement in Mathematics, Verbal Intelligence and Non-verbal Intelligence as covariates for subsample boys.

To study the relative effectiveness of Cognitively Guided Instructional Strategy and Existing method of teaching in enhancing Achievement in Mathematics (Higher order objectives) of upper primary school students, after making linear adjustments in posttest scores for individual as well as combined effect of Pre- Achievement in Mathematics, Verbal Intelligence and Non-verbal Intelligence, four separate one-way ANCOVA were employed on subsample Boys. The details are presented in a single table.

The data and results of covariance analysis on Achievement in Mathematics (Higher order objectives) for Boys subsample are given in Table 66.

Table 66

Summary of Analysis of Covariance of Achievement in Mathematics (Higher order objectives) – Subsample Boys

		Covariates			
	Source of Variance	Pre-Achievement in Mathematics	Verbal Intelligence	Non-verbal Intelligence	Combined Effect
Sum of squares	Between groups	46.57	42.36	28.83	33.54
	Within groups	134.75	166.16	150.30	126.51
df	Between groups	1	1	1	1
	Within groups	67	67	67	65
Mean squares	Between groups	46.57	42.36	28.83	33.54
	Within groups	2.01	2.48	2.24	1.95
	Total	208.57	208.57	208.57	208.57
F		23.15	17.08	12.85	17.23
Level of Significance		<.001	<.001	.001	<.001
Partial eta squared		.257	.203	.161	.210

It is clear from Table 66 that the calculated F values for the effect of Instructional Strategy on Achievement in Mathematics (Higher order objectives) for subsample Boys, after controlling the individual as well as combined effect of the three covariates, are greater than the table value for specified degrees of freedom at .01 level of significance. Hence the values F (1, 67) = 26.15, p<.001, η_p^2 =.257; F (1, 67) = 17.08, p<.001, η_p^2 =.203; F (1, 67) = 12.85, p=.001, η_p^2 =.161 and F (1, 65) = 17.23, p<.001, η_p^2 =.210 after controlling the effects of

Pre- Achievement in Mathematics, Verbal Intelligence, Non-verbal Intelligence and combined effect of covariates respectively are significant at .01 level of significance. So there is significant difference between posttest scores of Achievement in Mathematics (Higher order objectives) of experimental and control groups even after controlling the effects of covariates. This indicates significant effect of Instructional Strategy on Achievement in Mathematics (Higher order objectives) for subsample Boys. These results are substantiated by the values of Partial eta squared also.

Post hoc comparison of adjusted means on Achievement in Mathematics (Higher order objectives) of experimental and control groups for subsample boys.

To test whether there is any significant difference between experimental group taught through Cognitively Guided Instructional Strategy and control group taught through Existing method of teaching in adjusted mean posttest scores of Achievement in Mathematics (Higher order objectives) for Boys subsample, test of significance of difference between adjusted means was used with each ANCOVA.

The results of post hoc comparison of adjusted means are given in Table 67.

Table 67

Data and Results of Bonferroni's Test of Post Hoc comparison between the Adjusted Means of Achievement in Mathematics (Higher order objectives) - Subsample Boys

Covariates	Experimental Group		Control Group		SE	t
	N	Adjusted Mean	N	Adjusted Mean		
Pre- Achievement in Mathematics	38	3.61	32	1.97	0.34	4.81**
Verbal Intelligence	38	3.59	32	1.99	0.39	4.13**
Non-verbal Intelligence	38	3.46	32	2.14	0.37	3.59**
Combined Effect	38	3.53	32	2.06	0.35	4.15**

** p<.01

As per Table 67 the calculated t values are greater than the table value at .01 level of significance. So there is significant difference between adjusted mean posttest scores of Achievement in Mathematics (Higher order objectives) of Boys belonging to experimental and control groups. As higher adjusted mean scores are associated with experimental group, Cognitively Guided Instructional Strategy is more effective than Existing method of teaching in enhancing Achievement in Mathematics (Higher order objectives) of Boys.

Comparison of the adjusted mean scores of Achievement in Mathematics (Total) of experimental and control groups by considering Pre- Achievement in Mathematics, Verbal Intelligence and Non-verbal Intelligence as covariates for subsample girls.

To study the relative effectiveness of Cognitively Guided Instructional Strategy and Existing method of teaching in enhancing Achievement in Mathematics (Total) of upper primary school students, after making linear adjustments in posttest scores for individual as well as combined effect of Pre-Achievement in Mathematics, Verbal Intelligence and Non-verbal Intelligence, four separate one-way ANCOVA were employed on subsample Girls. The details are presented in a single table.

The data and results of covariance analysis on Achievement in Mathematics (Total) for Girls subsample are given in Table 68.

Table 68

Summary of Analysis of Covariance of Achievement in Mathematics (Total) – Subsample Girls

		Covariates			
	Source of Variance	Pre-Achievement in Mathematics	Verbal Intelligence	Non-verbal Intelligence	Combined Effect
Sum of squares	Between groups	410.30	496.04	162.08	512.18
	Within groups	2071.23	1658.43	1634.71	1100.09
df	Between groups	1	1	1	1
	Within groups	55	55	55	53
Mean squares	Between groups	410.30	496.04	162.08	512.18
	Within groups	37.66	30.15	29.72	20.77
	Total	3124.91	3124.91	3124.91	3124.91
F		10.90	16.45	5.45	24.68
Level of Significance		.002	<.001	.023	<.001
Partial eta squared		.165	.230	.090	.318

As per Table 68 the calculated F values for the effect of Instructional Strategy on Achievement in Mathematics (Total) for subsample Girls, $F (1, 55) = 10.90$, $p=.002$, $\eta_p^2 = .165$; $F (1, 55) = 16.45$, $p <.001$, $\eta_p^2 =.230$; $F (1, 53) = 24.68$, $p<.001$, $\eta_p^2 =.318$ after controlling Pre- Achievement in Mathematics, Verbal Intelligence and combined effect of covariates respectively, are greater than the table value at .01 level of significance . The value, $F (1, 55) = 5.45$, $p = .023$, $\eta_p^2 = .090$ after controlling Non-verbal Intelligence, is greater than the table value for .05 level. Hence there is significant difference between posttest scores of Achievement in Mathematics (Total) of experimental and control groups after controlling the individual as well as combined effect of the three covariates. This indicates that there is significant effect of Instructional Strategy on Achievement in Mathematics (Total) for subsample Girls. These results are substantiated by the values of Partial eta squared also.

Post hoc comparison of adjusted means on Achievement in Mathematics (Total) of experimental and control groups for subsample girls.

To test whether there is any significant difference between experimental group taught through Cognitively Guided Instructional Strategy and control group taught through Existing method of teaching in adjusted mean posttest scores of Achievement in Mathematics (Total) for Girls subsample, test of significance of difference between adjusted means was used with each ANCOVA. The results of post hoc comparison of adjusted mean posttest scores of Achievement in Mathematics (Total) are given in Table 69.

Table 69

Data and Results of Bonferroni's Test of Post Hoc Comparison between the Adjusted Means of Achievement in Mathematics (Total) - Subsample Girls

Covariates	Experimental Group		Control Group		SE	t
	N	Adjusted Mean	N	Adjusted Mean		
Pre- Achievement in Mathematics	28	20.07	30	14.50	1.69	3.30**
Verbal Intelligence	28	20.36	30	14.23	1.51	4.06**
Non-verbal Intelligence	28	18.92	30	15.57	1.43	2.34*
Combined Effect	28	20.75	30	13.86	1.39	4.97**

* p<.05 ** p<.01

It is clear from Table 69 that the calculated t values for test of significance of difference between adjusted mean posttest scores of Achievement in Mathematics (Total) are greater than the table value at .01 level of significance, after adjusting for the individual effects of Pre-Achievement in Mathematics, Verbal Intelligence and after adjusting for the combined effect of the covariates. The obtained t value after adjusting for the individual effect of Non-verbal Intelligence is greater than the table value at .05 level of significance. Hence there is significant difference between adjusted mean posttest scores of experimental and control groups. Since higher adjusted means are associated with experimental group, Cognitively Guided Instructional Strategy is more effective than Existing method of teaching in enhancing Achievement in Mathematics (Total) for subsample Girls.

Comparison of the adjusted mean scores of Achievement in Mathematics (Lower order objectives) of experimental and control groups by considering Pre- Achievement in Mathematics, Verbal Intelligence and Non-verbal Intelligence as covariates for subsample girls.

To study the relative effectiveness of Cognitively Guided Instructional Strategy and Existing method of teaching in enhancing Achievement in Mathematics (Lower order objectives) of upper primary school students, after making linear adjustments in posttest scores for individual as well as combined effect of Pre- Achievement in Mathematics, Verbal Intelligence and Non-verbal Intelligence, four separate one-way ANCOVA were employed on subsample Girls. The details are presented in a single table.

The data and results of covariance analysis on Achievement in Mathematics (Lower order objectives) for subsample Girls are given in Table 70.

Table 70

Summary of Analysis of Covariance of Achievement in Mathematics (Lower order objectives) – Subsample Girls

		Covariates			
	Source of Variance	Pre-Achievement in Mathematics	Verbal Intelligence	Non-verbal Intelligence	Combined Effect
Sum of squares	Between groups	226.18	267.36	81.63	264.83
	Within groups	1237.83	1033.45	945.19	658.93
df	Between groups	1	1	1	1
	Within groups	55	55	55	53

		Covariates			
	Source of Variance	Pre-Achievement in Mathematics	Verbal Intelligence	Non-verbal Intelligence	Combined Effect
Mean squares	Between groups	226.18	267.36	81.63	264.83
	Within groups	22.51	18.79	17.19	12.43
	Total	1880.78	1880.78	1880.78	1880.78
F		10.05	14.23	4.75	21.30
Level of Significance		.002	<.001	.034	<.001
Partial eta squared		.155	.206	.080	.287

As per Table 70 the calculated F values for the effect of Instructional Strategy on Achievement in Mathematics (Lower order objectives) for subsample Girls, F (1, 55) = 10.05, p=.002, η_p^2 =.155 ; F (1, 55) = 14.23, p <.001, η_p^2 = .206 ; F (1, 53) = 21.30, p<.001, η_p^2 = .287 after controlling Pre-Achievement in Mathematics, Verbal Intelligence and combined effect of covariates respectively, are greater than the table value at .01 level of significance . The value F(1, 55) = 4.75, p = .034, η_p^2 = .080 after controlling Non-verbal Intelligence is greater than the table value for .05 level. Hence there is significant difference between posttest scores of Achievement in Mathematics (Lower order objectives) of experimental and control groups after controlling the individual as well as combined effect of the three covariates. This indicates that there is significant effect of Instructional Strategy on Achievement in Mathematics (Lower order objectives) for subsample Girls. These results are substantiated by the values of Partial eta squared also.

Post hoc comparison of adjusted means on Achievement in Mathematics (Lower order objectives) of experimental and control groups for subsample girls.

To find out whether experimental and control groups differ significantly in terms of adjusted mean posttest scores of Achievement in Mathematics (Lower order objectives), test of significance of difference between adjusted means was used with each ANCOVA.

The details of post hoc comparison of adjusted mean scores of Achievement in Mathematics (Lower order objectives) for subsample Girls are presented in Table 71.

Table 71

Data and Results of Bonferroni's Test of Post Hoc Comparison between the Adjusted Means of Achievement in Mathematics (Lower order objectives) - Subsample Girls

Covariates	Experimental Group		Control Group		SE	t
	N	Adjusted Mean	N	Adjusted Mean		
Pre- Achievement in Mathematics	28	15.81	30	11.68	1.30	3.17**
Verbal Intelligence	28	16.00	30	11.50	1.19	3.77**
Non-verbal Intelligence	28	14.90	30	12.53	1.09	2.18*
Combined Effect	28	16.24	30	11.28	1.07	4.62**

* $p<.05$ ** $p<.01$

It is clear from Table 71 that the calculated t values for test of significance of difference between adjusted mean posttest scores of Achievement in Mathematics (Lower order objectives) are greater than the table value at .01 level of significance, after adjusting for the individual effects of Pre-

Achievement in Mathematics, Verbal Intelligence and after adjusting for the combined effect of covariates. The obtained t value after adjusting for the individual effect of Non-verbal Intelligence is greater than the table value at .05 level of significance. Hence there is significant difference between adjusted mean posttest scores of experimental and control groups. Since higher adjusted means are associated with experimental group, Cognitively Guided Instructional Strategy is more effective than Existing method of teaching in enhancing Achievement in Mathematics (Lower order objectives) for subsample Girls.

Comparison of the adjusted mean scores of Achievement in Mathematics (Higher order objectives) of experimental and control groups by considering Pre- Achievement in Mathematics, Verbal Intelligence and Non-verbal Intelligence as covariates for subsample girls.

To study the relative effectiveness of Cognitively Guided Instructional Strategy and Existing method of teaching in enhancing Achievement in Mathematics (Higher order objectives) of upper primary school students, after making linear adjustments in posttest scores for individual as well as combined effect of Pre- Achievement in Mathematics, Verbal Intelligence and Non-verbal Intelligence, four separate one-way ANCOVA were employed on Girls subsample. The details are presented in a single table.

The data and results of covariance analysis on Achievement in Mathematics (Higher order objectives) for subsample Girls are given in Table 72.

Table 72

Summary of Analysis of Covariance of Achievement in Mathematics (Higher order objectives) – Subsample Girls

		Covariates			
	Source of Variance	Pre-Achievement in Mathematics	Verbal Intelligence	Non-verbal Intelligence	Combined Effect
Sum of squares	Between groups	27. 21	35.06	13.66	40.42
	Within groups	206.77	173.45	192.68	153.02
df	Between groups	1	1	1	1
	Within groups	55	55	55	53
Mean squares	Between groups	27. 21	35.06	13.66	40.42
	Within groups	3.76	3.15	3.49	2.89
	Total	258.48	258.48	258.48	258.48
F		7.24	11.12	3.91	14.00
Level of Significance		.009	.002	.050	<.001
Partial eta squared		.116	.168	.066	.209

As per Table 72 the calculated F values for the effect of Instructional Strategy on Achievement in Mathematics (Higher order objectives) for subsample Girls, F (1, 55) = 7.24, p=.009, η_p^2 = .116; F (1, 55) = 11.12, p =.002, η_p^2 = .168 and F (1, 53) = 14.00, p<.001, η_p^2=.209 after controlling Pre-Achievement in Mathematics, Verbal Intelligence and combined effect of covariates respectively, are greater than the table value at .01 level of significance . The value F(1, 55) = 3.91, p = .050, η_p^2 = .066 after controlling Non-verbal Intelligence is equal to the table value for .05 level. Hence there is significant difference between posttest scores of Achievement in Mathematics

(Higher order objectives) of experimental and control groups after controlling the effects of Pre- Achievement in Mathematics, Verbal Intelligence, Non-verbal Intelligence and combined effect of the three covariates. This indicates that there is significant effect of Instructional strategy on Achievement in Mathematics (Higher order objectives) for subsample Girls. These results are substantiated by the values of Partial eta squared also.

Post hoc comparison of adjusted means on Achievement in Mathematics (Higher order objectives) of experimental and control groups for subsample girls.

To find out whether experimental and control groups differ significantly in terms of adjusted mean posttest scores of Achievement in Mathematics (Higher order objectives), test of significance of difference between adjusted means was used with each ANCOVA.

The details of post hoc comparison of adjusted means for subsample Girls are presented in Table 73.

Table 73

Data and Results of Bonferroni's Test of Post Hoc Comparison between the Adjusted Means of Achievement in Mathematics (Higher Order Objectives)- Subsample Girls

Covariates	Experimental Group		Control Group		SE	t
	N	Adjusted Mean	N	Adjusted Mean		
Pre- Achievement in Mathematics	28	4.26	30	2.83	0.53	2.69**
Verbal Intelligence	28	4.36	30	2.73	0.49	3.33**
Non-verbal Intelligence	28	4.02	30	3.05	0.49	1.98*
Combined Effect	28	4.52	30	2.58	0.52	3.74**

* p<.05 ** p<.01

It is clear from Table 73 that the calculated t values for test of significance of difference between adjusted mean posttest scores of Achievement in Mathematics (Higher order objectives) are greater than the table value at .01 level of significance, after adjusting for the individual effects of Pre-Achievement in Mathematics, Verbal Intelligence and after adjusting for the combined effect of the covariates. The obtained t value after adjusting for the individual effect of Non-verbal Intelligence is equal to the table value at .05 level of significance. Hence there is significant difference between adjusted mean posttest scores of experimental and control groups. Since higher adjusted means are associated with experimental group, Cognitively Guided Instructional Strategy is more effective than Existing method of teaching in enhancing Achievement in Mathematics (Higher order objectives) for subsample Girls.

Summary and discussion of ANCOVA of the dependent variables

Results of ANCOVA of dependent variables Mathematics Anxiety and Achievement in Mathematics (Total, Lower order objectives, Higher order objectives) employed to study the effectiveness of Instructional Strategy- Cognitively Guided Instructional Strategy and Existing method of teaching- after controlling the individual and combined effects of the covariates are presented in the following sections.

The calculated F values for the ANCOVA of dependent variables, t values of post hoc comparison and effect size Partial eta squared for Total sample, subsample Boys and subsample Girls are presented in Table 74, Table 75 and Table 76 respectively.

The summary of ANCOVA of the dependent variables and effect size for Total sample is given in Table 74.

Table 74

Summary of ANCOVA of the Dependent Variables- Total sample

Source of Variation	Dependent variable	Covariate	F	t	Level of Significance	Partial eta squared
Instructional Strategy (Cognitively Guided Instructional Strategy and Existing method of teaching)	Mathematics Anxiety	Pre- Achievement in Mathematics	11.67	3.42	.01	
		Verbal Intelligence	20.91	4.57	.01	.143
		Non-verbal Intelligence	7.65	2.77	.01	.058
		Combined Effect	17.62	4.20	.01	.125
	Achievement in Mathematics (Lower order objectives)	Pre- Achievement in Mathematics	18.16	4.26	.01	.127
		Verbal Intelligence	16.38	4.05	.01	.116
		Non-verbal Intelligence	3.99	2.00	.05	.031
		Combined Effect	27.29	5.22	.01	.182
	Achievement in Mathematics (Higher order objectives)	Pre- Achievement in Mathematics	26.29	5.13	.01	.174
		Verbal Intelligence	24.64	4.96	.01	.165
		Non-verbal Intelligence	13.07	3.62	.01	.095
		Combined Effect	27.28	5.22	.01	.182
	Achievement in Mathematics (Total)	Pre- Achievement in Mathematics	25.11	5.01	.01	.167
		Verbal Intelligence	22.31	4.72	.01	.151
		Non-verbal Intelligence	7.005	2.65	.01	.053
		Combined Effect	35.64	5.97	.01	.225

The results of Analysis of Covariance of the dependent variables given in Table 74 show that the experimental and control groups differed significantly in terms of Mathematics Anxiety and Achievement in Mathematics (Total, Lower order objectives, Higher order objectives) even after controlling the effects of the three covariates. This indicates that Cognitively Guided Instructional Strategy is more effective than Existing method of teaching in reducing Mathematics Anxiety and enhancing Achievement in Mathematics (Total, Lower order objectives, Higher order objectives) of Total sample of upper primary school students . The results are substantiated by the values of Partial eta squared also.

The summary of ANCOVA of the dependent variables and effect size for subsample Boys is given in Table 75.

Table 75

Summary of ANCOVA of the Dependent Variables- Subsample Boys

Source of Variation	Dependent variable	Covariate	F	t	Level of Significance	Partial eta squared
Instructional Strategy (Cognitively Guided Instructional Strategy and Existing method of teaching)	Mathematics Anxiety	Pre- Achievement in Mathematics	13.39	3.66	.01	.167
		Verbal Intelligence	14.36	3.79	.01	.177
		Non-verbal Intelligence	9.70	3.12	.01	.127
		Combined Effect	12.82	3.58	.01	.165
	Achievement in Mathematics (Lower order objectives)	Pre- Achievement in Mathematics	7.70	2.78	.01	.103
		Verbal Intelligence	5.96	2.44	.05	.082
		Non-verbal Intelligence	2.39	1.55	NS	.034
		Combined Effect	9.06	3.01	.01	.122
	Achievement in Mathematics (Higher order objectives)	Pre- Achievement in Mathematics	23.15	4.81	.01	.257
		Verbal Intelligence	17.08	4.13	.01	.203
		Non-verbal Intelligence	12.85	3.59	.01	.161
		Combined Effect	17.23	4.15	.01	.210
	Achievement in Mathematics (Total)	Pre- Achievement in Mathematics	14.00	3.74	.01	.173
		Verbal Intelligence	9.74	3.10	.01	.127
		Non-verbal Intelligence	4.78	2.19	.05	.067
		Combined Effect	13.96	3.74	.01	.177

NS Indicates Not Significant

Table 75 shows that the experimental and control groups differed significantly in terms of Mathematics Anxiety and Achievement in Mathematics (Total, Lower order objectives, Higher order objectives) after controlling the individual and combined effect of the three covariates, except in one instance. After controlling the individual effect of Non-verbal Intelligence, the two groups did not differ significantly on Achievement in Mathematics (Lower order objectives). Nevertheless, Cognitively Guided Instructional Strategy is more effective than Existing method of teaching in reducing Mathematics Anxiety and enhancing Achievement in Mathematics (Total, Lower order objectives, Higher order objectives) for subsample Boys as the two groups differed significantly after controlling the combined effect of the covariates. The values of Partial eta squared also substantiated these results.

The summary of ANCOVA of the dependent variables and effect size for subsample Girls is given in Table 76.

Table 76

Summary of ANCOVA of the Dependent Variables- Subsample Girls

Source of Variation	Dependent variable	Covariate	F	t	Level of Significance	Partial eta squared
Instructional Strategy (Cognitively Guided Instructional Strategy and Existing method of teaching)	Mathematics Anxiety	Pre- Achievement in Mathematics	1.07	1.03	NS	.019
		Verbal Intelligence	8.18	2.86	.01	.129
		Non-verbal Intelligence	0.95	0.97	NS	.017
		Combined Effect	5.78	2.41	.05	.098
	Achievement in Mathematics (Lower order objectives)	Pre- Achievement in Mathematics	10.05	3.17	.01	.155
		Verbal Intelligence	14.23	3.77	.01	.206
		Non-verbal Intelligence	4.75	2.18	.05	.080
		Combined Effect	21.30	4.62	.01	.287
	Achievement in Mathematics (Higher order objectives)	Pre- Achievement in Mathematics	7.24	2.69	.01	.116
		Verbal Intelligence	11.12	3.33	.01	.168
		Non-verbal Intelligence	3.91	1.98	.05	.066
		Combined Effect	14.00	3.74	.01	.209
	Achievement in Mathematics (Total)	Pre- Achievement in Mathematics	10.90	3.30	.01	.165
		Verbal Intelligence	16.45	4.06	.01	.230
		Non-verbal Intelligence	5.45	2.34	.05	.090
		Combined Effect	24.68	4.97	.01	.318

NS indicates Not Significant

Table 76 shows that the experimental and control groups differed significantly in terms of Mathematics Anxiety and Achievement in Mathematics (Total, Lower order objectives, Higher order objectives) after controlling the individual and combined effect of the three covariates, except in the case of Mathematics Anxiety after controlling the individual effects of Pre-Achievement in Mathematics and Non-verbal Intelligence. In the above mentioned two cases, the two groups did not differ significantly on Mathematics Anxiety. It is important to note that in the mean difference analysis of change scores, the two groups did not differ significantly with regard to Mathematics Anxiety. However, since the two groups differed in terms of Mathematics Anxiety after controlling the combined effect of the three covariates, it can be concluded that Cognitively Guided Instructional Strategy is more effective than Existing method of teaching in reducing Mathematics Anxiety and enhancing Achievement in Mathematics (Total, Lower order objectives, Higher order objectives) for subsample Girls also. These results are substantiated by the values of Partial eta squared also.

From the findings of mean difference analysis and Analysis of Covariance it can be concluded that Cognitively Guided Instructional Strategy is more effective than Existing method of teaching in reducing Mathematics Anxiety and in enhancing Achievement in Mathematics (Total, Lower order objectives, Higher order objectives) of upper primary school students belonging to Total sample, subsample Boys and subsample Girls.

Chapter VI

SUMMARY, FINDINGS AND SUGGESTIONS

- *Study in Retrospect*
- *Major Findings of the Study*
- *Tenability of Hypotheses*
- *Conclusion*
- *Educational Implications of the Study*
- *Suggestions for Further Research*

SUMMARY, FINDINGS AND SUGGESTIONS

This chapter includes the summary, major findings, conclusion, educational implications and suggestions for further research.

Study in Retrospect

Restatement of the Problem

The study was designed and carried out to develop an instructional strategy based on Cognitively Guided Instruction and to test its effectiveness in terms of Mathematics Anxiety and Achievement in Mathematics of upper primary school students. So the study was entitled as **EFFECTIVENESS OF COGNITIVELY GUIDED INSTRUCTIONAL STRATEGY ON MATHEMATICS ANXIETY AND ACHIEVEMENT IN MATHEMATICS OF UPPER PRIMARY SCHOOL STUDENTS**

Variables of the Study

The criterion variable of the preliminary survey was Mathematics Anxiety and the classificatory variables were Gender and Grade.

Following were the variables in the experiment phase:

Independent variable

Instructional Strategy with two levels namely, Cognitively Guided Instructional Strategy and Existing method of teaching

Dependent variables

- Mathematics Anxiety
- Achievement in Mathematics (Total, Lower order objectives, Higher Order Objectives)

Control variables

- Pre- Achievement in Mathematics
- Verbal Intelligence
- Non-verbal Intelligence

Objectives of the Study

1. To identify the existing level of Mathematics Anxiety of upper primary school students
2. To compare the existing level of Mathematics Anxiety of different subgroups of upper primary school students based on
   a) Gender (Boys/Girls)
   b) Grade (Standard V/Standard VI/Standard VII)
3. To develop an instructional strategy based on Cognitively Guided Instruction for teaching Mathematics at upper primary level
4. To find out the effectiveness of Cognitively Guided Instructional Strategy in reducing Mathematics Anxiety of upper primary school students for Total sample and subsamples based on Gender
5. To find out the effectiveness of Cognitively Guided Instructional Strategy in enhancing Achievement in Mathematics (Total, Lower order objectives, Higher order objectives) of upper primary school students for Total sample and subsamples based on Gender
6. To compare the effectiveness of Cognitively Guided Instructional Strategy and Existing method of teaching in reducing Mathematics Anxiety of upper primary school students for Total sample and subsamples based on Gender

7. To compare the effectiveness of Cognitively Guided Instructional Strategy and Existing method of teaching in enhancing Achievement in Mathematics (Total, Lower order objectives, Higher order objectives) of upper primary school students for Total sample and subsamples based on Gender

Hypotheses of the Study

1. There is no significant difference in the existing level of Mathematics Anxiety of different subgroups of upper primary school students based on
   a) Gender (Boys/ Girls)
   b) Grade (Standard V/Standard VI/Standard VII)
2. There is no significant difference in the mean pretest score of Mathematics Anxiety between experimental and control groups for
   a) Total sample
   b) Subsample Boys
   c) Subsample Girls
3. There is no significant difference in the mean pretest score of Achievement in Mathematics (Total) between experimental and control groups for
   a) Total sample
   b) Subsample Boys
   c) Subsample Girls
4. There is no significant difference in the mean pretest score of Achievement in Mathematics (Lower order objectives) between experimental and control groups for
   a) Total sample
   b) Subsample Boys
   c) Subsample Girls

5. There is no significant difference in the mean pretest score of Achievement in Mathematics (Higher order objectives) between experimental and control groups for
    a) Total sample
    b) Subsample Boys
    c) Subsample Girls
6. There is significant difference between the mean pretest and posttest scores of Mathematics Anxiety of the experimental group for
    a) Total sample
    b) Subsample Boys
    c) Subsample Girls
7. There is significant difference between the mean pretest and posttest scores of Achievement in Mathematics (Total) of the experimental group for
    a) Total sample
    b) Subsample Boys
    c) Subsample Girls
8. There is significant difference between the mean pretest and posttest scores of Achievement in Mathematics (Lower order objectives) of the experimental group for
    a) Total sample
    b) Subsample Boys
    c) Subsample Girls
9. There is significant difference between the mean pretest and posttest scores of Achievement in Mathematics (Higher order objectives) of the experimental group for
    a) Total sample
    b) Subsample Boys
    c) Subsample Girls

10. There is significant difference in the mean posttest score of Mathematics Anxiety between experimental and control groups for
    a) Total sample
    b) Subsample Boys
    c) Subsample Girls
11. There is significant difference in the mean posttest score of Achievement in Mathematics (Total) between experimental and control groups for
    a) Total sample
    b) Subsample Boys
    c) Subsample Girls
12. There is significant difference in the mean posttest score of Achievement in Mathematics (Lower order objectives) between experimental and control groups for
    a) Total sample
    b) Subsample Boys
    c) Subsample Girls
13. There is significant difference in the mean posttest score of Achievement in Mathematics (Higher order objectives) between experimental and control groups for
    a) Total sample
    b) Subsample Boys
    c) Subsample Girls
14. There is significant difference in the mean change score of Mathematics Anxiety between experimental and control groups for
    a) Total sample
    b) Subsample Boys
    c) Subsample Girls

15. There is significant difference in the mean gain score of Achievement in Mathematics (Total) between experimental and control groups for
    a) Total sample
    b) Subsample Boys
    c) Subsample Girls
16. There is significant difference in the mean gain score of Achievement in Mathematics (Lower order objectives) between experimental and control groups for
    a) Total sample
    b) Subsample Boys
    c) Subsample Girls
17. There is significant difference in the mean gain score of Achievement in Mathematics (Higher order objectives) between experimental and control groups for
    a) Total sample
    b) Subsample Boys
    c) Subsample Girls
18. There is significant difference in the adjusted mean score of Mathematics Anxiety between experimental and control groups by considering Pre-Achievement in Mathematics, Verbal Intelligence and Non-verbal Intelligence as covariates for
    a) Total sample
    b) Subsample Boys
    c) Subsample Girls

19. There is significant difference in the adjusted mean score of Achievement in Mathematics (Total) between experimental and control groups by considering Pre- Achievement in Mathematics, Verbal Intelligence and Non-verbal Intelligence as covariates for
    a) Total sample
    b) Subsample Boys
    c) Subsample Girls
20. There is significant difference in the adjusted mean score of Achievement in Mathematics (Lower order objectives) between experimental and control groups by considering Pre- Achievement in Mathematics, Verbal Intelligence and Non-verbal Intelligence as covariates for
    a) Total sample
    b) Subsample Boys
    c) Subsample Girls
21. There is significant difference in the adjusted mean score of Achievement in Mathematics (Higher order objectives) between experimental and control groups by considering Pre- Achievement in Mathematics, Verbal Intelligence and Non-verbal Intelligence as covariates for
    a) Total sample
    b) Subsample Boys
    c) Subsample Girls

Methodology

The study was carried out in two phases. First phase was preliminary survey and second phase was the experiment.

Design of the study

In the first phase, survey method was used and in the second phase quasi experimental method was used. The experimental design was pretest- posttest non equivalent groups design.

Sample

The sample for the preliminary survey consisted of 400 upper primary school students from seven schools of Malappuram and Palakkad districts of Kerala.

One twenty eight standard VI students belonging to four intact classes of two schools in Malappuram district constituted the sample for the experiment. There were 68 students in experimental group and 62 students in control group.

Tools and materials

1. Mathematics Anxiety Scale (Musthafa & Sunitha, 2012)
2. Lesson Transcripts based on Cognitively Guided Instructional Strategy (Musthafa & Sunitha, 2013)
3. Lesson Transcripts on Existing method of teaching (Musthafa & Sunitha, 2013)
4. Test of Achievement in Mathematics (Musthafa & Sunitha, 2013)
5. Verbal Group Test of Intelligence (Kumar, Hameed & Prasanna, 1997)
6. Standard Progressive Matrices Test (Raven, 1958)

Statistical techniques

1. Basic descriptive statistics
2. Standardised skewness and kurtosis
3. Correlation coefficient
4. Test of significance of difference between mean scores of
   - Two independent groups
   - Two dependent groups
5. Analysis of Covariance (ANCOVA)
6. Bonferroni's Test of Post Hoc Comparison
7. Effect size (Cohen's *d* and Partial eta squared)

Major Findings of the Study

The major findings of the study are presented sequentially in this section.

Findings of the Preliminary Survey

In the first phase of the study, a preliminary survey was conducted to identify the then existing level of Mathematics Anxiety of upper primary school students and to study the difference in Mathematics Anxiety of different subgroups of upper primary school students based on Gender (Boys/Girls) and Grade (Standard V/ Standard VI/ Standard VII). Following are the results of preliminary survey.

The level of Mathematics Anxiety of different subgroups of upper primary school students is below scale average value.

The mean Mathematics Anxiety scores (with standard deviations in parentheses) of different subgroups of upper primary students are as follows:

Total sample: 157.63 (43.96), Boys: 158.84 (43.51), Girls: 154.90 (44.35).

Standard V: 154.82 (48.56), Standard VI: 155.09 (36.72), Standard VII: 163.79 (49.18)

All the mean scores are less than the scale average value 204. The high standard deviation values suggest that there is great deal of variability among individual Mathematics Anxiety scores.

The existing levels of Mathematics Anxiety of Boys and Girls are almost equal when compared.

The obtained t value, $t(398) = 0.88$, $p > .05$ is not statistically significant at .05 level. So the mean Mathematics Anxiety scores of Boys and Girls among upper primary school students did not differ significantly. Hence Boys and Girls have same level of Mathematics Anxiety at upper primary level.

The existing levels of Mathematics Anxiety of standard V, VI and VII students are almost equal when compared.

The obtained F (2,397) = 1.69, p =.186 is not significant at .05 level. So there was no significant effect of Grade on mean Mathematics Anxiety scores of upper primary school students. Hence students studying in standard V, VI and VII have same levels of Mathematics Anxiety.

Findings of the Experiment

The following are the results of the experiment conducted to study the effectiveness of Cognitively Guided Instructional Strategy in reducing Mathematics Anxiety and enhancing Achievement in Mathematics of upper primary school students.

Cognitively Guided Instructional Strategy is effective in reducing Mathematics Anxiety of upper primary school students (Total and Boys samples) belonging to experimental group.

The mean posttest score of Mathematics Anxiety of upper primary school students belonging to experimental group is less than the mean pretest score for Total sample, Boys and Girls suggesting reduction in Mathematics Anxiety after intervention. The difference between mean pretest and posttest scores of Mathematics Anxiety are significant for Total sample and subsamples Boys and Girls.

Total pretest and posttest: M_{Pre} 148.39, M_{Post} 137.17; $t(65)=3.04$, $p<.01$, $r=.72$

Boys pretest and posttest: M_{Pre} 150.95, M_{Post} 136.95; $t(37)=2.58$, $p<.05$, $r=.67$

Girls pretest and posttest: M_{Pre} 144.93, M_{Post} 137.46; $t(27)=1.60$, $p>.05$, $r=.77$

The results were also supported by graphical representations. Hence Cognitively Guided Instructional Strategy is effective in reducing Mathematics Anxiety of upper primary school students in the experimental group for Total sample and subsample Boys and is not effective for Girls.

Cognitively Guided Instructional Strategy is effective in enhancing Achievement in Mathematics (Total) of upper primary school students (Total sample, subsample Boys and subsample Girls) belonging to experimental group.

The mean posttest score of Achievement in Mathematics (Total) of upper primary school students belonging to experimental group is greater than mean pretest score for Total sample, Boys and Girls suggesting increase in Achievement in Mathematics (Total) after intervention. The difference between mean pretest and posttest scores of Achievement in Mathematics (Total) is significant for Total sample, subsample Boys and subsample Girls.

Total pretest and posttest: M_{Pre} 5.74, M_{Post} 17.38; t(65)=15.81, p<.01, r= .56

Boys pretest and posttest: M_{Pre} 5.58, M_{Post} 16.32; t(37)=11.73, p<.01, r=.46

Girls pretest and posttest: M_{Pre} 5.96, M_{Post} 18.82; t(27) =10.79, p<.01, r=.65

The results were also supported by graphical representations. Hence Cognitively Guided Instructional Strategy is effective in enhancing Achievement in Mathematics (Total) of upper primary school students in the experimental group for Total sample, subsample Boys and subsample Girls.

Cognitively Guided Instructional Strategy is effective in enhancing Achievement in Mathematics (Lower order objectives) of upper primary school students (Total sample, subsample Boys and subsample Girls) belonging to experimental group.

The mean posttest score is greater than mean pretest score for Total sample, subsample Boys and subsample Girls suggesting increase in Achievement in Mathematics (Lower order objectives) after intervention for upper primary school students belonging to experimental group. The difference between mean pretest and posttest scores are significant for Total sample and subsamples based on Gender.

Total pretest and posttest: M_{Pre} 5.05, M_{Post} 13.64; $t(65) = 14.21$, $p<.01$, $r=.54$

Boys pretest and posttest: M_{Pre} 4.87, M_{Post} 12.76; $t(37) = 10.09$, $p<.01$, $r=.44$

Girls pretest and posttest: M_{Pre} 5.29, M_{Post} 14.82; $t(27)=10.18$, $p<.01$, $r=.62$

The results were substantiated by graphical representations also. Hence Cognitively Guided Instructional Strategy is effective in enhancing Achievement in Mathematics (Lower order objectives) of upper primary school students (Total sample, subsample Boys and subsample Girls) in the experimental group.

Cognitively Guided Instructional Strategy is effective in enhancing Achievement in Mathematics (Higher order objectives) of upper primary school students (Total sample, subsample Boys and subsample Girls) belonging to experimental group.

The mean posttest score is greater than mean pretest score for Total sample, subsample Boys and subsample Girls suggesting increase in Achievement in Mathematics (Higher order objectives) after intervention for upper primary school students belonging to experimental group. The difference between mean pretest and posttest scores are significant for Total sample and subsamples based on Gender.

Total pretest and posttest: M_{Pre} 0.70, M_{Post} 3.74; $t(65)= 14.83$, $p<.01$, $r=.48$

Boys pretest and posttest: M_{Pre} 0.71, M_{Post} 3.55; $t(37)= 12.47$, $p<.01$, $r=.45$

Girls pretest and posttest: M_{Pre} 0.68, M_{Post} 4.00; $t(27)= 8.95$, $p<.01$, $r = .54$

The results were also substantiated by graphical representations. Hence Cognitively Guided Instructional Strategy is effective in enhancing Achievement in Mathematics (Higher order objectives) of upper primary school students (Total sample, subsample Boys and subsample Girls) in the experimental group.

Cognitively Guided Instructional Strategy is more effective than Existing method of teaching in reducing Mathematics Anxiety of upper primary school students (Total sample, Subsample Boys and Subsample Girls).

Test of significance of difference between mean pretest score of Mathematics Anxiety of experimental and control groups revealed that the mean differences are not statistically significant at .05 level. Hence the pre experimental status in Mathematics Anxiety of experimental and control groups was almost the same for Total sample and subsample based on Gender.

Total Pretest: M_{Exp} 148.39, M_{Ctrl} 154.55; $t(126) = 0.83$, $p>.05$

Boys Pretest: M_{Exp} 150.95, M_{Ctrl} 161.47; $t(68) = 1.11$, $p>.05$

Girls Pretest: M_{Exp} 144.93, M_{Ctrl} 147.17; $t(56) = 0.19$, $p>.05$

The mean posttest score of Mathematics Anxiety of experimental group is less than that of control group for Total sample, subsample Boys and subsample Girls. The mean differences were found significant for Total and Boys samples but not for Girls.

Total Posttest: M_{Exp}137.17, M_{Ctrl} 160.02; $t(126) = 2.91$, $p<.01$

Boys Posttest: M_{Exp} 136.95, M_{Ctrl} 172.47; $t(68) = 3.43$, $p<.01$

Girls Posttest: M_{Exp} 137.46, M_{Ctrl} 146.73; $t(56) = 0.82$, $p>.05$

The mean change score of Mathematics Anxiety of experimental group is less than that of control group for Total, Boys and Girls samples and the mean change scores are negative values for experimental group suggesting reduction in Mathematics Anxiety after the intervention. The mean differences were found statistically significant for Total sample and Boys subsample but not for Girls. The calculated values of effect size, Cohen's *d* showed medium effect of Cognitively Guided Instructional Strategy in reducing Mathematics Anxiety of upper primary school students when compared to Existing method of teaching for Total sample and subsample Boys.

Total Change score: M_{Exp} -11.23, M_{Ctrl} 5.47; t (126) = 2.88, p<.01, *d* 0.51, Medium

Boys Change score: M_{Exp} -14.00, M_{Ctrl} 11.00; t (68) = 2.98, p<.01, *d* 0.72, Medium

Girls Change score: M_{Exp} -7.46, M_{Ctrl} -0.43; t (56) = 0.90, p>.05

The results were substantiated by graphical representations also.

The results of ANCOVA carried out on the dependent variable Mathematics Anxiety by considering Pre- Achievement in Mathematics, Verbal Intelligence and Non-verbal Intelligence as covariates and the results of Bonferroni's test of post hoc comparison are summarized in Table 77.

Table 77

Summary of ANCOVA of Mathematics Anxiety for Total, Boys and Girls Samples

Sample	Covariate	ANCOVA	Post Hoc Comparison			Partial eta squared
		F	Adjusted Means		t	
			Experimental group	Control group		
Total sample	Pre- Achievement in Mathematics	11.67**	135.34	161.96	3.42**	.085
	Verbal Intelligence	20.91***	132.27	165.23	4.57**	.143
	Non-verbal Intelligence	7.65**	138.32	158.79	2.77**	.058
	Combined Effect	17.62***	132.92	164.54	7.53**	.125
Boys	Pre- Achievement in Mathematics	13.39***	136.15	173.42	3.66**	.167
	Verbal Intelligence	14.36***	135.22	174.52	3.79**	.177
	Non-verbal Intelligence	9.70**	138.22	170.96	3.12**	.127
	Combined Effect	12.82**	135.76	173.88	3.58**	.165

Sample	Covariate	ANCOVA	Post Hoc Comparison			Partial eta squared
			Adjusted Means			
		F	Experimental group	Control group	t	
Girls	Pre- Achievement in Mathematics	1.07	135.82	148.27	1.03	.019
	Verbal Intelligence	8.18**	128.52	155.08	2.86**	.129
	Non-verbal Intelligence	0.95	137.06	147.11	0.97	.017
	Combined Effect	5.78*	129.25	154.40	2.41*	.098

* p<.05 ** p<.01 *** p<.001

It is clear from Table 77 that all the F values obtained for the effect of Instructional strategy after controlling the individual and combined effects of the three covariates and the respective t values of post hoc comparison of adjusted means of Mathematics Anxiety were statistically significant except the F values obtained after controlling the individual effects of Pre- Achievement in Mathematics and Non- verbal Intelligence for subsample Girls. But in all the cases, lower adjusted mean scores of Mathematics Anxiety were associated with experimental group. Moreover, experimental and control groups differed significantly after controlling the combined effects of Pre- Achievement in Mathematics, Verbal Intelligence and Non- verbal Intelligence for subsample girls. The results were also substantiated by the values of Partial eta squared.

Hence from the results of mean difference analysis of pretest scores, posttest scores and change scores of Mathematics Anxiety between experimental and control groups and from the results of ANCOVA, it can be concluded that Cognitively Guided Instructional Strategy is more effective than Existing method of teaching in reducing Mathematics Anxiety of upper primary school students for Total sample, subsample Boys and subsample Girls.

Cognitively Guided Instructional Strategy is more effective than Existing method of teaching in enhancing Achievement in Mathematics (Total) of upper primary school students (Total sample, subsample Boys and subsample Girls).

The mean difference analysis of pretest scores of Achievement in Mathematics (Total) showed that the experimental and control groups did not differ significantly for Boys subsample but the two groups differed significantly for Total and Girls samples and higher mean pretest scores were seen associated with control group.

Total Pretest: M_{Exp} 5.74, M_{Ctrl} 6.84; $t(126) = 2.27$, $p<.05$

Boys Pretest: M_{Exp} 5.58, M_{Ctrl} 6.00; $t(68) = 0.72$, $p>.05$

Girls Pretest: M_{Exp} 5.96, M_{Ctrl} 7.73; $t(56) = 2.27$, $p<.05$

The mean posttest scores of Achievement in Mathematics (Total) of experimental group are greater than those of control group for all the three samples. The results of mean difference analysis of posttest scores of experimental and control groups showed that the t values obtained are significant at .01 and .05 levels respectively for Total and Boys samples and the t value is not significant for subsample Girls.

Total Posttest: M_{Exp} 17.38, M_{Ctrl} 13.98; $t(126) = 2.78$, $p<.01$

Boys Posttest: M_{Exp} 16.32, M_{Ctrl} 12.41; $t(68) = 2.56$, $p<.05$

Girls Posttest: M_{Exp} 18.82, M_{Ctrl} 15.67; $t(56) = 1.65$, $p>.05$

The mean difference analysis of gain scores of Achievement in Mathematics (Total) of experimental and control groups showed that the two groups differed significantly at .01 level and greater gain scores were found associated with experimental group for all the three samples. The values of effect size in terms of Cohen's *d* showed large effect of Cognitively Guided

Instructional Strategy when compared to Existing method of teaching in enhancing Achievement in Mathematics (Total) of upper primary school students for Boys and Girls subsamples and medium effect of Cognitively Guided Instructional Strategy for Total sample.

Total Gain: M_{Exp} 11.64, M_{Ctrl} 7.15; t (126) =4.44, p<.01, *d* 0.79, Medium

Boys Gain: M_{Exp} 10.74, M_{Ctrl} 6.41; t (68) =3.44, p<.01, *d* 0.83, Large

Girls Gain: M_{Exp} 12.86, M_{Ctrl} 7.93; t (56) = 3.04, p<.01, *d* 0.80, Large

The results were substantiated by graphical representations also.

The results of ANCOVA carried out on the dependent variable Achievement in Mathematics (Total) by considering Pre- Achievement in Mathematics, Verbal Intelligence and Non-verbal Intelligence as covariates and the results of Bonferroni's test of post hoc comparison for Total sample, subsample Boys and subsample Girls are summarized in Table 78.

Table 78

Summary of ANCOVA of Achievement in Mathematics (Total) - Total, Boys and Girls Samples

Sample	Covariate	ANCOVA	Post Hoc Comparison			Partial eta squared
			Adjusted Means			
		F	Experimental group	Control group	t	
Total sample	Pre-Achievement in Mathematics	25.11***	18.18	13.14	5.01**	.167
	Verbal Intelligence	22.31***	18.24	13.07	4.72**	.151
	Non-verbal Intelligence	7.01**	17.12	14.26	2.65**	.053
	Combined Effect	35.64***	18.47	12.82	5.97**	.225
Boys	Pre-Achievement in Mathematics	14.00***	16.62	12.04	3.74**	.173
	Verbal Intelligence	9.74**	16.66	12.00	3.10**	.127
	Non-verbal Intelligence	4.78*	16.06	12.72	2.19*	.067
	Combined Effect	13.96***	16.71	11.94	3.74**	.177
Girls	Pre-Achievement in Mathematics	10.90**	20.07	14.50	3.30**	.165
	Verbal Intelligence	16.45***	20.36	14.23	4.06**	.230
	Non-verbal Intelligence	5.45*	18.92	15.57	2.34*	.090
	Combined Effect	24.68***	20.75	13.86	4.97**	.318

* p<.05 ** p<.01 *** p<.001

It is clear from Table 78 that all the F values obtained for the effect of Instructional strategy after controlling the individual and combined effects of the three covariates and the respective t values of post hoc comparison of adjusted means were statistically significant for Total sample, subsample Boys and subsample Girls. Moreover, in all the cases greater adjusted mean scores of Achievement in Mathematics (Total) were associated with experimental group. The results were also substantiated by the values of Partial eta squared.

Hence from the results of mean difference analysis of pretest scores, posttest scores and gain scores of Achievement in Mathematics (Total) between experimental and control groups and from the results of ANCOVA, it can be concluded that Cognitively Guided Instructional Strategy is more effective than Existing method of teaching in enhancing Achievement in Mathematics (Total) of upper primary school students for Total sample, subsample Boys and subsample Girls.

Cognitively Guided Instructional Strategy is more effective than Existing method of teaching in enhancing Achievement in Mathematics (Lower order objectives) of upper primary school students (Total sample, subsample Boys and subsample Girls).

The mean difference analysis of pretest scores of Achievement in Mathematics (Lower order objectives) of experimental and control groups showed that the two groups did not differ significantly for Boys sample but differed significantly for Total sample and subsample Girls at .05 level of significance. But greater means were associated with control group before intervention.

Total Pretest: M_{Exp} 5.05, M_{Ctrl} 6.06; $t(126) = 2.58$, $p<.05$

Boys Pretest: M_{Exp} 4.87, M_{Ctrl} 5.47; $t(68) = 1.26$, $p>.05$

Girls Pretest: M_{Exp} 5.29, M_{Ctrl} 6.70; $t(56) = 2.20$, $p<.05$

The mean difference analysis of posttest scores of Achievement in Mathematics (Lower order objectives) of experimental and control groups showed that the two groups differed significantly for Total sample but not for Boys and Girls subsamples. But greater means were associated with experimental group after intervention.

Total Posttest: M_{Exp} 13.64, M_{Ctrl} 11.45; t (126) = 2.21, p<.05

Boys Posttest: M_{Exp} 12.76, M_{Ctrl} 10.38; t (68) = 1.85, p>.05

Girls Posttest: M_{Exp} 14.82, M_{Ctrl} 12.60; t (56) = 1.49, p>.05

The mean difference analysis of gain scores showed that the experimental and control groups differed significantly in terms of Achievement in Mathematics (Lower order objectives) as all the obtained t values are significant at .01 level. Greater mean gain scores were associated with experimental group. These results and the obtained values of Cohen's *d* showed medium effect of Cognitively Guided Instructional Strategy in enhancing Achievement in Mathematics (Lower order objectives) of upper primary school students when compared to Existing method of teaching for Total, Boys and Girls samples.

Total Gain: M_{Exp} 8.59, M_{Ctrl} 5.39; t (126) = 3.83, p<.01, *d* 0.68, Medium

Boys Gain: M_{Exp} 7.89, M_{Ctrl} 4.91; t (68) = 2.70, p<.01, *d* 0.65, Medium

Girls Gain: M_{Exp} 9.54, M_{Ctrl} 5.90; t (56) =2.86, p<.01, *d* 0.75, Medium

These results were substantiated by graphical representations also.

The results of ANCOVA carried out on the variable Achievement in Mathematics (Lower order objectives) by considering Pre- Achievement in Mathematics, Verbal Intelligence and Non-verbal Intelligence as covariates and the results of Bonferroni's test of post hoc comparison for Total sample, subsample Boys and subsample Girls are summarized in Table 79.

Table 79

Summary of ANCOVA of Achievement in Mathematics (Lower order objectives) for Total, Boys and Girls Samples

Sample	Covariate	ANCOVA	Post Hoc Comparison		t	Partial eta squared
			Adjusted Means			
		F	Experimental group	Control group		
Total sample	Pre-Achievement in Mathematics	18.16***	14.27	10.78	4.26**	.127
	Verbal Intelligence	16.38***	14.32	10.72	4.05**	.116
	Non-verbal Intelligence	3.99*	13.44	11.66	2.00*	.031
	Combined Effect	27.29***	14.56	10.47	5.22**	.182
Boys	Pre-Achievement in Mathematics	7.70**	13.01	10.08	2.78**	.103
	Verbal Intelligence	5.96*	13.07	10.01	2.44*	.082
	Non-verbal Intelligence	2.39	12.60	10.57	1.55	.034
	Combined Effect	9.06**	13.19	9.87	3.01**	.122
Girls	Pre-Achievement in Mathematics	10.05**	15.81	11.68	3.17**	.155
	Verbal Intelligence	14.23***	16.00	11.50	3.77**	.206
	Non-verbal Intelligence	4.75*	14.90	12.53	2.18*	.080
	Combined Effect	21.30***	16.24	11.28	4.62**	.287

* $p<.05$ ** $p<.01$ *** $p<.001$

It is clear from Table 79 that all the F values obtained for the effect of Instructional strategy after controlling the individual and combined effects of the three covariates and the respective t values of post hoc comparison of adjusted means were statistically significant for Total sample, subsample Boys and subsample Girls except the F value obtained after controlling the individual effect of Non- verbal Intelligence for subsample Boys. However, in all the cases greater adjusted mean scores of Achievement in Mathematics (Lower order objectives) were associated with experimental group. These results were also substantiated by the values of Partial eta squared.

Hence from the results of mean difference analysis of pretest, posttest and gain scores and the results of ANCOVA it can be concluded that Cognitively Guided Instructional Strategy is more effective than Existing method of teaching in enhancing Achievement in Mathematics (Lower order objectives) of upper primary school students for Total sample, subsample Boys and subsample Girls.

Cognitively Guided Instructional Strategy is more effective than Existing method of teaching in enhancing Achievement in Mathematics (Higher order objectives) of upper primary school students (Total sample, subsample Boys and subsample Girls).

Mean difference analysis of pretest scores showed that the experimental and control groups did not differ significantly in Achievement in Mathematics (Higher order objectives) before intervention as the t values are not significant at .05 level for Total sample, subsample Boys and subsample Girls.

Total Pretest: M_{Exp} 0.70, M_{Ctrl} 0.76; $t(126) = 0.44$, $p>.05$

Boys Pretest: M_{Exp} 0.71, M_{Ctrl} 0.50; $t(68) = 1.18$, $p>.05$

Girls Pretest: M_{Exp} 0.68, M_{Ctrl} 1.03; $t(56) = 1.66$, $p>.05$

The comparison of mean posttest scores of Achievement in Mathematics (Higher order objectives) of experimental and control groups showed that the two groups differed significantly for Total and Boys samples but not for Girls. For all the three samples, greater means were associated with experimental group after intervention.

Total Posttest: M_{Exp} 3.74, M_{Ctrl} 2.53; t (126) = 3.69, p<.01

Boys Posttest: M_{Exp} 3.55, M_{Ctrl} 2.03; t (68) = 4.03, p<.01

Girls Posttest: M_{Exp} 4.00, M_{Ctrl} 3.07; t (56) = 1.70, p>.05

The mean difference analysis of gain scores of Achievement in Mathematics (Higher order objectives) showed that the experimental and control groups differed significantly for all the three samples as the obtained t values are significant. Greater mean gain scores were associated with experimental group. These results and the values of effect size in terms of Cohen's *d* showed large effect Cognitively Guided Instructional Strategy in enhancing Achievement in Mathematics (Higher order objectives) of upper primary school students as compared to Existing method of teaching for Total and Boys samples and medium effect of Cognitively Guided Instructional Strategy for Girls.

Total Gain: M_{Exp} 3.05, M_{Ctrl} 1.77; t (126) = 4.59, p<.01, d 0.82, Large

Boys Gain: M_{Exp} 2.84, M_{Ctrl} 1.53; t (68) = 4.36, p<.01, d 1.04, Large

Girls Gain: M_{Exp} 3.32, M_{Ctrl} 2.03; t (56) =2.63, p<.05, d 0.69, Medium

These results were substantiated by graphical representations also.

The results of ANCOVA carried out on the variable Achievement in Mathematics (Higher order objectives) by considering Pre- Achievement in Mathematics, Verbal Intelligence and Non-verbal Intelligence as covariates and the results of Bonferroni's test of post hoc comparison for Total sample, subsample Boys and subsample Girls are summarized in Table 80.

Table 80

Summary of ANCOVA of Achievement in Mathematics (Higher order objectives) for Total, Boys and Girls Samples

Sample	Covariate	ANCOVA	Post Hoc Comparison		t	Partial eta squared
			Adjusted Means			
		F	Experimental	Comparison		
Total sample	Pre-Achievement in Mathematics	26.29***	3.90	2.36	5.13**	.174
	Verbal Intelligence	24.64***	3.92	2.35	4.91**	.165
	Non-verbal Intelligence	13.07***	3.68	2.60	3.62**	.095
	Combined Effect	27.28***	3.92	2.35	5.22**	.182
Boys	Pre-Achievement in Mathematics	23.15***	3.61	1.97	4.81**	.257
	Verbal Intelligence	17.08***	3.59	1.99	4.13**	.203
	Non-verbal Intelligence	12.85**	3.46	2.14	3.59**	.161
	Combined Effect	17.23***	3.53	2.06	4.15**	.210
Girls	Pre-Achievement in Mathematics	7.24**	4.26	2.83	2.69**	.116
	Verbal Intelligence	11.12**	2.83	2.73	3.33**	.168
	Non-verbal Intelligence	3.91*	4.02	3.05	1.98*	.066
	Combined Effect	14.00***	4.52	2.58	3.74**	.209

* p<.05 ** p<.01 *** p<.001

It is clear from Table 80 that all the F values obtained for the effect of Instructional strategy after controlling the individual and combined effects of Pre-Achievement in Mathematics, Verbal Intelligence and Non-verbal Intelligence and their respective t values of post hoc comparison of adjusted means were statistically significant for Total sample, subsample Boys and subsample Girls. Moreover, in all the cases greater adjusted mean scores of Achievement in Mathematics (Higher order objectives) were associated with experimental group. These results were also substantiated by the values of Partial eta squared.

Hence from the results of mean difference analysis of pretest scores, posttest scores and gain scores between experimental and control groups and from the results of ANCOVA it can be concluded that Cognitively Guided Instructional Strategy is more effective than Existing method of teaching in enhancing Achievement in Mathematics (Higher order objectives) of upper primary school students (Total sample, subsample Boys and subsample Girls).

Tenability of Hypotheses

The tenability of the hypotheses formulated for the present study is examined in the light of the major findings of the study.

The first hypothesis of the study states "There is no significant difference in the existing level of Mathematics Anxiety of different subgroups of upper primary school students based on

a) Gender (Boys/ Girls)
b) Grade (Standard V/Standard VI/Standard VII)".

Statistically significant difference was not found in the mean Mathematics Anxiety scores of Boys and Girls subsamples of upper primary school students and in the mean Mathematics Anxiety scores of students of standard V, VI and VII.

Therefore the first hypothesis is fully accepted.

The second hypothesis of the study states “There is no significant difference in the mean pretest score of Mathematics Anxiety between experimental and control groups for

a) Total sample
b) Subsample Boys
c) Subsample Girls”.

Statistically significant difference was not found between mean pretest scores of Mathematics Anxiety of experimental and control groups for the Total sample, subsample Boys and subsample Girls.

Therefore the second hypothesis is fully accepted.

The third hypothesis states “There is no significant difference in the mean pretest score of Achievement in Mathematics (Total) between experimental and control groups for

a) Total sample
b) Subsample Boys
c) Subsample Girls”.

Statistically significant difference was not found between mean pretest scores of Achievement in Mathematics (Total) of experimental and control groups for subsample Boys and statistically significant difference was found for Total sample and subsample Girls.

Therefore the hypothesis 3(b) is accepted and the hypotheses 3(a) and 3 (c) are rejected

The fourth hypothesis states “There is no significant difference in the mean pretest score of Achievement in Mathematics (Lower order objectives) between experimental and control groups for

a. Total sample
b. Subsample Boys
c. Subsample Girls”.

Statistically significant difference was not found between mean pretest scores of Achievement in Mathematics (Lower order objectives) of experimental and control groups subsample Boys and statistically significant difference was found for Total sample and subsample Girls.

Therefore the hypothesis 4(b) is accepted and the hypotheses 4(a) and 4(c) are rejected

The fifth hypothesis of the study states "There is no significant difference in the mean pretest score of Achievement in Mathematics (Higher order objectives) between experimental and control groups for

a) Total sample
b) Subsample Boys
c) Subsample Girls

Statistically significant difference was not found between mean pretest scores of Achievement in Mathematics (Higher order objectives) of experimental and control groups for Total sample, subsample Boys and subsample Girls

Therefore the fifth hypothesis is fully accepted

The sixth hypothesis of the study states "There is significant difference between the mean pretest and posttest scores of Mathematics Anxiety of the experimental group for

a) Total sample
b) Subsample Boys
c) Subsample Girls".

Statistically significant difference was found between mean pretest scores and posttest scores of Mathematics Anxiety of upper primary school students in the experimental group for Total sample and subsample Boys but significant difference was not found for subsample Girls.

Therefore the hypotheses 6(a) &6 (b) are accepted and 6(c) is rejected.

The seventh hypothesis of the study states “There is significant difference between the mean pretest and posttest scores of Achievement in Mathematics (Total) of the experimental group for

a) Total sample
b) Subsample Boys
c) Subsample Girls”.

Statistically significant difference was found between mean pretest and posttest scores of Achievement in Mathematics (Total) of students belonging to experimental group for Total sample, subsample Boys and subsample Girls.

Hence the seventh hypothesis is fully accepted

The eighth hypothesis states “There is significant difference between the mean pretest and posttest scores of Achievement in Mathematics (Lower order objectives) of the experimental group for

a) Total sample
b) Subsample Boys
c) Subsample Girls”.

Statistically significant difference was found between mean pretest and posttest scores of Achievement in Mathematics (Lower order objectives) of upper primary school students belonging to experimental group for Total sample, subsample Boys and subsample Girls.

Hence the eighth hypothesis is fully accepted

The ninth hypothesis of the study states “There is significant difference between the mean pretest and posttest scores of Achievement in Mathematics (Higher order objectives) of the experimental group for

a) Total sample

b) Subsample Boys

c) Subsample Girls

Statistically significant difference was found between mean pretest and posttest scores of Achievement in Mathematics (Higher order objectives) of upper primary school students belonging to experimental group for Total sample, subsample Boys and subsample Girls.

Therefore the ninth hypothesis is fully accepted

The tenth hypothesis of the study states "There is significant difference in the mean posttest score of Mathematics Anxiety between experimental and control groups for

a. Total sample
b. Subsample Boys
c. Subsample Girls".

Statistically significant difference was found between mean posttest scores of Mathematics Anxiety of experimental and control groups for Total sample and subsample Boys and significant difference was not found for subsample Girls.

Therefore the hypotheses 10 (a) and 10 (b) are accepted and 10(c) is rejected

The eleventh hypothesis of the study states "There is significant difference in the mean posttest score of Achievement in Mathematics (Total) between experimental and control groups for

a) Total sample
b) Subsample Boys
c) Subsample Girls".

Statistically significant difference was found between mean posttest scores of experimental and control groups in Achievement in Mathematics (Total) for Total sample and subsample Boys and statistically significant difference was not found for subsample Girls.

Therefore the hypotheses 11 (a) and 11(b) are accepted and 11 (c) is rejected

The twelfth hypothesis of the study states “There is significant difference in the mean posttest score of Achievement in Mathematics (Lower order objectives) between experimental and control groups for

a) Total sample
b) Subsample Boys
c) Subsample Girls”.

Statistically significant difference was found between mean posttest scores of experimental and control groups in Achievement in Mathematics (Lower order objectives) for Total sample and statistically significant difference was not found for subsamples Boys and Girls.

Therefore the hypothesis 12(a) is accepted and 12(b) and 12 (c) are rejected

The thirteenth hypothesis of the study states “There is significant difference in the mean posttest score of Achievement in Mathematics (Higher order objectives) between experimental and control groups for

a) Total sample
b) Subsample Boys
c) Subsample Girls

Statistically significant difference was found between mean posttest scores of experimental and control groups in Achievement in Mathematics (Higher order objectives) for Total and Boys samples and statistically significant difference was not found for Girls.

Therefore the hypotheses 13 (a) and 13 (b) are accepted and 13 (c) is rejected

The fourteenth hypothesis of the study states "There is significant difference in the mean change score of Mathematics Anxiety between experimental and control groups for

a) Total sample
b) Subsample Boys
c) Subsample Girls".

Statistically significant difference was found between mean change scores of Mathematics Anxiety of experimental and control groups for Total sample and subsample Boys but not for subsample Girls.

Therefore the hypotheses 14 (a) and 14 (b) are accepted and 14 (c) is rejected

The fifteenth hypothesis of the study states "There is significant difference in the mean gain score of Achievement in Mathematics (Total) between experimental and control groups for

a) Total sample
b) Subsample Boys
c) Subsample Girls".

Statistically significant difference was found between mean gain scores of Achievement in Mathematics (Total) of experimental and control groups for Total sample, subsample Boys and subsample Girls.

Therefore the fifteenth hypothesis is fully accepted.

The sixteenth hypothesis of the study states "There is significant difference in the mean gain score of Achievement in Mathematics (Lower order objectives) between experimental and control groups for

a) Total sample
b) Subsample Boys
c) Subsample Girls".

Statistically significant difference was found between mean gain scores of Achievement in Mathematics (Lower order objectives) of experimental and control groups for Total sample, subsample Boys and subsample Girls.

Hence the sixteenth hypothesis is fully accepted

The seventeenth hypothesis of the study states "There is significant difference in the mean gain score of Achievement in Mathematics (Higher order objectives) between experimental and control groups for

a) Total sample
b) Subsample Boys
c) Subsample Girls".

Statistically significant difference was found between mean gain scores of Achievement in Mathematics (Higher order objectives) of experimental and control groups for Total sample, subsamples Boys and Girls.

Therefore the seventeenth hypothesis is fully accepted

The eighteenth hypothesis of the study states "There is significant difference in the adjusted mean score of Mathematics Anxiety between experimental and control groups by considering Pre- Achievement in Mathematics, Verbal Intelligence and Non-verbal Intelligence as covariates for

a) Total sample
b) Subsample Boys
c) Subsample Girls".

Statistically significant difference was found in the adjusted mean scores of Mathematics Anxiety between experimental and control groups after controlling the combined effect of the covariates Pre- Achievement in Mathematics, Verbal Intelligence and Non-verbal Intelligence for Total sample, subsample Boys and subsample Girls.

Therefore the eighteenth hypothesis is fully accepted.

The nineteenth hypothesis of the study states "There is significant difference in the adjusted mean score of Achievement in Mathematics (Total) between experimental and control groups by considering Pre- Achievement in Mathematics, Verbal Intelligence and Non-verbal Intelligence as covariates for

a) Total sample
b) Subsample Boys
c) Subsample Girls".

Statistically significant difference was found in the adjusted mean scores of Achievement in Mathematics (Total) between experimental and control groups after controlling the individual and combined effect of the covariates Pre- Achievement in Mathematics, Verbal Intelligence and Non-verbal Intelligence for Total sample, subsample Boys and subsample Girls.

Therefore the nineteenth hypothesis is fully accepted.

The twentieth hypothesis of the study states "There is significant difference in the adjusted mean score of Achievement in Mathematics (Lower order objectives) between experimental and control groups by considering Pre- Achievement in Mathematics, Verbal Intelligence and Non-verbal Intelligence as covariates for

a) Total sample
b) Subsample Boys
c) Subsample Girls".

Statistically significant difference was found in the adjusted mean scores of Achievement in Mathematics (Lower order objectives) between experimental and control groups after controlling the combined effect of the covariates Pre-Achievement in Mathematics, Verbal Intelligence and Non-verbal Intelligence for Total sample, subsamples Boys and Girls.

Therefore the twentieth hypothesis is fully accepted

The twenty first hypothesis of the study states "There is significant difference in the adjusted mean score of Achievement in Mathematics (Higher order objectives) between experimental and control groups by considering Pre-Achievement in Mathematics, Verbal Intelligence and Non-verbal Intelligence as covariates for

a) Total sample
b) Subsample Boys
c) Subsample Girls"

Statistically significant difference was found in the adjusted mean scores of Achievement in Mathematics (Higher order objectives) between experimental and control groups after controlling the individual as well as combined effect of the covariates Pre- Achievement in Mathematics, Verbal Intelligence and Non-verbal Intelligence for Total sample and subsamples based on Gender.

Therefore the twenty -first hypothesis is fully accepted

Conclusion

The analysis and further testing of hypothesis as detailed in the previous sections lead the investigator to derive the following conclusion.

The prime objective of the study was to design and develop a Cognitively Guided Instructional Strategy to reduce Mathematics Anxiety and to enhance Achievement in Mathematics of upper primary school students. The conclusions derived out of the systematically planned, sequentially arranged research procedure are:

1. The level of Mathematics Anxiety of upper primary school students is below the scale average value. Gender differences and Grade differences were not found statistically significant with regard to Mathematics Anxiety. However, boys have higher level of Mathematics Anxiety than girls and the level of Mathematics Anxiety of students tended to increase with Grade.
2. The developed Cognitively Guided Instructional Strategy was found more effective than the existing method of teaching mathematics in the upper primary schools of Kerala in reducing Mathematics Anxiety and enhancing Achievement in Mathematics.

The theoretical framework on the dependent variable Mathematics Anxiety and the related issues with mathematics learning and teaching, that the investigator conceptualized during the review and meta reading of the observations of educationists and thinkers especially on school curriculum and allied psycho-social perspectives clearly depicted the significant role of Mathematics Anxiety as a prominent affective factor on Achievement. There have been meticulous efforts from the part of all stake holders of education to make the learning, especially Mathematics learning, a joyful experience. The recent curricular reforms have contributed significantly to this. This is clearly evident from the obtained level of Mathematics Anxiety of upper primary school students, which is below the scale average value for the total as well as the subsamples categorized.

However, the existence and adverse effects of Mathematics Anxiety cannot be ignored. This necessitated the development of an instructional strategy which caters optimally to the cognitive level of the students ensuring academic achievement that can be measured in terms of specified instructional objectives. The output of this research effort is such an instructional strategy applicable to the teaching learning milieu of the state of Kerala. Following well defined methodological procedures the investigator was able to validate the effectiveness of the developed Cognitively Guided Instructional Strategy in reducing Mathematics Anxiety and enhancing Achievement in Mathematics of upper primary school students.

Educational Implications of the Study

The preliminary survey revealed that the level of Mathematics Anxiety of upper primary school students is below the scale average value. But there exists Mathematics Anxiety among upper primary school students.

The curricular reforms based on NCF (2005) and KCF (2007) gave much importance to Mathematics teaching and learning. The slogan has been 'joyful learning environment for stress free Mathematics learning'. The study reveals that in spite of all these attempts, still there remains anxiety among students towards Mathematics and related activities in the academic pursuit. This warranties the need for accelerating the efforts to create learning environments where the students can learn Mathematics devoid of fear or tension. The attempts formulated in the above curricular revisions are to be strengthened so as to reflect its fullest accomplishment at the grass root level.

The preliminary survey with the objective to find out the existing gender differences and grade differences in Mathematics Anxiety revealed that there is no significant difference related to gender and grade of upper primary school students in Mathematics Anxiety. This necessitates common strategies for students of all upper primary grades irrespective of their gender. This finding of the study is an eye opener to prospective researchers to probe into the differences in Mathematics Anxiety as related to other socio familial variables as criterions. It can also be implied that there exist some common elements for both boys and girls as precursors of Mathematics Anxiety. If it is pertaining to the curricular experiences that children at primary school receives, the sole responsibility lies on the shoulders of the teachers to identify specifically and remove the same.

The development and validation of Cognitively Guided Instructional Strategy paved the way for teachers to implement an innovative instructional strategy for teaching Mathematics at upper primary level. The foundation behind the effectiveness of Cognitively Guided Instructional Strategy is “flexibility and divergence” allowed in solving the common problem raised at the class, contrary to the conventional instructional approach to Mathematics. The innovations by Mathematics teachers should take this spirit which is the apparent ramification of the basic instinct of human being: the individual difference.

The effectiveness of Cognitively Guided Instructional Strategy for total sample and subsamples is a clear indication of its generalisability and scope at the upper primary level reducing Mathematics Anxiety and Achievement in Mathematics.

It is a general observation that the curricular reformations and experiments and innovations which are students centered very often help to reduce academic fear, since its thrust is freedom of the learner. In the midst of this over enthusiasm, it is apparent that the achievement in terms of curricular objectives is pushed back. The educational and practical implication of this strategy signifies most in this context that by reducing the anxiety of students in situations pertaining to Mathematics and Mathematics related activities Cognitively Guided Instructional Strategy ensures Achievement in Mathematics compared to the Existing method of teaching. Recent reports and documents published by national educational agencies like NCERT reflect on the poor performance of students even at secondary level indicating their inability of performing even the basic concepts. This can be attributed to the lack of importance given to the product- process outcomes of learning measured in terms of Achievement. There is the significant role of the developed instructional strategy which threshold both to the reduction of anxiety and enhancing of achievement at the same time.

The practicing Mathematics teachers can either utilize Cognitively Guided Instructional Strategy exclusively for curricular transactions or integrate the essence of this strategy to his/her teaching of Mathematics.

Any academic reform that intends to bring about systemic improvement in Mathematics learning can make use of the present research effort- the developed Cognitively Guided Instructional Strategy.

There have been a lot of scattered efforts throughout the state at institutional and governmental levels to identify and uplift poor achievers in Mathematics into the main stream. Instead of doing such things in a piece meal style, the planners at institutional and governmental level can utilize the Cognitively Guided Instructional Strategy as a referent.

The major complaint raised by the Mathematics teachers of higher grades of schools and even under graduate programme is the lack of basic mathematical competencies among students. The developed Cognitively Guided Instructional Strategy can be applied as an effective strategy specially for developing the basic mathematical skills and competencies at primary level and even as a remedial programme at higher levels to the weaker sections of students.

Effective implementation of Cognitively Guided Instructional Strategy requires highly resourceful, committed teachers who are having deep understanding of properties of numbers and relations between fundamental operations to understand children’s strategies and to select and sequence problems according to the understanding level of students. Hence the qualification criteria for Mathematics teachers are to be reframed and talented personnel are to be attracted and retained at schools with more incentives.

The prospective teachers at primary level may be oriented with Cognitively Guided Instruction so that they can use it during their practice teaching as well as when they are enrolled as teachers in the field.

Cognitively Guided Instructional Strategy can be incorporated as an essential input in the various in service programmes of teachers. Training can be given to the Mathematics teachers on how to use Cognitively Guided Instructional Strategy in their classrooms for better learning outcomes.

This research attempt made by the investigator is a real depicter of the research trends related to the variable Mathematics Anxiety. This is a clear reference for the prospective researchers in this area.

Suggestions for Further Research

Through this research attempt the investigator was able to reveal and depict the research trend related to Mathematics Anxiety and was able to design and develop an instructional strategy based on Cognitively Guided Instruction to reduce Mathematics Anxiety and to enhance Achievement in Mathematics. It is hoped that the output of this attempt is valid and generalisable. Since cognition, instructional strategy and factors related to achievement are vast areas of research, the future researchers can attempt a number of research efforts at micro and macro level related to this research quest.

A few suggestions are presented here.

1. The preliminary survey conducted by the investigator revealed that there exists Mathematics Anxiety among upper primary school students. A

study can be conducted to identify the different psycho social and school related factors that contribute to Mathematics Anxiety other than gender, since this study revealed that there is no gender difference in Mathematics Anxiety among upper primary school students.

2. It would be worthwhile to conduct a longitudinal study on Mathematics Anxiety to identify the level of existence of Mathematics Anxiety across various academic grades.
3. The study through analysing the research trend reveals that the learner experience at schools is having greater effect to the level of Mathematics Anxiety. Hence a critical appraisal of the teacher education programmes as well as of the Mathematics curricular transactions in the schools at primary and secondary level can be conducted.
4. Using the developed Cognitively Guided Instructional Strategy as a reference, a multimedia instructional package can be developed for the field use.
5. To strengthen the in service teacher education programme, a research attempt can be made to develop an instructional programme based on Cognitively Guided Instruction framework suitable to Indian conditions.

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APPENDICES

Appendix A1

DEPARTMENT OF EDUCATION
UNIVERSITY OF CALICUT

MATHEMATICS ANXIETY SCALE - DRAFT

Dr. M.N. Mohamedunni Alias Musthafa | **Sunitha. T.P**
Assistant Professor | Research Scholar

നിർദ്ദേശങ്ങൾ

ഗണിതവുമായി ബന്ധപ്പെട്ട വിവിധ സാഹചര്യങ്ങളിൽ നിങ്ങൾക്ക് അനുഭവപ്പെടുന്ന/തോന്നുന്ന പ്രയാസങ്ങളുമായി ബന്ധപ്പെട്ട പ്രസ്താവനകളാണ് താഴെ കൊടുത്തിരിക്കുന്നത്. ഓരോ പ്രസ്താവനയും ശ്രദ്ധയോടെ വായിച്ച് പ്രസ്താവനയിൽ പറഞ്ഞിട്ടുള്ള കാര്യം നിങ്ങൾക്ക് എത്രമാത്രം അനുഭവപ്പെടാറുണ്ട്/തോന്നാറുണ്ട് എന്ന് തീരുമാനിക്കുക. നിങ്ങളുടെ പ്രതികരണം ഓരോ പ്രസ്താവനക്കും നേരെ 'എല്ലായ്പ്പോഴും', 'മിക്കപ്പോഴും', 'ചിലപ്പോൾ', 'വല്ലപ്പോഴും', 'ഒരിക്കലുമില്ല' എന്നിവയിൽ നിങ്ങൾക്ക് ഏറ്റവും അനുയോജ്യമായി തോന്നുന്ന കോളത്തിൽ '✓' (ടിക്ക്) ചിഹ്നമുപയോഗിച്ച് രേഖപ്പെടുത്തുക. എല്ലാ പ്രസ്താവനകൾക്കും സത്യസന്ധമായി പ്രതികരണം രേഖപ്പെടുത്തുക. നിങ്ങളുടെ പ്രതികരണം രഹസ്യമായി സൂക്ഷിക്കുന്നതും ഗവേഷണാവശ്യങ്ങൾക്കായി മാത്രം ഉപയോഗിക്കുന്നതുമായിരിക്കും.

ക്രമ നമ്പർ	പ്രസ്താവനകൾ	എല്ലായ്പ്പോഴും	മിക്കപ്പോഴും	ചിലപ്പോൾ	വല്ലപ്പോഴും	ഒരിക്കലുമില്ല
1.	കണററിലെ പ്രശ്നഗ്ഗ ൾ നിഷ്ലാരണം ചെർ ാനുള്ള എന്റെ കഴിവിസ്റ്റയ്മയെ ററ ുറിൺഞാൻ വേവലാതിപ്പെടാറുണ്ട്.					
2.	പുസ്തകഗ്ഗ ൾ, പേനകൾ തുടഗ്ഗ ിയവ വാഗ്ഗ ുമ്പോൾ ആവശ്യമായ ഗണിതക്രിയകൾ ആങ്ങവിശ്വാസത്തോടെ ചെർ ാൻ സാധിററ ാറിസ്റ്റ					
3.	കണററ ുമായി ബന്ധപ്പെശ്ലകാര്യഗ്ഗ ൾ അറിയാവുങ്ക താണെങ്കിനു പോലും ക്ലാസിനു വൺമറങ്ക ു പോകാറുണ്ട്.					
4.	കണററിലെ പ്രശ്നഗ്ഗ ൾ നിഷ്ലാരണം ചെർ ുമ്പോൾ വ്യക്തമായി ചിട്ട ിററ ാൻ കഴിയാറിസ്റ്റ					

ക്രമ നമ്പര്‍	പ്രസ്താവനകള്‍	എല്ലായ്പ്പോഴും	മിക്കപ്പോഴും	ചിലപ്പോള്‍	വല്ലപ്പോഴും	ഒരിക്കലുമില്ല
5.	ദൈനംദിന ജീവിതത്തിനു ആവശ്യമായി വരുങ്ക ഗണിതക്രിയകള്‍ ചെര്‍ ുമ്പോള്‍ പേടിയുണ്ടാവാറുണ്ട്.					
6.	കണററ് ക്ലാസിനു ഇരിററ ാന്‍ പേടി തോങ്ക ാറുണ്ട്.					
7.	അധികം ബുദ്ധിമുട്ടില്ലാതെ തങ്കെ ഗണിതപ്രശ്നഗ്ഗ ള്‍ നിഷ്ലാരണം ചെര്‍ ാന്‍ എനിററ് കഴിയാറുണ്ട്.					
8.	ഭാവി ജീവിതത്തിലും കണററ് ഉപയോഗിററ ാനുള്ള കഴിവ് എനിററ ുണ്ടെങ്ക് തോങ്ക ാറുണ്ട്.					
9.	കണററ് ക്ലാസിനു ടീണ്ട്ല ചോദ്യം ചോദിററ ുമോ എങ്കേ ാഫ്ലത്ത് ഭയം തോങ്ക ാറുണ്ട്.					
10.	പാഠപുസ്തകത്തിലെ ഗണിതപ്രശ്നഗ്ഗ ള്‍ററ ു പുറമെ പുതിയ ഗണിതപ്രശ്നഗ്ഗ ള്‍ നിഷ്ലാരണം ചെയ്തു നോററ ാന്‍ എനിററിഷ്ടമാണ്.					
11.	ബസ് യാത്രയിനു ടിററ റ്റ് എടുററ ുവാനാവശ്യമായ പണം ആത്മവിശ്വാസത്തോടെ കൈകാര്യം ചെര്‍ ാന്‍ സാധിററ ാറിസ്റ്റ					
12.	കണററ് ക്ലാസിനു സംശയഗ്ഗ ള്‍ ചോദിററ ാന്‍ എനിററ് പേടി തോങ്ക ാറുണ്ട്.					
13.	വഴിററ ണററ ുകള്‍ ചെര്‍ ുമ്പോള്‍ ഞാന്‍ പരിഭ്രമിററ ാറു ണ്ട്.					
14.	ഉപരിപഠനത്തിന് ഏത് വിഷയം തെരഞ്ഞെ ടുത്താലും അതിനു കണററ് ഫലപ്രദമായി ഉപയോഗിററ ാന്‍ എനിററ് സാധിററ ുമെങ്ക് തോങ്ക ാറുണ്ട്.					
15.	കണററ് ക്ലാസിനു ഉത്തരം അറിയാവുങ്ക ചോദ്യഗ്ഗ ള്‍ററ ുപോലും ഉത്തരം പറയാന്‍ ബുദ്ധിമുട്ടില്ലതോങ്ക ാറുണ്ട്.					
16.	തെറ്റിപ്പോകുമെങ്ക പേടി കാരണം ഗണിത പ്രശ്ന ഗ്ഗ ള്‍ സമയത്തിനുള്ളിനു ചെയ്തു തീഷ്ലററ ാന്‍ സാധി ററ ാറിസ്റ്റ					

ക്രമ നമ്പർ	പ്രസ്താവനകൾ	എല്ലായ്പ്പോഴും	മിക്കപ്പോഴും	ചിലപ്പോൾ	വല്ലപ്പോഴും	ഒരിക്കലുമില്ല
17.	പാഠ്യേതര വിഷയഗ്ഗ ളിനു ഗണിതം ഉപയോഗിററാൻ എനിററ് താനുപര്യമുണ്ട്.					
18.	എന്റെ കഴിവുകൾ ഒങ്കും തങ്കെ കണററിനു എങ്കെ സഹായിററാറിസ്റ്റ					
19.	ഓരോ പുതിയ ഗണിതപ്രശ്നം നിഷ്ലാരണം ചെർേണ്ടി വരുമ്പോഴും എനിററ് ചെർാൻ സാധിററുമോ എങ്ക പേടി എങ്കെ അലശ്ലറുണ്ട്.					
20.	ഓരോ കാര്യഗ്ഗ ളും ചെയ്തുതീഷ്ലററാൻ എത്ര സമയം വേണ്ടി വരുമെങ്ക് മുൻകൂശ്ല കണററാററാൻ ഉത്കണ്ഠ തോങ്കാറുണ്ട്.					
21.	മനററണററുകൾ ആത്മവിശ്വാസത്തോടെ ചെർാൻ സാധിററാറുണ്ട്.					
22.	കണററിലെ പ്രശ്നഗ്ഗ ൾററ് ശരിയുത്തരം കിശ്ലൻ എത്ര പ്രാവശ്യം ശ്രമിററാനും എനിററ് സട്ടേ ാഷമേ ഉള്ളൂ					
23.	കണററുമായി ബന്ധപ്പെശ്ല കടംകഥകൾററ് ഉത്തരം കണ്ടെത്താൻ എനിററിഷ്ടമാണ്.					
24.	ഉയഷ്ലക്ലാസുകളിനു എത്താൻ കണററിനു നസ്റ്റ ഗ്രേഡ് വേണമെങ്ക ചിട്ട എങ്കെ ഉത്കണ്ഠപ്പെടുത്താറുണ്ട്.					
25.	കണററ് ക്ലാസിലെ എന്റെ പ്രകടനത്തെററുറിൺഞാൻ വേവലാതിപ്പെടാറുണ്ട്.					
26.	കണററ് വിരസമായി അനുഭവപ്പെടാറുണ്ട്.					
27.	എനിററ് ക്ലാസിനു ഹാജരാവാൻ കഴിയാതിരിററുമ്പോഴും കണററ് പാഠഗ്ഗ ൾ പഠിണ്ടെുററാമെങ്ക വിശ്വാസമുണ്ട്.					

ക്രമ നമ്പർ	പ്രസ്താവനകൾ	എല്ലായ്പ്പോഴും	മിക്കപ്പോഴും	ചിലപ്പോൾ	വല്ലപ്പോഴും	ഒരിക്കലുമില്ല
28.	കണററിനെററുറിൺഞാൻ പേടി സ്വപ്നഗ്ഗ ൾ കാണാ റുണ്ട്.					
29.	കണറെറങ്ക വിഷയത്തെ ഭയത്തോടെ മാത്രമേ എനി ററ് സമീപിററാൻ കഴിയാറുള്ളൂ.					
30.	എത്രയധികം ശ്രമിൺലും എനിററ് ഒരിററലും കണററ് പഠിററാൻ കഴിയിസ്റ്റെങ്ക് തോങ്ക ാറുണ്ട്.					
31.	കണററിലെ ചിഹ്നഗ്ഗ ൾ എങ്കെ അസ്വസ്ഥ മാററ ാറുണ്ട്.					
32.	ടീൺല്ല ഗണിതസൂത്രവാക്യമോ പ്രശ്നമോ ബോഷ്ഡിനു എഴുതുങ്ക ത് കാണുമ്പോൾ മനസ്സ് അസ്വസ്ഥ മാകാറുണ്ട്.					
33.	ശരിയായി ഉത്തരം പറയാൻ കഴിബ്ബ ിസ്റ്റെങ്കിലോ എങ്ക പേടികൊണ്ട് ഗണിതക്വിസിനു പങ്കെടുററ ാറിസ്റ്റ					
34.	കണററ് എന്റെ ഇഷ്ടവിഷയമാണ്.					
35.	കണററ് ക്ലാസിനു മറ്റുള്ള കുശ്ലകളുടെ ഒപ്പം എത്താൻ കഴിയിസ്റ്റെങ്ക പേടി തോങ്ക ാറുണ്ട്.					
36.	കണററ് ഒരു വ്യക്തിയുടെ മാനസിക വളഷ്ഷൺയയും ചിട്ട ാശക്തിയേയും ഉയഷ്ഷത്താൻ സഹായിററുങ്കു എങ്ക് തോങ്ക ാറുണ്ട്.					
37.	ജ്യാമിതി ചെർ ുമ്പോൾ, എടുററുങ്ക അളവുകൾ ശരി യായിസ്റ്റെങ്കിലോ എങ്ക പേടി അലശ്ലറുണ്ട്.					
38.	കണററ് പഠനം ഞാൻ ആസ്വദിററ ാറുണ്ട്.					
39.	നങ്ക ായി പരിശ്രമിററ ാറുണ്ടെങ്കിലും കണററ് എനിററ് കൂടുതനു ബുദ്ധിമുശ്ലയി തോങ്ക ാറുണ്ട്.					
40.	ശാസ്ത്രത്തിന്റെ വളഷ്ഷയ്ററ് ഗണിതശാസ്ത്രം വള രെയധികം സംഭാവനകൾ നനുകിയിശ്ലണ്ടെങ്ക് തോങ്ക ാറുണ്ട്.					

ക്രമ നമ്പർ	പ്രസ്താവനകൾ	എല്ലായ്പ്പോഴും	മിക്കപ്പോഴും	ചിലപ്പോൾ	വല്ലപ്പോഴും	ഒരിക്കലുമില്ല
41.	കണററ് പരീക്ഷകളിനു നങ്കാ ായി അറിയാവുങ്കാ ചോദ്യഗ്ഗ ൾററുള്ള ഉത്തരഗ്ഗ ളിനു പോലും പരിഭ്രമം കാരണം തെറ്റാറുണ്ട്.					
42.	ഉങ്കാ തപഠനത്തിന് കണററ് തെരെബ്ലെ ടുററാൻ എനിററിഷ്ടമാണ്.					
43.	നങ്കാ ായി പഠിൺലും കണററ് പരീക്ഷകൾ നങ്കാ ായി എഴുതുവാൻ എനിററ് സാധിററാറിസ്റ്റ					
44.	ഗണിതാധിഷ്ഠിത കോഴ്സുകൾ പഠിററാൻ എനിററ് ആഗ്രഹമുണ്ട്.					
45.	നിത്യേന ഉപയോഗിററാറുള്ള കണററുകൂശ്ലുകൾ പോലും പരീക്ഷയ്ററ് ബുദ്ധിമുശ്ലയി തോങ്കാ ാറുണ്ട്.					
46.	ഉയഷ്ലങ്കാ ക്ലാസുകളിലെ കണററ് ചെർ ാൻ എനിററ് സാധിററിസ്റ്റെങ്കാ് തോങ്കാ ാറുണ്ട്.					
47.	നങ്കാ ായി പഠിൺ ഗണിതസൂത്രവാക്യഗ്ഗ ളും വസ്തുതകളും വരെ പരീക്ഷാസമയത്ത് ഞാൻ മറങ്കാ ു പോകാറുണ്ട്.					
48.	ഗണിതശാസ്ത്രപാഠഗ്ഗ ൾ വായിററുമ്പോൾ എനിററ് അസ്വത്ത ത തോങ്കാ ാറുണ്ട്.					
49.	മുങ്കാ റിയിപ്പിസ്റ്റതെ ക്ലാസിനു ഗണിതശാസ്ത്രക്വിസ് നടത്തുമ്പോൾ ഉത്കണ്ഠ അനുഭവപ്പെടാറുണ്ട്.					
50.	ഹോംവഷ്ലററ് ചെർ ുവാൻ വേണ്ടി കണററ് പുസ്തകം എടുററുമ്പോൾ തങ്കെ മനസ്സ് അസ്വത്ത മാകാറുണ്ട്.					
51.	കണററ് പരീക്ഷ എഴുതുമ്പോൾ വ്യക്തമായി ചിട്ട ിററാൻ കഴിയാറിസ്റ്റ					
52.	കുറെ അധികം ഗണിത പ്രശ്നഗ്ഗ ൾ ഒങ്കാ ിൺ കാണുമ്പോൾ പേടി തോങ്കാ ാറുണ്ട്.					

ക്രമ നമ്പർ	പ്രസ്താവനകൾ	എല്ലായ്പ്പോഴും	മിക്കപ്പോഴും	ചിലപ്പോൾ	വല്ലപ്പോഴും	ഒരിക്കലുമില്ല
53.	മറ്റു പരീക്ഷകളേററാൾ കൂടുതനു പിരിമുറുററം കണററ് പരീക്ഷയ്ററ് അനുഭവപ്പെടാറുണ്ട്.					
54.	കണററ് പുസ്തകത്തിലെ ഒരു പുതിയ അധ്യായം തുടഗ്ഗ ുമ്പോൾ അസ്വത്ത ത തോങ്ക ാറുണ്ട്.					
55.	എത്ര പഠിൺലും ആങ്ങവിശ്വാസത്തോടെ കണററ് പരീക്ഷ എഴുതുവാൻ എനിററ് സാധിററ ാറിസ്റ്റ					
56.	കണററ് എങ്കിനു പരിഭ്രമം ഉണ്ടാററുങ്ക ു.					
57.	ഗണിത പ്രശ്നഗ്ഗ ൾ നിഷ്ലാരണം ചെയ്തുകൊണ്ടിരിററുമ്പോൾ ടീൺ്ല നോററുങ്കുണ്ടെങ്ക് തോങ്കിയാനു തുടഷ്ലക് ചെർ ാൻ എനിററ് ബുദ്ധിമുശ്ലതോങ്ക ാറുണ്ട്.					
58.	മൂഷ്ലത്തമായ ഉദാഹരണഗ്ഗ ളിലൂടെ അവതരിപ്പിററുങ്ക ഗണിത ആശയഗ്ഗ ൾ മാത്രമേ എളുപ്പത്തിനു മനസ്സിലാകാറുള്ളൂ.					
59.	തെറ്റു വരാമെങ്കു തോങ്കിയാലും ശ്ശ ാക്ബോഷ്ലധിനു കണററ് പ്രശ്നഗ്ഗ ൾ ചെർ ാൻ ഞാൻ തർ ാറാവാറുണ്ട്.					
60.	പഠിൺ സൂത്രവാക്യഗ്ഗ ൾ പോലും ആവശ്യമുള്ള സമയത്ത് ഓഷ്ലമ വരാറിസ്റ്റ					
61.	മറ്റുള്ളവരുടെ ഗണിത ശാസ്ത്രത്തിലുള്ള കഴിവുകൾ എന്റെ കഴിവുകളുമായി താരതമ്യം ചെയ്ത് ഞാൻ ഉത്കണ്ഠപ്പെടാറുണ്ട്.					
62.	ഗണിതാശയഗ്ഗ ൾ അഷ്ലക്കമിസ്ഥത്തവയായാണ് എനിററ് തോങ്ക ാറുള്ളത്					
63.	കണററ് പാഠഗ്ഗ ൾ മനസ്സിലാററാൻ ബുദ്ധിമുശ്ലകാണിററുമ്പോൾ ടീൺ്ലഎങ്കെ കുറ്റപ്പെടുത്താറുണ്ട്.					
64.	കണററ് പഠിറേണ്ട രീതിയെപ്പറ്റി എനിററ് ശരിയായ ധാരണയിസ്റ്റെങ്ക് തോങ്ക ാറുണ്ട്.					

ക്രമ നമ്പർ	പ്രസ്താവനകൾ	എല്ലായ്പ്പോഴും	മിക്കപ്പോഴും	ചിലപ്പോൾ	വല്ലപ്പോഴും	ഒരിക്കലുമില്ല
65.	പ്രശ്നനിർദ്ധാരണത്തിന് എനിററ ാവശ്യമായ സമയം ടീച്ചർ അനുവദിററ ാതിരിററ ുമ്പോൾ അസ്വസ്ഥത തോ ന്ന ാറുണ്ട്.					
66.	കണററ് പഠിററ ുന്ന തു കൊണ്ട് പ്രയോജനമില്ലെന്ന് തോന്ന ാറുണ്ട്.					
67.	ഗണിതാശയഗ്ഗ ൾ മനസ്സിലായോ ഇല്ലയോ എന്ന് ടീച്ചർ എന്നേ ാട് ചോദിററ ാതിരിററ ുമ്പോൾ വിഷമം തോന്ന ാ റുണ്ട്.					
68.	ഗണിത സൂത്രവാക്യഗ്ഗ ളും മറ്റും എഗ്ഗ ിനെയാണ് ഓർത്തു വറേ ണ്ടതെന്ന് എനിററ റിയില്ല					
69.	മറ്റുള്ളവർ പരിഹസിററ ുമെന്ന് കരുതി കണററ് ക്ലാസിനു ഞാൻ ടീച്ചറോട് സംശയഗ്ഗ ൾ ചോദിററ ാറില്ല					
70.	ശരിയായി മനസ്സിലാററി പഠിച്ചില്ലെങ്കിലും ഞാൻ കണ ററിനു ജയിററ ാറുണ്ട്.					
71.	ക്ലാസിനു കണററ് മനസ്സിലാററ ാൻ ബുദ്ധിമുട്ടുള്ളത് എനിററ് മാത്രമാണെന്ന് തോന്ന ാറുണ്ട്.					
72.	കണററിലെ പ്രശ്നഗ്ഗ ൾ എപ്പോഴും ഒരു ശരിയുത്ത രത്തിലേററ് നയിററ ുന്ന തിനാനു കണററ് എനിററി ഷ്ടമാണ്.					
73.	ദൈനംദിന ജീവിതത്തിലുള്ള ഗണിതക്രിയകൾ ചെർ ാൻ ഞാൻ മറ്റുള്ളവരെ ആശ്രയിററ ാറുണ്ട്.					
74.	കണററ് ചെർ ുന്ന തിനെററ ുറിച്ച് ചിട്ട ിററ ുമ്പോൾ ത്തന്നെ വയറ്റിനു ഒരു ആളനു അനുഭവപ്പെടാറുണ്ട്.					
75.	ടീച്ചർ ഗണിതപ്രശ്നഗ്ഗ ൾ ബോർഡിനു ചെയ്ത്, അത് പകർത്തി എഴുതുന്ന താണ് എനിററിഷ്ടം					
76.	കണററ് പരീക്ഷയുടെ തലേ രാത്രി ഉറഗ്ഗ ാൻ ബുദ്ധി മുട്ട് അനുഭവപ്പെടാറുണ്ട്.					

ക്രമ നമ്പർ	പ്രസ്താവനകൾ	എല്ലായ്പ്പോഴും	മിക്കപ്പോഴും	ചിലപ്പോൾ	വല്ലപ്പോഴും	ഒരിക്കലുമില്ല
77.	തെറ്റുമെങ്ക് പേടിൽ ഞാൻ എന്റെ അടുത്തിരിററുങ്ക കുള്ളയുടെ പുസ്തകം നോററിയെഴുതാറുണ്ട്.					
78.	കണററ് ചെർ ുമ്പോൾ ഹൃദയം വേഗത്തിനു മിടിററ ാറുണ്ട്.					
79.	തെറ്റുമെങ്ക പേടി കൊണ്ട് ഗണിതപ്രശ്നഗ്ഗ ൾ സ്വയം ചെർ ാൻ എനിററ് സാധിററ ാറിസ്റ്റ					
80.	കണററിനെററ ുറിൺചിട്ട ിററ ുമ്പോൾത്തങ്കെ കൈകൾ തണുററ ാറുണ്ട്.					
81.	ടീണ്ട്ല കണററ് ചെർ ുങ്ക രീതിററ് പുറമെ ഞാൻ എന്റേതായ രീതികൾ പരീക്ഷിററ ാറുണ്ട്.					
82.	കണററ ുമായി ബന്ധപ്പെശ്ലപ്രവൃത്തികൾ ചെർ ുമ്പോൾ തലവേദന അനുഭവപ്പെടാറുണ്ട്.					
83.	കണററ് നങ്ക ായി പഠിററ ാനുള്ള കഴിവ് എനിററ ുണ്ട്.					
84.	കണററ് പരീക്ഷ എഴുതുമ്പോൾ പേടി കൊണ്ട് ശ്വാസമെടുററ ാൻ ബുദ്ധിമുശ്ല തോങ്ക ാറുണ്ട്.					
85.	ടീണ്ട്ല തരുങ്ക ഹോംവശ്ലറ ുകൾ ചെർ ാൻ ഞാൻ മറ്റുള്ളവരെ ആശ്രയിററ ാറുണ്ട്.					
86.	കണററ് ചെർ ുമ്പോൾ കൈകൾ വിററ ാറുണ്ട്.					
87.	കണററ് പരീക്ഷററ് വേണ്ട തർ ാറെടുപ്പുകൾ സ്വയം ചെർ ാൻ എനിററ് സാധിററ ാറിസ്റ്റ					
88.	കണററ ുമായി ബന്ധപ്പെശ്ലപ്രവൃത്തികളിനു സ്വത്ത മായി ഏഷ്ലപ്പടാൻ എനിററ് സാധിററ ാറുണ്ട്.					

Appendix A2

DEPARTMENT OF EDUCATION
UNIVERSITY OF CALICUT

MATHEMATICS ANXIETY SCALE - DRAFT

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Assistant Professor Research Scholar

Instructions

Following are some statements related to different difficulties/worries faced by you while dealing with Mathematics related situations. Read each statement carefully. Decide how frequently you feel the matter mentioned in each statement. Record your response against each statement by putting a '✓' (tick) mark in the column corresponding to one category among 'Always', 'Frequently', 'Sometimes', 'Rarely' and 'Never' which you feel is most appropriate. Honestly respond to all statements. Your response will be kept confidential and will be used for research purpose only.

Sl. No.	Statements	Always	Frequently	Sometimes	Rarely	Never
1.	I am worried about my inability to solve Mathematics problems					
2.	I am unable to do the apt calculations with confidence while purchasing books, pens etc.					
3.	While in the class I fail to recollect even those Mathematics related facts which I normally know					
4.	I am unable to think clearly while solving Mathematics problems					
5.	I feel nervous while doing Mathematics calculations in day to day life					
6.	I am afraid of attending a Mathematics class					
7.	I can solve Mathematics problems without much difficulty					

Sl. No.	Statements	Always	Frequently	Sometimes	Rarely	Never
8.	I feel that I have the ability to use Mathematics in future life.					
9.	I feel tensed about the teacher asking questions in Mathematics class					
10.	I enjoy solving Mathematics problems beyond the text book					
11.	While travelling by bus I am not confident enough to handle money required to buy ticket					
12.	I am afraid to clarify my doubts in Mathematics class					
13.	I feel nervous while attempting statement problems in Mathematics					
14.	Whatever be my subject for higher study, I will be able to use Mathematics effectively wherever required					
15.	In a Mathematics class I find it difficult to answer even the questions which I know very well					
16.	Due to the fear of going wrong somewhere I am unable to solve Mathematics problems on time					
17.	I am interested to use Mathematics beyond school subjects					
18.	None of my talents help me in Mathematics					
19.	While solving each new problem I fear whether I will be able to do it or not					
20.	I feel worried in estimating the time required to complete each task					
21.	I am able to carry out mental calculations with confidence					
22.	I am happy to work out a problem any number of times to arrive at the correct answer					

Sl. No.	Statements	Always	Frequently	Sometimes	Rarely	Never
23.	I love solving Mathematics related puzzles					
24.	The thought that good grades in Mathematics is necessary to be reach higher classes makes me feel uneasy					
25.	I am worried regarding my performance in Mathematics class					
26.	I feel Mathematics is boring					
27.	I believe that I will be able to make up for my absence in Mathematics classes					
28.	I see nightmares related to Mathematics					
29.	I am only able to approach the subject Mathematics with fear					
30.	I feel I can never learn Mathematics no matter how hard I try					
31.	Mathematics symbols makes me feel uneasy					
32.	The very sight of the teacher writing a mathematical formula or problem on black board makes me feel uneasy					
33.	Due to fear, I do not usually participate in Mathematics quiz					
34.	Mathematics is my favourite subject					
35.	I am afraid that I won't be able to keep up with the rest of the class in Mathematics					
36.	I feel that Mathematics helps in developing a person's mental abilities and thinking skills.					
37.	I am nervous while taking measurements in geometry					
38.	I enjoy learning Mathematics					
39.	In spite of hard work Mathematics seems to be tough for me					

Sl. No.	Statements	Always	Frequently	Sometimes	Rarely	Never
40.	I feel that Mathematics has contributed much to the development of science					
41.	During Mathematics tests, due to tension, I make mistakes even when answering to questions which are thorough to me.					
42.	I would like to opt Mathematics for higher studies					
43.	Despite of thorough preparation I am unable to perform well in Mathematics examinations					
44.	I wish to study Mathematics based courses					
45.	Even day to day Mathematical calculations appears difficult to me in Mathematics tests					
46.	I feel that I won't be able to do higher Mathematics					
47.	I forget even well learnt Mathematical formulae and facts at the time of examination					
48.	I feel upset when reading Mathematics texts					
49.	Mathematics quiz conducted in class without prior notification makes me feel nervous					
50.	I feel uneasy even while picking up Mathematics book to do home work					
51.	I am not able to think clearly during Mathematics test					
52.	I feel scared seeing a lot of Mathematics problems together					
53.	I feel more stressed while attending a Mathematics test than any other test					
54.	I feel uneasy while beginning a new Mathematics chapter					
55.	I am unable to take Mathematics tests with confidence no matter how well I study					
56.	Mathematics makes me feel nervous					
57.	While doing Mathematics problems, being noticed by the teacher makes it difficult for me to proceed					

Sl. No.	Statements	Always	Frequently	Sometimes	Rarely	Never
58.	I am able to understand with ease only those concepts which are presented with concrete examples					
59.	I am ready to do Mathematics problems on the black board even if I feel that I may go wrong					
60.	I am unable to recollect even well learnt formulae when required					
61.	I often worry comparing my math abilities with that of my peers					
62.	I feel that Mathematics concepts are meaningless					
63.	Teacher blames me when I find it difficult to understand Mathematics lessons					
64.	I feel that I don't know the proper method of learning Mathematics					
65.	I feel uncomfortable when the teacher doesn't give me enough time to solve Mathematics problems in class					
66.	I feel that there is no use of learning Mathematics					
67.	I feel sad when the Mathematics teacher doesn't ask me whether I have understood the concepts or not					
68.	I don't know how to memorize Mathematics formulae					
69.	I usually avoid clearing doubts in Mathematics class for fear of being teased by others					
70.	I get a pass mark in Mathematics even if I don't learn by understanding the concepts					
71.	I feel that I am the only one in the class who has difficulty in understanding Mathematics					
72.	I love Mathematics since Mathematics problems always lead to a right answer					

Sl. No.	Statements	Always	Frequently	Sometimes	Rarely	Never
73.	I rely on other people to help me with day to day Mathematics calculations					
74.	I feel disturbed in my stomach even by the thought of doing Mathematics					
75.	I am happy if the teacher does all the problems on the black board so that I can copy it down					
76.	I have trouble sleeping on the night before Mathematics test					
77.	Because of the fear of making mistakes, I copy from the books of my peers					
78.	My heart beats fast while doing Mathematics problems					
79.	I am unable to do Mathematics problems myself for fear of making mistakes					
80.	My hands get cold at the very thought of Mathematics					
81.	Apart from the methods used by teacher in doing Mathematics I try my own					
82.	I get headache while doing Mathematics related activities					
83.	I can study Mathematics well					
84.	I have trouble breathing while taking Mathematics test due to fear					
85.	I depend on others to do my home works					
86.	My hands shiver while doing Mathematics					
87.	I am unable to prepare for Mathematics exam on my own					
88.	I am able to participate in Mathematics related activities with ease					

Appendix A3

Mathematics Anxiety Scale

(Component Matrix Table)

Principal Component Analysis of Mathematics Anxiety Scale

Item No	Factor Loading	Item No	Factor Loading	Item No	Factor Loading
ITEM1	.472	ITEM33	.378	ITEM61	.585
ITEM2	.274	ITEM34	.259	ITEM62	.472
ITEM3	.470	ITEM35	.646	ITEM63	.403
ITEM4	.428	ITEM36	.278	ITEM64	.602
ITEM5	.473	ITEM37	.461	ITEM65	.542
ITEM6	.392	ITEM38	.352	ITEM66	.441
ITEM9	.562	ITEM39	.609	ITEM67	.461
ITEM11	.205	ITEM40	.130	ITEM68	.495
ITEM12	.562	ITEM41	.571	ITEM69	.519
ITEM13	.502	ITEM42	.350	ITEM71	.619
ITEM14	.182	ITEM43	.470	ITEM72	.320
ITEM15	.542	ITEM44	.311	ITEM73	.543
ITEM16	.510	ITEM45	.564	ITEM74	.536
ITEM17	.270	ITEM46	.530	ITEM75	.443
ITEM18	.362	ITEM47	.587	ITEM76	.467
ITEM19	.544	ITEM48	.495	ITEM77	.437
ITEM20	.414	ITEM49	.462	ITEM78	.558
ITEM21	.326	ITEM50	.585	ITEM79	.535
ITEM23	.165	ITEM51	.506	ITEM80	.494
ITEM24	.346	ITEM52	.576	ITEM82	.508
ITEM25	.563	ITEM53	.563	ITEM83	.294
ITEM26	.437	ITEM54	.558	ITEM84	.494
ITEM27	.183	ITEM55	.376	ITEM85	.539
ITEM28	.436	ITEM56	.624	ITEM86	.546
ITEM29	.589	ITEM57	.598	ITEM87	.246
ITEM30	.606	ITEM58	.287	ITEM88	.213
ITEM31	.525	ITEM59	.189		
ITEM32	.647	ITEM60	.516		

Appendix A4

DEPARTMENT OF EDUCATION
UNIVERSITY OF CALICUT

MATHEMATICS ANXIETY SCALE - FINAL

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Assistant Professor

Sunitha. T.P
Research Scholar

നിർദ്ദേശങ്ങൾ

ഗണിതവുമായി ബന്ധപ്പെട്ട വിവിധ സാഹചര്യങ്ങളിൽ നിങ്ങൾക്ക് അനുഭവപ്പെടുന്ന/തോന്നുന്ന പ്രയാസങ്ങളുമായി ബന്ധപ്പെട്ട പ്രസ്താവനകളാണ് താഴെ കൊടുത്തിരിക്കുന്നത്. ഓരോ പ്രസ്താവനയും ശ്രദ്ധയോടെ വായിച്ച് പ്രസ്താവനയിൽ പറഞ്ഞിട്ടുള്ള കാര്യം നിങ്ങൾക്ക് എത്രമാത്രം അനുഭവപ്പെടാറുണ്ട്/ തോന്നാറുണ്ട് എന്ന് തീരുമാനിക്കുക. നിങ്ങളുടെ പ്രതികരണം ഓരോ പ്രസ്താവനക്കും നേരെ 'എല്ലായ്പ്പോഴും', 'മിക്കപ്പോഴും', 'ചിലപ്പോൾ', 'വല്ലപ്പോഴും', 'ഒരിക്കലുമില്ല' എന്നിവയിൽ നിങ്ങൾക്ക് ഏറ്റവും അനുയോജ്യമായി തോന്നുന്ന കോളത്തിൽ '✓' (ടിക്ക്) ചിഹ്നമുപയോഗിച്ച് രേഖപ്പെടുത്തുക. എല്ലാ പ്രസ്താവനകൾക്കും സത്യസന്ധമായി പ്രതികരണം രേഖപ്പെടുത്തുക. നിങ്ങളുടെ പ്രതികരണം രഹസ്യമായി സൂക്ഷിക്കുന്നതും ഗവേഷണാവശ്യങ്ങൾക്കായി മാത്രം ഉപയോഗിക്കുന്നതുമായിരിക്കും.

ക്രമ നമ്പർ	പ്രസ്താവനകൾ	എല്ലായ്പ്പോഴും	മിക്കപ്പോഴും	ചിലപ്പോൾ	വല്ലപ്പോഴും	ഒരിക്കലുമില്ല
1.	കണററിലെ പ്രശ്നഗ്ഗ ൾ നിഷ്ലാരണം ചെർ ാനുള്ള എന്റെ കഴിവിസ്റ്റയ്മയെ ററ ുറിഞ്ഞാൻ വേവലാതിപ്പെടാറുണ്ട്.					
2.	കണററ ുമായി ബന്ധപ്പെട്ടകാര്യഗ്ഗ ൾ അറിയാവുങ്ക താണെങ്കിന്ദ പോലും ക്ലാസിന്ദ വൺമറങ്ക ു പോകാറുണ്ട്.					
3.	കണററിലെ പ്രശ്നഗ്ഗ ൾ നിഷ്ലാരണം ചെർ ുമ്പോൾ വ്യക്തമായി ചിട്ട ിററ ാൻ കഴിയാറിസ്റ്റ					
4.	ദൈനംദിന ജീവിതത്തിന്ദ ആവശ്യമായി വരുങ്ക ഗണിതക്രിയകൾ ചെർ ുമ്പോൾ പേടിയുണ്ടാവാറുണ്ട്.					

ക്രമ നമ്പർ	പ്രസ്താവനകൾ	എല്ലായ്പ്പോഴും	മിക്കപ്പോഴും	ചിലപ്പോൾ	വല്ലപ്പോഴും	ഒരിക്കലുമില്ല
5.	കണററ് ക്ലാസിനു ഇരിററാൻ പേടി തോങ്ക ാറുണ്ട്.					
6.	കണററ് ക്ലാസിനു ടീണ്ച്ലചോദ്യം ചോദിററുമോ എങ്കേ ാഫ്ലത്ത് ഭയം തോങ്ക ാറുണ്ട്.					
7.	കണററ് ക്ലാസിനു സംശയഗ്ഗ ൾ ചോദിററാൻ എനിററ് പേടി തോങ്ക ാറുണ്ട്.					
8.	വഴിററണററുകൾ ചെർ ുമ്പോൾ ഞാൻ പരിഭ്രമിററാറുണ്ട്.					
9.	കണററ് ക്ലാസിനു ഉത്തരം അറിയാവുങ്ക ചോദ്യഗ്ഗ ൾ ററുപോലും ഉത്തരം പറയാൻ ബുദ്ധിമുശ്ലതോങ്ക ാറുണ്ട്.					
10.	തെറ്റിപ്പോകുമെങ്ക പേടി കാരണം ഗണിത പ്രശ്നഗ്ഗ ൾ സമയത്തിനുള്ളിനു ചെയ്തു തീഫ്ലററാൻ സാധിററാറിസ്റ്റ					
11.	എന്റെ കഴിവുകൾ ഒങ്ക ും തങ്കെ കണററിനു എങ്കെ സഹായിററാറിസ്റ്റ					
12.	ഓരോ പുതിയ ഗണിതപ്രശ്നം നിഷ്ലാരണം ചെർേ ണ്ടി വരുമ്പോഴും എനിററ് ചെർ ാൻ സാധിററുമോ എങ്ക പേടി എങ്കെ അലശ്ലറുണ്ട്.					
13.	ഓരോ കാര്യഗ്ഗ ളും ചെയ്തുതീഫ്ലററാൻ എത്ര സമയം വേണ്ടി വരുമെങ്ക് മുൻകൂശ്ല കണററ ാററാൻ ഉത്കണ്ഠ തോങ്ക ാറുണ്ട്.					
14.	മനററണററുകൾ ആത്മവിശ്വാസത്തോടെ ചെർ ാൻ സാധിററ ാറുണ്ട്.					
15.	ഉയഫ്ലങ്ക ക്ലാസുകളിനു എത്താൻ കണററിനു നസ്റ്റഗ്രേഡ് വേണമെങ്ക ചിട്ട എങ്കെ ഉത്കണ്ഠപ്പെടുത്താറുണ്ട്.					
16.	കണററ് ക്ലാസിലെ എന്റെ പ്രകടനത്തെററുറിൺഞാൻ വേവലാതിപ്പെടാറുണ്ട്.					
17.	കണററ് വിരസമായി അനുഭവപ്പെടാറുണ്ട്.					

ക്രമ നമ്പർ	പ്രസ്താവനകൾ	എല്ലായ്പ്പോഴും	മിക്കപ്പോഴും	ചിലപ്പോൾ	വല്ലപ്പോഴും	ഒരിക്കലുമില്ല
18.	കണററിനെററുറിൺഞാൻ പേടി സ്വപ്നഗ്ഗ ൾ കാണാറുണ്ട്.					
19.	കണറെറങ്ക വിഷയത്തെ ഭയത്തോടെ മാത്രമേ എനിററ് സമീപിററാൻ കഴിയാറുള്ളൂ.					
20.	എത്രയധികം ശ്രമിൺലും എനിററ് ഒരിററലും കണററ് പഠിററാൻ കഴിയിന്റ്ല്ലെക് തോങ്ക ാറുണ്ട്.					
21.	കണററിലെ ചിഹ്നഗ്ഗ ൾ എങ്കെ അസ്വത്ത മാററാറുണ്ട്.					
22.	ടീൺല്ല ഗണിതസൂത്രവാക്യമോ പ്രശ്നമോ ബോഫ്ലഡിനു എഴുതുങ്ക ത് കാണുമ്പോൾ മനസ്സ് അസ്വത്ത മാകാറുണ്ട്.					
23.	ശരിയായി ഉത്തരം പറയാൻ കഴിബ്ല്ല ിന്റ്ല്ലെങ്കിലോ എങ്ക പേടികൊണ്ട് ഗണിതക്വിസിനു പങ്കെടുററാറിസ്റ്റ					
24.	കണററ് ക്ലാസിനു മറ്റുള്ള കുശ്ലകളുടെ ഒപ്പം എത്താൻ കഴിയിന്റ്ല്ലെങ്ക പേടി തോങ്ക ാറുണ്ട്.					
25.	ജ്യാമിതി ചെർ ുമ്പോൾ, എടുററുങ്ക അളവുകൾ ശരിയായിന്റ്ല്ലെങ്കിലോ എങ്ക പേടി അലശ്ലറുണ്ട്.					
26.	കണററ് പഠനം ഞാൻ ആസ്വദിററാറുണ്ട്.					
27.	നങ്കായി പരിശ്രമിററാറുണ്ടെങ്കിലും കണററ് എനിററ് കൂടുതനു ബുദ്ധിമുശ്ലയി തോങ്ക ാറുണ്ട്.					
28.	കണററ് പരീക്ഷകളിനു നങ്കായി അറിയാവുങ്ക ചോദ്യഗ്ഗ ൾററുള്ള ഉത്തരഗ്ഗ ളിനു പോലും പരിഭ്രമം കാരണം തെറ്റാറുണ്ട്.					
29.	ഉങ്കതപഠനത്തിന് കണററ് തെരെബ്ലെ ടുററാൻ എനിററിഷ്ടമാണ്.					
30.	നങ്കായി പഠിൺലും കണററ് പരീക്ഷകൾ നങ്കായി എഴുതുവാൻ എനിററ് സാധിററാറിസ്റ്റ					

ക്രമ നമ്പര്	പ്രസ്താവനകൾ	എല്ലായ്പ്പോഴും	മിക്കപ്പോഴും	ചിലപ്പോൾ	വല്ലപ്പോഴും	ഒരിക്കലുമില്ല
31.	ഗണിതാധിഷ്ഠിത കോഴ്സുകൾ പഠിററാൻ എനിററ് ആഗ്രഹമുണ്ട്.					
32.	നിത്യേന ഉപയോഗിററാറുള്ള കണററുകൂട്ടലുകൾ പോലും പരീക്ഷയ്ററ് ബുദ്ധിമുട്ടയി തോങ്ക ാറുണ്ട്.					
33.	ഉയഷ്ക്ക ക്ലാസുകളിലെ കണററ് ചെർ ാൻ എനിററ് സാധിററിസ്സെക്ക് തോങ്ക ാറുണ്ട്.					
34.	നങ്ക ായി പഠിൺ ഗണിതസൂത്രവാക്യഗ്ഗ ളും വസ്തുത കളും വരെ പരീക്ഷാസമയത്ത് ഞാൻ മറങ്കു പോകാറുണ്ട്.					
35.	ഗണിതശാസ്ത്രപാഠഗ്ഗ ൾ വായിററുമ്പോൾ എനിററ് അസ്വത്ത ത തോങ്ക ാറുണ്ട്.					
36.	മുങ്ക റിയിപ്പിസ്സതെ ക്ലാസിനൂ ഗണിതശാസ്ത്രക്വിസ് നടത്തുമ്പോൾ ഉത്കണ്ഠ അനുഭവപ്പെടാറുണ്ട്.					
37.	ഹോംവഷ്ലറ് ചെർ ുവാൻ വേണ്ടി കണററ് പുസ്തകം എടുററുമ്പോൾ തങ്കെ മനസ്സ് അസ്വത്ത മാകാറുണ്ട്.					
38.	കണററ് പരീക്ഷ എഴുതുമ്പോൾ വ്യക്തമായി ചിട്ട ി ററാൻ കഴിയാറിസ്സ					
39.	കുറെ അധികം ഗണിത പ്രശ്നഗ്ഗ ൾ ഒങ്ക ിൺ കാണുമ്പോൾ പേടി തോങ്ക ാറുണ്ട്.					
40.	മറ്റു പരീക്ഷകളേററാൾ കൂടുതനൂ പിരിമുറുററം കണററ് പരീക്ഷയ്ററ് അനുഭവപ്പെടാറുണ്ട്.					
41.	കണററ് പുസ്തകത്തിലെ ഒരു പുതിയ അധ്യായം തുടഗ്ഗ ുമ്പോൾ അസ്വത്ത ത തോങ്ക ാറുണ്ട്.					
42.	എത്ര പഠിൺലും ആങ്ങവിശ്വാസത്തോടെ കണററ് പരീക്ഷ എഴുതുവാൻ എനിററ് സാധിററാറിസ്സ					
43.	കണററ് എങ്ക ിനൂ പരിഭ്രമം ഉണ്ടാററുങ്ക ു.					

ക്രമ നമ്പർ	പ്രസ്താവനകൾ	എല്ലായ്പ്പോഴും	മിക്കപ്പോഴും	ചിലപ്പോൾ	വല്ലപ്പോഴും	ഒരിക്കലുമില്ല
44.	ഗണിത പ്രശ്നഗ്ഗ ൾ നിഷ്ലാരണം ചെയ്തുകൊണ്ടിരിററുമ്പോൾ ടീണ്ഠ്ല നോററുങ്കുണ്ടെങ്ക് തോങ്കിയാനു തുടഷ്ഷ്ക് ചെർ ാൻ എനിററ് ബുദ്ധിമുട്ല്ലതോങ്ക ാറുണ്ട്.					
45.	പഠിൺ സൂത്രവാക്യഗ്ഗ ൾ പോലും ആവശ്യമുള്ള സമയത്ത് ഓഷ്മ്മ വരാറിസ്റ്റ					
46.	മറ്റുള്ളവരുടെ ഗണിത ശാസ്ത്രത്തിലുള്ള കഴിവുകൾ എന്റെ കഴിവുകളുമായി താരതമ്യം ചെയ്ത് ഞാൻ ഉത്കണ്ഠപ്പെടാറുണ്ട്.					
47.	ഗണിതാശയഗ്ഗ ൾ അഷ്ക്കമിസ്റ്റത്തവയായാണ് എനിററ് തോങ്ക ാറുള്ളത്					
48.	കണററ് പാഠഗ്ഗ ൾ മനസ്സിലാററാൻ ബുദ്ധിമുട്ല്ല കാണിററുമ്പോൾ ടീണ്ഠ്ലഎങ്കെ കുറ്റപ്പെടുത്താറുണ്ട്.					
49.	കണററ് പഠിറേണ്ട രീതിയെപ്പറ്റി എനിററ് ശരിയായ ധാരണയിസ്റ്റെങ്ക് തോങ്ക ാറുണ്ട്.					
50.	പ്രശ്നനിഷ്ലാരണത്തിന് എനിററാവശ്യമായ സമയം ടീണ്ഠ്ല അനുവദിററാതിരിററുമ്പോൾ അസ്വത്തത തോങ്ക ാറുണ്ട്.					
51.	കണററ് പഠിററുങ്കതു കൊണ്ട് പ്രയോജനമിസ്റ്റെങ്ക് തോങ്ക ാറുണ്ട്.					
52.	ഗണിതാശയഗ്ഗ ൾ മനസ്സിലായോ ഇസ്റ്റയോ എങ്ക് ടീണ്ഠ്ല എങ്കോട് ചോദിററാതിരിററുമ്പോൾ വിഷമം തോങ്ക ാറുണ്ട്.					
53.	ഗണിത സൂത്രവാക്യഗ്ഗ ളും മറ്റും എഗ്ഗ ിനെയാണ് ഓഷ്ലത്തു വറേണ്ടതെങ്ക് എനിററ റിയിസ്റ്റ					
54.	മറ്റുള്ളവഷ്ലപരിഹസിററുമെങ്ക് കരുതി കണററ് ക്ലാസിനു ഞാൻ ടീണ്ഠറോട് സംശയഗ്ഗ ൾ ചോദിററാറിസ്റ്റ					
55.	ക്ലാസിനു കണററ് മനസ്സിലാററാൻ ബുദ്ധിമുട്ലുള്ളത് എനിററ് മാത്രമാണെങ്ക് തോങ്ക ാറുണ്ട്.					

ക്രമ നമ്പർ	പ്രസ്താവനകൾ	എല്ലായ്പ്പോഴും	മിക്കപ്പോഴും	ചിലപ്പോൾ	വല്ലപ്പോഴും	ഒരിക്കലുമില്ല
56.	കണററിലെ പ്രശ്നഗ്ഗ ൾ എപ്പോഴും ഒരു ശരിയുത്തര ത്തിലേററ് നയിററുങ്ക തിനാനു കണററ് എനിററിഷ്ട മാണ്.					
57.	ദൈനംദിന ജീവിതത്തിലുള്ള ഗണിതക്രിയകൾ ചെർ ാൻ ഞാൻ മറ്റുള്ളവരെ ആശ്രയിററ ാറുണ്ട്.					
58.	കണററ് ചെർ ുങ്ക തിനെററ ുറിൺ ചിട്ട ിററ ുമ്പോൾ ത്തങ്കെ വയറ്റിനു ഒരു ആളനു അനുഭവപ്പെടാറുണ്ട്.					
59.	ടീൺല്ല ഗണിതപ്രശ്നഗ്ഗ ൾ ബോഹ്ലധിനു ചെയ്ത്, അത് പകഹ്ലത്തി എഴുതുങ്ക താണ് എനിററിഷ്ടം					
60.	കണററ് പരീക്ഷയുടെ തലേ രാത്രി ഉറഗ്ഗ ാൻ ബുദ്ധി മുശ്ല അനുഭവപ്പെടാറുണ്ട്.					
61.	തെറ്റുമെങ്ക് പേടിൺ ഞാൻ എന്റെ അടുത്തിരിററുങ്ക കുശ്ലയുടെ പുസ്തകം നോററിയെഴുതാറുണ്ട്.					
62.	കണററ് ചെർ ുമ്പോൾ ഹൃദയം വേഗത്തിനു മിടിററ ാറുണ്ട്.					
63.	തെറ്റുമെങ്ക പേടി കൊണ്ട് ഗണിതപ്രശ്നഗ്ഗ ൾ സ്വയം ചെർ ാൻ എനിററ് സാധിററ ാറിസ്റ്റ					
64.	കണററിനെററ ുറിൺചിട്ട ിററ ുമ്പോൾത്തങ്കെ കൈകൾ തണുററ ാറുണ്ട്.					
65.	കണററ ുമായി ബന്ധപ്പെശ്ല പ്രവൃത്തികൾ ചെർ ുമ്പോൾ തലവേദന അനുഭവപ്പെടാറുണ്ട്.					
66.	കണററ് പരീക്ഷ എഴുതുമ്പോൾ പേടി കൊണ്ട് ശ്വാസമെടുററ ാൻ ബുദ്ധിമുശ്ല തോങ്ക ാറുണ്ട്.					
67.	ടീൺല്ല തരുങ്ക ഹോംവഹ്ലററ ുകൾ ചെർ ാൻ ഞാൻ മറ്റുള്ളവരെ ആശ്രയിററ ാറുണ്ട്.					
68.	കണററ് ചെർ ുമ്പോൾ കൈകൾ വിററ ാറുണ്ട്.					

Appendix A 5

DEPARTMENT OF EDUCATION
UNIVERSITY OF CALICUT

MATHEMATICS ANXIETY SCALE - FINAL

Dr. M.N. Mohamedunni Alias Musthafa Assistant Professor

Sunitha. T.P Research Scholar

Instructions

Following are some statements related to different difficulties/worries faced by you while dealing with Mathematics related situations. Read each statement carefully. Decide how frequently you feel the matter mentioned in each statement. Record your response against each statement by putting a '✓' (tick) mark in the column corresponding to one category among 'Always', 'Frequently', 'Sometimes', 'Rarely' and 'Never' which you feel is most appropriate. Honestly respond to all statements. Your response will be kept confidential and will be used for research purpose only.

Sl. No.	Statements	Always	Frequently	Sometimes	Rarely	Never
1.	I am worried about my inability to solve Mathematics problems					
2.	While in the class I fail to recollect even those Mathematics related facts which I normally know					
3.	I am unable to think clearly while solving Mathematics problems					
4.	I feel nervous while doing Mathematics calculations in day to day life					
5.	I am afraid of attending a Mathematics class					

Sl. No.	Statements	Always	Frequently	Sometimes	Rarely	Never
6.	I feel tensed about the teacher asking questions in Mathematics class					
7.	I am afraid to clarify my doubts in Mathematics class					
8.	I feel nervous while attempting statement problems in Mathematics					
9.	In a Mathematics class I find it difficult to answer even the questions which I know very well					
10.	Due to the fear of going wrong somewhere I am unable to solve Mathematics problems on time					
11.	None of my talents help me in Mathematics					
12.	While solving each new problem I fear whether I will be able to do it or not					
13.	I feel worried in estimating the time required to complete each task					
14.	I am able to carry out mental calculations with confidence					
15.	The thought that good grades in Mathematics is necessary to be reach higher classes makes me feel uneasy					
16.	I am worried regarding my performance in Mathematics class					
17.	I feel Mathematics is boring					
18.	I see nightmares related to Mathematics					
19.	I am only able to approach the subject Mathematics with fear					
20.	I feel I can never learn Mathematics no matter how hard I try					

Sl. No.	Statements	Always	Frequently	Sometimes	Rarely	Never
21.	Mathematics symbols makes me feel uneasy					
22.	The very sight of the teacher writing a mathematical formula or problem on black board makes me feel uneasy					
23.	Due to fear, I do not usually participate in Mathematics quiz					
24.	I am afraid that I won't be able to keep up with the rest of the class in Mathematics					
25.	I am nervous while taking measurements in geometry					
26.	I enjoy learning Mathematics					
27.	In spite of hard work Mathematics seems to be tough for me					
28.	During Mathematics tests, due to tension, I make mistakes even when answering to questions which are thorough to me.					
29.	I would like to opt Mathematics for higher studies					
30.	Despite of thorough preparation I am unable to perform well in Mathematics examinations					
31.	I wish to study Mathematics based courses					
32.	Even day to day Mathematical calculations appears difficult to me in Mathematics tests					
33.	I feel that I won't be able to do higher Mathematics					
34.	I forget even well learnt Mathematical formulae and facts at the time of examination					
35.	I feel upset when reading Mathematics texts					

Sl. No.	Statements	Always	Frequently	Sometimes	Rarely	Never
36.	Mathematics quiz conducted in class without prior notification makes me feel nervous					
37.	I feel uneasy even while picking up Mathematics book to do home work					
38.	I am not able to think clearly during Mathematics test					
39.	I feel scared seeing a lot of Mathematics problems together					
40.	I feel more stressed while attending a Mathematics test than any other test					
41.	I feel uneasy while beginning a new Mathematics chapter					
42.	I am unable to take Mathematics tests with confidence no matter how well I study					
43.	Mathematics makes me feel nervous					
44.	While doing Mathematics problems, being noticed by the teacher makes it difficult for me to proceed					
45.	I am unable to recollect even well learnt formulae when required					
46.	I often worry comparing my math abilities with that of my peers					
47.	I feel that Mathematics concepts are meaningless					
48.	Teacher blames me when I find it difficult to understand Mathematics lessons					
49.	I feel that I don’t know the proper method of learning Mathematics					

Sl. No.	Statements	Always	Frequently	Sometimes	Rarely	Never
50.	I feel uncomfortable when the teacher doesn't give me enough time to solve Mathematics problems in class					
51.	I feel that there is no use of learning Mathematics					
52.	I feel sad when the Mathematics teacher doesn't ask me whether I have understood the concepts or not					
53.	I don't know how to memorize Mathematics formulae					
54.	I usually avoid clearing doubts in Mathematics class for fear of being teased by others					
55.	I feel that I am the only one in the class who has difficulty in understanding Mathematics					
56.	I love Mathematics since Mathematics problems always lead to a right answer					
57.	I rely on other people to help me with day to day Mathematics calculations					
58.	I feel disturbed in my stomach even by the thought of doing Mathematics					
59.	I am happy if the teacher does all the problems on the black board so that I can copy it down					
60.	I have trouble sleeping on the night before Mathematics test					
61.	Because of the fear of making mistakes, I copy from the books of my peers					
62.	My heart beats fast while doing Mathematics problems					

Sl. No.	Statements	Always	Frequently	Sometimes	Rarely	Never
63.	I am unable to do Mathematics problems myself for fear of making mistakes					
64.	My hands get cold at the very thought of Mathematics					
65.	I get headache while doing Mathematics related activities					
66.	I have trouble breathing while taking Mathematics test due to fear					
67.	I depend on others to do my home works					
68.	My hands shiver while doing Mathematics					

Appendix B1

DEPARTMENT OF EDUCATION
UNIVERSITY OF CALICUT

Lesson Transcripts Based on Cognitively Guided Instructional Strategy

(Malayalam Version)

By

Dr. M.N. Mohamedunni Alias Musthafa	**Sunitha T.P.**
Assistant Professor	Research Scholar

2013

LESSON TRANSCRIPT-1

Name of Teacher	:	Sunitha T.P			
Name of School	:	GMHSS CU Campus/ AUPS Velimukku	Class	:	VI
Subject:	:	Mathematics	Division	:	F/A
Unit	:	Volume	Time	:	40 mts
Topic	:	Volume of Rectangular Prism Shaped Objects			

പഠനോദ്ദേശ്യങ്ങൾ

1. വ്യാപ്തം എന്ന ആശയം മനസ്സിലാക്കുന്നതിന്
2. ചതുരക്കട്ടയുടെ ആകൃതിയിലുള്ള വസ്തുക്കളുടെ വ്യാപ്തം എന്ന ആശയം മനസ്സിലാക്കുന്നതിന്.
3. ഒരു ചതുരക്കട്ടയിൽ ഉൾക്കൊണ്ടിരിക്കുന്ന ചെറിയ ചതുരക്കട്ടകളുടെ എണ്ണം കണ്ടെത്തുന്ന വിവിധ രീതികൾ മനസ്സിലാക്കുന്നതിന്.

ആശയങ്ങൾ

1. ഒരു വസ്തുവിന്റെ വലിപ്പത്തെ സൂചിപ്പിക്കുന്ന അളവാണ് വ്യാപ്തം
2. എല്ലാ വസ്തുക്കൾക്കും വ്യാപ്തം ഉണ്ട്.
3. ഒരു ചതുരക്കട്ടയുടെ വ്യാപ്തം എന്നത് അതിൽ ഒരു സെന്റീമീറ്റർ വീതം നീളവും, വീതിയും ഉയരവുമുള്ള എത്ര സമചതുരക്കട്ടകൾ അടുക്കാം എന്നതിന് തുല്യമാണ്.

പഠന സാമഗ്രികൾ

ചെറിയ ചതുരക്കട്ടകൾ ചേർത്തുണ്ടാക്കിയ വലിയ ചതുരക്കട്ടകൾ.

ഘട്ടം 1: പ്രശ്നാവതരണം

ടീച്ചർ കുട്ടികളെ അഭിവാദ്യം ചെയ്ത ശേഷം ഒരു ചെറിയ ചർച്ചയ്ക്ക് തുടക്കമിടുന്നു.

ചർച്ച ചെയ്യേണ്ട വസ്തുതകൾ

- നമ്മുടെ ചുറ്റും പല ആകൃതിയിലും വലിപ്പത്തിലും ഉള്ള അനേകം വസ്തുക്കൾ ഉണ്ട്.
- ചില വസ്തുക്കൾക്ക് നിശ്ചിത ആകൃതി ഉണ്ട്.
- ചില വസ്തുക്കളിൽ ഏതാണ് വലുത് ഏതാണ് ചെറുതെന്ന് കാഴ്ചയിൽ മനസ്സിലാക്കാൻ കഴിയില്ല.
- വസ്തുക്കളുടെ വലിപ്പം നിശ്ചയിക്കേണ്ട വിവിധ ജീവിത സന്ദർഭങ്ങൾ
- വസ്തുക്കളുടെ വലിപ്പത്തിനെ സൂചിപ്പിക്കുന്നതിന് ഒരു പ്രത്യേക അളവിന്റെ ആവശ്യകത.

ടീച്ചർ : ഒരുവസ്തുവിന്റെ വലിപ്പത്തെ സൂചിപ്പിക്കുന്ന അളവാണ് വ്യാപ്തം. ഇന്ന് നമ്മൾ പഠിക്കാൻ പോകുന്നത് ചതുരക്കട്ടയുടെ ആകൃതിയിലുള്ള വസ്തുക്കളുടെ വ്യാപ്തത്തെക്കുറിച്ചാണ്. ചതുരക്കട്ടയുടെ പ്രത്യേകത എന്താണെന്ന് അറിയാമോ?

കുട്ടികൾ : നീളവും വീതിയും ഉയരവും ഉണ്ടാകും.

ടീച്ചർ : നമ്മുടെ ക്ലാസ്റൂമിൽ ചതുരക്കട്ടയുടെ ആകൃതിയിലുള്ള വസ്തുക്കൾ എന്തെല്ലാമാണുള്ളത്?

കുട്ടികൾ : പുസ്തകം, പെൻസിൽ ബോക്സ്, ചുമർ, ബഞ്ച് തുടങ്ങിയവ.

ടീച്ചർ : ഇത്തരം വസ്തുക്കളുടെ വ്യാപ്തം എങ്ങിനെ കണ്ടുപിടിക്കാം എന്ന് നോക്കാം.

പ്രവർത്തനം

കുട്ടികളെ ചെറിയ ഗ്രൂപ്പുകളാക്കി തിരിക്കുന്നു. ഓരോ ഗ്രൂപ്പിനും ചെറിയ ചതുരക്കട്ടകൾ ചേർത്തുണ്ടാക്കിയ ഓരോ ചതുരക്കട്ട വീതം നൽകുന്നു. ഓരോ ഗ്രൂപ്പിനും കിട്ടിയ ചതുരക്കട്ടയിലെ ചെറിയ ചതുരക്കട്ടകളുടെ എണ്ണം കണ്ടുപിടിക്കാൻ ആവശ്യപ്പെടുന്നു. പ്രവർത്തനം എല്ലാ കുട്ടികൾക്കും മനസ്സിലായിട്ടുണ്ടെന്ന് ഉറപ്പു വരുത്തുന്നു.

ഘട്ടം 2: പ്രശ്ന നിർദ്ധാരണം

ഓരോ ഗ്രൂപ്പിനോടും സ്വന്തമായി ഉത്തരം കണ്ടെത്താൻ ആവശ്യപ്പെടുന്നു. ഒരു പ്രത്യേക രീതിയിൽ ഉത്തരം കണ്ടെത്തണമെന്ന് നിർബന്ധമില്ല. ടീച്ചർ പ്രവർത്തനങ്ങൾ നിരീക്ഷിക്കുകയും, ആവശ്യമായ നിർദേശങ്ങൾ നൽകുകയും ചെയ്യുന്നു. എല്ലാ കുട്ടികളും പ്രവർത്തനത്തിൽ പങ്കാളിയാവുന്നുണ്ടെന്ന് ഉറപ്പുവരുത്തുന്നു. കുട്ടികൾ ഉത്തരം കണ്ടെത്തുന്നു.

ഘട്ടം 3: പ്രശ്നപരിഹാര തന്ത്രങ്ങളുടെ ചർച്ച

<u>സ്റ്റെപ്പ്-1: പരിഹാര തന്ത്രങ്ങൾ പങ്കുവെയ്ക്കൽ</u>

ടീച്ചർ ഓരോ ഗ്രൂപ്പിലെയും കുട്ടികളോട് എന്താണ് ഉത്തരം കിട്ടിയതെന്ന് ചോദിക്കുന്നു. അതിനുശേഷം ഓരോ ഗ്രൂപ്പിനോടും അവർ ഉത്തരം കണ്ടെത്തിയ രീതി മുഴുവൻ ക്ലാസിനുമായി വിശദീകരിക്കാൻ ആവശ്യപ്പെടുന്നു. ടീച്ചർ ക്ലാസിലെ മുഴുവൻ കുട്ടികളും ശ്രദ്ധയോടെ കേൾക്കുന്നുണ്ടെന്നും, ചർച്ചയെ ഗൗരവമായി എടുക്കുന്നുണ്ടെന്നും ഉറപ്പാക്കുന്നു. ഓരോ ഗ്രൂപ്പും, അവർ ചെറിയ ചതുരക്കട്ടകളുടെ എണ്ണം കണ്ടെത്തിയ രീതി അവതരിപ്പിക്കുന്നു.

സാധ്യമായ പരിഹാര തന്ത്രങ്ങൾ

1. ചിട്ടയായി, ഉള്ളിലും പുറത്തുമുള്ള ചെറിയ ചതുരക്കട്ടകൾ കണക്കാക്കി എണ്ണുന്നു.
2. ഒരു വരിയിലോ, നിരയിലോ ഉള്ള ചെറിയ ചതുരക്കട്ടകളുടെ എണ്ണം നോക്കി, ആകെ എണ്ണം കൂട്ടി കണക്കാക്കുന്നു.
3. ഓരോ അടുക്കിലും എത്ര ചെറിയ കട്ടകൾ ഉണ്ടെന്ന് കണക്കാക്കി, ആകെ അടുക്കുകളുടെ എണ്ണവും നോക്കി ആവർത്തിച്ച് കൂട്ടി ആകെ എണ്ണം കണക്കാക്കുന്നു.
4. ഒരടുക്കിലെ കട്ടകളുടെ എണ്ണത്തെ ആകെ അടുക്കുകളുടെ എണ്ണം കൊണ്ട് ഗുണിച്ച് ആകെ എണ്ണം കണ്ടെത്തുന്നു.

<u>സ്റ്റെപ് -2: പരിഹാരതന്ത്രങ്ങളുടെ ന്യായീകരണം</u>

ഓരോ ഗ്രൂപ്പിന്റെയും പ്രശ്നപരിഹാര രീതികൾ ചർച്ചയ്ക്ക് വിധേയമാക്കുന്നു. ഓരോ ഗ്രൂപ്പിനോടും ടീച്ചർ ചോദ്യങ്ങൾ ചോദിയ്ക്കുന്നു. കുട്ടികളുടെ ധാരണകൾ മനസ്സിലാക്കുന്നതിനു വേണ്ടി താഴെ കൊടുത്തിരിക്കുന്ന ചോദ്യങ്ങളും തുടർ ചോദ്യങ്ങളും ചോദിക്കുന്നു.

സൂക്ഷ്മ പരിശോധനാ ചോദ്യങ്ങൾ

1. എന്തുകൊണ്ടാണ് ഈ രീതി ഉപയോഗിച്ചത്?
2. ഇത് വേറെ രീതിയിൽ ചെയ്യാൻ സാധിക്കുമോ?

ടീച്ചർ ഒരു രീതിയും മോശമെന്നോ, നല്ലതെന്നോ സ്ഥാപിക്കാൻ ശ്രമിക്കുന്നില്ല. കുട്ടികളുടെ അറിവിന് പ്രാധാന്യം നൽകുന്നു.

<u>സ്റ്റെപ് -3: പരിഹാരതന്ത്രങ്ങളുടെ അപഗ്രഥനം</u>

ടീച്ചർ കുട്ടികളോട് അവർക്ക് ഏത് രീതിയാണ് എളുപ്പമായി തോന്നുന്നതെന്ന് ചോദിയ്ക്കുന്നു. ഓരോ രീതിയും തമ്മിലുള്ള താരതമ്യത്തിലൂടെ, ഒരടുക്കിലെ കട്ടകളുടെ എണ്ണത്തിനെ ആകെ അടുക്കുകളുടെ എണ്ണം കൊണ്ട് ഗുണിച്ചാൽ എളുപ്പത്തിൽ ഉത്തരം കണ്ടെത്താമെന്ന് കുട്ടികൾ മനസ്സിലാക്കുന്നു. എന്നാൽ ഈ രീതിയിൽ മാത്രമേ ഉത്തരം കാണാവൂ എന്ന് നിർബന്ധമില്ല.

ഒരു ചതുരക്കട്ടയിൽ ഒരു സെന്റീമീറ്റർ വീതം നീളവും, വീതിയും, ഉയരവും ഉള്ള എത്ര സമചതുരക്കട്ടകൾ അടുക്കാമെന്നതിന് തുല്യമാണ് ആ ചതുരക്കട്ടയുടെ വ്യാപ്തം.

തുടർപ്രവർത്തനങ്ങൾ

1. സോപ്പുകഷണമോ റബ്ബറോ മുറിച്ച് 1 സെന്റീമീറ്റർ വീതം നീളവും, വീതിയും ഉയരവുമുള്ള സമചതുരക്കട്ട നിർമ്മിക്കുക.
2. ഒരു മാന്ത്രിക സമചതുരക്കട്ടയിലെ ചതുരക്കട്ടകളുടെ എണ്ണം കണ്ടെത്തുക.

LESSON TRANSCRIPT-2

Name of Teacher	:	Sunitha T.P			
Name of School	:	GMHSS CU Campus/ AUPS Velimukku	Class	:	VI
Subject:	:	Mathematics	Division	:	F/A
Unit	:	Volume	Time	:	40 mts
Topic	:	Volume of Rectangular Prisms			

പഠനോദ്ദേശ്യങ്ങൾ

1. വ്യാപ്തത്തിന്റെ യൂണിറ്റ് ഘന സെന്റിമീറ്റർ ആണെന്ന് മനസ്സിലാക്കുന്നതിന്.
2. ചതുരക്കട്ടയുടെ ആകൃതിയിലുള്ള വസ്തുക്കളുടെ വ്യാപ്തം കണ്ടുപിടിക്കുന്ന വിവിധ രീതികൾ മനസ്സിലാക്കുന്നതിന്.
3. ചതുരക്കട്ടയുടെ ആകൃതിയിലുള്ള വസ്തുക്കളുടെ വ്യാപ്തം കണ്ടുപിടിക്കുന്നതിന്.

ആശയങ്ങൾ

1. നീളവും, വീതിയും, ഉയരവും 1 സെന്റിമീറ്റർ ആയ സമചതുരക്കട്ട (cube) യുടെ വ്യാപ്തം 1 ഘനസെന്റിമീറ്റർ ആണ്.
2. വ്യാപ്തത്തിന്റെ യൂണിറ്റ് ഘനസെന്റിമീറ്ററർ ആണ്
3. ഒരു ചതുരക്കട്ടയുടെ വ്യാപ്തം അതിന്റെ നീളത്തിന്റെയും, വീതിയുടെയും, ഉയരത്തിന്റെയും ഗുണനഫലത്തിന് തുല്യമാണ്.

പഠന സാമഗ്രികൾ

1. ഒരു സെന്റിമീറ്റർ വീതം നീളവും, വീതിയും, ഉയരവുമുള്ള സമചതുരക്കട്ടകൾ, പല വലിപ്പത്തിലുള്ള ചതുരക്കട്ടകൾ.

മുന്നറിവുകൾ

1. ചതുരക്കട്ടയുടെ വ്യാപ്തം എന്ന ആശയം.
2. ചതുരക്കട്ടയുടെ വ്യാപ്തം അതിൽ ഉൾക്കൊള്ളാവുന്ന 1 സെന്റിമീറ്റർ വീതം നീളവും വീതിയും ഉയരവുമുള്ള സമചതുരക്കട്ടകളുടെ എണ്ണത്തിന് തുല്യമാണ്.

ഘട്ടം 1: പ്രശ്നാവതരണം

ടീച്ചർ കുട്ടികളെ അഭിവാദ്യം ചെയ്യുന്നു. അതിനുശേഷം കുട്ടികൾ നിർമ്മിച്ച 1 സെന്റിമീറ്റർ വീതം നീളവും വീതിയും ഉയരവുമുള്ള സമചതുരക്കട്ടകൾ പരിശോധിക്കുന്നു. അവയുടെ വലിപ്പം മറ്റു വസ്തുക്കളുടെ വലിപ്പവുമായി താരതമ്യം ചെയ്യുകയും, പ്രത്യേകതകളെക്കുറിച്ച് ചർച്ച ചെയ്യുകയും ചെയ്യുന്നു. അതിനുശേഷം,

ടീച്ചർ : ഇത്തരത്തിൽ നീളവും, വീതിയും, ഉയരവുമെല്ലാം 1 സെന്റീമീറ്റർ ആയ സമചതുരക്കട്ടയുടെ വ്യാപ്തം 1 ഘനസെന്റീമീറ്റർ എന്നാണ് പറയുന്നത്. കഴിഞ്ഞ ക്ലാസിൽ നമ്മൾ ചതുരക്കട്ടയുടെ വ്യാപ്തത്തെക്കുറിച്ച് പഠിച്ചതോർക്കുന്നുണ്ടോ?

കുട്ടികൾ : ഉണ്ട്.

ടീച്ചർ : ചതുരക്കട്ടയുടെ വ്യാപ്തം എന്തിനു തുല്യമാണ്?

കുട്ടികൾ : അതിൽ അടുക്കാവുന്ന 1 സെന്റീമീറ്റർ നീളവും, വീതിയും, ഉയരവുമുള്ള സമചതുരക്കട്ടകളുടെ എണ്ണത്തിന്.

ടീച്ചർ : അതുകൊണ്ട് വ്യാപ്തത്തിന്റെ യൂണിറ്റ് ഘന സെന്റീമീറ്റർ ആണ്.

അതിനു ശേഷം ചതുരക്കട്ടയും, ചതുരവും താരതമ്യപ്പെടുത്തി ചർച്ച ചെയ്യുന്നു.

ചർച്ച ചെയ്യേണ്ട വസ്തുതകൾ

- അളവുകൾ തമ്മിലുള്ള വ്യത്യാസം (നീളം, വീതി, ഉയരം)
- ചതുരത്തിന്റെ പരപ്പളവ്, യൂണിറ്റ്.

പ്രവർത്തനം

ടീച്ചർ കുട്ടികളെ ചെറിയ ഗ്രൂപ്പുകളാക്കി തിരിക്കുന്നു. ഓരോ ഗ്രൂപ്പിനും വ്യത്യസ്ത വലിപ്പത്തിലുള്ള ചതുരക്കട്ടകൾ നൽകുന്നു. നീളവും, വീതിയും, ഉയരവും വശങ്ങളിൽ രേഖപ്പെടുത്തിയിരിക്കുന്നു. വ്യാപ്തം എത്ര ഘനസെന്റീമീറ്റർ ആയിരിക്കും എന്ന് കണക്കാക്കാൻ ആവശ്യപ്പെടുന്നു.

ഘട്ടം 2: പ്രശ്ന നിർദ്ധാരണം

ഓരോ ഗ്രൂപ്പും സ്വന്തമായ രീതിയിൽ ഉത്തരം കണ്ടെത്തുന്നു. ടീച്ചർ പ്രവർത്തനങ്ങൾ നിരീക്ഷിക്കുകയും ആവശ്യമായ മാർഗനിർദേശങ്ങൾ നൽകുകയും ചെയ്യുന്നു.

ഘട്ടം 3: പ്രശ്നപരിഹാര തന്ത്രങ്ങളുടെ ചർച്ച

<u>സ്റ്റെപ്പ്-1: പരിഹാര തന്ത്രങ്ങൾ പങ്കുവെയ്ക്കൽ</u>

ഓരോ ഗ്രൂപ്പിനോടും അവർക്ക് കിട്ടിയ ചതുരക്കട്ടയുടെ അളവുകളും, കിട്ടിയ ഉത്തരവും, കണ്ടെത്തിയ രീതിയും, അവതരിപ്പിക്കാൻ ആവശ്യപ്പെടുന്നു.

സാധ്യമായ പരിഹാര തന്ത്രങ്ങൾ

1. ഒരടുക്കിൽ എത്ര സമചതുരക്കട്ടകൾ കൊള്ളുമെന്ന് എണ്ണിയോ, വശങ്ങളിൽ വരച്ചുനോക്കിയോ കണക്കാക്കി, അടുക്കുകളുടെ എണ്ണത്തിനനുസരിച്ച് ആവർത്തിച്ച് കൂട്ടി ആകെ എണ്ണം കണ്ടെത്തുന്നു.
2. ഒരടുക്കിലെ സമചതുരക്കട്ടകളുടെ എണ്ണം നീളവും, വീതിയും തമ്മിൽ ഗുണിച്ച് കണ്ടെത്തി, അടുക്കുകളുടെ എണ്ണത്തിനനുസരിച്ച് ആവർത്തിച്ച് കൂട്ടി ആകെ എണ്ണം കണ്ടെത്തുന്നു.
3. ഒരടുക്കിലെ സമചതുരക്കട്ടകളുടെ എണ്ണം നീളവും, വീതിയും തമ്മിൽ ഗുണിച്ച് കണ്ടെത്തി, കിട്ടിയ ഉത്തരത്തിനെ അടുക്കുകളുടെ എണ്ണം കൊണ്ട് ഗുണിച്ച് ആകെ എണ്ണം കണ്ടെത്തുന്നു.

ടീച്ചർ ഓരോ ഗ്രൂപ്പിന്റെയും, ചതുരക്കട്ടയുടെ നീളം, വീതി, ഉയരം, ആകെ ചതുരക്കട്ടകളുടെ എണ്ണം അഥവാ വ്യാപ്തം എന്നിവ ബോർഡിൽ രേഖപ്പെടുത്തുന്നു.

സ്റ്റെപ്പ് -2: പരിഹാരതന്ത്രങ്ങളുടെ ന്യായീകരണം

ഓരോ ഗ്രൂപ്പിന്റെയും പ്രശ്നപരിഹാര രീതികൾ ചർച്ച ചെയ്യുന്നു. കുട്ടികളുടെ അറിവ് മനസ്സിലാക്കുന്നതിനായി, ഉത്തരം കണ്ടെത്തിയ രീതിയെക്കുറിച്ചുള്ള സൂക്ഷ്മ പരിശോധനാ ചോദ്യങ്ങളും, തുടർ ചോദ്യങ്ങളും ചോദിക്കുന്നു.

സൂക്ഷ്മ പരിശോധനാ ചോദ്യങ്ങൾ

1. ഒരടുക്കിലെ കട്ടകളുടെ എണ്ണം കണ്ടെത്തിയതെങ്ങിനെ?
2. വേറെ ഏതെങ്കിലും രീതിയിൽ ഒരടുക്കിലെ കട്ടകളുടെ എണ്ണം കണ്ടെത്താമോ?
3. ആകെ കട്ടകളുടെ എണ്ണം എന്തുകൊണ്ടാണ് ഇങ്ങനെ കണക്കു കൂട്ടിയത്?
4. വെറെ ഏതെങ്കിലും എളുപ്പ മാർഗമുണ്ടോ?

സ്റ്റെപ്പ് -3: പരിഹാരതന്ത്രങ്ങളുടെ അപഗ്രഥനം

എല്ലാ ഗ്രൂപ്പുകളുടെയും പ്രശ്നപരിഹാര രീതികൾ ടീച്ചറും കുട്ടികളും ചേർന്ന് താരതമ്യം ചെയ്യുന്നു. ഒരു ചതുരക്കട്ടയിലെ ഒരടുക്കിലെ സമചതുരക്കട്ടകളുടെ എണ്ണം നീളവും, വീതിയും ഗുണിച്ച് കണ്ടെത്താമെന്നും, അടുക്കുകളുടെ എണ്ണം ഉയരത്തിന് തുല്യമാണെന്നും കുട്ടികൾ മനസ്സിലാക്കുന്നു.

അതിനു ശേഷം ടീച്ചർ കുട്ടികളോട് ബോർഡിലെ പട്ടിക ശ്രദ്ധിക്കാൻ ആവശ്യപ്പെടുന്നു.

നീളം	വീതി	ഉയരം	വ്യാപ്തം
4 സെ.മീ.	2 സെ.മീ.	3 സെ.മീ.	24 ഘ. സെ.മീ.
6 സെ.മീ.	2 സെ.മീ.	3 സെ.മീ.	36 ഘ. സെ.മീ.
5 സെ.മീ.	4 സെ.മീ.	3 സെ.മീ.	60 ഘ. സെ.മീ.
8 സെ.മീ.	3 സെ.മീ.	4 സെ.മീ.	96 ഘ. സെ.മീ.
5 സെ.മീ.	3 സെ.മീ.	2 സെ.മീ.	30 ഘ. സെ.മീ.
4 സെ.മീ.	2 സെ.മീ.	5 സെ.മീ.	40 ഘ. സെ.മീ.

ചതുരക്കട്ടകളുടെ നീളവും, വീതിയും, ഉയരവും, വ്യാപ്തവും തമ്മിലുള്ള ബന്ധം ചർച്ച ചെയ്യുന്നു. മൂന്നളവുകളുടെയും ഗുണനഫലമാണ് വ്യാപ്തം എന്ന് കുട്ടികൾ മനസ്സിലാക്കുന്നു.

ചതുരക്കട്ടയുടെ വ്യാപ്തം = നീളം × വീതി × ഉയരം

തുടർപ്രവർത്തനങ്ങൾ

1. ഒരു ഇരുമ്പ് ചതുരപ്പെട്ടിയുടെ നീളം 8 സെന്റീമീറ്റർ, വീതി 5 സെന്റീമീറ്റർ, ഉയരം 2 സെന്റീമീറ്റർ. അതിന്റെ വ്യാപ്തമെത്ര?
2. ഒരു മരക്കട്ടയുടെ നീളം 11 സെന്റീമീറ്റർ, വീതി 10 സെന്റീമീറ്റർ, ഉയരം 9 സെന്റീമീറ്റർ. അതിന്റെ വ്യാപ്തമെത്ര?

LESSON TRANSCRIPT-3

Name of Teacher	:	Sunitha T.P			
Name of School	:	GMHSS CU Campus/ AUPS Velimukku	Class	:	VI
Subject:	:	Mathematics	Division	:	F/A
Unit	:	Volume	Time	:	40 mts
Topic	:	Change in Volume with Change in Dimensions			

പഠനോദ്ദേശ്യങ്ങൾ

1. ഒരു സമചതുരക്കട്ടയുടെ വ്യാപ്തം കണ്ടുപിടിക്കുന്നതിന്
2. ചതുരക്കട്ടയുടെ വശങ്ങളുടെ അളവുകൾ വ്യത്യാസം വരുന്ന തിനനുസരിച്ച് വ്യാപ്തത്തിൽ വരുന്ന വ്യത്യാസം മനസ്സിലാക്കുന്നതിന്.

ആശയങ്ങൾ

1. ഒരു ചതുരക്കട്ടയുടെ വശത്തിന്റെ അളവുകൾ എല്ലാം രണ്ട് മടങ്ങായാൽ വ്യാപ്തം 8 മടങ്ങാകുന്നു.
2. ഒരു ചതുരക്കട്ടയുടെ വശത്തിന്റെ അളവുകൾ എല്ലാം മൂന്ന് മടങ്ങായാൽ വ്യാപ്തം 27 മടങ്ങാകുന്നു.

മുന്നറിവുകൾ

1. ഒരു ചതുരക്കട്ടയുടെ വ്യാപ്തം അതിന്റെ നീളത്തിന്റെയും, വീതിയുടെയും, ഉയരത്തിന്റെയും ഗുണനഫലമാണ്.
2. ഒരു സമചതുരക്കട്ടയുടെ വശത്തിന്റെ അളവുകൾ തുല്യമായിരിക്കും.

ഘട്ടം 1: പ്രശ്നാവതരണം

ടീച്ചർ കുട്ടികളെ അഭിവാദ്യം ചെയ്ത്, കഴിഞ്ഞ ക്ലാസിൽ പഠിച്ച കാര്യങ്ങൾ ഓർമിപ്പിക്കുന്നു. അതിനു ശേഷം,

ടീച്ചർ : 1 സെന്റീമീറ്റർ സമചതുരക്കട്ടയുടെ വ്യാപ്തം എത്രയാണ്?

കുട്ടികൾ : 1 ഘന സെന്റീമീറ്റർ

ടീച്ചർ : ആ സമചതുരക്കട്ടയുടെ വശങ്ങൾ എല്ലാം രണ്ട് മടങ്ങായാൽ വ്യാപ്തമെത്ര?

കുട്ടികൾ : 8 ഘന സെന്റീമീറ്റർ

ടീച്ചർ : ഇനി നമുക്ക് ഒരു പ്രവർത്തനം ചെയ്യാം.

കുട്ടികളെ ചെറിയ ഗ്രൂപ്പുകളാക്കി തിരിക്കുന്നു.

പ്രവർത്തനം

ഒരു ചതുരക്കട്ടയുടെ നീളം---- സെന്റീമീറ്റർ, വീതി ---- സെന്റീമീറ്റർ, ഉയരം ---- സെന്റീമീറ്റർ.

ഈ ചതുരക്കട്ടയുടെ വശങ്ങളുടെ അളവുകൾ എല്ലാം 2 മടങ്ങായാൽ വ്യാപ്തമെത്ര? വ്യാപ്തത്തിൽ വരുന്ന വ്യത്യാസമെന്ത്?

ഓരോ ഗ്രൂപ്പിനും വ്യത്യസ്തമായ അളവുകൾ നൽകുന്നു.

ഘട്ടം 2: പ്രശ്ന നിർദ്ധാരണം

ഓരോ ഗ്രൂപ്പും അവരുടേതായ രീതിയിൽ ഉത്തരം കണ്ടെത്തുന്നു. ടീച്ചർ പ്രവർത്തനങ്ങൾ നിരീക്ഷിക്കുകയും ആവശ്യമായ മാർഗ നിർദേശങ്ങൾ നൽകുകയും ചെയ്യുന്നു.

ഘട്ടം 3: പ്രശ്നപരിഹാര തന്ത്രങ്ങളുടെ ചർച്ച

സ്റ്റെപ്പ്-1 : പരിഹാരതന്ത്രങ്ങൾ പങ്കുവെക്കൽ

ഓരോ ഗ്രൂപ്പിനോടും അവർക്ക് കിട്ടിയ ചതുരക്കട്ടയുടെ അളവുകൾ, വ്യാപ്തം, വശങ്ങളുടെ അളവുകൾ രണ്ട് മടങ്ങായാൽ ലഭിക്കുന്ന വ്യാപ്തം, വ്യാപ്തത്തിൽ വരുന്ന വ്യത്യാസമെന്തെന്ന നിഗമനവും, ഉത്തരം കണ്ടെത്തിയ രീതിയും, അവതരിപ്പിക്കാൻ ആവശ്യപ്പെടുന്നു.

സാധ്യമായ പരിഹാര തന്ത്രങ്ങൾ

1. ഓരോ വശങ്ങളുടെയും രണ്ട് മടങ്ങ് കണ്ടെത്തിയ ശേഷം, ഗുണനഫലം കണ്ട് വ്യാപ്തം കാണുക.
2. ആദ്യം ലഭിച്ച വ്യാപ്തത്തെ 8 കൊണ്ട് ഗുണിച്ച്, വശങ്ങൾ 2 മടങ്ങായാൽ ഉള്ള വ്യാപ്തം കാണുക.

സ്റ്റെപ്പ്-2 : പരിഹാരതന്ത്രങ്ങളുടെ ന്യായീകരണം

ഓരോ ഗ്രൂപ്പിനോടും ടീച്ചർ ഉത്തരം കണ്ടെത്തിയ രീതിയും, നിഗമനവും വ്യക്തമാക്കുന്നതിനാവശ്യമായ ചോദ്യങ്ങൾ ചോദിക്കുന്നു. കുട്ടികളുടെ ചിന്താരീതി മനസ്സിലാക്കുകയാണ് ലക്ഷ്യം. അതിനോടൊപ്പം മറ്റു കുട്ടികൾക്കും സംശയങ്ങൾ ചോദിക്കാനുള്ള അവസരം നൽകുന്നു.

സ്റ്റെപ്പ് -3: പരിഹാരതന്ത്രങ്ങളുടെ അപഗ്രഥനം

ടീച്ചർ കുട്ടികളോട് ബോർഡിലെ പട്ടിക ശ്രദ്ധിക്കാൻ ആവശ്യപ്പെടുന്നു.

നീളം	വീതി	ഉയരം	വ്യാപ്തം 1	വ്യാപ്തം 2
2	1	2	4	32
3	2	2	12	72
3	3	3	27	216
4	3	2	24	192
5	2	1	10	80
5	2	2	20	160
4	4	4	64	512

ഓരോ ചതുരകട്ടയുടെയും വ്യാപ്തവും, വശങ്ങളുടെ അളവുകൾ രണ്ട് മടങ്ങായാൽ ലഭിക്കുന്ന വ്യാപ്തവും തമ്മിലുള്ള ബന്ധം ചർച്ച ചെയ്യുന്നു. എല്ലാ ചതുരക്കട്ടകളിലും വശങ്ങളുടെ അളവുകൾ രണ്ട് മടങ്ങായാൽ വ്യാപ്തം 8 മടങ്ങാകുന്നു എന്ന നിഗമനത്തിൽ എത്തിച്ചേരുന്നു.

സമചതുരക്കട്ടകളുടെ വ്യാപ്തത്തിന്റെ പ്രത്യേകതകളും ചർച്ച ചെയ്യുന്നു.

തുടർന്ന് വശങ്ങളുടെ അളവുകൾ 3 മടങ്ങായാൽ വ്യാപ്തത്തിൽ വരുന്ന വ്യത്യാസം അറിയുന്നതിനായി ഓരോ കുട്ടിയോടും ഇഷ്ടമുള്ള ചതുരക്കട്ടയുടെ അളവുകൾ എടുത്ത് ഉത്തരം കണ്ടെത്താൻ ആവശ്യപ്പെടുന്നു. വ്യാപ്തം 27 മടങ്ങാകുന്നു എന്ന നിഗമനത്തിൽ ചർച്ചയിലൂടെ എത്തിച്ചേരുന്നു.

തുടർപ്രവർത്തനങ്ങൾ

1. 8 സെ.മീ. വശങ്ങളുള്ള ഒരു മരക്കട്ടയുടെ വ്യാപ്തമെത്ര?
2. 12 സെന്റീമീറ്റർ വശങ്ങളുള്ള മരക്കട്ടയുടെ വ്യാപ്തം എത്ര?

LESSON TRANSCRIPT-4

Name of Teacher	:	Sunitha T.P			
Name of School	:	GMHSS CU Campus/ AUPS Velimukku	Class	:	VI
Subject:	:	Mathematics	Division	:	F/A
Unit	:	Volume	Time	:	40 mts
Topic	:	Calculation of Length/Breadth/Height from Volume and Two Given Dimensions			

പഠനോദ്ദേശ്യങ്ങൾ

1. ഒരു ചതുരക്കട്ടയുടെ നീളം, വീതി, ഉയരം എന്നിവയിൽ എതെങ്കിലും രണ്ടളവുകളും വ്യാപ്തവും തന്നാൽ ബാക്കിയുള്ള അളവ് കണ്ടുപിടിക്കാൻ.
2. ഒരു ചതുരക്കട്ടയുടെ നീളം, വീതി, ഉയരം എന്നിവയിൽ രണ്ടളവുകളും വ്യാപ്തവും തന്നാൽ ബാക്കിയുള്ള അളവ് കണ്ടുപിടിക്കാനുള്ള വിവിധ രീതികൾ മനസ്സിലാക്കുന്നതിന്.

ആശയങ്ങൾ

1. ഒരു ചതുരക്കട്ടയുടെ നീളം, വീതി, ഉയരം എന്നിവയിൽ ഏതെങ്കിലും രണ്ടളവുകളും, വ്യാപ്തവും തന്നാൽ ബാക്കിയുള്ള അളവ് കണ്ടെത്താം.

മുന്നറിവുകൾ

1. ഒരു ചതുരക്കട്ടയുടെ വ്യാപ്തം അതിന്റെ നീളം, വീതി, ഉയരം എന്നിവയുടെ ഗുണനഫലമാണ്.

ഘട്ടം 1: പ്രശ്നാവതരണം

ടീച്ചർ : ഗുഡ്മോർണിംഗ്

കുട്ടികൾ : ഗുഡ് മോർണിംഗ് ടീച്ചർ

ടീച്ചർ : നമ്മൾ ഇതുവരെ പഠിച്ചത് ഒരു ചതുരക്കട്ടയുടെ നീളവും, വീതിയും, ഉയരവും തന്നാൽ വ്യാപ്തം എങ്ങിനെ കണക്കാക്കാം എന്നായിരുന്നല്ലോ?

കുട്ടികൾ : അതെ

ടീച്ചർ : ഇന്ന് നമുക്ക് നീളം, വീതി, ഉയരം എന്നിവയിൽ രണ്ട് അളവുകളും വ്യാപ്തവും തന്നാൽ വിട്ടുപോയ അളവ് എങ്ങിനെ കണ്ടുപിടിയ്ക്കാം എന്ന് നോക്കാം.

പ്രവർത്തനം

ഒരു ചതുരക്കട്ടയുടെ നീളം 7 സെന്റീമീറ്ററും, വീതി 5 സെന്റിമീറ്ററും ആണ്. ആ ചതുരക്കട്ടയുടെ വ്യാപ്തം 140 ഘനസെന്റീമീറ്റർ ആണെന്നറിയാം. എന്നാൽ അതിന്റെ ഉയരം എത്ര സെന്റീമീറ്റർ ആയിരിക്കും.

ഓരോ കുട്ടിയോടും ഉത്തരം സ്വയം കണ്ടെത്താൻ ആവശ്യപ്പെടുന്നു.

ഘട്ടം 2: പ്രശ്ന നിർദ്ധാരണം

ടീച്ചർ ഓരോ കുട്ടിയുടെയും പ്രവർത്തനം നിരീക്ഷിക്കുന്നു. അവർക്ക് അറിയുന്ന രീതിയിൽ ഉത്തരം കണ്ടെത്താൻ ഓരോ കുട്ടിയെയും പ്രോത്സാഹിപ്പി ക്കുന്നു. ടീച്ചർ ആവശ്യമായ മാർഗനിർദേശങ്ങൾ നൽകുന്നു. ഉത്തരം കണ്ടെത്തി കഴിഞ്ഞ കുട്ടികളുടെ ഉത്തരങ്ങൾ പരിശോധിക്കുകയും കണ്ടെത്തിയ രീതിയെക്കു റിച്ച് ചോദ്യങ്ങൾ ചോദിക്കുകയും ചെയ്യുന്നു. പെട്ടെന്ന് ഉത്തരം കണ്ടെത്തിയ കുട്ടി കളോട് വേറെ രീതിയിൽ ഉത്തരം കണ്ടെത്താൻ ശ്രമിക്കാൻ ആവശ്യപ്പെടുന്നു.

ഘട്ടം 3: പ്രശ്നപരിഹാര തന്ത്രങ്ങളുടെ ചർച്ച

കുട്ടികൾ ഉത്തരം കണ്ടെത്തി കഴിഞ്ഞാൽ പ്രശ്ന പരിഹാര രീതികൾ ചർച്ച ചെയ്യുന്നു.

സ്റ്റെപ്പ്-1 : പരിഹാരതന്ത്രങ്ങൾ പങ്കുവെക്കൽ

ടീച്ചർ വ്യത്യസ്തമായ രീതികളിൽ ഉത്തരം കണ്ടെത്തിയ ഒരോ കുട്ടിയോട് വീതം ഉത്തരം കണ്ടെത്തിയ രീതി അവതരിപ്പിക്കാൻ ആവശ്യപ്പെടുന്നു.

സാധ്യമായ പരിഹാര തന്ത്രങ്ങൾ

1. 35 എത്ര പ്രാവശ്യം കൂട്ടിയാൽ ആണ് 140 കിട്ടുക എന്ന് കണ്ടുപിടിക്കുന്നു.
2. 140നെ 7 കൊണ്ടും 5 കൊണ്ടും വേറെ വേറെ ഹരിച്ച് ഉത്തരം കണ്ടെത്തുന്നു.
3. 140നെ 35 കൊണ്ട് ഹരണക്രിയ ഉപയോഗിച്ച് ഹരിച്ച് ഉത്തരം കണ്ടെത്തുന്നു.

സ്റ്റെപ് -2: പരിഹാരതന്ത്രങ്ങളുടെ ന്യായീകരണം

ടീച്ചർ കുട്ടികളോട് അവർ ഉപയോഗിച്ച രീതിയെകുറിച്ച് ചോദ്യങ്ങൾ ചോദിക്കുന്നു. മറ്റുള്ള കുട്ടികൾക്ക് വ്യക്തമായി മനസ്സിലാവുന്നതിനു വേണ്ടി യുള്ള ചോദ്യങ്ങളാണ് ചോദിക്കുന്നത്. മറ്റുകുട്ടികൾക്കും സംശയങ്ങൾ ഉണ്ടെങ്കിൽ ചോദിക്കാനുള്ള അവസരം നൽകുന്നു.

സൂക്ഷ്മ പരിശോധനാ ചോദ്യങ്ങൾ

1. എങ്ങിനെയാണ് ഉത്തരം കണ്ടെത്തിയത്?
2. എന്തു കൊണ്ടാണ് ഈ രീതി ഉപയോഗിച്ചത്?

കുട്ടികളുടെ ഉത്തരങ്ങൾക്കനുസരിച്ച് തുടർചോദ്യങ്ങളും ചോദിക്കുന്നു.

സ്റ്റെപ് -3: പരിഹാരതന്ത്രങ്ങളുടെ അപഗ്രഥനം

ടീച്ചറും കുട്ടികളും ഓരോ പ്രത്യേക രീതിയും താരതമ്യം ചെയ്ത് ചർച്ച ചെയ്യുന്നു. കുട്ടികൾക്ക് അവർക്ക് ഏറ്റവും നന്നായി മനസ്സിലാക്കി ഉത്തരം കണ്ടെ ത്താൻ കഴിയുന്ന രീതി ഉപയോഗിക്കാനുള്ള നിർദേശം നൽകുന്നു.

ടീച്ചർ : ഇതുപോലെ നീളം, വീതി, ഉയരം ഇവയിൽ ഏതെങ്കിലും രണ്ടളവുകളും വ്യാപ്തവും തന്നിട്ടുണ്ടെങ്കിൽ നമുക്ക് ഒരു ചതുരക്കട്ടയുടെ തന്നിട്ടില്ലാത്ത അളവ് കണക്കാക്കാം.

ഈ പ്രശ്നത്തിലെ സംഖ്യകൾക്ക് പകരം കൂടുതൽ വലിയ സംഖ്യകൾ നൽകി പ്രവർത്തനം ആവർത്തിക്കുന്നു.

തുടർപ്രവർത്തനങ്ങൾ

1. ഒരു ചതുരക്കട്ടയുടെ നീളം 40 സെ.മീ., ഉയരം 30 സെ.മീ., വ്യാപ്തം 6000 ഘ. സെ.മി. എങ്കിൽ വീതി എത്ര?
2. ഒരു ചതുരക്കട്ടയുടെ വീതി 15 സെ.മീ. ഉയരം 16 സെ.മീ., വ്യാപ്തം 1440 ഘ. സെ.മീ. എങ്കിൽ നീളം എത്ര?

LESSON TRANSCRIPT-5

Name of Teacher	:	Sunitha T.P		
Name of School	:	GMHSS C U Campus/ VAUPS Velimukku	Class:	VI
Subject:	:	Mathematics	Division:	F/A
Unit	:	Volume	Time:	40 mts
Topic	:	Volume and Height		

പഠനോദ്ദേശ്യങ്ങൾ

1. ഒരു വസ്തുവിന്റെ വ്യാപ്തവും, ഭാരവും, സാന്ദ്രതയും തമ്മിലുള്ള ബന്ധം മനസ്സിലാക്കുന്നതിന്.
2. ഒരു ചതുരക്കട്ടയുടെ വ്യാപ്തവും, ഒരു ഘനസെന്റിമീറ്ററിന്റെ ഭാരവും തന്നാൽ ചതുരക്കട്ടയുടെ ഭാരം കണ്ടുപിടിക്കുന്നതിന്

ആശയങ്ങൾ

1. ഒരു വസ്തുവിന്റെ വ്യാപ്തവും ഭാരവും ബന്ധപ്പെട്ടിരിക്കുന്നു.
2. ഒരേ വ്യാപ്തമുള്ള രണ്ട് വസ്തുക്കൾക്ക് വ്യത്യസ്തമായ ഭാരം ഉണ്ടാകാം.
3. ഒരു വസ്തുവിന്റെ ഒരു ഘനസെന്റിമീറ്ററിന്റെ ഭാരമാണ് ആ വസ്തുവിന്റെ സാന്ദ്രത.
4. ഒരു വസ്തുവിന്റെ ഭാരം കാണാൻ അതിന്റെ വ്യാപ്തത്തെ ഒരു ഘനസെന്റിമീറ്ററിന്റെ ഭാരം കൊണ്ട് ഗുണിക്കുക.

പഠനസാമഗ്രികൾ

1. ഒരേ വലിപ്പത്തിലുള്ള ഇരുമ്പ് ചതുരക്കട്ടയും മരചതുരക്കട്ടയും.

മുന്നറിവ്

1. ഒരു ചതുരക്കട്ടയുടെ വ്യാപ്തം അതിൽ ഉൾക്കൊള്ളാവുന്ന 1 ഘനസന്റിമീറ്റർ സമചതുരക്കട്ടകളുടെ എണ്ണത്തിന് തുല്യമാണ്.

ഘട്ടം-1: പ്രശ്നാവതരണം

ടീച്ചർ കുട്ടികളെ അഭിവാദ്യം ചെയ്തതിന് ശേഷം വസ്തുക്കളുടെ ഭാരത്തേയും വ്യാപ്തത്തേയും കുറിച്ച് ചർച്ച ചെയ്യുന്നു.

ചർച്ച ചെയ്യേണ്ട വസ്തുതകൾ

- നമ്മുടെ ചുറ്റുമുള്ള വസ്തുക്കൾക്ക് വ്യത്യസ്തമായ ഭാരമാണ് ഉള്ളത്.
- ഒരേ വലിപ്പത്തിലുള്ള രണ്ട് വസ്തുക്കൾക്ക്, വ്യത്യസ്ത ഭാരം ഉണ്ടാകാം.
- ഒരു ഇരുമ്പു കട്ടയുടെ ഭാരമല്ല അതേ വലിപ്പത്തിലുള്ള മരക്കട്ടയ്ക്ക്. (ഇരുമ്പുകട്ടയുടെയും, മരക്കട്ടയുടെയും ഭാരം താരതമ്യം ചെയ്യാൻ അവസരം നൽകുന്നു.)

- ഒരു വസ്തുവിന്റെ ഭാരം അത് എന്തു പദാർത്ഥം കൊണ്ടാണ് ഉണ്ടാക്കിയിട്ടുള്ളത് എന്നതിനെ ആശ്രയിച്ചിരിക്കുന്നു.
- ഒരു വസ്തുവിന്റെ ഒരു ഘന സെന്റീമീറ്ററിന്റെ ഭാരത്തെ ആ വസ്തുവിന്റെ സാന്ദ്രത എന്ന് പറയുന്നു.
- ഒരു വസ്തുവിന്റെ വ്യാപ്തത്തിൽ നിന്നും ആ വസ്തുവിൽ എത്ര ഘന സെന്റിമീറ്റർ ഉണ്ടെന്ന് മനസ്സിലാക്കാം.
- ഒരു വസ്തുവിന്റെ ആകെ ഘന സെന്റീമീറ്ററിന്റെ ഭാരമാണ് ആ വസ്തുവിന്റെ ഭാരം.
- ഒരു വസ്തുവിന്റെ ഭാരം കാണാൻ അതിന്റെ വ്യാപ്തത്തെ ഒരു ഘനസെന്റീമീറ്ററിന്റെ ഭാരം കൊണ്ട് ഗുണിച്ചാൽ മതി.

പ്രവർത്തനം

ഒരു വസ്തുവിന്റെ ഒരു ഘനസെന്റീമീറ്ററിന്റെ ഭാരം 8 ഗ്രാം ആണ്. ആ വസ്തുവിന്റെ വ്യാപ്തം 196 ഘനസെന്റീമീറ്റർ ആണെങ്കിൽ അതിന്റെ ഭാരം എത്ര ഗ്രാം ആയിരിക്കും?

കുട്ടികളോട് സ്വയം ഉത്തരം കണ്ടെത്താൻ ആവശ്യപ്പെടുന്നു.

ഘട്ടം-2: പ്രശ്ന നിർധാരണം

കുട്ടികൾ ഭാരം സ്വയം കണക്കാക്കുന്നു. ടീച്ചർ ഓരോ കുട്ടിയുടെയും പ്രവർത്തനം നിരീക്ഷിക്കുകയും ആവശ്യമായ മാർഗ നിർദേശങ്ങൾ നൽകുകയും ചെയ്യുന്നു. ടീച്ചർ ഉത്തരങ്ങൾ പരിശോധിക്കുകയും, അവരുടെ ചിന്താരീതി മനസ്സിലാക്കുന്നതിനായി ചോദ്യങ്ങൾ ചോദിയ്ക്കുകയും ചെയ്യുന്നു.

ഘട്ടം-3: പ്രശ്ന പരിഹാര തന്ത്രങ്ങളുടെ ചർച്ച

<u>സ്റ്റെപ്പ്-1</u> : <u>പരിഹാരതന്ത്രങ്ങൾ പങ്കുവെക്കൽ</u>

ഭാരം കണ്ടെത്താൻ വ്യത്യസ്തമായ രീതികൾ ഉപയോഗിച്ച കുട്ടികളിൽ ഒരു കുട്ടിയോട് വീതം ഉത്തരം കണ്ടെത്തിയ രീതി വിശദീകരിക്കാൻ ആവശ്യപ്പെടുന്നു.

സാധ്യമായ പരിഹാര തന്ത്രങ്ങൾ

1. **196** നെ 8 പ്രാവശ്യം കൂട്ടി ഉത്തരം 1568 എന്ന് കണ്ടെത്തുന്നു.
2. **196** നെ നൂറുകൾ, പത്തുകൾ, ഒന്നുകൾ എന്നിങ്ങനെ പിരിച്ച് ഓരോന്നിനേയും 8 കൊണ്ട് ഗുണിക്കുന്നു. 800, 720, 48 എന്നിവ കൂട്ടി ഉത്തരം കണ്ടെത്തുന്നു.
3. **200** നെ 8 കൊണ്ട് ഗുണിച്ച് അതിൽ നിന്നും 32 കുറച്ച് ഉത്തരം കണ്ടെത്തുന്നു.
4. **196** നെ 8 കൊണ്ട് ഗുണനക്രിയ ഉപയോഗിച്ച് ഗുണിച്ച് ഉത്തരം കണ്ടെത്തുന്നു.

<u>സ്റ്റെപ്പ് -2: പരിഹാര തന്ത്രങ്ങളുടെ ന്യായീകരണം</u>

ടീച്ചർ വിശദീകരണം നൽകുന്ന കുട്ടികളോട് ഭാരം കണ്ടെത്തിയ രീതികളെക്കുറിച്ച് ആവശ്യമായ ചോദ്യങ്ങളും അവരുടെ ഉത്തരങ്ങൾക്കനുസരിച്ചുള്ള തുടർ ചോദ്യങ്ങളും ചോദിക്കുന്നു.

സ്റ്റെപ്പ് –3: പരിഹാര തന്ത്രങ്ങളുടെ അപഗ്രഥനം

ഗുണനഫലം കണ്ട വ്യത്യസ്ത രീതികൾ താരതമ്യം ചെയ്യുന്നു. ഏത് രീതിയാണ് കൂടുതൽ എളുപ്പം, എല്ലാ സന്ദർഭങ്ങളിലും ഉപയോഗിക്കാവുന്ന രീതി ഏതാണ് തുടങ്ങിയ കാര്യങ്ങൾ ചർച്ച ചെയ്യുന്നു.

ഈ പ്രശ്നത്തിലെ സംഖ്യകൾക്കു പകരം വലിയ സംഖ്യകൾ ഉപയോഗിച്ച് പ്രവർത്തനം ആവർത്തിക്കുന്നു.

തുടർപ്രവർത്തനം

ഒരു ചെമ്പുചതുരപ്പെട്ടിയുടെ നീളം 19 സെ.മീ, വീതി, 15 സെ.മീ, ഉയരം 4 സെ.മീ. ഒരു ഘനസെന്റീമീറ്റർ ചെമ്പിന്റെ ഭാരം ഏകദേശം 9 ഗ്രാം ആണെങ്കിൽ ആ പെട്ടിയുടെ ഏകദേശഭാരം എത്ര ഗ്രാം ആയിരിക്കും?

LESSON TRANSCRIPT-6

Name of Teacher	:	Sunitha T.P			
Name of School	:	GMHSS CU Campus/ AUPS Velimukku	Class	:	VI
Subject:	:	Mathematics	Division	:	F/A
Unit	:	Volume	Time	:	40 mts
Topic	:	Capacity of Rectangular Prism Shaped Objects			

പഠനോദ്ദേശ്യങ്ങൾ

1. വസ്തുക്കളുടെ ഉള്ളളവ് എന്ന ആശയം മനസ്സിലാക്കുന്നതിന്
2. ചതുരാകൃതിയിലുള്ള വസ്തുക്കളുടെ ഉള്ളളവ്, വ്യാപ്തവുമായി ബന്ധപ്പെടുത്തി മനസ്സിലാക്കുന്നതിന്.
3. ചതുരാകൃതിയായ വസ്തുക്കളുടെ ഉള്ളളവ് ഘനസെന്റിമീറ്ററിൽ കാണുന്നതിന്.

ആശയങ്ങൾ

1. പാത്രങ്ങൾ, പെട്ടികൾ, ടാങ്കുകൾ, കുഴികൾ തുടങ്ങിയ ഓരോന്നിലും ഉൾക്കൊള്ളുന്ന അളവാണ് ഉള്ളളവ്.
2. ഒരു ചതുരപ്പെട്ടിയുടെ ഉള്ളിൽ നിറഞ്ഞിരിക്കാവുന്ന ചതുരക്കട്ടയുടെ വ്യാപ്തമാണ് ആ ചതുരപ്പെട്ടിയുടെ ഉള്ളളവ്.

പഠന സാമഗ്രികൾ

മരം കൊണ്ടുള്ള ചെറിയ ചതുരപ്പെട്ടി, നനവുള്ള മണ്ണ്.

മുന്നറിവ്

1. ഒരു ചതുരക്കട്ടയുടെ വ്യാപ്തം അതിന്റെ അളവുകളുടെ ഗുണനഫലമാണ്.

ഘട്ടം 1: പ്രശ്നാവതരണം

ടീച്ചർ	:	നമ്മൾ ഇതുവരെ പഠിച്ചത് വസ്തുക്കളുടെ വ്യാപ്തത്തെക്കുറിച്ചായിരുന്നില്ലേ?
കുട്ടികൾ	:	അതെ
ടീച്ചർ	:	ഇന്ന് നമുക്ക് പുതിയൊരുകാര്യം പഠിക്കാം. ഈ പെട്ടിയുടെ പ്രത്യേകത എന്താണെന്ന് പറയാമോ? (മരം കൊണ്ടുള്ള ചതുരപ്പെട്ടി കാണിക്കുന്നു.)
കുട്ടികൾ	:	മരം കൊണ്ടുള്ളതാണ്, ചതുരാകൃതിയാണ്...
ടീച്ചർ	:	ഈ പെട്ടിയുടെ അകത്തെ നീളവും, വീതിയും, ഉയരവും, പുറത്തെ നീളവും, വീതിയും, ഉയരവും തുല്യമാണോ?

കുട്ടികൾ	:	അല്ല
ടീച്ചർ	:	കാരണമെന്താണ്?
കുട്ടികൾ	:	കട്ടിയുള്ള പലക കൊണ്ടാണ് ഉണ്ടാക്കിയിരിക്കുന്നത്.
ടീച്ചർ	:	ഇതുപൊലെ അകത്തെയും പുറത്തെയും അളവുകൾ വ്യത്യാസം വരാവുന്ന വസ്തുക്കൾ ഏവ?
കുട്ടികൾ	:	ടാങ്കുകൾ, കട്ടിയുള്ള പാത്രങ്ങൾ....
ടീച്ചർ	:	ഇങ്ങനെയുള്ള വസ്തുക്കളുടെ അകത്ത് കൊള്ളാവുന്ന അളവിനെ പറയുന്ന പേരാണ് ഉള്ളളവ്. ഉദാഹരണത്തിന് ഒരു ടാങ്കിൽ ഉൾക്കൊള്ളാവുന്ന വെള്ളത്തിന്റെ അളവ്, ഒരു കുഴി നിറയാൻ വേണ്ട മണ്ണിന്റെ അളവ്. നമ്മുടെ കയ്യിലുള്ള ഈ പെട്ടിയുടെ ഉള്ള ളവ് എങ്ങിനെ കണ്ടുപിടിക്കാം എന്ന് നോക്കാം. (മരപ്പെട്ടിയുടെ അകത്ത് നനവുള്ള മണ്ണ് നിറച്ച്, ആകൃതി നഷ്ടപ്പെ ടാതെ മൺ ചതുരക്കട്ട പുറത്തെടുക്കുന്നു.)
ടീച്ചർ	:	ഈ ചതുരക്കട്ടയും, പെട്ടിയുടെ ഉള്ളിലെ അളവുകളും തമ്മിൽ എന്ത് ബന്ധമാണ് ഉള്ളത്?
കുട്ടികൾ	:	തുല്യമാണ്.
ടീച്ചർ	:	അതുകൊണ്ട് ഈ മൺകട്ടയുടെ വ്യാപ്തമാണ് ഈ പെട്ടിയുടെ ഉള്ളളവ്.

പ്രവർത്തനം

ഒരു ചതുരപ്പെട്ടിയുടെ അകത്തെ നീളം 40 സെന്റിമീറ്റർ, വീതി 25 സെന്റീമീറ്റർ, ഉയരം 10 സെന്റിമീറ്റർ, അതിന്റെ ഉള്ളളവെത്ര?

കുട്ടികളോട് ഉത്തരം കണ്ടെത്താൻ ആവശ്യപ്പെടുന്നു.

ഘട്ടം 2: പ്രശ്ന നിർദ്ധാരണം

കുട്ടികൾ ഉള്ളളവ് കണക്കാക്കുന്നു. ടീച്ചർ ആവശ്യമായ നിർദേശങ്ങൾ നൽകുന്നു. ഒരു പ്രത്യേക രീതിയിൽ ഗുണനഫലം കാണണമെന്ന് നിർബന്ധമില്ല. ടീച്ചർ കുട്ടികളുടെ ഉത്തരങ്ങൾ പരിശോധിക്കുകയും, ഓരോ കുട്ടിയോടും ഉത്തരം കണ്ടെത്തിയ രീതിയെക്കുറിച്ച് ചോദ്യങ്ങൾ ചോദിക്കുകയും ചെയ്യുന്നു.

ഘട്ടം 3: പ്രശ്നപരിഹാര തന്ത്രങ്ങളുടെ ചർച്ച

<u>സ്റ്റെപ്പ്-1: പരിഹാര തന്ത്രങ്ങൾ പങ്കുവെയ്ക്കൽ</u>

വ്യത്യസ്തമായ രീതികൾ ഉപയോഗിച്ചവരിൽ, ഓരോ പ്രത്യേക രീതിയിൽ നിന്നും ഒരു കുട്ടി വീതം ഉത്തരം കണ്ടെത്തിയ രീതി വിശദമാക്കുന്നു.

സാധ്യമായ പരിഹാര തന്ത്രങ്ങൾ

1. നാല് തവണ 25 കൂട്ടിയാൽ 100, അതുകൊണ്ട് 25നെ 40 കൊണ്ട് ഗുണിച്ചാൽ 1000. പത്ത് ആയിരങ്ങൾ കൂടിയാൽ 10000. വ്യാപ്തം 10000 ഘന സെന്റിമീറ്റർ.
2. 25 നെ 10 കൊണ്ട് ഗുണിച്ചാൽ 250. നാല് 250 ചേർന്നാൽ 1000, നാൽപത് 250 ചേർന്നാൽ 10000.

3. 25 നെ 10 കൊണ്ട് ഗുണിച്ചാൽ ഉത്തരം 250. 250 നെ 40 കൊണ്ട് ഗുണിച്ചാൽ ഉത്തരം 10000.
4. 25 നെ 4 കൊണ്ട് ഗുണിച്ചാൽ 100, പിന്നീട് 40 ലെ ഒരു പൂജ്യം ചേർത്താൻ 1000. 10 ലെ ഒരു പൂജ്യം ചേർത്താൻ 10000.

സ്റ്റെപ് -2: പരിഹാരതന്ത്രങ്ങളുടെ ന്യായീകരണം

ടീച്ചർ വ്യാപ്തം കണ്ടുപിടിച്ച രീതി അവതരിപ്പിക്കുന്ന കുട്ടികളോട് വിശദീകരണങ്ങൾ വ്യക്തമാക്കുന്നതിനാവശ്യമായ ചോദ്യങ്ങൾ ചോദിക്കുന്നു. മറ്റ് കുട്ടികൾക്കും ചോദ്യങ്ങൾ ചോദിക്കാനുള്ള അവസരം നൽകുന്നു.

സ്റ്റെപ് -3: പരിഹാരതന്ത്രങ്ങളുടെ അപഗ്രഥനം

അവതരിപ്പിച്ച വിവിധ രീതികൾ ചർച്ച ചെയ്യുന്നു. ഓരോ രീതിയും പരസ്പരം താരതമ്യം ചെയ്യുന്നു. കുട്ടികളോട് അവർക്ക് നന്നായി മനസ്സിലാവുന്ന രീതി ഉപയോഗിക്കാൻ പറയുന്നു.

അളവുകളിൽ മാറ്റം വരുത്തി പ്രവർത്തനം ആവർത്തിക്കുന്നു.

തുടർപ്രവർത്തനം

ഒരു ചതുരാകൃതിയിലുള്ള പാത്രത്തിന്റെ അകത്തെ നീളം 22 സെ.മീ., വീതി, 20 സെ.മീ., ഉയരം 15 സെ.മീ. അതിന്റെ ഉള്ളളവ് എത്രയാണ്?

LESSON TRANSCRIPT-7

Name of Teacher	:	Sunitha T.P			
Name of School	:	GMHSS CU Campus/ AUPS Velimukku	Class	:	VI
Subject:	:	Mathematics	Division	:	F/A
Unit	:	Volume	Time	:	40 mts
Topic	:	Capacity in Litre			

പഠനോദ്ദേശ്യങ്ങൾ

1. ലിറ്റർ, ഘനസെന്റിമീറ്റർ ഇവ തമ്മിലുള്ള ബന്ധം മനസ്സിലാക്കുന്നതിന്.
2. ഘനസെന്റിമീറ്ററിൽ ഉള്ള അളവുകളെ ലിറ്റർ, മില്ലീലിറ്റർ എന്നീ അളവുകളിലേക്ക് മാറ്റുന്നതിന്.

ആശയങ്ങൾ

1. അകത്തെ അളവുകളെല്ലാം 10 സെന്റിമീറ്റർ ആയ ഒരു സമചതുരപ്പാത്രത്തിൽ ഉൾക്കൊള്ളാവുന്ന ദ്രാവകത്തിന്റെ അളവാണ് ഒരു ലിറ്റർ.
2. ഒരു ലിറ്റർ, 1000 ഘനസെന്റീമീറ്ററിന് തുല്യമാണ്
3. വശങ്ങളെല്ലാം 1 സെന്റീമീറ്റർ വീതമായ സമചതുരപ്പാത്രത്തിൽ ഉൾക്കൊള്ളാവുന്ന ദ്രാവകത്തിന്റെ അളവാണ് ഒരു മില്ലി ലിറ്റർ.
4. ഒരു മില്ലിലിറ്റർ, ഒരു ഘനസെന്റിമീറ്ററിന് തുല്ല്യമാണ്.

പഠന സാമഗ്രികൾ

വശങ്ങളെല്ലാം 10 സെന്റിമീറ്റർ ആയ സമചതുരപ്പെട്ടി, വെള്ളം.

മുന്നറിവ്

1. ഒരു ചതുരപ്പാത്രത്തിന്റെ ഉള്ളളവ് അതിന്റെ അകത്തെ അളവുകളുടെ ഗുണനഫലമാണ്.

ഘട്ടം 1: പ്രശ്നാവതരണം

ടീച്ചർ : കഴിഞ്ഞ ക്ലാസിൽ ഉള്ളളവ് ഘനസെന്റിമീറ്ററിൽ കണക്കാക്കാൻ പഠിച്ചു. അല്ലേ?

കുട്ടികൾ : അതെ

ടീച്ചർ : പാൽ, വെള്ളം, എണ്ണ തുടങ്ങിയവ ഏതളവിലാണ് പറയാറുള്ളത്? ഘനസെന്റിമീറ്ററിൽ അണോ?

കുട്ടികൾ : അല്ല

ടീച്ചർ : പിന്നെ, ഏതളവിലാണ് ദ്രാവകങ്ങൾ പറയാറുള്ളത്?

കുട്ടികൾ : ലിറ്റർ, മില്ലി ലിറ്റർ

ടീച്ചർ : ഇതുവരെ നമ്മൾ വ്യാപ്തവും, ഉള്ളളവും എല്ലാം പറഞ്ഞിരുന്നത് ഘനസെന്റിമീറ്ററിൽ ആണ്. അതുകൊണ്ട് ഘനസെന്റിമീറ്ററും, ലിറ്ററും തമ്മിൽ ബന്ധമുണ്ടോ എന്ന് നോക്കാം.

(10 സെന്റിമീറ്റർ വീതം നീളവും വീതിയും ഉയരവും ഉള്ള സമചതുരപ്പെട്ടി എടുത്ത് അതിൽ വെള്ളം നിറക്കുന്നു.)

ടീച്ചർ : ഈ പെട്ടിയുടെ നീളവും, വീതിയും, ഉയരവും എല്ലാം 10 സെന്റിമീറ്റർ ആണ്. ഇതിൽ കൊള്ളാവുന്ന വെള്ളത്തിന്റെ അളവാണ് ഒരു ലിറ്റർ. ഈ പെട്ടിയുടെ ഉള്ളളവ് എത്ര ഘനസെന്റിമീറ്റർ ആയിരിക്കും?

കുട്ടികൾ : 1000 ഘനസെന്റീമീറ്റർ

ടീച്ചർ : അപ്പോൾ എത്ര ഘനസെന്റിമീറ്റർ ആണ് ഒരു ലിറ്റർ?

കുട്ടികൾ : 1000 ഘനസെന്റീമീറ്റർ

ടീച്ചർ : എത്ര മില്ലീലിറ്ററാണ് ഒരു ലിറ്റർ എന്ന് ഓർമ്മയുണ്ടോ?

കുട്ടികൾ : ഉണ്ട്. 1000 മില്ലീലിറ്റർ

ടീച്ചർ : 1000 മില്ലി ലിറ്ററാണ് ഒരു ലിറ്റർ, ഒരു ലിറ്റർ ആണെങ്കിൽ 1000 ഘനസെന്റിമീറ്ററും. അതുകൊണ്ട് 1000 മില്ലിലിറ്റർ 1000 ഘനസെന്റിമീറ്ററിനും തുല്ല്യം.

അപ്പോൾ ഒരു മില്ലിലിറ്റർ എത്ര ഘനസെന്റിമീറ്ററാണ്?

കുട്ടികൾ : ഒരു ഘന സെന്റിമീറ്റർ

ടീച്ചർ : അതിന്റെ അർത്ഥമെന്തെന്നറിയാമോ? ഒരു സെന്റിമീറ്റർ നീളവും, വീതിയും, ഉയരവുമുള്ള സമചതുരപ്പെട്ടിയിൽ ഉൾക്കൊള്ളാവുന്ന വെള്ളത്തിന്റെ അളവാണ് ഒരു മില്ലിലിറ്റർ.

പ്രവർത്തനം

ഒരു ചതുരപാത്രത്തിന്റെ അകത്തെ നീളം 22 സെന്റിമീറ്റർ, വീതി 15 സെന്റിമീറ്റർ, ഉയരം 12 സെന്റിമീറ്റർ. ഇതിൽ എത്ര ലിറ്റർ വെള്ളം കൊള്ളും?

കുട്ടികളോട് ഉത്തരം കണ്ടെത്താൻ ആവശ്യപ്പെടുന്നു.

ഘട്ടം 2: പ്രശ്നനിർധാരണം

കുട്ടികൾ ഉത്തരം കണ്ടെത്തുന്നു. ടീച്ചർ കുട്ടികൾക്ക് അവർക്ക് അറിയുന്ന രീതിയിൽ ഉള്ളളവ് കണ്ടെത്താനും, ഘനസെന്റിമീറ്ററിൽ നിന്ന് ലിറ്ററിലേക്ക് മാറ്റാനും ഉള്ള മാർഗനിർദേശങ്ങൾ നൽകുന്നു. കുട്ടികൾക്കു കിട്ടിയ ഉത്തരങ്ങൾ പരിശോധിക്കുകയും, ഉപയോഗിച്ച രീതി മനസ്സിലാക്കുന്നതിനുള്ള ചോദ്യങ്ങൾ ചോദിക്കുകയും ചെയ്യുന്നു.

ഘട്ടം 3: പ്രശ്നപരിഹാര തന്ത്രങ്ങളുടെ ചർച്ച

സ്റ്റെപ്പ്-1: പരിഹാര തന്ത്രങ്ങൾ പങ്കുവെയ്ക്കൽ

വ്യത്യസ്തമായ തന്ത്രങ്ങൾ ഉപയോഗിച്ച് ഉള്ളളവ് കണക്കാക്കുകയും, ലിറ്ററും മില്ലിലിറ്ററും കണക്കാക്കുകയും ചെയ്ത കുട്ടികളിൽ ഓരോ പ്രത്യേക രീതി

യിൽ നിന്നും ഒരു കുട്ടിയോട് വീതം അവരുടെ രീതി വിശദീകരിക്കാൻ ആവശ്യപ്പെടുന്നു.

സാധ്യമായ പരിഹാര തന്ത്രങ്ങൾ

1. ഇരുപത്തി രണ്ടിലെ 20 കൊണ്ട് 15 നെ ഗുണിച്ചാൽ 300 കിട്ടും, 2 നെ 15 കൊണ്ട് ഗുണിച്ചാൽ 30ഉം. മുന്നൂറിനോട് 30 കൂട്ടിയാൽ 330. അതിനെ 12 കൊണ്ട് ഗുണിക്കുന്നതിന്, 330നെ 10 കൊണ്ട് ഗുണിച്ചാൽ 3300, 330നെ 2 കൊണ്ട് ഗുണിച്ചാൽ 660. 3300ഉം 660 ഉം കൂട്ടിയാൽ 3960

    ഉള്ളളവ് 3960 ഘന സെന്റിമീറ്റർ. 3960 ൽ 3 ആയിരങ്ങൾ, അതുകൊണ്ട് 3 ലിറ്റർ, 960 മില്ലി ലിറ്റർ.

2. ഗുണനക്രിയ ഉപയോഗിച്ച് 22നെ 15 കൊണ്ട് ഗുണിച്ചാൽ 330, അതിനെ 12 കൊണ്ട് ഗുണിച്ചാൽ 3960. അതുകൊണ്ട് ഉള്ളളവ് 3960 ഘന സെന്റിമീറ്റർ.

    ലിറ്ററിലേക്ക് മാറ്റുന്നതിന് 3960 നെ 1000 കൊണ്ട് ഹരണക്രിയ ഉപയോഗിച്ച് ഹരിച്ചാൽ, ഹരണഫലം 3 ശിഷ്ടം 960.

    അതുകൊണ്ട് 3 ലിറ്റർ, 960 മില്ലിലിറ്റർ

3. ഗുണനക്രിയ ഉപയോഗിച്ച്, ഉള്ളളവ് 3960 ഘനസെന്റിമീറ്റർ.

    3960നെ 1000 കൊണ്ട് തുടർച്ചയായി ശിഷ്ടം പൂജ്യമാകുന്നതുവരെ ഹരിച്ചാൽ, ഹരണഫലം 3.96. അതുകൊണ്ട് 3.96 ലിറ്റർ.

    ഈ ചോദ്യത്തിൽ കുട്ടികൾ ഗുണനം, ഹരണം എന്നിവ എങ്ങിനെ ചെയ്യുന്നു എന്നതിനനുസരിച്ച് കൂടുതൽ പരിഹാര തന്ത്രങ്ങൾക്കുള്ള സാധ്യതയുണ്ട്.

<u>സ്റ്റെപ് -2: പരിഹാരതന്ത്രങ്ങളുടെ ന്യായീകരണം</u>

കുട്ടികൾ ഉപയോഗിച്ച രീതികൾ വ്യക്തമായി വിശദീകരിക്കാൻ സഹായിക്കുന്നതിനായി ടീച്ചർ അവരോട് ചോദ്യങ്ങൾ ചോദിക്കുന്നു. കുട്ടികളുടെ രീതിക്കനുസരിച്ച് കൂടുതൽ ചോദ്യങ്ങൾക്കും, വിശദീകരണങ്ങൾക്കും, ചർച്ചയ്ക്കുള്ള സാധ്യത ഉണ്ട്. മറ്റു കുട്ടികൾക്കും ചോദ്യങ്ങൾ ചോദിക്കാനുള്ള അവസരം നൽകുന്നു. 3.96 ലിറ്റർ, 3 ലിറ്റർ, 960 മില്ലീലിറ്റർ എന്നിവ തുല്യമാണെന്ന് കുട്ടികൾ മനസിലാക്കുന്നു.

<u>സ്റ്റെപ് -3: പരിഹാരതന്ത്രങ്ങളുടെ അപഗ്രഥനം</u>

വിവിധ പരിഹാരതന്ത്രങ്ങൾ വിശദമായി ചർച്ച ചെയ്യുന്നു. ഓരോ രീതിയും പരസ്പരം താരതമ്യം ചെയ്യുന്നു. കുട്ടികൾക്ക് കൂടുതൽ വ്യക്തമാകുന്നതിനായി വ്യത്യസ്തമായ സംഖ്യകൾ ഉപയോഗിച്ച് ടീച്ചർ വിശദീകരണങ്ങളും നൽകുന്നു.

തുടർപ്രവർത്തനം

ക്യൂബിന്റെ ആകൃതിയിലുള്ള ഒരു പാത്രത്തിന്റെ അകത്തെ വശങ്ങൾക്കെല്ലാം 15 സെ.മീ. നീളമുണ്ട്. ഇതിൽ എത്ര ലിറ്റർ വെള്ളം കൊള്ളും?

LESSON TRANSCRIPT-8

Name of Teacher	:	Sunitha T.P			
Name of School	:	GMHSS CU Campus/ AUPS Velimukku	Class	:	VI
Subject:	:	Mathematics	Division	:	F/A
Unit	:	Volume	Time	:	40 mts
Topic	:	Calculation of Lenght/Breadth/Height if Capacity in Litre and Two Dimensions are Known			

പഠനോദ്ദേശ്യങ്ങൾ

1. ഒരു ചതുരക്കട്ടയുടെ ആകൃതിയിലുള്ള വസ്തുവിന്റെ നീളം, വീതി, ഉയരം എന്നിവയിൽ ഏതെങ്കിലും രണ്ടളവുകളും, ഉള്ള ളവ് ലിറ്ററിലും തന്നാൽ ബാക്കിയുള്ള അളവ് കണ്ടുപിടിക്കാൻ.
2. ഒരു ചതുരക്കട്ടയുടെ ആകൃതിയിലുള്ള വസ്തുവിന്റെ നീളം, വീതി, ഉയരം എന്നിവയിൽ ഏതെങ്കിലും രണ്ടളവുകളും, ഉള്ളളവ് ലിറ്ററിലും തന്നാൽ ബാക്കിയുള്ള അളവ് കണ്ടുപിടി ക്കാനുള്ള വിവിധ രീതികൾ മനസ്സിലാക്കുന്നതിന്.

ആശയം

1. ഒരു ചതുരക്കട്ടയുടെ ആകൃതിയിലുള്ള വസ്തുവിന്റെ നീളം, വീതി, ഉയരം എന്നിവയിൽ ഏതെങ്കിലും രണ്ടളവുകളും, ഉള്ള ളവ് ലിറ്ററിലും തന്നാൽ ബാക്കിയുള്ള അളവ് കണ്ടെത്താം.

മുന്നറിവ്

1. ചതുരക്കട്ടയുടെ ആകൃതിയിലുള്ള ഒരു വസ്തുവിന്റെ ഉള്ള ളവ് അതിന്റെ നീളം, വീതി, ഉയരം എന്നിവയുടെ ഗുണനഫ ലമാണ്.
2. ഒരു ലിറ്റർ 1000 ഘനസെന്റിമീറ്ററിന് തുല്യമാണ്.

ഘട്ടം 1: പ്രശ്നാവതരണം

ടീച്ചർ : ചതുരക്കട്ടയുടെ ആകൃതിയിലുള്ള വസ്തുക്കളുടെ ഉള്ളളവ് ഘന സെന്റിമീറ്ററിലും, ലിറ്ററിലും കണക്കാക്കാൻ നമ്മൾ പഠിച്ചല്ലോ?

കുട്ടികൾ : പഠിച്ചു.

ടീച്ചർ : രണ്ടളവുകളും വ്യാപ്തവും തന്നാൽ, ചതുരക്കട്ടയുടെ മൂന്നാമത്തെ അളവ് കണ്ടുപിടിച്ചത് ഓർക്കുന്നുണ്ടോ?

കുട്ടികൾ : ഉണ്ട്.

ടീച്ചർ : ഇന്ന് നാം പഠിക്കാൻ പോകുന്നത്, ഉള്ളളവ് ലിറ്ററിലും നീളം, വീതി ഉയരം ഏതെങ്കിലും രണ്ടളവുകളും തന്നാൽ മൂന്നാമത്തെ അളവ് കണ്ടു പിടിക്കുന്നതെങ്ങിനെ എന്നാണ്.

പ്രവർത്തനം

ഒരു കുഴിയുടെ അകത്തെ നീളം 80 സെന്റിമീറ്റർ, ഉയരം 25 സെന്റിമീറ്റർ. അതിൽ 72 ലിറ്റർ വെള്ളം കൊള്ളുമെങ്കിൽ അതിന്റെ വീതി എത്ര സെന്റിമീറ്റർ?

കുട്ടികളോട് വീതി കണ്ടെത്താൻ ആവശ്യപ്പെടുന്നു.

ഘട്ടം 2: പ്രശ്നനിർധാരണം

കുഴിയുടെ വീതി, അവർക്കറിയാവുന്ന രീതിയിൽ കുട്ടികൾ കണ്ടെത്തുന്നു. ടീച്ചർ ഒരു പ്രത്യേക രീതി നിർദേശിക്കാതെ അവർക്ക് ആവശ്യമായ മാർഗ്ഗനിർദേശങ്ങൾ നൽകുന്നു. വീതി കണ്ടുപിടിച്ചുകഴിഞ്ഞ കുട്ടികളുടെ ഉത്തരങ്ങൾ പരിശോധിക്കുകയും, അവരുടെ അറിവും ചിന്താരീതിയും മനസ്സിലാക്കുന്നതിനായി ചോദ്യങ്ങൾ ചോദിക്കുകയും ചെയ്യുന്നു.

ഘട്ടം 3: പ്രശ്നപരിഹാര തന്ത്രങ്ങളുടെ ചർച്ച

<u>സ്റ്റെപ്പ്-1: പരിഹാര തന്ത്രങ്ങൾ പങ്കുവെയ്ക്കൽ</u>

കുഴിയുടെ വീതി വ്യത്യസ്തമായ രീതിയിൽ കണ്ടെത്തിയ കുട്ടികളിൽ ഓരോ രീതി ഉപയോഗിച്ച ഒരു കുട്ടിയോട് വീതം ടീച്ചർ അവർ ഉപയോഗിച്ച രീതി അവതരിപ്പിക്കാൻ ആവശ്യപ്പെടുന്നു.

സാധ്യമായ പരിഹാര തന്ത്രങ്ങൾ

1 ലിറ്റർ 1000 ഘനസെന്റിമീറ്ററിന് തുല്യമാണ്. അതുകൊണ്ട് 72 ലിറ്റർ 72000 ഘനസെന്റിമീറ്ററിന് തുല്യമാണ്.

1. 72 ൽ ഒമ്പത് 8.
   720 ൽ ഒമ്പത് 80.
   7200 ൽ തൊണ്ണൂറ് 80
   72000 ൽ തൊള്ളായിരം 80
   900 ൽ ഒമ്പത് 100
   ഒരു നൂറിൽ 25 നാല് തവണ
   900 ൽ 25 മുപ്പത്തിആറ് തവണ
   ഉത്തരം 36 സെ.മീ.
2. 80 നെ 25 കൊണ്ട് ഗുണിക്കുന്നതിന്,
   നാല് 25 ചേർന്നാൽ 100. അതുകൊണ്ട് എട്ട് 25 ചേർന്നാൽ 200 ആകും. അപ്പോൾ എൺപത് 25 ചേർന്നാൽ 2000.
   72000 ൽ എത്ര 2000 ഉണ്ടെന്ന് നോക്കുന്നതിന്
   2000 നാല് തവണ ചേർന്നാൽ 8000
   8000 നെ 9 കൊണ്ട് ഗുണിച്ചാൽ 72000
   9 നെ 4 കൊണ്ട് ഗുണിച്ചാൽ 36
   അതായത് 36 രണ്ടായിരങ്ങൾ ചേർന്നാൽ 72000
   വീതി 36 സെ.മീ.
3. 25 നെ 80 കൊണ്ട് ഗുണിക്കുന്നതിന്,
   25നെ 8 കൊണ്ട് ഗുണിച്ചാൽ 200.
   അതുകൊണ്ട് 25 നെ 80 കൊണ്ട് ഗുണിച്ചാൽ 2000.
   72000 ൽ 72 ആയിരങ്ങൾ.

അപ്പോൾ 36 രണ്ടായിരങ്ങൾ
അതുകൊണ്ട് വീതി 36 സെ.മി.

4. 80 നെ 25നെ കൊണ്ട് ഗുണിക്കുന്നതിന്,
 25 നെ 8 കൊണ്ട് ഗുണനക്രിയ ഉപയോഗിച്ച് ഗുണിച്ച്, 80 ലെ പൂജ്യം ചേർന്നാൽ 2000.
 72000 നെ 2000 കൊണ്ട് ഹരിക്കുന്നതിന്,
 72നെ 2 കൊണ്ട് ഹരണക്രിയ ഉപയോഗിച്ച് ഹരിച്ചാൽ ഹരണഫലം 36.
 അതുകൊണ്ട് വീതി 36 സെ.മി.
5. 72000 നെ ആദ്യ 80 കൊണ്ട് ഹരണക്രിയ ഉപയോഗിച്ച് ഹരിച്ചാൽ, ഹരണഫലം 900
 900 നെ ഹരണക്രിയ ഉപയോഗിച്ച് 25 കൊണ്ട് ഹരിച്ചാൽ, ഹരണഫലം 36
 വീതി 36 സെ.മി.
6. 80നെ 25 കൊണ്ട് ഗുണനക്രിയ ഉപയോഗിച്ച് ഗുണിച്ചാൽ ഗുണനഫലം 2000.
 72000 നെ ഹരണക്രിയ ഉപയോഗിച്ച് 2000 കൊണ്ട് ഹരിച്ചാൽ ഹരണഫലം 36.
 വീതി 36 സെ.മി.

കുട്ടികൾ ഹരണവും ഗുണനവും ചെയ്യുന്ന രീതിക്കനുസരിച്ച് കൂടുതൽ തന്ത്രങ്ങൾക്കുള്ള സാധ്യത ഉണ്ട്.

സ്റ്റെപ് -2: പരിഹാരതന്ത്രങ്ങളുടെ ന്യായീകരണം

ടീച്ചർ, കുട്ടികൾ അവതരിപ്പിച്ച ഓരോ പ്രത്യേക രീതിക്കും അനുസരിച്ച് അവരോട് വ്യത്യസ്തമായ ചോദ്യങ്ങളും, കുട്ടികളുടെ ഉത്തരങ്ങൾക്കനുസരിച്ച് തുടർ ചോദ്യങ്ങളും ചോദിക്കുന്നു. മറ്റു കുട്ടികൾക്കും അവരുടെ സംശയങ്ങൾ ചോദിക്കാനുള്ള അവസരം നൽകുന്നു.

സ്റ്റെപ് -3: പരിഹാരതന്ത്രങ്ങളുടെ അപഗ്രഥനം

ടീച്ചർ കുട്ടികൾ ഉപയോഗിച്ച വ്യത്യസ്ത രീതികൾ ക്രോഡീകരിക്കുന്നു. ഓരോ രീതിയും ചർച്ച ചെയ്യുന്നു. ആവശ്യമെങ്കിൽ, കൂടുതൽ വ്യക്തതക്കായി ഓരോ രീതിയിലും ഉള്ള സ്റ്റെപ്പുകൾ ടീച്ചർ ബോർഡിൽ എഴുതുന്നു. ഓരോ രീതി കളും തമ്മിലുള്ള വ്യത്യാസങ്ങളും, സാമ്യതകളും മനസ്സിലാക്കാൻ കുട്ടികളെ സഹായിക്കുന്നു.

തുടർപ്രവർത്തനം

ഒരു വീട്ടിലെ ടാങ്കിന്റെ അകത്തെ നീളം 150 സെന്റിമീറ്ററും വീതി 90 സെന്റീ മീറ്ററും ആണ്. അതിൽ 1080 ലിറ്റർ വെള്ളം കൊള്ളുമെങ്കിൽ, അതിന്റെ ഉയരം എത്ര സെൻറി മീറ്റർ?

LESSON TRANSCRIPT-9

Name of Teacher	:	Sunitha T.P			
Name of School	:	GMHSS CU Campus, AUPS Velimukku	Class	:	VI
Subject:	:	Mathematics	Division	:	F/A
Unit	:	Volume	Time	:	40 mts
Topic	:	Rain and Volume			

പഠനോദ്ദേശ്യങ്ങൾ

1. ഒരു ഘനമീറ്റർ 1000000 ഘനസെന്റീമീറ്ററിന് തുല്യമാണെന്ന് മനസ്സിലാക്കുന്നതിന്.
2. മഴവെള്ളത്തിന്റെ അളവിനെക്കുറിച്ച് മനസ്സിലാക്കുന്നതിന്
3. മഴവെള്ളവും, വ്യാപ്തവുമായി ബന്ധപ്പെട്ട ഗണിത പ്രശ്നങ്ങൾ നിർധാരണം ചെയ്യുന്നതിന്.

ആശയങ്ങൾ

1. ഒരു ഘനമീറ്റർ 1000000 ഘനസെന്റീമീറ്ററിന് തുല്യമാണ്.
2. മഴയുടെ തോത് അളക്കുന്നത് സെന്റീമീറ്ററിൽ ആണ്.

മുന്നറിവ്

1. ഒരു ചതുരക്കട്ടയുടെ ആകൃതിയിലുള്ള വസ്തുവിന്റെ ഉള്ളളവ് അതിന്റെ അളവുകളുടെ ഗുണനഫലമാണ്.
2. ഒരു മീറ്റർ 100 സെന്റീമീറ്ററിന് തുല്യമാണ്.

ഘട്ടം 1: പ്രശ്നാവതരണം

ടീച്ചർ : നിങ്ങൾ കാലാവസ്ഥയുമായി ബന്ധപ്പെട്ട വാർത്തകൾ കേൾക്കാറുണ്ടോ?

കുട്ടികൾ : ഉണ്ട്.

ടീച്ചർ : അതിൽ മഴയുടെ അളവിനെക്കുറിച്ച് പറയുന്നത് കേട്ടിട്ടുണ്ടോ?

കുട്ടികൾ : ഉണ്ട്.

ടീച്ചർ : എന്ത് അളവിലാണ് മഴ പറയാറുള്ളത്?

കുട്ടികൾ : സെന്റീമീറ്ററിൽ

ടീച്ചർ : ഇന്ന് നമ്മൾ മഴവെള്ളത്തിന്റ അളവുമായി ബന്ധപ്പെട്ട ഗണിതപ്രശ്നങ്ങൾ ആണ് ചെയ്യാൻ പോകുന്നത്. ഒരു പ്രദേശത്ത് 6 സെന്റീമീറ്റർ മഴ പെയ്തു എന്നാൽ എന്താണ് അർഥമെന്നറിയാമോ?

കുട്ടികൾ : ഇല്ല

ടീച്ചർ : ഒഴിഞ്ഞ ഒരു സ്ഥലത്തെ ഒരു പാത്രത്തിൽ നിറയുന്ന മഴവെള്ളത്തിന്റെ ഉയരം 6 സെന്റീമീറ്റർ എന്നാണ്.

		ഒരു പ്രത്യേക സ്ഥലത്ത് പെയ്യുന്ന മഴയാണ് നാം അളക്കുന്നത്. വലിയ സ്ഥലങ്ങളുടെ അളവുകൾ നമ്മൾ മീറ്ററിൽ ആണ് പറയുന്നത്. എത്ര സെന്റിമീറ്ററാണ് ഒരു മീറ്റർ
കുട്ടികൾ	:	100 സെന്റിമീൾക്ക്ത
ടീച്ചർ	:	അപ്പോൾ ഒരു മീറ്റർ വീതം നീളവും, വീതിയും, ഉയരവുമുള്ള ഒരു സമചതുരക്കട്ടയുടെ വ്യാപ്തം എത്ര ഘനസെന്റിമീറ്റർ ആയിരിക്കും? (ടീച്ചറുടെ സഹായത്തോടെ കുട്ടികൾ കണക്കു കൂട്ടുന്നു)
കുട്ടികൾ	:	പത്തു ലക്ഷം ഘനസെന്റിമീറ്റർ.
ടീച്ചർ	:	വ്യാപ്തം സമചതുരക്കട്ടകളുടെ എണ്ണവുമായി ബന്ധപ്പെടുത്തി പറയുകയാണെങ്കിലോ?
കുട്ടികൾ	:	ഒരു മീറ്റർ നീളവും, വീതിയും, ഉയരവുമുള്ള സമചതുരക്കട്ടയുടെ ഉള്ളിൽ ഒരു സെന്റിമീറ്റർ വീതം നീളവും, വീതിയും ഉയരവുമുള്ള പത്തു ലക്ഷം സമചതുരക്കട്ടകൽ അടുക്കാം.

പ്രവർത്തനം

ഒരു വീടിന്റെ ടെറസിന് 14 മീറ്റർ നീളവും, 11 മീറ്റർ വീതിയും ഉള്ള ചതുരാകൃതിയാണ്. അവിടെ 7 സെന്റിമീറ്റർ മഴ പെയ്താൽ, ടെറസിൽ നിറയുന്ന വെള്ളത്തിന്റെ അളവെത്ര?

ടീച്ചർ : ഇവിടെ നീളവും, വീതിയും തന്നിരിക്കുന്നത് മീറ്ററിലും, ഉയരം തന്നിരിക്കുന്നത് സെന്റിമീറ്ററിലും ആണെന്ന കാര്യം ശ്രദ്ധിക്കുക.

ഘട്ടം 2: പ്രശ്നനിർധാരണം

കുട്ടികൾ മഴവെള്ളത്തിന്റെ അളവ് സ്വന്തമായി കണ്ടെത്തുന്നു. ടീച്ചർ ആവശ്യമായ മാർഗ നിർദേശങ്ങൾ നൽകുന്നു. വെള്ളത്തിന്റെ അളവ് കണ്ടെത്തിയ കുട്ടികളുടെ ഉത്തരങ്ങൾ പരിശോധിക്കുകയും, ആവശ്യമായ ചോദ്യങ്ങൾ ചോദിക്കുകയും ചെയ്യുന്നു.

ഘട്ടം 3: പ്രശ്നപരിഹാര തന്ത്രങ്ങളുടെ ചർച്ച

<u>സ്റ്റെപ് -1: പരിഹാരതന്ത്രങ്ങൾ പങ്കുവെയ്ക്കൽ</u>

വ്യത്യസ്തമായ തന്ത്രങ്ങൾ ഉപയോഗിച്ച് മഴവെള്ളത്തിന്റെ അളവ് കണ്ടുപിടിച്ച് ഓരോ കുട്ടിയോട് വീതം ഉത്തരംകണ്ടെത്തിയ രീതി അവതരിപ്പിക്കാൻ ആവശ്യപ്പെടുന്നു.

സാധ്യമായ പരിഹാര തന്ത്രങ്ങൾ

14 മീറ്റർ, 1400 സെന്റിമീറ്ററിന് തുല്യമാണ്.

11 മീറ്റർ, 1100 സെന്റിമീറ്ററിന് തുല്യമാണ്.

1. 14, 11, 7 എന്നിവയുടെ ഗുണനഫലം കാണുന്നതിന്, 11 നെ 7 കൊണ്ട് ഗുണിച്ചാൽ 77.
   77 നെ 14 കൊണ്ട് 4 കൊണ്ട് ഗുണിക്കുന്നതിന്, 77 നെ 14 ലെ 10 കൊണ്ട് ഗുണിച്ചാൽ 770 കിട്ടും.
   77 നെ 14ലെ 4 കൊണ്ട് ഗുണിക്കുന്നതിന്, 70 നെ 4 കൊണ്ട് ഗുണിച്ചാൽ 280കിട്ടും. 77 ലെ 7 നെ 4 കൊണ്ട് ഗുണിച്ചാൽ 28 കിട്ടും.

770, 280, 28 എന്നിവ കൂട്ടുന്നതിന്,
770 നോട് 200 കൂട്ടിയാൽ 970.
970 നോട് 280 ലെ 80 കൂട്ടുന്നതിന്,
970 നോട് 30 കൂട്ടിയാൽ 1000, ബാക്കി 50 കൂട്ടിയാൽ
1050 കിട്ടും. 1050ഉം 28 ഉം കൂട്ടിയാൽ 1078
വ്യാപ്തം 10780000 ഘനസെന്റിമീറ്റർ.
10780000ൽ 10780 ആയിരങ്ങൾ.
അതുകൊണ്ട് മഴവെള്ളത്തിന്റെ അളവ് 10780 ലിറ്റർ.

2. 14നെ 11 കൊണ്ട് ഗുണിക്കുന്നതിന്,
14നെ 10 കൊണ്ട് ഗുണിച്ചാൽ 140
അതിനോട് 14 കൂടി കൂട്ടിയാൽ 154
154 നെ 7 കൊണ്ട് ഗുണിക്കുന്നതിന്, 150 നെ 7 കൊണ്ട് ഗുണിക്കുക. പിന്നീട് 4 നെ 7 ഗുണിക്കുക.
150ലെ 100 നെ 7 കൊണ്ട് ഗുണിച്ചാൽ 700
150 നെ 50 നെ 7 കൊണ്ട് ഗുണിച്ചങന്റ 350
700ഉം 350ഉം കൂട്ടിയാൽ 1050.
അതായത് 150 ന്റെയും 7 ന്റെയും ഗുണനഫലം 1050.
4 ന്റെയും 7 ന്റെയും ഗുണനഫലം 28
അതുകൊണ്ട് 14, 11, 7 എന്നിവയുടെ ഗുണനഫലം, 1050 ന്റെയും 28 ന്റെയും തുക, അതായത് 1078.
വ്യാപ്തം 10780000 ഘനസെന്റിമീറ്റർ.
ആയിരം ഘനസെന്റിമീറ്റർ, ഒരു ലിറ്റർ. അതുകൊണ്ട് വെള്ളത്തിന്റെ അളവ് 10780 ലിറ്റർ.

3. 14, 11, 7 എന്നിവയുടെ ഗുണനഫലം ഗുണനക്രിയ ഉപയോഗിച്ച് കണ്ടുപിടിച്ച്, വ്യാപ്തം 10780000 ഘനസെന്റിമീറ്റർ.
വെള്ളത്തിന്റെ അളവ് 10780 ലിറ്റർ.

4. 1400, 1100, 7 എന്നിവയുടെ ഗുണനഫലം, ഗുണനക്രിയ ഉപയോഗിച്ച് കണ്ടുപിടിച്ച്, ഗുണനഫലം 10780000 അതായത് വ്യാപ്തം 10780000 ഘനസെന്റിമീറ്റർ. വെള്ളത്തിന്റെ അളവ് ലിറ്ററിൽ കണക്കാക്കാൻ, 10780000നെ ആയിരം കൊണ്ട് ഹരണക്രിയ ഉപയോഗിച്ച് ഹരിച്ചാൽ, ഉത്തരം 10780 ലിറ്റർ.

കുട്ടികൾ ഗുണനം, ഹരണം എന്നിവ ചെയ്യുന്ന വ്യത്യസ്ത രീതികൾക്കനുസരിച്ച് കൂടുതൽ തന്ത്രങ്ങൾക്കുള്ള സാധ്യത ഉണ്ട്.

സ്റ്റെപ് -2: പരിഹാരതന്ത്രങ്ങളുടെ ന്യായീകരണം

കുട്ടികൾ അവരുടെ രീതികൾ വിശദീകരിക്കുമ്പോൾ ടീച്ചർ ആവശ്യമായ ചോദ്യങ്ങൾ ചോദിക്കുന്നു. ആവശ്യമെങ്കിൽ സ്റ്റെപ്പുകൾ അവർ പറയുമ്പോൾ തന്നെ ബോർഡിൽ എഴുതി വിശദീകരണങ്ങൾ വ്യക്തമാക്കാൻ സഹായിക്കുന്നു. മറ്റുള്ള കുട്ടികൾക്കും ചോദ്യങ്ങൾ ചോദിക്കാനുള്ള അവസരം നൽകുന്നു.

സ്റ്റെപ്പ് –3: പരിഹാരതന്ത്രങ്ങളുടെ അപഗ്രഥനം

ടീച്ചറും കുട്ടികലും ചേർന്ന് ഓരോ രീതിയും പരസ്പരം താരതമ്യം ചെയ്ത് ചർച്ച ചെയ്യുന്നു. ഏത് രീതിയാണ് കൂടുതൽ എളുപ്പം, ഏത് രീതിയാണ് എല്ലാ സാഹചര്യങ്ങളിലും ഉപയോഗിക്കാവുന്നത് തുടങ്ങിയ കാര്യങ്ങൾ ചർച്ച ചെയ്യുന്നു.

തുടർപ്രവർത്തനം

1. 24 മീറ്റർ നീളവും, 13 മീറ്റർ വീതിയും ഉള്ള ഒരു മൈതാനത്തിൽ 9 സെ.മീ. മഴ പെയ്താൽ നിറയുന്ന വെള്ളത്തിന്റെ അളവെത്ര?

LESSON TRANSCRIPT-10

Name of Teacher	:	Sunitha T.P			
Name of School	:	GMHSS CU Campus, AUPS Velimukku	Class	:	VI
Subject:	:	Mathematics	Division	:	F/A
Unit	:	Volume	Time	:	40 mts
Topic	:	Volume and Price			

പഠനോദ്ദേശ്യങ്ങൾ

1. വ്യാപ്തവും വിലയും തമ്മിലുള്ള ബന്ധം മനസ്സിലാക്കുന്നതിന്
2. വ്യാപ്തവും, വിലയുമായി ബന്ധപ്പെട്ട ഗണിത പ്രശ്നങ്ങൾ നിർധാരണം ചെയ്യുന്നതിന്

ആശയം

1. വസ്തുക്കളുടെ വ്യാപ്തത്തെ അവയുടെ വിലയുമായി ബന്ധപ്പെടുത്തി ഏതാണ് കൂടുതൽ ലാഭകരമെന്ന് തീരുമാനിക്കാം.

മുന്നറിവ്

1. ഒരു ചതുരക്കട്ടയുടെ വ്യാപ്തം അതിന്റെ നീളത്തിന്റെയും, വീതിയുടെയും, ഉയരത്തിന്റെയും, ഗുണനഫലമാണ്.

ഘട്ടം 1: പ്രശ്നാവതരണം

ടീച്ചർ കുട്ടികളെ അഭിവാദ്യം ചെയ്തതിനു ശേഷം, വ്യാപ്തവും വിലയും തമ്മിലുള്ള ബന്ധത്തെക്കുറിച്ച് കുട്ടികളുമായി ചർച്ച ചെയ്യുന്നു.

ചർച്ച ചെയ്യേണ്ട വസ്തുതകൾ

- നിത്യ ജീവിതത്തിൽ വ്യാപ്തവും, വിലയും ബന്ധപ്പെട്ടിരിക്കുന്ന സാഹചര്യങ്ങൾ.
- വസ്തുക്കളുടെ വ്യാപ്തവും, വിലയും താരതമ്യം ചെയ്ത് ഏതാണ് കൂടുതൽ ലാഭകരമെന്ന് നിശ്ചയിക്കേണ്ട ആവശ്യകത.

പ്രവർത്തനം

വശങ്ങളുടെ നീളം 10 സെന്റിമീറ്റർ ആയ ക്യൂബ് ആകൃതിയിലുള്ള ഒരു കേക്കിന് 20 രൂപയാണ് വില. ഇതേ ആകൃതിയിലുള്ളതും, 20 സെ.മീ. വശമുള്ളതുമായ കേക്കിന് 120 രൂപയാണ് വില. ഏത് വാങ്ങുന്നതാണ് ലാഭകരം? എന്തുകൊണ്ട്?

കുട്ടികളെ ചെറിയ ഗ്രൂപ്പുകളാക്കി തിരിക്കുന്നു. ഓരോ ഗ്രൂപ്പിനോടും സ്വന്തമായി ഉത്തരം കണ്ടെത്താൻ ആവശ്യപ്പെടുന്നു.

ഘട്ടം 2: പ്രശ്നനിർധാരണം

ഓരോ ഗ്രൂപ്പും സ്വന്തമായ രീതിയിൽ ഉത്തരം കണ്ടെത്തുന്നു. ടീച്ചർ ഓരോ ഗ്രൂപ്പിന്റെയും പ്രവർത്തനം നിരീക്ഷിക്കുകയും, ആവശ്യമായ നിർദേശങ്ങൾ നൽകുകയും ചെയ്യുന്നു. ഒരു പ്രത്യേക രീതിയിൽ ഉത്തരം കണ്ടെത്തണമെന്ന് നിർബന്ധമില്ല.

ഘട്ടം 3: പ്രശ്നപരിഹാര തന്ത്രങ്ങളുടെ ചർച്ച

സ്റ്റെപ്പ് -1: പരിഹാരതന്ത്രങ്ങൾ പങ്കുവെയ്ക്കൽ

ഓരോ ഗ്രൂപ്പിനോടും അവരുടെ ഉത്തരവും, അവർ ഉത്തരം കണ്ടെത്തിയ രീതിയും വിശദീകരിക്കാൻ ആവശ്യപ്പെടുന്നു.

സാധ്യമായ പരിഹാര തന്ത്രങ്ങൾ

1. 10 സെ.മീ. വശമുള്ള ക്യൂബിന്റെ വ്യാപ്തം 1000 ഘനസെന്റിമീറ്റർ.
   1000 ഘന സെന്റിമീറ്ററിന്റെ വില 20 രൂപ
   100 ഘനസെന്റിമീറ്ററിന്റെ വില 2 രൂപ
   20 സെ.മി. വശമുള്ള ക്യൂബിന്റെ വ്യാപ്തം 8000 ഘനസെന്റിമീറ്റർ.
   8000 ഘനസെന്റിമീറ്ററിന് 120 രൂപ
   800 ഘനസെന്റിമീറ്ററിന് 12 രൂപ
   400 ഘനസെന്റിമീറ്ററിന് 6 രൂപ
   200 ഘനസെന്റിമീറ്ററിന് 3 രൂപ
   100 ഘനസെന്റിമീറ്ററിന് 1 രൂപ 50 പൈസ
   രണ്ടാമത്തെ കേക്കാണ് ലാഭകരം
2. ആദ്യത്തെ കേക്കിന്റെ നീളവും, വീതിയും, ഉയരവുമെല്ലാം രണ്ട് മടങ്ങായതാണ് രണ്ടാമത്തെ കേക്ക്.
   അതുകൊണ്ട് രണ്ടാമത്തെ കേക്കിന്റെ വ്യാപ്തം, ഒന്നാമത്തെ കേക്കിന്റെ 8 മടങ്ങായിരിക്കും.
   ഒന്നാമത്തെ കേക്കിന്റെ വില 20 രൂപ
   അതിന്റെ 8 മടങ്ങ്, 160 രൂപ
   രണ്ടാമത്തെ കേക്കിന്റെ വില 120 രൂപ
   അതുകൊണ്ട് രണ്ടാമത്തെ കേക്കാണ് ലാഭകരം
3. ഒന്നാമത്തെ കേക്കിന്റെയും, രണ്ടാമത്തെ കേക്കിന്റെയും വ്യാപ്തം കണ്ടുപിടിച്ച്, ഓരോ കേക്കിന്റെയും വിലയെ അതിന്റെ വ്യാപ്തംകൊണ്ട് ഹരണക്രിയ ഉപയോഗിച്ച് ഏത് കേക്കാണ് ലാഭകരമെന്ന് പറയുന്നു.
   ഒന്നാമത്തെ കേക്കിന്റെ വില 1.5 പൈസ.
   രണ്ടാമത്തെ കേക്കാണ് ലാഭകരം

സ്റ്റെപ് -2: പരിഹാരതന്ത്രങ്ങളുടെ ന്യായീകരണം

ഓരോ ഗ്രൂപ്പിനോടും അവരുടെ ഉത്തരത്തെക്കുറിച്ചും, അവർ ഉപയോഗിച്ച രീതിയെക്കുറിച്ചും ടീച്ചർ ചോദ്യങ്ങൾ ചോദിക്കുന്നു. മറ്റുള്ള കുട്ടികൾക്കും ചോദ്യങ്ങൾ ചോദിക്കാൻ അവസരം നൽകുന്നു.

സ്റ്റെപ് -3: പരിഹാരതന്ത്രങ്ങളുടെ അപഗ്രഥനം

ടീച്ചറും കുട്ടികളും ഓരോ രീതിയും പരസ്പരം താരതമ്യം ചെയ്ത് ചർച്ച ചെയ്യുന്നു. കുട്ടികൾക്ക് ഓരോ രീതിയും തമ്മിലുള്ള വ്യത്യാസവും, സാമ്യവും മനസ്സിലാക്കുന്നതിനാവശ്യമായ സഹായങ്ങൾ ചെയ്യുന്നു.

തുടർപ്രവർത്തനങ്ങൾ

1. വീനസ് ബേക്കറിയിലെ മൈസൂർപാക്കിന്റെ നീളം 6 സെ.മീ. വീതി 4 സെന്റിമീറ്റർ, ഉയരം 2 സെന്റിമീറ്റർ. ഒന്നിന്റെ വില 4 രൂപ. മൈസൂർ പാക്കിന്റെ നീളം, വീതി, ഉയരം ഇവ പകുതിയായി കുറച്ച് പകുതി വിലക്ക് വിറ്റാൽ ഏത് മൈസൂർ പാക്കാണ് ഉപഭോക്താക്കൾക്ക് ലാഭകരം?
2. ഒരു പലകയുടെ നീളം 60 സെന്റിമീറ്റർ, വീതി 40 സെന്റിമീറ്റർ, കനം 2 സെന്റിമീറ്റർ മരത്തിന്റെ വിലയെന്ത്?

LESSON TRANSCRIPT-11

Name of Teacher	:	Sunitha T.P			
Name of School	:	GMHSS CU Campus, AUPS Velimukku	Class	:	VI
Subject:	:	Mathematics	Division	:	F/A
Unit	:	Decimal Numbers	Time	:	40 mts
Topic	:	Different Forms of Dicimal Numbers			

പഠനോദ്ദേശ്യങ്ങൾ

1. ഒരേ സംഖ്യയുടെ ദശാംശരൂപവും, ഭിന്നരൂപവും മനസ്സിലാക്കുന്നതിന്.
2. വ്യത്യസ്ത രൂപത്തിലുള്ള സംഖ്യകൾ താരതമ്യം ചെയ്യുന്നതിന്.
3. തുല്ല്യമായി പങ്കുവെക്കുന്നതുമായി ബന്ധപ്പെട്ട ഗണിത പ്രശ്നങ്ങൾ പരിഹരിക്കുന്നതിന്.

ആശയങ്ങൾ

1. ഒരു ദശാംശ സംഖ്യയ്ക്ക് പല രൂപങ്ങൾ ഉണ്ട്.
2. വസ്തുക്കളെ തുല്ല്യമായി പങ്കുവെക്കുന്ന വിവിധ ജീവിത സാഹചര്യങ്ങൾ ഉണ്ട്.

മുന്നറിവ്

1. എണ്ണൽ സംഖ്യകളിലെ സ്ഥാനവില.

ഘട്ടം 1: പ്രശ്നാവതരണം

ടീച്ചർ കുട്ടികൾക്ക് പ്രവർത്തനം നൽകുന്നു. കുട്ടികളോട് ഉത്തരം സ്വയം കണ്ടെത്താൻ ആവശ്യപ്പെടുന്നു.

പ്രവർത്തനം

സെലീനയുടെ കയ്യിൽ 84 ചെറിയ പന്തുകൾ ഉണ്ട്. ഒരു ബാഗിൽ 10 പന്തുകൾ കൊള്ളും. എല്ലാ പന്തുകളും ബാഗിനുള്ളിൽ വെച്ചാൽ സെലീനയുടെ കയ്യിൽ എത്ര ബാഗ് പന്തുകൾ ഉണ്ട്.

ഘട്ടം 2: പ്രശ്നനിർധാരണം

കുട്ടികൾ സ്വന്തമായി ബാഗുകളുടെ എണ്ണം കണക്കാക്കുന്നു. ടീച്ചർ ആവശ്യമായ മാർഗനിർദേശങ്ങൾ നൽകുന്നു. ഒരു പ്രത്യേക രീതിയിൽ ഉത്തരം കണ്ടെത്തണമെന്നില്ല. ടീച്ചർ കുട്ടികളുടെ ഉത്തരങ്ങൾ പരിശോധിക്കുകയും ചോദ്യങ്ങൾ ചോദിക്കുകയും ചെയ്യുന്നു. ഹരണക്രിയ ഉപയോഗിച്ച് ഉത്തരം കണ്ടെത്തിയ കുട്ടികളോട്, വേറെ രീതി ഉപയോഗിച്ചും ഉത്തരം കണ്ടെത്താൻ പറയുന്നു.

ഘട്ടം 3: പ്രശ്നപരിഹാര തന്ത്രങ്ങളുടെ ചർച്ച

സ്റ്റെപ് -1: പരിഹാരതന്ത്രങ്ങൾ പങ്കുവെയ്ക്കൽ

വ്യത്യസ്തമായ രീതികൾ ഉപയോഗിച്ച കുട്ടികളോട്, അവർ ബാഗുകളുടെ എണ്ണം കണ്ടെത്തിയ രീതി അവതരിപ്പിക്കാൻ ആവശ്യപ്പെടുന്നു.

സാധ്യമായ പരിഹാര തന്ത്രങ്ങൾ

1. 84 ൽ 8 പത്തുകൾ ഉള്ളതുകൊണ്ട് 8 ബാഗുകൾ

   ബാക്കിയുള്ള 4 പന്തുകൾ ഒരു ബാഗിൽ വെച്ചാൽ ആ ബാഗിന്റെ $\frac{4}{10}$ ഭാഗം നിറയും.

   അതായത് $\frac{1}{5}$ ഭാഗം നിറയും.

   $8\frac{1}{5}$ ബാഗുകൾ
2. 84 നെ 10 കൊണ്ട് ഹരിച്ചാൽ ഹരണഫലം 8, ശിഷ്ടം 4

   അതുകൊണ്ട് $8\frac{4}{10}$ ബാഗുകൾ.
3. 84നെ 10 കൊണ്ട് ഹരണക്രിയ ഉപയോഗിച്ച് ഹരിച്ചാൽ ഹരണഫലം 8.4 അതുകൊണ്ട് 8.4 ബാഗുകൾ.

സ്റ്റെപ് -2: പരിഹാരതന്ത്രങ്ങളുടെ ന്യായീകരണം

കുട്ടികളോട് അവർ ഉപയോഗിച്ച രീതിയെകുറിച്ച് ടീച്ചർ ചോദ്യങ്ങൾ ചോദിക്കുന്നു.

സൂക്ഷ്മ പരിശോധനാ ചോദ്യങ്ങൾ

1. എങ്ങിനെയാണ് ബാഗുകളുടെ എണ്ണം കണ്ടെത്തിയത്?
2. എന്തുകൊണ്ടാണ് ഈ രീതി ഉപയോഗിച്ചത്?
3. ഇങ്ങിനെ ചെയ്താൽ ഉത്തരം കിട്ടുമെന്ന് എങ്ങിനെ മനസ്സിലായി?

സ്റ്റെപ് -3: പരിഹാരതന്ത്രങ്ങളുടെ അപഗ്രഥനം

വ്യത്യസ്തമായ രീതികൾ ചർച്ച ചെയ്യുന്നു. ഓരോ രീതിയും താരതമ്യം ചെയ്യുന്നു. അതിനു ശേഷം ഉത്തരമായി വന്ന സംഖ്യകൾ എങ്ങിനെ ബന്ധപ്പെട്ടിരിക്കുന്നു, അവ സമാനമാണോ തുടങ്ങിയ കാര്യങ്ങൾ ചർച്ച ചെയ്യുന്നു.

പന്തുകളുടെ എണ്ണം വർധിപ്പിച്ച് പ്രവർത്തനം ആവർത്തിക്കുന്നു.

തുടർപ്രവർത്തനങ്ങൾ

1. ഒരു കുടിൽ വ്യവസായത്തിൽ ഒരു ദിവസം 359 ഉണ്ണിയപ്പം ഉണ്ടാക്കി. ഒരു പായ്ക്കറ്റിൽ 10 ഉണ്ണിയപ്പം വീതം മുഴുവൻ ഉണ്ണിയപ്പവും പായ്ക്കു ചെയ്താൽ, എത്ര പായ്ക്കറ്റ് ഉണ്ണിയപ്പം ഉണ്ടാകും.
2. ഒരു ദിവസം 529 ഉണ്ണിയപ്പം ഉണ്ടാക്കുകയും, ഒരു പായ്ക്കറ്റിൽ 100 എണ്ണം വീതം പായ്ക്കു ചെയ്യുകയും ചെയ്താൽ, എത്ര പായ്ക്കറ്റ് ഉണ്ണിയപ്പം ഉണ്ടാകും?
3. ഒരു പെൻസിൽ ഫാക്ടറിയിൽ ഒരു ദിവസം ______ പെൻസിലുകൾ ഉണ്ടാക്കുന്നു. ഒരു പെട്ടിയിൽ ______ പെൻസിൽ ഇട്ടാൽ, ഒരു ദിവസം എത്ര പെട്ടി പെൻസിൽ ഉണ്ടാക്കുന്നുണ്ട്? (3875, 10), (3875, 100)

LESSON TRANSCRIPT-12

Name of Teacher	:	Sunitha T.P			
Name of School	:	GMHSS CU Campus, AUPS Velimukku	Class	:	VI
Subject:	:	Mathematics	Division	:	F/A
Unit	:	Decimal Numbers	Time	:	40 mts
Topic	:	Fractional and Decimal Forms of Metric Units			

പഠനോദ്ദേശ്യങ്ങൾ

1. മെട്രിക് അളവുകളെ ഭിന്നസംഖ്യാ രൂപത്തിലും ദശാംശസം ഖ്യാരൂപത്തിലും എഴുതുന്നതിന്
2. ഒരു മെട്രിക് യൂണിറ്റിൽ നിന്നും മറ്റൊരു യൂണിറ്റിലേക്ക് മാറ്റു ന്നതിന്.
3. ദശാംശ സംഖ്യകളുമായി കൂടുതൽ പരിചയപ്പെടുന്നതിന്.

ആശയം

1. മെട്രിക് യൂണിറ്റുകളെ ഭിന്നരൂപത്തിലും, ദശാംശരൂപത്തിലും എഴുതാം.

മുന്നറിവുകൾ

1. വിവിധ മെട്രിക് അളവുകൾ
2. ഒരു മെട്രിക് അളവിൽ നിന്നും മറ്റൊരു അളവിലേക്കുള്ള മാറ്റം.

ഘട്ടം 1: പ്രശ്നാവതരണം

ടീച്ചർ കുട്ടികളെ അഭിവാദ്യം ചെയ്തതിനുശേഷം മെട്രിക് അളവുകളെക്കു റിച്ച് ചർച്ച ചെയ്യുന്നു.

ചർച്ച ചെയ്യേണ്ട വസ്തുതകൾ

- വിവിധ മെട്രിക് അളവുകൾ
- മീറ്റർ, സെന്റിമീറ്റർ, മില്ലിമീറ്റർ എന്നിവ തമ്മിലുള്ള ബന്ധം
- ലിറ്റർ, മില്ലിലിറ്റർ എന്നിവ തമ്മിലുള്ള ബന്ധം.
- ഗ്രാം, കിലോഗ്രാം എന്നിവ തമ്മിലുള്ള ബന്ധം.

പ്രവർത്തനം

8 സെന്റിമീറ്റർ, 5 മില്ലിമീറ്റർ എന്നതിനെ മീറ്റർ, സെന്റിമീറ്റർ, മില്ലിമീറ്റർ എന്നീ അളവുകളിലേക്ക് മാറ്റി എഴുതുക.

കുട്ടികളെ ചെറിയ ഗ്രൂപ്പുകൾ ആക്കി, ഉത്തരം കണ്ടെത്താൻ ആവശ്യപ്പെടു ന്നു.

ഘട്ടം 2: പ്രശ്നനിർധാരണം

കുട്ടികൾ തന്നിട്ടുള്ള അളവിനെ മീറ്റർ, സെന്റിമീറ്റർ, മില്ലിമീറ്റർ എന്നീ അളവുകളിലേക്ക് മാറ്റി എഴുതുന്നു. ടീച്ചർ ആവശ്യമായ മാർഗനിർദ്ദേശങ്ങൾ നൽകുന്നു. മെട്രിക് അളവിന്റെ വ്യത്യാസത്തിനനുസരിച്ച് സംഖ്യകളുടെ രൂപത്തിൽ വരുന്ന മാറ്റം മനസ്സിലാക്കുന്നു.

ഘട്ടം 3: പ്രശ്നപരിഹാര തന്ത്രങ്ങളുടെ ചർച്ച

സ്റ്റെപ്പ് -1: പരിഹാരതന്ത്രങ്ങൾ പങ്കുവെയ്ക്കൽ

ടീച്ചർ ഓരോ ഗ്രൂപ്പിനോടും അവരുടെ ഉത്തരവും, ഉത്തരം കണ്ടെത്തിയ രീതിയും അവതരിപ്പിക്കാൻ ആവശ്യപ്പെടുന്നു.

850 മില്ലിമീറ്റർ, 8.5 സെന്റിമീറ്റർ, $8\frac{5}{10}$ സെന്റിമീറ്റർ, $8\frac{1}{2}$ സെന്റിമീറ്റർ, 0.850 മീറ്റർ, $\frac{850}{1000}$ മീറ്റർ, $\frac{85}{100}$ മീറ്റർ തുടങ്ങിയ ഉത്തരങ്ങൾ ചർച്ച ചെയ്യുന്നു.

ഒരേ സംഖ്യയുടെ തന്നെ വിവിധ ദശാംശ രൂപങ്ങളും, ഭിന്നസംഖ്യാരൂപങ്ങളും കുട്ടികൾ പരിചയപ്പെടുന്നു. ഒരു മെട്രിക് അളവ് തന്നെ വിവിധ രൂപത്തിൽ എഴുതാൻ സാധിക്കുമെന്ന് കുട്ടികൾ മനസ്സിലാക്കുന്നു.

ഓരോ ഗ്രൂപ്പും അവർ ഉത്തരം കണ്ടെത്തിയ രീതി അവതരിപ്പിക്കുന്നു. മെട്രിക് അളവുകളെക്കുറിച്ചുള്ള കുട്ടികളുടെ ധാരണക്കനുസരിച്ച് പല രീതികൾക്കുള്ള സാധ്യത ഉണ്ട്.

സ്റ്റെപ്പ് -2: പരിഹാരതന്ത്രങ്ങളുടെ ന്യായീകരണം

ഓരോ ഗ്രൂപ്പിനോടും അവർ ഉപയോഗിച്ച രീതിയെ കുറിച്ച് ടീച്ചർ ചോദ്യങ്ങൾ ചോദിക്കുന്നു. മെട്രിക് അളവുകളെ കുറിച്ചുള്ള കുട്ടികളുടെ ധാരണകൾ ടീച്ചർക്ക് മനസ്സിലാവുന്നു. അതേ സമയം മെട്രിക് അളവുകളെ വിവിധ രൂപത്തിൽ എഴുതാം എന്നും, അതിനു വ്യത്യസ്തമായ രീതികൾ ഉണ്ടെന്നും കുട്ടികൾ മനസ്സിലാക്കുന്നു.

സ്റ്റെപ്പ് -3: പരിഹാരതന്ത്രങ്ങളുടെ അപഗ്രഥനം

ഉത്തരം കണ്ടുപിടിച്ച രീതികൾ ചർച്ച ചെയ്യുന്നു.

വിവിധ അളവുകൾ ഉപയോഗിച്ച് പ്രവർത്തനം ആവർത്തിക്കുന്നു.

തുടർപ്രവർത്തനങ്ങൾ

1. താഴെ കൊടുത്തിരിക്കുന്ന അളവുകളെ മില്ലിലിറ്റർ, ലിറ്റർ എന്നീ അളവുകളിലേക്ക് മാറ്റി എഴുതുക.

a) 3 ലിറ്റർ 200 മില്ലിലിറ്റർ

b) 250 മില്ലിലിറ്റർ

2. താഴെ കൊടുത്തിരിക്കുന്ന അളവുകളെ ഗ്രാം, മില്ലിഗ്രാം, കിലോഗ്രാം എന്നീ അളവുകളിലേക്ക് മാറ്റി എഴുതുക.

a) 2 കിലോഗ്രാം, 250 ഗ്രാം

b) 750 ഗ്രാം

LESSON TRANSCRIPT-13

Name of Teacher	:	Sunitha T.P			
Name of School	:	GMHSS CU Campus, AUPS Velimukku	Class	:	VI
Subject:	:	Mathematics	Division	:	F/A
Unit	:	Decimal Numbers	Time	:	40 mts
Topic	:	Equal Sharing Problems			

പഠനോദ്ദേശ്യങ്ങൾ

1. ഒരു സംഖ്യയിലെ പത്തിലൊന്നുകളുടെ എണ്ണം കണ്ടെത്തുന്നതിന്.
2. തുല്ല്യമായി പങ്കുവെക്കുന്നതുമായി ബന്ധപ്പെട്ട ഗണിത പ്രശ്നങ്ങൾ പരിഹരിക്കുന്നതിന്.

ആശയം

1. ഒരു സംഖ്യയിലെ പത്തിലൊന്നുകളുടെ എണ്ണം കണ്ടെത്താം.

മുന്നറിവ്

1. ഭിന്നസംഖ്യകളെ കുറിച്ചുള്ള അറിവ്

ഘട്ടം 1: പ്രശ്നാവതരണം

ടീച്ചർ ഒരു പ്രവർത്തനം അവതരിപ്പിക്കുന്നു.

പ്രവർത്തനം

ജൂലിയുടെ കയ്യിൽ 6 വലിയ ചോക്ലേറ്റ് ബാറുകൾ ഉണ്ട്. ജൂലി ഓരോ ദിവസവും ഒരു ചോക്ലേറ്റിന്റെ $\frac{1}{10}$ ഭാഗം കഴിക്കുന്നു. അങ്ങിനെയെങ്കിൽ 6 ചോക്ലേറ്റുകൾ എത്ര ദിവസം കൊണ്ട് കഴിച്ചു തീർക്കും?

ടീച്ചർ കുട്ടികളെ ചെറിയ ഗ്രൂപ്പുകളാക്കി തിരിക്കുന്നു. ദിവസത്തിന്റെ എണ്ണം കണ്ടുപിടിക്കാൻ ആവശ്യപ്പെടുന്നു.

ഘട്ടം 2: പ്രശ്നനിർധാരണം

ഓരോ ഗ്രൂപ്പും സ്വന്തമായി ഉത്തരം കണ്ടെത്തുന്നു. ടീച്ചർ ഓരോ ഗ്രൂപ്പിന്റെയും പ്രവർത്തനങ്ങൾ നിരീക്ഷിക്കുകയും, ചോദ്യങ്ങൾ ചോദിക്കുകയും, ആവശ്യമായ മാർഗ നിർദേശങ്ങൾ നൽകുകയും ചെയ്യുന്നു. ചിത്രം വരച്ചു നോക്കിയോ, കണക്കുകൂട്ടിയോ കുട്ടികൾ ഉത്തരം കണ്ടെത്തുന്നു.

ഘട്ടം 3: പ്രശ്നപരിഹാര തന്ത്രങ്ങളുടെ ചർച്ച

സ്റ്റെപ്പ് -1: പരിഹാരതന്ത്രങ്ങൾ പങ്കുവെയ്ക്കൽ

ഓരോ ഗ്രൂപ്പിനോടും അവരുടെ ഉത്തരവും, അവർ ഉത്തരം കണ്ടെത്തിയ രീതിയും വിശദീകരിക്കാൻ ആവശ്യപ്പെടുന്നു.

സാധ്യമായ പരിഹാര തന്ത്രങ്ങൾ

1. ഒരു ചതുരം വരച്ച് അതിനെ 10 തുല്ല്യ ഭാഗങ്ങളാക്കി, 10 ദിവസം കൊണ്ട് ഒരു ചോക്ലേറ്റ് തീരുമെന്ന് മനസ്സിലാക്കുന്നു. അതുകൊണ്ട് 6 ചോക്ലേറ്റ് 60 ദിവസം കൊണ്ട് കഴിച്ചു തീരും.
2. പത്തുതവണ $\frac{1}{10}$ കൂട്ടിയാൽ $\frac{10}{10}$. അത് 1 ന് തുല്ല്യമാണ്. അതുകൊണ്ട് 10 ദിവസം കൊണ്ട് ഒരു ചോക്ലേറ്റ് തീരും.
   6 ചോക്ലേറ്റ് കഴിയാൻ 60 ദിവസം.
3. 10 പത്തിലൊന്നുകൾ ചേർന്നാൽ 1. അതുകൊണ്ട് 1 ചോക്ലേറ്റ് തീരാൻ 10 ദിവസം, 6 ചോക്ലേറ്റ് തീരാൻ 60 ദിവസം.
4. 6 നെ $\frac{1}{10}$ കൊണ്ട് ഹരിച്ചാൽ ഉത്തരംകിട്ടും.
   6 നെ $\frac{1}{10}$ കൊണ്ട് ഹരിക്കുന്നതിന് വ്യുൽക്രമംകൊണ്ട് ഗുണിച്ചാൽ,
   ഗുണനഫലം 60
   അതുകൊണ്ട് 60 ദിവസം

സ്റ്റെപ്പ് -2: പരിഹാരതന്ത്രങ്ങളുടെ ന്യായീകരണം

ടീച്ചർ ഓരോ ഗ്രൂപ്പിനോടും അവരുടെ പ്രശ്ന പരിഹാര തന്ത്രങ്ങളെക്കുറിച്ചുള്ള ചോദ്യങ്ങൾ ചോദിക്കുന്നു. എങ്ങിനെയാണ് ഉത്തരം കണ്ടെത്തിയത്, ഇങ്ങനെ ചെയ്താൽ ഉത്തരം കിട്ടുമെന്ന് എങ്ങിനെ മനസ്സിലായി തുടങ്ങിയ ചോദ്യങ്ങളും, കുട്ടികളുടെ ഉത്തരങ്ങൾക്കനുസരിച്ചുള്ള തുടർ ചോദ്യങ്ങളും ചോദിക്കുന്നു. മറ്റു കുട്ടികൾക്കും ചോദ്യങ്ങൾ ചോദിക്കാനുള്ള അവസരം നൽകുന്നു.

സ്റ്റെപ്പ് -3: പ്രശ്നപരിഹാരതന്ത്രങ്ങളുടെ അപഗ്രഥനം

ഓരോ പരിഹാരതന്ത്രങ്ങളും ചർച്ച ചെയ്യുന്നു. ആവശ്യമെങ്കിൽ ഓരോ പ്രശ്നപരിഹാര തന്ത്രങ്ങളിലെയും സ്റ്റെപ്പുകൾ ടീച്ചർ ബോർഡിൽ എഴുതുന്നു, ഓരോ തന്ത്രവും താരതമ്യം ചെയ്യുന്നു.

തുടർപ്രവർത്തനങ്ങൾ

1. അമ്മയുടെ കയ്യിൽ $3\frac{7}{10}$ പായ്ക്കറ്റ് പായസം മിക്സ് ഉണ്ട്. ഒരു കപ്പ് പായസം ഉണ്ടാക്കുന്നതിന് ഒരു പാക്കറ്റിന്റെ $\frac{1}{10}$ ഭാഗം പായസം മിക്സ് ആവശ്യമാണ്. എങ്കിൽ അമ്മയുടെ കയ്യിൽ ഉള്ള പായസം മിക്സ് ഉപയോഗിച്ച് എത്ര കപ്പ് പായസം ഉണ്ടാക്കാം?

LESSON TRANSCRIPT-14

Name of Teacher	:	Sunitha T.P			
Name of School	:	GMHSS CU Campus, AUPS Velimukku	Class	:	VI
Subject:	:	Mathematics	Division	:	F/A
Unit	:	Decimal Numbers	Time	:	40 mts
Topic	:	Equivalence and Ordering of Decimal Numbers			

പഠനോദ്ദേശ്യങ്ങൾ

1. ദശാംശസംഖ്യകളെ ഭിന്നസംഖ്യാ രൂപത്തിൽ എഴുതുന്നതിന്
2. ദശാംശസംഖ്യകൾ തമ്മിൽ താരതമ്യം ചെയ്യുന്നതിന്.

ആശയങ്ങൾ

1. ദശാംശ സംഖ്യകളെ ഭിന്നസംഖ്യാരൂപത്തിൽ എഴുതാം.

മുന്നറിവ്

1. എണ്ണൽ സംഖ്യകൾ, ഭിന്നസംഖ്യകൾ എന്നിവയിലുള്ള അറിവ്.

ഘട്ടം 1: പ്രശ്നാവതരണം

ടീച്ചർ : കഴിഞ്ഞ ക്ലാസുകളിൽ നമ്മൾ ഭിന്നസംഖ്യകളുമായും, ദശാംശസംഖ്യകളുമായും ബന്ധപ്പെട്ട പ്രവർത്തനങ്ങളല്ലേ ചെയ്തത്?

കുട്ടികൾ : അതെ

ടീച്ചർ : എന്തൊക്കെയാണ് ചെയ്തത് എന്ന് ഓർമ്മയുണ്ടോ?

കുട്ടികൾ : ഉണ്ട്

ടീച്ചർ : ആദ്യം എന്താണ് പഠിച്ചത്?

കുട്ടികൾ : വിവിധ വസ്തുക്കളെ 10 എണ്ണമായും, 100 എണ്ണമായും തുല്യമായി വീതിക്കാൻ.

ടീച്ചർ : പിന്നെയോ?

കുട്ടികൾ : മെട്രിക് അളവുകളെ പലരൂപത്തിൽ എഴുതി.

ടീച്ചർ : കഴിഞ്ഞ ക്ലാസിലോ?

കുട്ടികൾ : വിവിധ സംഖ്യകളിലെ പത്തിലൊന്നുകളുടെ എണ്ണം കണ്ടുപിടിച്ചു.

ടീച്ചർ : ഇനി ദശാംശ സംഖ്യകളെക്കുറിച്ച് കൂടുതൽ കാര്യങ്ങൾ പഠിക്കാം. $\frac{3}{10}$ എന്നാൽ എന്താണ്?

കുട്ടികൾ : 3 ഹരിക്കണം 10, 3 പത്തിലൊന്നുകൾ ചേർന്നത്....

ടീച്ചർ : ഇതിനെ നമുക്ക് 0.3 എന്നെഴുതാം. അപ്പോൾ 0.03 ഭിന്നസംഖ്യയായി എങ്ങിനെ എഴുതാം എന്നറിയാമോ?

കുട്ടികൾ : ഇല്ല

ടീച്ചർ : $\frac{3}{100}$

അതായത് 3 നൂറിലൊന്നുകൾ ചേർന്നത്, 3 നെ 100കൊണ്ട് ഹരിച്ചാൽ കിട്ടുന്ന സംഖ്യ, 3 സാധനങ്ങൾ 100 പേർക്ക് തുല്ല്യമായി വീതിച്ചാൽ ഒരാൾക്ക് കിട്ടുന്ന വീതം, 1 സാധനത്തെ 100 തുല്ല്യ ഭാഗങ്ങളായതിൽ 3 ഭാഗം. 1.3 എന്നാൽ ഇതുപോലെ എന്താണ് അർഥം?

കുട്ടികൾ : $1\frac{3}{10}, \frac{13}{10}$, ഒന്നും മൂന്ന് പത്തിലൊന്നുകളും, 13 സാധനങ്ങളെ 10 പേർക്ക് തുല്യമായി വീതിച്ചാൽ ഒരാളുടെ വീതം.

ടീച്ചർ : ഒരു മുഴുവൻ വസ്തുവിനോട്, അതിനെ 10 തുല്യ ഭാഗങ്ങളാക്കിയ തിൽ 3 ഭാഗം ചേർത്തത് എന്ന അർഥവും ഉണ്ട്.

പ്രവർത്തനം

താഴെ കൊടുത്തിരിക്കുന്ന ദശാംശ സംഖ്യകൾക്ക് സമാനമായ ഭിന്നസംഖ്യ കൾ എഴുതുക.

a) 0.27 b) 1.23 c) 2.731 d) 7.003

കുട്ടികളെ ചെറിയ ഗ്രൂപ്പുകളാക്കി, ഉത്തരങ്ങൾ കണ്ടെത്താൻ ആവശ്യപ്പെടുന്നു.

ഘട്ടം 2: പ്രശ്നനിർധാരണം

കുട്ടികൾ വിവിധ ഭിന്നസംഖ്യകൾ എഴുതുന്നു. ടീച്ചർ ആവശ്യമായ മാർഗ നിർദ്ദേശങ്ങൾ നൽകുന്നു. കുട്ടികൾ ദശാംശ സംഖ്യകൾക്ക് കൽപ്പിക്കുന്ന അർഥ ത്തിനനുസരിച്ച് അവർ ഉത്തരം കണ്ടെത്തുന്ന രീതി വ്യത്യാസമുണ്ടാകാം.

ഘട്ടം 3: പ്രശ്നപരിഹാര തന്ത്രങ്ങളുടെ ചർച്ച

സ്റ്റെപ് -1: പരിഹാരതന്ത്രങ്ങൾ പങ്കുവെയ്ക്കൽ

ഓരോ ഗ്രൂപ്പിനോടും അവർ എഴുതിയ ഭിന്നസംഖ്യകളും, അവ കണ്ടുപിടിച്ച രീതിയും വിവരിക്കാൻ ആവശ്യപ്പെടുന്നു.

സ്റ്റെപ് -2: പരിഹാരതന്ത്രങ്ങളുടെ ന്യായീകരണം

ഓരോ ഗ്രൂപ്പിന്റേയും ഉത്തരങ്ങൾക്കനുസരിച്ച് ടീച്ചർ അവർ ഓരോ ഭിന്നസംഖ്യയും എന്തുകൊണ്ട് ഇങ്ങനെ എഴുതി എന്ന് വിശദീകരിക്കാൻ ആവശ്യപ്പെടുന്നു.

സ്റ്റെപ്പ് –3: പരിഹാരതന്ത്രങ്ങളുടെ അപഗ്രഥനം

ഓരോ ഗ്രൂപ്പും എഴുതിയ ഭിന്നസംഖ്യകൾ ടീച്ചർ ബോർഡിൽ പട്ടികപ്പെടുത്തുന്നു. ഉത്തരം കണ്ടെത്തിയ രീതികൾ ചർച്ച ചെയ്യുന്നു.

അതിനു ശേഷം പ്രവർത്തനത്തിൽ കൊടുത്തിട്ടുള്ള ദശാംശസംഖ്യകളിൽ വലുതേത് ചെറുതേത് എന്ന് ചർച്ച ചെയ്യുന്നു. കുട്ടികൾ അവയെ വലിപ്പക്രമത്തിൽ എഴുതുന്നു.

തുടർപ്രവർത്തനങ്ങൾ

1. താഴെ കൊടുത്തിരിക്കുന്ന ദശാംശസംഖ്യകളെ വലിപ്പക്രമത്തിൽ എഴുതുക 1.05, 1.5, 1.25
2. താഴെ കൊടുത്തിരിക്കുന്ന ദശാംശ സംഖ്യകൾക്ക് സമാനമായ ഭിന്ന സംഖ്യകൾ എഴുതുക.

   0.90, 0.900, 0.09, 2.30, 3.05

LESSON TRANSCRIPT-15

Name of Teacher	:	Sunitha T.P			
Name of School	:	GMHSS CU Campus, AUPS Velimukku	Class	:	VI
Subject:	:	Mathematics	Division	:	F/A
Unit	:	Decimal Numbers	Time	:	40 mts
Topic	:	Place Values in Decimal Numbers			

പഠനോദ്ദേശ്യങ്ങൾ

1. ദശാംശസംഖ്യകളിലെ സ്ഥാനവിലകൾ മനസ്സിലാക്കുന്നതിന്.
2. ദശാംശ സംഖ്യകളിലെ പ്രത്യേക സ്ഥാനങ്ങളിലുള്ള അക്കങ്ങൾ തിരിച്ചറിയുന്നതിന്.

ആശയം

1. എണ്ണൽ സംഖ്യകളിലെ പോലെ ദശാംശ സംഖ്യകളിലും സ്ഥാനവിലകൾ ഉണ്ട്.

മുന്നറിവ്

1. എണ്ണൽ സംഖ്യകളിലെ സ്ഥാനവില.

ഘട്ടം 1: പ്രശ്നാവതരണം

ടീച്ചർ കുട്ടികളെ അഭിവാദ്യം ചെയ്തതിനു ശേഷം എണ്ണൽ സംഖ്യകളിലെയും, ദശാംശസംഖ്യകളിലെയും സ്ഥാന വിലകളെകുറിച്ച് ചർച്ച ചെയ്യുന്നു.

പ്രവർത്തനം

3.2 എന്ന ദശാംശ സംഖ്യയിലെ പത്തിലൊന്നുകളുടെ എണ്ണമെത്ര?

കുട്ടികളോട് ഉത്തരം കണ്ടെത്താൻ ആവശ്യപ്പെടുന്നു

ഘട്ടം 2: പ്രശ്നനിർധാരണം

കുട്ടികൾ പത്തിൽ ഒന്നുകളുടെ എണ്ണം കണ്ടുപിടിക്കുന്നു. ടീച്ചർ ആവശ്യമായ മാർഗ നിർദേശങ്ങൾ നൽകുന്നു. ഒരു സംഖ്യയിലെ ആകെ പത്തിലൊന്നുകളുടെ എണ്ണവും, പത്തിലൊന്നിന്റെ സ്ഥാനത്തെ അക്കവും തമ്മിലുള്ള വ്യത്യാസം കുട്ടികൾ മനസ്സിലാക്കേണ്ടതുണ്ട്.

ഘട്ടം 3: പ്രശ്നപരിഹാര തന്ത്രങ്ങളുടെ ചർച്ച

സ്റ്റെപ്പ് -1: പരിഹാരതന്ത്രങ്ങൾ പങ്കുവെയ്ക്കൽ

വ്യത്യസ്തമായ രീതിയിൽ ഉത്തരം കണ്ടെത്തിയ കുട്ടികളോട് ടീച്ചർ അവർ ഉപയോഗിച്ച രീതി വിശദീകരിക്കാൻ ആവശ്യപ്പെടുന്നു. കൂടാതെ പത്തിലൊന്നുകളുടെ എണ്ണവും, പത്തിലൊന്നിന്റെ സ്ഥാനത്തെ അക്കം ഏതാണെന്നും ചോദിക്കുന്നു.

സാധ്യമായ പരിഹാര തന്ത്രങ്ങൾ

3.2ലെ പത്തിലൊന്നിന്റെ സ്ഥാനത്തെ അക്കം 2.

1. 10 പത്തിലൊന്നുകൾ ചേർന്നാൽ 1.
   30 പത്തിലൊന്നുകൾ ചേർന്നാൽ 3
   0.2 ൽ 2 പത്തിലൊന്നുകൾ
   ആകെ 32 പത്തിലൊന്നുകൾ
2. 3 നെ $\frac{30}{10}$ എന്നെഴുതാം.
   അതുകൊണ്ട് 30 പത്തിലൊന്നുകൾ
   0.2 എന്നത് $\frac{2}{10}$ എന്നെഴുതാം
   അതുകൊണ്ട് 2 പത്തിലൊന്നുകൾ
   ആകെ 32 പത്തിലൊന്നുകൾ
3. 3.2 നെ $\frac{32}{10}$ എന്നെഴുതാം
   ആകെ 32 പത്തിലൊന്നുകൾ

സ്റ്റെപ് –2: പരിഹാരതന്ത്രങ്ങളുടെ ന്യായീകരണം

കുട്ടികളോട് അവർ ഉത്തരം കണ്ടെത്തിയ രീതിയെക്കുറിച്ച് ആവശ്യമായ ചോദ്യങ്ങൾ ചോദിക്കുന്നു. മറ്റു കുട്ടികൾക്കും സംശയങ്ങൾ ചോദിക്കാൻ അവസരം നൽകുന്നു.

സ്റ്റെപ് –3: പ്രശ്നപരിഹാരതന്ത്രങ്ങളുടെ അപഗ്രഥനം

കുട്ടികളും ടീച്ചറും ചേർന്ന് ഓരോ രീതിയും ചർച്ച ചെയ്യുന്നു. കൂടാതെ ഈ ദശാംശ സംഖ്യകൾ 3 എന്ന അക്കം ഒന്നിന്റെ സ്ഥാനത്താണെന്നും, 2 പത്തിലൊന്നിന്റെ സ്ഥാനത്താണെന്നും കുട്ടികൾ മനസ്സിലാക്കുന്നു..

തുടർപ്രവർത്തനങ്ങൾ

1. താഴെ കൊടുത്തിരിക്കുന്ന ദശാംശ സംഖ്യകളിലെ പത്ത്, ഒന്ന്, പത്തിലൊന്ന്, നൂറിലൊന്ന്, ആയിരത്തിലൊന്ന് എന്നീ സ്ഥാനങ്ങളിലുള്ള അക്കങ്ങൾ എഴുതുക.

   a) 4.5 b) 3.25 c) 24.28 d) 24.736

LESSON TRANSCRIPT-16

Name of Teacher	:	Sunitha T.P			
Name of School	:	GMHSS CU Campus, AUPS Velimukku	Class	:	VI
Subject:	:	Mathematics	Division	:	F/A
Unit	:	Decimal Numbers	Time	:	40 mts
Topic	:	Additon of Decimal Numbers			

പഠനോദ്ദേശ്യങ്ങൾ

1. ദശാംശസംഖ്യകളുടെ സങ്കലനം ഉൾക്കൊള്ളുന്ന വിവിധ ഗണിത പ്രശ്നങ്ങൾ പരിഹരിക്കുന്നതിന്.
2. ദശാംശ സംഖ്യകളുടെ സങ്കലനം നിർവഹിക്കുന്നതിനുള്ള വിവിധ രീതികൾ മനസ്സിലാക്കുന്നതിന്.

ആശയം

1. ദശാംശ സംഖ്യകൾ തമ്മിൽ കൂട്ടാം.

മുന്നറിവുകൾ

1. ദശാംശ സംഖ്യകളിലെ സ്ഥാനവില
2. എണ്ണൽ സംഖ്യകളുടെ സങ്കലനം

ഘട്ടം 1: പ്രശ്നാവതരണം

ടീച്ചർ : ഇന്ന് നാം പഠിക്കാൻ പോകുന്നത് രണ്ട് ദശാംശ സംഖ്യകളെ എങ്ങിനെ കൂട്ടാം എന്നാണ്.

പ്രവർത്തനം

8.3 സെന്റീമീറ്റർ നീളമുള്ള ഒരു ഈർക്കിൽ കഷണവും, 2.6 സെ.മീ. നീളമുള്ള മറ്റൊരു ഈർക്കിൽ കഷണവും അറ്റത്തോടറ്റം ചേർത്ത് വച്ചാൽ ആകെ എത്ര നീളമായി?

കുട്ടികളോട് ഉത്തരം കണ്ടെത്താൻ ആവശ്യപ്പെടുന്നു

ഘട്ടം 2: പ്രശ്നനിർധാരണം

കുട്ടികൾ ഉത്തരം കണ്ടെത്തുന്നു. ടീച്ചർ ആവശ്യമായ മാർഗനിർദേശങ്ങൾ നൽകുന്നു. ഒരു പ്രത്യേക രീതിയിൽ ഉത്തരം കണ്ടെത്തണമെന്നില്ല. സാധാരണ ഗണിതക്രിയ ഉപയോഗിച്ച് കൂട്ടുവാൻ ശ്രമിക്കുന്ന കുട്ടികൾ സ്ഥാനവിലക്കനുസരിച്ച് സംഖ്യകൾ എഴുതേണ്ടതിന്റെ ആവശ്യകത മനസ്സിലാക്കേണ്ടതുണ്ട്.

ഘട്ടം 3: പ്രശ്നപരിഹാര തന്ത്രങ്ങളുടെ ചർച്ച

<u>സ്റ്റെപ് -1: പരിഹാരതന്ത്രങ്ങൾ പങ്കുവെയ്ക്കൽ</u>

വ്യത്യസ്തമായ രീതിയിൽ ഉത്തരം കണ്ടെത്തിയ കുട്ടികളോട് അവരുടെ രീതി വിശദീകരിക്കാൻ ആവശ്യപ്പെടുന്നു.

സാധ്യമായ പരിഹാര തന്ത്രങ്ങൾ

1. 8 സെന്റി മീറ്ററും, 2 സെന്റിമീറ്ററും കൂട്ടിയാൽ 10 സെന്റിമീറ്റർ
   8.3 സെന്റിമീറ്ററിലെ 3 മില്ലിമീറ്ററും
   2.6 സെന്റിമീറ്ററിലെ 6 മില്ലിമീറ്ററും കൂട്ടിയാൽ 9 മില്ലിമീറ്റർ
   ആകെ 10 സെന്റി മീറ്റർ 9 മില്ലിമീറ്റർ
   അതായത് 10.9 സെന്റിമീറ്റർ
2. 8 ഉം 2 ഉം കൂട്ടിയാൽ 10
   6 ഉം 3 ഉം കൂട്ടിയാൽ 9
   ആകെ 10.9 സെന്റിമീറ്റർ
3. 8.3 നെ $\frac{83}{10}$ എന്നെഴുതാം
   2.6 നെ $\frac{26}{10}$ എന്നെഴുതാം
   83 ഉം 26 ഉം എഴുതിക്കൂട്ടിയാൽ 109
   ഉത്തരം $\frac{109}{10}$ = 10.9 സെന്റിമീറ്റർ
4. 8.3, 2.6 എന്നിവ എഴുതിക്കൂട്ടി
   ഒരു സ്ഥാനം വലത്തോട്ടു നീക്കി ദശാംശമിട്ടാൽ
   ഉത്തരം 10.9 സെന്റിമീറ്റർ

സ്റ്റെപ് -2: പരിഹാരതന്ത്രങ്ങളുടെ ന്യായീകരണം

വ്യത്യസ്തമായ രീതിയിൽ ഉത്തരം കണ്ടെത്തിയ കുട്ടികളോട് ടീച്ചർ ആവശ്യമായ ചോദ്യങ്ങൾ ചോദിക്കുന്നു.

സ്റ്റെപ് -3: പ്രശ്നപരിഹാരതന്ത്രങ്ങളുടെ അപഗ്രഥനം

ഓരോ രീതിയും താരതമ്യം ചെയ്യുന്നു. ഓരോ കുട്ടിയോടും അവർക്ക് നന്നായി മനസ്സിലായ രീതി ഉപയോഗിക്കാൻ പറയുന്നു.

ഈ പ്രശ്നത്തിലെ സംഖ്യകൾക്കു പകരം വ്യത്യസ്തമായ സംഖ്യകൾ ചേർന്ന് പ്രവർത്തനം ആവർത്തിക്കുന്നു.

തുടർപ്രവർത്തനങ്ങൾ

1. ഒരു പ്രദേശത്ത് രണ്ടു ദിവസമായി പെയ്ത മഴയുടെ അളവ് 2.85 ഇഞ്ചും, 0.48 ഇഞ്ചും ആയിരുന്നു. എങ്കിൽ രണ്ടു ദിവസത്തിലുമായി ആകെ എത്ര മഴ ലഭിച്ചു?
2. ഒരു ത്രികോണത്തിന്റെ മൂന്നു വശങ്ങളുടെ നീളങ്ങൾ യഥാക്രമം 12.4 സെന്റിമീറ്റർ, 8.3 സെന്റിമീറ്റർ, 15.9 സെന്റിമീറ്റർ ആണ്. അതിന്റെ ചുറ്റളവെത്ര?
3. ഒരു ചതുരത്തിന്റെ നീളം 4.5 മീറ്ററും, വീതി 2.5 മീറ്ററും ആണ്. ചുറ്റളവെത്ര?
4. ഒരു ചതുരാകൃതിയിലുള്ള പച്ചക്കറി തോട്ടത്തിന്റെ നീളം 20.4 മീറ്ററും വീതി 18.7 മീറ്ററും ആണ്. അതിനുചുറ്റും കമ്പി വേലി കെട്ടണം. ഒരു ചുറ്റിന് ആവശ്യമായ കമ്പിയുടെ നീളം എത്ര മീറ്റർ?

LESSON TRANSCRIPT-17

Name of Teacher	:	Sunitha T.P			
Name of School	:	GMHSS CU Campus, AUPS Velimukku	Class	:	VI
Subject:	:	Mathematics	Division	:	F/A
Unit	:	Decimal Numbers	Time	:	40 mts
Topic	:	Subtraction of Decimal Numbers			

പഠനോദ്ദേശ്യങ്ങൾ

1. ദശാംശസംഖ്യകളുടെ വ്യവകലനം ഉൾക്കൊള്ളുന്ന വിവിധ ഗണിത പ്രശ്നങ്ങൾ പരിഹരിക്കുന്നതിന്.
2. ദശാംശ സംഖ്യകളുടെ വ്യവകലനം നിർവഹിക്കുന്നതിനുള്ള വിവിധ രീതികൾ മനസ്സിലാക്കുന്നതിന്.

ആശയം

1. ഒരു ദശാംശ സംഖ്യയിൽ നിന്നും മറ്റൊരു ദശാംശ സംഖ്യ കുറയ്ക്കാം.

മുന്നറിവുകൾ

1. ദശാംശ സംഖ്യയിലെ സ്ഥാനവില
2. എണ്ണൽ സംഖ്യകളുടെ വ്യവകലനം

ഘട്ടം 1: പ്രശ്നാവതരണം

ടീച്ചർ : കഴിഞ്ഞ ക്ലാസിൽ നമ്മൾ പഠിച്ചത് ദശാംശ സംഖ്യകൾ എങ്ങിനെ കൂട്ടാം എന്നായിരുന്നു. അല്ലേ?

കുട്ടികൾ : അതെ

ടീച്ചർ : ഇന്ന് നമ്മൾ പഠിക്കാൻ പോകുന്നത് ഒരു ദശാംശ സംഖ്യയിൽനിന്നും മറ്റൊരു ദശാംശ സംഖ്യ എങ്ങിനെ കുറയ്ക്കാം എന്നാണ്.

പ്രവർത്തനം

രണ്ടു കുട്ടികൾ ഒരു ലോംഗ് ജമ്പ് മത്സരത്തിൽ പങ്കെടുത്തു. ഒന്നാമത്തെ കുട്ടി 7.22 മീറ്റർ ഉയരത്തിൽ ചാടി. രണ്ടാമത്തെ കുട്ടി 5.1 മീറ്ററും. ഒന്നാമത്തെ കുട്ടി, രണ്ടാമത്തെ കുട്ടിയേക്കാൾ എത്രമീറ്റർ കൂടുതൽ ഉയരത്തിൽ ചാടി?

കുട്ടികളോട് ഉത്തരം കണ്ടെത്താൻ ആവശ്യപ്പെടുന്നു.

ഘട്ടം 2: പ്രശ്നനിർധാരണം

കുട്ടികൾ ഉത്തരം കണ്ടെത്തുന്നു. ടീച്ചർ ആവശ്യമായ മാർഗ നിർദേശങ്ങൾ നൽകുന്നു. സാധാരണ വ്യവകലന ക്രിയ ഉപയോഗിച്ച് ഉത്തരം കണ്ടെത്തുന്ന കുട്ടി

കൾ, സ്ഥാനവിലയുടെ അടിസ്ഥാനത്തിൽ സംഖ്യകൾ എഴുതേണ്ടതിന്റെ ആവശ്യകത മനസ്സിലാക്കേണ്ടതുണ്ട്.

ഘട്ടം 3: പ്രശ്നപരിഹാരതന്ത്രങ്ങളുടെ ചർച്ച

സ്റ്റെപ് -1: പരിഹാരതന്ത്രങ്ങൾ പങ്കുവെയ്ക്കൽ

വ്യത്യസ്തമായ രീതിയിൽ ഉത്തരം കണ്ടെത്തിയ കുട്ടികളോട് ടീച്ചർ, അവർ ഉത്തരം കണ്ടെത്തിയ രീതി അവതരിപ്പിക്കാൻ ആവശ്യപ്പെടുന്നു.

സാധ്യമായ പരിഹാര തന്ത്രങ്ങൾ

1. 7 മീറ്ററിൽ നിന്നും 5 മീറ്റർ കുറച്ചാൽ 2 മീറ്റർ
   22 സെന്റിമീറ്ററിൽ നിന്നും 10 സെന്റിമീറ്റർ കുറച്ചാൽ 12 സെന്റിമീറ്റർ
   ഉത്തരം 2 മീറ്റർ 12 സെന്റിമീറ്റർ
   അതായത് 2.12 മീറ്റർ
2. 7 ൽ നിന്നും 5 കുറച്ചാൽ 2
   22ൽ നിന്നും 10 കുറച്ചാൽ 12
   ഉത്തരം 2.12 മീറ്റർ
3. 7.22 നെ $7\frac{22}{100}$ എന്നെഴുതാം.

   6.1 നെ $5\frac{1}{10}$ എന്നെഴുതാം

   $\frac{10}{100}$ ന് തുല്ല്യമാണ് $\frac{1}{10}$

   അതുകൊണ്ട് $5\frac{10}{100}$

   7 ൽ നിന്നും 5 കുറച്ചാൽ 2.

   $\frac{22}{100}$ ൽ നിന്നും $\frac{10}{100}$ കുറച്ചാൽ $\frac{12}{100}$

   അതായത് 0.12

   ഉത്തരം 2.12 മീറ്റർ
4. 7.22ൽ നിന്നും വ്യവകലനക്രിയ ഉപയോഗിച്ച് 5.1 കുറച്ച് സ്ഥാനവിലക്കനുസരിച്ച് ദശാംശമിട്ടാൽ, ഉത്തരം 2.12 മീറ്റർ.

സ്റ്റെപ് -2: പരിഹാരതന്ത്രങ്ങളുടെ ന്യായീകരണം

വ്യത്യസ്തമായ രീതികളെക്കുറിച്ച് അവതരിപ്പിച്ച കുട്ടികളോട് ടീച്ചർ ചോദ്യങ്ങൾ ചോദിക്കുന്നു. മറ്റു കുട്ടികൾക്കും ചോദ്യങ്ങൾ ചോദിക്കാനുള്ള അവസരം നൽകുന്നു.

സ്റ്റെപ് -3: പരിഹാരതന്ത്രങ്ങളുടെ അപഗ്രഥനം

ഓരോ രീതിയും ടീച്ചറും കുട്ടികളും ചേർന്ന് ചർച്ച ചെയ്യുന്നു.

തന്നിട്ടുള്ള പ്രശ്നങ്ങളിലെ സംഖ്യകൾ മാറ്റം വരുത്തി പ്രവർത്തനം ആവർത്തിക്കുന്നു.

തുടർപ്രവർത്തനങ്ങൾ

1. 16.8 സെന്റിമീറ്റർ നീളമുള്ള ഒരു ഈർക്കിലിൽ നിന്ന് 9.1 സെന്റിമീറ്റർ നീളമുള്ള ഒരു കഷണം മുറിച്ചെടുത്താൽ മിച്ചമുള്ള നീളമെത്ര?
2. കുട്ടിയെയും എടുത്ത് അമ്മ ഭാരം നോക്കിയപ്പോൾ 54 കിലോഗ്രാം. അമ്മ മാത്ര മായി ഭാരം നോക്കിയപ്പോൾ ഭാരം 50.5 കിലോഗ്രാം. കുട്ടിയുടെ ഭാരം എത്ര?
3. ഒരു പഞ്ചായത്തിൽ 24.375 കിലോമീറ്റർ റോഡ് ടാർ ചെയ്യാനുണ്ട്. അതിൽ 18.43 കിലോമീറ്റർ ടാർ ചെയ്തു. ഇനി എത്ര ദൂരം ടാർ ചെയ്യാനുണ്ട്.
4. ഒരു ത്രികോണത്തിന്റെ ചുറ്റളവ് 29.6 സെന്റിമീറ്ററും, രണ്ടു വശങ്ങളുടെ നീള ങ്ങൾ 11.8 സെന്റിമീറ്ററും, 9.4 സെന്റിമീറ്ററും ആണ്. മൂന്നാമത്തെ വശത്തിന്റെ നീളമെത്ര?

LESSON TRANSCRIPT-18

Name of Teacher	:	Sunitha T.P			
Name of School	:	GMHSS CU Campus, AUPS Velimukku	Class	:	VI
Subject:	:	Mathematics	Division	:	F/A
Unit	:	Decimal Numbers	Time	:	40 mts
Topic	:	Multiplicationof Decimal Numbers			

പഠനോദ്ദേശ്യങ്ങൾ

1. ദശാംശസംഖ്യകളുടെ ഗുണനം ഉൾക്കൊള്ളുന്ന വിവിധ ഗണിത പ്രശ്നങ്ങൾ പരിഹരിക്കുന്നതിന്.
2. ദശാംശ സംഖ്യകളുടെ ഗുണനഫലം കാണുന്നതിനുള്ള വിവിധ രീതികൾ മനസ്സിലാക്കുന്നതിന്.

ആശയങ്ങൾ

1. ദശാംശ സംഖ്യകളെ എണ്ണൽ സംഖ്യ കൊണ്ട് ഗുണിക്കാം.
2. ദശാംശ സംഖ്യകളെ ദശാംശ സംഖ്യകൾ കൊണ്ട് ഗുണിക്കാം.

മുന്നറിവുകൾ

1. ദശാംശ സംഖ്യകളിലെ സ്ഥാനവില
2. എണ്ണൽ സംഖ്യകളുടെ ഗുണനം

ഘട്ടം 1: പ്രശ്നാവതരണം

ടീച്ചർ : ദശാംശസംഖ്യകളുടെ ഗുണനമാണ് നമ്മൾ ഇന്ന് പഠിക്കുന്നത്.

പ്രവർത്തനം

ഒരു പെന്റിംഗ് തയ്യാറാക്കാൻ 0.1 ജാർ പെയിന്റ് വേണം. അങ്ങിനെയെങ്കിൽ 25 പെന്റിംഗുകൾ തയ്യാറാക്കാൻ എത്ര പെയിന്റ് വേണം?

കുട്ടികളോട് ഉത്തരം കണ്ടെത്താൻ ആവശ്യപ്പെടുന്നു.

ഘട്ടം 2: പ്രശ്നനിർധാരണം

കുട്ടികൾ അവർക്കറിയാവുന്ന രീതിയിൽ ഉത്തരം കണ്ടെത്തുന്നു. ടീച്ചർ ആവശ്യമായ മാർഗനിർദേശങ്ങൾ നൽകുന്നു. ഉത്തരം കണ്ടുപിടിച്ചു കഴിഞ്ഞ കുട്ടികളുടെ ഉത്തരങ്ങൾ പരിശോധിക്കുകയും, അവരുടെ ചിന്താരീതി മനസ്സിലാക്കുന്നതിനായുള്ള ചോദ്യങ്ങൾ ചോദിക്കുകയും ചെയ്യുന്നു.

ഘട്ടം 3: പ്രശ്നപരിഹാരതന്ത്രങ്ങളുടെ ചർച്ച

സ്റ്റെപ് -1: പരിഹാരതന്ത്രങ്ങൾ പങ്കുവെയ്ക്കൽ

വ്യത്യസ്തമായ രീതിയിൽ ഉത്തരം കണ്ടെത്തിയ കുട്ടികളോട് ടീച്ചർ, അവർ ഉത്തരം കണ്ടെത്തിയ രീതി അവതരിപ്പിക്കാൻ ആവശ്യപ്പെടുന്നു.

സാധ്യമായ പരിഹാര തന്ത്രങ്ങൾ

1. 1 പെയിന്റിംഗിന് 0.1 ജാർ
   10 പെയിന്റിംഗിന് 1 ജാർ
   20 പെയിന്റിംഗിന് 2 ജാർ
   5 പെയിന്റിംഗിന് 0.5 ജാർ
   ആകെ 2.5 ജാർ പെയിന്റ് ആവശ്യമാണ്.
2. 1 പെയിന്റിംഗിന് 0.1 ജാർ
   0.1 എന്നാൽ $\frac{1}{10}$
   1 പെയിന്റിംഗിന് $\frac{1}{10}$ ജാർ
   5 പെയിന്റിംഗിന് $\frac{5}{10}=\frac{1}{2}$ ജാർ
   10 പെയിന്റിംഗിന് 1 ജാർ
   20 പെയിന്റിംഗിന് 2 ജാർ
   ആകെ 2 ½ ജാർ
   അതായത് 2.5 ജാർ
3. 2.5 നെ 0.1 കൊണ്ട് ഗുണിച്ചാൽ ഉത്തരം കിട്ടും.
   0.1 എന്നത് $\frac{1}{10}$ ന് തുല്ല്യമാണ്.
   $2.5\times\frac{1}{10}=\frac{25}{10}=2.5$
   2.5 ജാർ പെയിന്റ് ആവശ്യമാണ്.

സ്റ്റെപ് -2: പരിഹാരതന്ത്രങ്ങളുടെ ന്യായീകരണം

പരിഹാര തന്ത്രങ്ങൾ അവതരിപ്പിച്ച കുട്ടികളോട് ടീച്ചർ ആവശ്യമായ ചോദ്യങ്ങൾ ചോദിക്കുന്നു. മറ്റുകുട്ടികൾക്കും ചോദ്യങ്ങൾ ചോദിക്കാനുള്ള അവസരം നൽകുന്നു.

സ്റ്റെപ് -3: പരിഹാരതന്ത്രങ്ങളുടെ അപഗ്രഥനം

ഓരോ രീതിയും ടീച്ചർ കുട്ടികളോടൊപ്പം ചർച്ച ചെയ്യുന്നു. ഓരോ രീതിയും പരസ്പരം താരതമ്യം ചെയ്യുന്നു.

പ്രശ്നത്തിലെ 25 എന്ന സംഖ്യക്ക് പകരം 364 ഉപയോഗിച്ചും, പിന്നീട് രണ്ട് സംഖ്യകളും വ്യത്യാസം വരുത്തിയും പ്രവർത്തനം ആവർത്തിക്കുന്നു.

തുടർപ്രവർത്തനങ്ങൾ

1. 6.3 മീറ്റർ നീളവും, 5 മീറ്റർ വീതിയുമുള്ള ചതുരത്തിന്റെ പരപ്പളവ് എത്രയാണ്?
2. ഒരു കിലോഗ്രാം പയറിന് 13.5 രൂപയാണെങ്കിൽ 3.5 കിലോഗ്രാം പയറിന്റെ വില യെന്ത്?
3. വിമാനത്താവളത്തിനുവേണ്ടി സർക്കാർ ചതുരാകൃതിയിലുള്ള ഒരു സ്ഥലം ഏറ്റെടുത്തു. അതിന്റെ നീളം 6.25 കിലോമീറ്ററും വീതി 4.5 കിലോമീറ്ററും ആണ്. ആ സ്ഥലത്തിന്റെ പരപ്പളവെത്ര?
4. ഒരിനം പ്ലാസ്റ്റിക് കയർ കിലോഗ്രാമിന് 11.5 മീറ്റർ നീളമുണ്ട്. ഒരാൾ ആ ഇനം പ്ലാസ്റ്റിക് കയർ 3.5 കിലോഗ്രാം വാങ്ങി. ഇതിന് എത്ര മീറ്റർ നീളമുണ്ടാകും?

LESSON TRANSCRIPT-19

Name of Teacher	:	Sunitha T.P			
Name of School	:	GMHSS CU Campus, AUPS Velimukku	Class	:	VI
Subject:	:	Mathematics	Division	:	F/A
Unit	:	Decimal Numbers	Time	:	40 mts
Topic	:	Division of Counting Numbers by a Decimal Number			

പഠനോദ്ദേശ്യങ്ങൾ

1. ഒരു എണ്ണൽ സംഖ്യയെ ഒരു ദശാംശ സംഖ്യ കൊണ്ടുള്ള ഹരണം ഉൾക്കൊള്ളുന്ന ഗണിത പ്രശ്നങ്ങൾ പരിഹരിക്കുന്നതിന്
2. ഒരു എണ്ണൽ സംഖ്യയെ ഒരു ദശാംശ സംഖ്യ കൊണ്ട് ഹരിക്കുന്നതിനുള്ള വിവിധ രീതികൾ മനസ്സിലാക്കുന്നതിന്.

ആശയം

1. ഒരു എണ്ണൽസംഖ്യയെ ഒരു ദശാംശ സംഖ്യ കൊണ്ട് ഹരിക്കാം.

മുന്നറിവ്

1. എണ്ണൽ സംഖ്യകളുടെ ചതുഷ്ക്രിയകൾ

ഘട്ടം 1: പ്രശ്നാവതരണം

ടീച്ചർ ഒരു പ്രവർത്തനം നൽകുന്നു. കുട്ടികളോട് ഉത്തരം കണ്ടെത്താൻ ആവശ്യപ്പെടുന്നു.

പ്രവർത്തനം

രാജുവിന്റെ നായക്കുട്ടി ഒരു ദിവസം ഒരു പായ്ക്കറ്റിന്റെ 0.2 ഭാഗം തീറ്റ കഴിക്കും. 145 പായ്ക്കറ്റ് തീറ്റ കഴിക്കാൻ എത്ര ദിവസം എടുക്കും?

ഘട്ടം 2: പ്രശ്നനിർധാരണം

കുട്ടികൾ ദിവസത്തിന്റെ എണ്ണം കണക്കാക്കുന്നു. ടീച്ചർ കുട്ടികളുടെ പ്രവർത്തനങ്ങൾ നിരീക്ഷിക്കുകയും, ആവശ്യമായ മാർഗനിർദേശങ്ങൾ നൽകുകയും ചെയ്യുന്നു. ടീച്ചർ ഉത്തരം കണ്ടെത്തിയ കുട്ടികളുടെ ഉത്തരങ്ങൾ പരിശോധിക്കുകയും, അവരുടെ ചിന്താരീതി മനസ്സിലാക്കുന്നതിനാവശ്യമായ ചോദ്യങ്ങൾ ചോദിക്കുകയും ചെയ്യുന്നു.

ഘട്ടം 3: പ്രശ്നപരിഹാരതന്ത്രങ്ങളുടെ ചർച്ച

സ്റ്റെപ് -1: പരിഹാരതന്ത്രങ്ങൾ പങ്കുവെയ്ക്കൽ

വ്യത്യസ്തമായ രീതിയിൽ ഉത്തരം കണ്ടെത്തിയ കുട്ടികളോട് അവരുടെ രീതി അവതരിപ്പിക്കാൻ ആവശ്യപ്പെടുന്നു.

സാധ്യമായ പരിഹാര തന്ത്രങ്ങൾ

1. 1 പായ്ക്കറ്റ് തീരാൻ 5 ദിവസം

   5 പായ്ക്കറ്റ് തീരാൻ 25 ദിവസം

   10 പായ്ക്കറ്റ് തീരാൻ 50 ദിവസം

   40 പായ്ക്കറ്റ് തീരാൻ 200 ദിവസം

   100 പായ്ക്കറ്റ് തീരാൻ 500 ദിവസം

   ആകെ 500 + 200 + 25 = 725 ദിവസം

2. 0.2 എന്നാൽ $\frac{2}{10}$

   $$\frac{2}{10}+\frac{2}{10}+\frac{2}{10}+\frac{2}{10}+\frac{2}{10}=\frac{10}{10}=1$$

   1 പായ്ക്കറ്റ് 5 ദിവസം കൊണ്ട് തീരും

   145 പായ്ക്കറ്റ് തീരാൻ 145 × 5 ദിവസം

   100 നെ 5 കൊണ്ട് ഗുണിച്ചാൽ 500

   40 നെ 5 കൊണ്ട് ഗുണിച്ചാൽ 200

   5 നെ 5 കൊണ്ട് ഗുണിച്ചാൽ 25

   ആകെ 500 + 200 + 25 = 725 ദിവസം.

3. 0.2 എന്നാൽ $\frac{2}{10}$ അത് 2 പത്തിലൊന്നുകൾ ചേർന്നതാണ്.

   145 ൽ 1450 പത്തിലൊന്നുകൾ. ഒരു ദിവസം 0.1 ഭാഗമാണ് കഴിക്കുന്നതെങ്കിൽ 1450 ദിവസം എടുക്കും. പക്ഷേ ഒരു ദിവസം 0.2 ഭാഗം കഴിക്കുന്നുണ്ട്. ആയതിനാൽ 1450ന്റെ പകുതി ദിവസങ്ങൾ. അതായത് 725 ദിവസം.

4. ആകെ ദിവസം കിട്ടാൻ 145നെ 0.2 കൊണ്ട് ഹരിച്ചാൽ മതി

   0.2 എന്നാൽ $\frac{2}{10}$

   145 നെ $\frac{2}{10}$ കൊണ്ട് ഹരിയ്ക്കാൻ

   വ്യുൽക്രമം കൊണ്ട് ഗുണിക്കുക.

   1450 നെ 2 കൊണ്ട് ഹരണക്രിയ ഉപയോഗിച്ച് ഹരിച്ചാൽ

   <u>725 ദിവസം</u>

സ്റ്റെപ്പ് -2: പരിഹാരതന്ത്രങ്ങളുടെ ന്യായീകരണം

ടീച്ചർ രീതികൾ അവതരിപ്പിച്ച കുട്ടികളോട് ആവശ്യമായ ചോദ്യങ്ങൾ ചോദിക്കുന്നു. ഓരോ രീതിയും വ്യക്തമായി മനസ്സിലാക്കുന്നതിനായി ആവശ്യമായ വിശദീകരണങ്ങൾ നൽകാൻ കുട്ടികളെ സഹായിക്കുന്നു. ആവശ്യമെങ്കിൽ സ്റ്റെപ്പുകൾ ബോർഡിൽ എഴുതുന്നു. മറ്റു കുട്ടികൾക്കും ചോദ്യങ്ങൾ ചോദിക്കാനുള്ള അവസരം നൽകുന്നു.

സ്റ്റെപ്പ് -3: പരിഹാരതന്ത്രങ്ങളുടെ അപഗ്രഥനം

ടീച്ചറും കുട്ടികളും ചേർന്ന് ഓരോ രീതിയും ചർച്ച ചെയ്യുന്നു. ഓരോ രീതിയും താരതമ്യം ചെയ്യുന്നു. ഓരോ രീതിയും കുട്ടികൾക്ക് വ്യക്തമായി മനസ്സിലാകുന്നുണ്ടെന്ന് ഉറപ്പാക്കുന്നു.

സംഖ്യകളിൽ മാറ്റം വരുത്തി പ്രവർത്തനം ആവർത്തിക്കുന്നു.

തുടർപ്രവർത്തനങ്ങൾ

താഴെ കൊടുത്തിരിക്കുന്നവയുടെ ഉത്തരങ്ങൾ കാണുക.

a) $240 \div 0.2 =$ ....

b) $84 \div 0.5 =$ ....

c) $28 \div 0.02 =$ ....

d) $35 \div 0.03 =$ ....

LESSON TRANSCRIPT-20

Name of Teacher	:	Sunitha T.P			
Name of School	:	GMHSS CU Campus, AUPS Velimukku	Class	:	VI
Subject:	:	Mathematics	Division	:	F/A
Unit	:	Decimal Numbers	Time	:	40 mts
Topic	:	Division of Decimal Numbers			

പഠനോദ്ദേശ്യങ്ങൾ

1. ദശാംശസംഖ്യകളുടെ ഹരണം ഉൾക്കൊള്ളുന്ന വിവിധ ഗണിത പ്രശ്നങ്ങൾ പരിഹരിക്കുന്നതിന്
2. ദശാംശസംഖ്യകളുടെ ഹരണം നിർവഹിക്കുന്നതിനുള്ള വിവിധ രീതികൾ മനസ്സിലാക്കുന്നതിന്.

ആശയം

1. ഒരു ദശാംശ സംഖ്യയെ മറ്റൊരു ദശാംശ സംഖ്യ കൊണ്ട് ഹരിക്കാം.

മുന്നറിവുകൾ

1. ദശാംശ സംഖ്യകളിലെ സ്ഥാനവില
2. എണ്ണൽ സംഖ്യകളുടെ ചതുഷ്ക്രിയകൾ

ഘട്ടം 1: പ്രശ്നാവതരണം

ടീച്ചർ ഒരു പ്രവർത്തനം അവതരിപ്പിക്കുന്നു. കുട്ടികളോട് ഉത്തരം കണ്ടെത്താൻ ആവശ്യപ്പെടുന്നു.

പ്രവർത്തനം

ഒരു ഗോൾഡ്ഫിഷ് ഒരു ദിവസം ഒരു പായ്ക്കറ്റിന്റെ 0.2 ഭാഗം തീറ്റ കഴിക്കും. ആകെ 8.4 പായ്ക്കറ്റ് തീറ്റ ഉണ്ടെങ്കിൽ, എത്ര ദിവസത്തേക്കുള്ള തീറ്റ ഉണ്ട്?

ഘട്ടം 2: പ്രശ്നനിർധാരണം

കുട്ടികൾ ദിവസങ്ങളുടെ എണ്ണം കണ്ടെത്തുന്നു. ടീച്ചർ കുട്ടികൾക്കു വേണ്ട മാർഗനിർദ്ദേശങ്ങൾ നൽകുന്നു. കുട്ടികളെ സഹായിക്കുന്നതിനും, അവരുടെ ചിന്താരീതി മനസ്സിലാക്കുന്നതിനുമായി ചോദ്യങ്ങൾ ചോദിക്കുന്നു.

ഘട്ടം 3: പ്രശ്നപരിഹാരതന്ത്രങ്ങളുടെ ചർച്ച

<u>സ്റ്റെപ് -1: പരിഹാരതന്ത്രങ്ങൾ പങ്കുവെയ്ക്കൽ</u>

വ്യത്യസ്തമായ രീതിയിൽ ഉത്തരം കണ്ടെത്തിയ കുട്ടികളോട് ടീച്ചർ അവരുടെ രീതി അവതരിപ്പിക്കാൻ ആവശ്യപ്പെടുന്നു.

സാധ്യമായ പരിഹാര തന്ത്രങ്ങൾ

1. 0.2 എന്നാൽ $\frac{2}{10}$

   5 തവണ $\frac{2}{10}$ കൂട്ടിയാൽ $\frac{10}{10}$, അതായത് 1.

   ഒരു പായ്ക്കറ്റ് 5 ദിവസം കൊണ്ട് കഴിക്കും

   8 പായ്ക്കറ്റ് 40 ദിവസം കൊണ്ട് കഴിക്കും

   ബാക്കി 0.4 എന്നാൽ $\frac{4}{10}$ ഭാഗം, 2 ദിവസം കൊണ്ട് കഴിക്കും.

   ആകെ 42 ദിവസം.

2. ഒരു ദിവസം 0.2 ഭാഗം

   ഒരു പായ്ക്കറ്റ് 5 ദിവസം കൊണ്ട് കഴിക്കും

   8.4 നെ 5 കൊണ്ട് ഗുണിച്ചാൽ

   ആകെ ദിവസത്തിന്റെ എണ്ണം കിട്ടും.

   8 നെ 5 കൊണ്ട് ഗുണിച്ചാൽ 40

   0.4 എന്നാൽ $\frac{4}{10}$

   $\frac{4}{10}$ നെ 5 കൊണ്ട് ഗുണിച്ചാൽ 2.

   ആകെ 42 ദിവസം

3. 8 ൽ 80 പത്തിലൊന്നുകൾ

   0.2 എന്നാൽ $\frac{2}{10}$

   പത്തിലൊന്നുകൾ രണ്ടെണ്ണം ചേർന്നതാണ് $\frac{2}{10}$

   8 ൽ 40 എണ്ണം $\frac{2}{10}$

   അതുകൊണ്ട് 40 ദിവസം

   0.4 എന്നാൽ $\frac{4}{10}$, രണ്ട് $\frac{2}{10}$ കൾ ചേർന്നത്.

   അതുകൊണ്ട് 2 ദിവസം

   ആകെ 42 ദിവസം

4. 8.4 = $\frac{84}{10}$

   0.2 = $\frac{2}{10}$

   84 പത്തിലൊന്നുകളിൽ 2 പത്തിലൊന്നുകൾ 42 എണ്ണം

   അതുകൊണ്ട് 42 ദിവസം

5. 8.4 നെ 0.2 കൊണ്ട് ഹരിച്ചാൽ ഉത്തരം കിട്ടും.

$$\frac{8.4}{0.2} = \frac{84}{10} \div \frac{2}{10}$$

ഹരിക്കുന്നതിന് വ്യുൽക്രമം കൊണ്ട് ഗുണിച്ചാൽ, $\frac{840}{20}$

840 നെ 20 കൊണ്ട് ഹരണക്രിയ ഉപയോഗിച്ച് ഹരിച്ചാൽ ഉത്തരം 42.

ആകെ 42 ദിവസം

സ്റ്റെപ് -2: പരിഹാരതന്ത്രങ്ങളുടെ ന്യായീകരണം

വ്യത്യസ്തമായ രീതികൾ അവതരിപ്പിച്ച കുട്ടികളോട് ടീച്ചർ ചോദ്യങ്ങൾ ചോദിക്കുന്നു. മറ്റുള്ള കുട്ടികൾക്ക് ഓരോ രീതിയും വ്യക്തമായി മനസ്സിലാക്കുന്നതിനാവശ്യമായ വിശദീകരണങ്ങൾ നൽകാൻ സഹായിക്കുന്നു.

ഓരോ രീതിയുടെയും സ്റ്റെപ്പുകൾ ആവശ്യമെങ്കിൽ ബോർഡിൽ എഴുതുന്നു. മറ്റു കുട്ടികൾക്കും ചോദ്യങ്ങൾ ചോദിക്കാനുള്ള അവസരം നൽകുന്നു.

സ്റ്റെപ് -3: പരിഹാരതന്ത്രങ്ങളുടെ അപഗ്രഥനം

ടീച്ചറും കുട്ടികളും ചേർന്ന് ഓരോ രീതിയും ചർച്ച ചെയ്യുന്നു. വ്യത്യസ്ത രീതികൾ താരതമ്യം ചെയ്യുന്നു.

പ്രശ്നത്തിലെ സംഖ്യകൾ മാറ്റം വരുത്തി പ്രവർത്തനം ആവർത്തിക്കുന്നു.

തുടർപ്രവർത്തനങ്ങൾ

1. താഴെ കൊടുത്തിരിക്കുന്നവയ്ക്ക് ഉത്തരം കണ്ടെത്തുക.

   a) 8.45 ÷ 2.2 = ...

   b) 8.04 ÷ 2.2 = ...

2. 5 പേനയുടെ വില 42.50 രൂപയാണ്. ഒരു പേനയുടെ വില എത്രയാണ്?
3. ഒരു ചതുരത്തിന്റെ പരപ്പളവ് 3.45 ചതുരശ്ര സെന്റിമീറ്റർ ആണ്. അതിന്റെ ഒരു വശത്തിന്റെ നീളം 1.5 സെന്റി മീറ്ററാണ്. എങ്കിൽ മറ്റേ വശത്തിന്റെ നീളമെന്ത്?

Appendix B2

DEPARTMENT OF EDUCATION
UNIVERSITY OF CALICUT

Lesson Transcripts Based on Cognitively Guided Instructional Strategy

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(English Version)

By

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2013

LESSON TRANSCRIPT-1

Name of Teacher	:	Sunitha T.P			
Name of School	:	GMHSS CU Campus/ AUPS Velimukku	Class	:	VI
Subject:	:	Mathematics	Division	:	F/A
Unit	:	Volume	Time	:	40 mts
Topic	:	Volume of Rectangular Prism Shaped objects			

Learning Objectives

1. To understand the concept of volume
2. To understand the concept of volume of rectangular shaped objects.
3. To understand different methods of enumerating the numbers of small rectangular prisms contained in a rectangular prism.

Concepts

1. Volume is a measure to indicate the size of an object
2. Every object has volume
3. The volume of a rectangular prism is the total number of unit cubes that can be stacked in it.

Learning Materials

1. Rectangular prism made by stacking smaller rectangular prisms.

Phase 1: Presentation of the Problem

Teacher wishes the students and then starts a small discussion.

Facts to be discussed

- There are many objects of various shapes and sizes around us.
- Some objects have definite shape.
- It is difficult sometimes to decide which one is bigger or smaller just by seeing.
- Life situations where we have to measure the size of an object.
- The necessity of a definite measure to indicate the size of an object.

Teacher	:	A measure used to indicate the size of an object is volume. We are going to study about the volume of rectangular prism shaped objects. Do you know the peculiarity of a rectangular prism?
Students	:	It has length, breadth and height.
Teacher	:	Name a few objects in our classroom which are rectangular prism shaped?
Students	:	Books, Pencil, Box, Wall, Bench etc.
Teacher	:	Let us see how to find out the volume of such objects.

Activity:

Teacher divides the students into different small groups. Each group is provided with a rectangular prism made by stacking smaller rectangular prisms. Students are instructed to find out the number of smaller rectangular prisms in the given rectangular prism. Teacher makes sure that the activity is clear to each and every student.

Phase 2: Finding Solution to the Problem

Teacher asks each group to find the answer on their own. It is not compulsory to follow a specific procedure. Teacher monitors activities of each group and gives necessary instructions. Teacher makes sure that each student is participating in the activity. Students find out the answer.

Phase 3: Discussion of Solution Strategies

Step 1: Sharing of Solution Strategies

Teacher asks every group what is the answer they got. Then each group is asked to present the procedure they adopted to solve the problem. Teacher makes sure that each student is hearing attentively and is taking the discussion seriously. Each group presents the procedures used by them to enumerate the number of smaller rectangular prisms.

Possible Solution Strategies

1. Counts systematically, attempting to count both inside and outside cubes.
2. Students count the number of smaller rectangular prisms in a raw or column and then find the total number using addition.

3. Count the number of smaller rectangular prisms in each layer and then finds out the total number by repeated addition.
4. Find out the total number of smaller rectangular prisms by multiplying the number of rectangular prisms in a layer by the total number of layers.

Step 2: Justification of Solution Strategies

Discuss the solution strategies adopted by each group. Teacher asks probing questions to each group. It is for understanding the knowledge level of students.

Probing questions

1. Why did you use this procedure?
2. Is it possible to find out the answer in another way?

Teacher does not try to establish one procedure as bad or another as good. Importance is given to understanding of students.

Step 3: Analysis of Solution Strategies

Teacher discusses with students, which strategy is easy for them. By comparing the various procedures adopted students understand that the easy method is to calculate the number of rectangular prisms in one layer and then multiply the obtained number by total number of layers to get the total number of smaller rectangular prisms. But it is not necessary to adopt only this particular procedure.

The volume of a rectangular prism equals the number of unit cubes that can be stacked in it.

Follow-up activities

1. Construct cube with length, breadth and height one centimeter each by cutting soap piece or rubber.
2. Enumerate the number of cubes in a magic cube.

LESSON TRANSCRIPT-2

Name of Teacher	:	Sunitha T.P			
Name of School	:	GMHSS CU Campus/ AUPS Velimukku	Class	:	VI
Subject:	:	Mathematics	Division	:	F/A
Unit	:	Volume	Time	:	40 mts
Topic	:	Volume of Rectangular Prisms			

Learning Objectives

1. To understand that the unit of volume is cubic centimeter
2. To understand different methods of calculating volume of rectangular prism shaped objects.
3. To calculate the volume of rectangular prism shaped objects.

Concepts:

1. Volume of a unit cube is 1 cubic centimeter
2. Unit of volume is cubic centimeter
3. Volume of a rectangular prism is equal to the product of its length, breadth and height.

Learning Materials

Cubes with length, breadth and height 1 centimeter each, rectangular prisms of different size.

Previous Knowledge

1. The concept of volume of a rectangular prism.
2. Volume of a rectangular prism is equal to the total number of unit cubes that can be stacked in it.

Phase 1: Presentation of the problem

Teacher wishes the students and then examines the unit cubes made by them. Teacher compares its size with size of other objects and discussion its peculiarities. Then, Teacher : Volume of such unit cubes of length, breadth and height 1 centimeter each is 1 cubic centimeter. Do you remember what we learned in the last class about volume of rectangular prisms?

Students : Yes

Teacher : What is equivalent to the volume of a rectangular prism?

Students : The total number of unit cubes that can be stacked in the rectangular prism.

Teacher : So, the unit of volume is cubic centimeter.

Then conducts a short discussion comparing squares and rectangular prisms.

Facts to be discussed:

- Difference between dimensions (length, breadth, height)
- Area of square, unit.

Activity:

Teacher divides the students into small groups. Teacher gives rectangular prisms of different size to each group. Length, breadth and height are written on the respective sides of the rectangular prisms. Teacher instructs each group to calculate the volume of the obtained rectangular prism in cubic centimeter.

Phase -2: Finding Solution to the Problem:

Each group finds out the answer in their own way. Teacher monitors the activities and provides necessary guidance.

Phase 3: Discussion of Solution Strategies

<u>Step 1: Sharing of solution strategies</u>

Each group is asked to present the dimensions of their rectangular prism, calculated answer and problem solving procedure.

Possible Solution Strategies

1. Calculates the number of unit cubes in a layer by counting or drawing in faces of the rectangular prism. Then obtained number is added repeatedly according to the number of layers to get total number of unit cubes.

2. Calculates the number of unit cubes in a layer by multiplying length and breath. Then uses repeated addition according to the number of layers to get total number of unit cubes.
3. Calculates the number of unit cubes in a layer by multiplying length and breadth and then obtained number is multiplied by the number of layers to get the total number of unit cubes.

Teacher tabulates the dimensions of rectangular prisms and its volume or total number of unit cubes on the blackboard.

Step 2: Justification of Solution Strategies

Teacher and students discuss the solution strategies of each group. Teacher asks probing questions to understand the knowledge level of students.

Probing questions

1. How did you calculate the number of unit cubes in a layer?
2. Can you find out the number of unit cubes in a layer in some other way?
3. Why did you adopt this procedure to calculate total number of unit cubes?
4. Is there any other simple way of doing this?

Step 3: Analysis of Solution Strategies

Teacher and students together compares the problem solving procedures adopted by each group. Students understand that the number of unit cubes in a layer of a rectangular prism can be calculated by multiplying length and breadth and the total number of layers is equivalent to the height of the prism.

Then the teacher asks the students to look at the table on the blackboard.

Length	Breadth	Height	Volume
4 cm	2 cm	3 cm	24 cu.cm
6 cm	2 cm	3 cm	36 cu.cm
5 cm	4 cm	3 cm	60 cu.cm
8 cm	3 cm	4 cm	96 cu.cm
5 cm	3 cm	2 cm	30 cu.cm
4 cm	2 cm	5 cm	40 cu.cm

Teacher and students discuss the relationship between the dimensions and volume of each rectangular prism. Students understand that the volume of a rectangular prism is equal to the product of its dimensions.

Volume of a rectangular prism = Length x Breadth x Height

Follow up activity

1. What is the volume of a rectangular iron box of length 8 cm, breadth 5 cm, and height 2 cm?
2. What is the volume of a rectangular prism of length 14 cm, breadth 10 cm and height 5 centimeter?

LESSON TRANSCRIPT-3

Name of Teacher	:	Sunitha T.P			
Name of School	:	GMHSS CU Campus/ AUPS Velimukku	Class	:	VI
Subject:	:	Mathematics	Division	:	F/A
Unit	:	Volume	Time	:	40 mts
Topic	:	Changes in Volume with Change in Dimensions			

Learning Objectives

1. To calculate the volume of cubes
2. To understand the change in volume corresponding to the change in dimensions of rectangular prisms.

Concepts

1. When the dimensions of a rectangular prism are doubled, volume becomes 8 times the original volume.
2. When the dimensions of a rectangular prism are tripled, volume becomes 27 times the original volume.

Previous Knowledge

1. Volume of a rectangular prism is the product of its dimensions.
2. The dimensions of a cube are equal

Phase 1: Presentation of the Problem

Teacher wishes the students, revisits important points of the previous class and then,

Teacher : What is the volume of a 1 cm cube?

Students : 1 cubic centimeter

Teacher : Suppose, the sides of the cube are doubled. Then what is the volume?

Students : 8 cubic centimeters.

Teacher : Now, we will do an activity.

Divides the students into small groups.

Activity

A rectangular prism has length ……….cm, breadth……… cm and height ……… cm

If the dimensions of this rectangular prism are doubled, what is the volume? What is the change in original volume?

Teacher gives each group, different numbers for dimensions of the rectangular prism.

Phase 2: Finding Solution to the Problem

Each group finds out the answer in their own way. Teacher monitors the activities of the groups and gives necessary guidance.

Phase 3: Discussion of Solution Strategies

Step 1: Sharing of Solution Strategies

Teacher asks each group to present the dimensions of their rectangular prisms, volume, volume obtained after doubling the dimensions, their assumption regarding the change in volume, and their problem solving procedure.

Possible Solution Strategies

1. Doubles each dimensions of the rectangular prism and then multiples to get the volume.
2. Multiplies initial volume of the rectangular prism by 8 to get volume after doubling the dimensions.

With presentation of each group, teacher tabulates dimensions of the rectangular prisms, volume and volume after doubling the dimensions on the blackboard.

Step 2: Justification of Solution Strategies

Teacher asks questions to each group to clarify their assumption and problem solving procedure. It is for understanding the way of thinking of students. Teacher gives other students also opportunity to clarify their doubts regarding the different procedures.

Step 3: Analysis of Solution Strategies

Teacher asks the students to look at the table given on the blackboard.

Length	Breadth	Height	Volume 1	Volume 2
2	1	2	4	32
3	2	2	12	72
3	3	3	27	216
4	3	2	24	192
5	2	1	10	80
5	2	2	20	160
4	4	4	64	512

Teacher and students discuss the relationship between initial volume and the volume obtained after doubling the dimensions of each rectangular prism. Derive the conclusion that in all the rectangular prisms, volume becomes 8 times the initial volume after doubling the dimensions.

Teacher and students also discuss the volume of cubes.

Then to understand what is the difference in volume if the dimensions are tripled, teacher asks all students to find the answer for a rectangular prism of their choice. Through discussion concludes that volume becomes 27 times the original volume if the dimensions are tripled.

Follow up activities

1. What is the volume of a cube with side 8 cm?
2. What is the volume of a wooden cube with side 12 cm?

LESSON TRANSCRIPT-4

Name of Teacher	:	Sunitha T.P			
Name of School	:	GMHSS CU Campus/ AUPS Velimukku	Class	:	VI
Subject:	:	Mathematics	Division	:	F/A
Unit	:	Volume	Time	:	40 mts
Topic	:	Calculations of Length/Breadth/Height from volume and two given dimensions.			

Learning Objectives

1. To calculate the unknown dimensions of a rectangular prism if its volume and any two of length, breadth, height are known.
2. To understand different methods to calculate the unknown dimension of a rectangular prism if its volume and any two of length, breadth, height are known.

Concept

1. It is possible to calculate unknown dimension of a rectangular prism if its volume and any two of length, breadth, height are known.

Previous Knowledge

1. Volume of a rectangular prism is product of its length, breadth and height.

Phase -1: Presentation of the Problem

Teacher : Good morning students.

Students : Good morning teacher

Teacher : We have learned how to calculate the volume of a rectangular prism if its length, breadth and height are given. Haven't we?

Students : Yes

Teacher : Today we are going to find out the way to calculate the unknown dimension of a rectangular prism if its volume and any two of length, breadth and height are provided.

Activity:

The length of a rectangular prism is 7 cm and its breadth is 5 cm. We know that the volume of the rectangular prism is 140 cu. cm. Then how many centimeters will be its length?

Each student is required to find out the answer individually.

Phase -2: Finding solution to the Problem

Teacher monitors the activity of each student. Teacher encourages the students to find out the answer as they know and gives necessary guidance. Teacher checks the answers calculated by students and asks them questions about problem solving procedure. Those students who calculated the answers more quickly than others are asked to try to find out the answer in another way.

Phase 3: Discussion of Solution Strategies

After students finding out the answer, problem solving procedures are discussed.

Step 1: Sharing of Solution Strategies

Among the students who have utilized different procedures, teacher asks one student each to present the problem solving procedure.

Possible Solution Strategies

1. Calculates how many times 35 gives 140 to get the answer.
2. Divides 140 by 7 and 5 separately and finds the answer.
3. Divides 140 by 35 using standard logarithm.

Step-2 Justification of Solution Strategies

Teacher asks students questions about their problem solving procedure. The questions are asked with the objective of providing clarity to other students. Other students are also given opportunity to clarity doubts, if any.

Probing questions

1. How did you find out the answer?
2. Why did you use the particular procedure?

   Teacher continues by asking questions based on answers given by students.

Step-3: Analysis of Solution Strategies

Teacher and students compare each problem solving procedure and discuss. Teacher asks the students to adopt the procedure which they are able to understand most clearly.

Teacher : Like this, we can calculate the unknown dimension of a rectangular prism if its volume and other two dimensions among length, breadth and height are given.

Teacher replaces the numbers given in the problem by large numbers and then repeats the activity.

Follow-up Activities

1. A rectangular prism has length 40 centimeters, height 30 centimeters and volume 6000 cubic centimeters. Then what is its breadth?
2. A rectangular prism has breadth 15 centimeters, height 16 centimeters and volume 1440 cubic centimeters. Then what is its length?

LESSON TRANSCRIPT-5

Name of Teacher	:	Sunitha T.P			
Name of School	:	GMHSS CU Campus/ AUPS Velimukku	Class	:	VI
Subject:	:	Mathematics	Division	:	F/A
Unit	:	Volume	Time	:	40 mts
Topic	:	Volume and Weight			

Learning Objectives

1. To understand the relationship among volume, weight and density of an object.
2. To calculate the weight of a rectangular prism if its volume and weight of one cubic centimeter are given.

Concepts

1. Volume and weight of an object are related.
2. Two different objects of equal volume may have unequal weight.
3. Density of an object is the weight of one cubic centimeter of that object.
4. To calculate the weight of an object, multiply the volume of the object by weight of one cubic centimeter.

Learning Materials

1. Iron and wooden rectangular prisms of equal volume.

Previous Knowledge

1. Volume of a rectangular prism is equal to the total number of unit cubes that can be stacked in it.

Phase 1: Presentation of the problem

Teacher wishes the students and starts a discussion about weight and volume of objects.

Facts to be discussed

- Different objects around us have different weight

- Two objects of same size may have different weight
- Weight of an iron rectangular prism is not equal to the weight of a wooden rectangular prism.

  (Gives students opportunity to compare the weight of iron and wooden rectangular prisms)

- The weight of an object depends on the material using which the object is made.
- The weight of one cubic centimeter of an object is called its density.
- The volume of an object gives the information about how many cubic centimeters are in that object.
- The weight of total cubic centimeters of an object is the weight of that particular object.
- To calculate the weight of an object, multiply the volume of that object by weight of one cubic centimeter.

Activity:

The weight of one cubic centimeter of an object is 8 grams and its volume is 196 cubic centimeters. Then how many grams is its weight?

Teacher asks the students to find the answer on their own.

Phase 2: Finding Solution to the Problem

Students calculate weight on their own. Teacher monitors the activities of each student and gives necessary guidance. Teacher checks the answers calculated by students and asks questions to understand their ways of thinking.

Phase 3: Discussion of Solution Strategies

<u>Step 1: Sharing of Solution Strategies</u>

Among the students who have adopted different problem solving procedures, teacher asks one student each to describe his/her procedure.

Possible solution strategies

1. Adds 196 eight times to get the answer 1568.
2. Breaks 196 into hundreds, tens and ones and multiplies each by 8. Then adds 800, 720 and 48 together to get answer.
3. Multiplies 200 by 8 and subtracts 32 from it to get answer.

4. Multiplies 196 by 8 using standard algorithm to get answer.

Step 2: Justification of Solution Strategies

Teacher asks the students who are presenting their solution procedures probing questions and continues questioning according to the answers given by them.

Step 3: Analysis of Solution Strategies

Teacher compares the ways of finding the product. Points such as which among the procedures is more simple, which is applicable in all situations etc. are discussed.

Replaces the numbers in the problem by larger numbers and repeat the activity.

Follow up Activity

A copper rectangular box has length 1.9 centimeters, breadth 15 centimeters and height 4 centimeters. The weight of one cubic centimeter of copper is approximately 9 grams. Then what is the approximate weight of the copper box?

LESSON TRANSCRIPT-6

Name of Teacher	:	Sunitha T.P			
Name of School	:	GMHSS CU Campus/ AUPS Velimukku	Class	:	VI
Subject:	:	Mathematics	Division	:	F/A
Unit	:	Volume	Time	:	40 mts
Topic	:	Capacity of Rectangular Shaped Objects			

Learning Objectives

1. To understand the concept of capacity of objects.
2. To understand the capacity of object in relation to volume.
3. To calculate the capacity of rectangular shaped objects in cubic centimeters.

Concepts

1. The maximum amount that can be held in each of vessels, boxes, tanks, pits, etc. is its capacity.
2. The capacity of a rectangular box is the volume of a rectangular prism that can be fitted tight in the box.

Learning Materials

1. A small wooden rectangular box and wet mud.

Previous Knowledge

1. Volume of a rectangular prism is equal to the product of its dimensions.

Phase 1: Presentation of the Problem

Teacher : Till now we were studying about volume of objects. Right?

Students : Yes

Teacher : Today we are going to learn something new. Can you say the peculiarity of this box?
(Shows a wooden rectangular box)

Students : Made of wood, rectangular shape…

Teacher : Are the length, breadth and height inside the box same as those outside the box?

Students : No

Teacher : What is the reason?

Students : It is made of thick wooden planks.

Teacher : Which are the objects with different dimensions inside and outside?

Students : Tanks, thick vessels…

Teacher : The maximum amount that can be held inside such objects is called capacity. For example, maximum amount of water that can be held in a tank, the amount of mud required to fill a pit. Let us see how to find out the capacity of this box.

(Fills the wooden box with wet mud and takes out the mud rectangular prism without losing shape)

Teacher : What is the relation between this rectangular prism and inside dimensions of the box?

Students : Both are equal

Teacher : So the volume of this mud rectangular prism is the capacity of the box.

Activity

A rectangular box has inside length 40 centimeters, breadth 25 centimeters and height 10 centimeters. What is the capacity of this box?

Teacher asks students to find out the answer.

Phase 2: Finding Solution to the Problem

Students calculate the capacity. Teacher gives necessary instructions. It is not compulsory to find out the product in a particular way. Teacher checks students' answers and asks questions about the procedure adopted by them.

Phase 3: Discussion of Solution Strategies

Step 1: Sharing of Solution Strategies

Among the students who have utilized different strategies, teacher asks one student each to describe their procedure of finding answer.

Possible solution strategies

1. Adding 25 four times gives 100, so 25 multiplied by 40 is 1000. Adding 1000 ten times gives 10000. So volume 10000 cubic centimeters.
2. 25 multiplied by 10 give 250. Four times 250 is 1000. Forty times 250 are 10000. So volume is 10000 cubic centimeters.
3. Multiplies 25 by 10 to get 250. Multiplies 250 by 40 to get the answer 10000.
4. Multiplies 25 by 4 to get 100, adding zero of 40 gives 1000 and then adding zero of 10 gives 10000.

Step 2: Justification of Solution Strategies

Teacher asks necessary questions to those students who are presenting the procedures used to find out volume, for clarity. Other students are also given opportunity to ask questions.

Step 3: Analysis of Solution Strategies

The various solution strategies presented are discussed. Teacher and compares the strategies to one another and asks students to adopt the procedure which is thoroughly understood by them.

Teacher repeats the activity by changing the numbers in the problem.

Follow up Activity

A rectangular vessel has inside length 22 centimeter, breadth 20 centimeter, and height 15 centimeter. What is its capacity?

LESSON TRANSCRIPT-7

Name of Teacher	:	Sunitha T.P			
Name of School	:	GMHSS CU Campus/ AUPS Velimukku	Class	:	VI
Subject:	:	Mathematics	Division	:	F/A
Unit	:	Volume	Time	:	40 mts
Topic	:	Capacity in Liter			

Learning Objectives

1. To understand the relationship between liter and cubic centimeter.
2. To convert measures in cubic centimeter units into liter and milliliter

Concepts

1. One liter is the maximum amount of liquid that can be held in a cube shaped vessel of 10 centimeters length.
2. One liter is equal to 1000 cubic centimeters.
3. One milliliter is the maximum amount of liquid that can be held in a cube shaped vessel of 1 centimeter length.
4. One milliliter is equal to one cubic centimeter.

Learning Materials

1. Cube shaped box with each side of 10 centimeters length, water.

Previous Knowledge

1. Capacity of a rectangular shaped vessel is the produce of its dimensions.

Phase 1: Presentation of the problem

Teacher : In the previous class we learned, how to calculate capacity in cubic centimeters. Right?

Student : Yes

Teacher : In which unit does we usually mention milk, water oil etc? Is it in cubic centimeters?

Students : No

Teacher : Then, in what unit do we say liquids?

Students : Liter, milliliter.

Teacher : Till now, we have described volume and capacity in cubic centimeters. So let us see, whether there is any relationship between cubic centimeters and liter.

(Takes the 10 centimeter cubic box and fills water in it).

Teacher : All the dimensions length, breadth and height of this box is 10 centimeters each. The maximum amount of water that can be held in this box is one liter. How many cubic centimeters will be its capacity?

Students : 1000 cubic centimeters.

Teacher : Then, how many cubic centimeters is one liter?

Students : 1000 cubic centimeters.

Teacher : Do you remember how many milliliters are in one liter?

Students : Yes, 1000 milliliters.

Teacher : 1000 milliliters are one liter and one liter is 1000 cubic centimeters. So 1000 milliliters are equal to 1000 cubic centimeters. Then how many cubic centimeters is one milliliter?

Students : One cubic centimeter.

Teacher : Do you know its meaning? The maximum amount of water than can be held in a one centimeter cubic box is one milliliter.

Activity

A rectangular vessel has length 22 centimeters, breadth 15 centimeters and height 12 centimeters. How many liters of water can be held in it?

Teacher asks the students to find out the answer.

Phase -2: Finding Solution to the Problem

Students calculate the answer. Teacher gives necessary guidance for students to find out capacity and to convert cubic centimeters in to liters in way they know best. Teacher checks the answers found out by the students and asks necessary questions to understand the procedures adopted by them.

Phase 3: Discussion of Solution Strategies

Step 1: Sharing of Solution Strategies

Teacher asks the students, who have calculated capacity, litres and milliliters using different strategies, to describe their procedures.

Possible Solution Strategies

1. If 15 are multiplied by 20 from 22 we get 300 and 15 multiplied by 2 gives 30. Three hundred added to 30 gives 330. To multiply it by 12, 330 multiplied by 10 gives 3300 and 330 multiplied by 2 gives 660. Adding 3300 and 660 we get 3960.

   So capacity is 3960 cubic centimeters. In 3960, there are 3 thousands. So the answer is 3 liters and 960 milliliters.
2. Twenty two multiplied by 15 using standard algorithm is 330, again if it is multiplied by 12 we get 3960. So capacity is 3960 cubic centimeters.

   To convert it into liters, if 3960 is divided by 1000 using standard algorithm, quotient is 3 and remainder is 960.

   So 3 liters 960 milliliters
3. Using standard algorithm, capacity is 3960 cubic centimeters.

   If 3960 is divided by 1000 continuously till remainder becomes zero using standard algorithms, quotient is 3.96. So 3.96 liters

   In this question, there are possibilities of more solution strategies according to the procedures adopted by students to multiply and divide.

Step 2: Justification of Solution Strategies

To help students to clearly explain the procedures utilized by them, teacher asks questions. There are possibilities for more questions, explanations and discussions. Other students are also given opportunities to ask questions to clarify their doubts regarding the procedures.

Step 3: Analysis of Solution Strategies

Teacher and students discuss various solution strategies in detail and compares each procedure to one another. Teacher illustrates using different numbers so that students understand more clearly.

Follow-up Activity

1. All sides of a cube shaped vessel have length 15 centimeters. How many liters of water can be held in it?

LESSON TRANSCRIPT-8

Name of Teacher	:	Sunitha T.P			
Name of School	:	GMHSS CU Campus / AUPS Velimukku	Class	:	VI
Subject:	:	Mathematics	Division	:	F/A
Unit	:	Volume	Time	:	40 mts
Topic	:	Length/Breadth/Height if Capacity in Liter and Two Dimensions are Known			

Learning Objectives

1. To calculate unknown dimension of a rectangular prism shaped object if capacity in liter and other two dimensions are known.
2. To understand different methods of finding out the unknown dimension of a rectangular prism shaped object if capacity in liter and other two dimensions are known.

Concept

1. It is possible to calculate the unknown dimension of a rectangular prism shaped object if any two dimensions among length, breadth, height and capacity in liter are given.

Previous Knowledge

1. The capacity of a rectangular prism shaped object is the product of its length, breadth and height.
2. One liter is equal to 1000 cubic centimeters.

Phase 1: Presentation of the Problem

Teacher : We have learned how to calculate capacity of rectangular prism shaped objects in cubic centimeters. Right?

Students : Yes

Teacher : Do you remember how we calculated unknown dimension of a rectangular prism if two dimensions and volume are given?

Students : Yes

Teacher : Today we are going to study, how to calculate the unknown dimensions if capacity in liter and any two dimensions among length, breadth and height are given.

Activity

A pit has inside length 80 centimeters and height 25 centimeters. If it can hold 72 liters of water, how many centimeters is its breadth?

Teacher asks students to find out breadth.

Phase 2: Finding Solution to the Problem

Students find out the breadth as they know. Teacher gives guidance to them without prescribing a particular procedure. Checks the answers of students who have found out breadth and asks them questions to know their understanding and ways of thinking.

Phase 3: Discussion of Solution Strategies

Step 1: Sharing of Solution Strategies

Among the students who have found out the breadth of the pit using different procedures, teacher asks one student each to present the procedure adopted by them.

Possible Solution Strategies

1 liter is equal to 1000 cubic centimeter. So 72 liters are equal to 72000 cubic centimeters

1. In 72 there are nine 8
   In 720 there are nine 80
   In 7200 there are ninety 80
   In 72000 there are nine hundred 80
   In 900 there are 9 hundreds
   100 is 4 times 25
   In 900 there are thirty six 25
   So answer is 36 centimeters
2. To multiply 80 by 25,
   4 times 25 are 100.
   So 8 times 25 becomes 200

Then 80 times 25 give 2000
4 times 2000 are 8000
If 8000 is multiplied by 9, we get 72000
If this 9 is multiplied by 4, we get 36.
That is, 36 times 2000 give 72000.
So Breadth is 36 centimeters.

3. To multiply 25 by 80,
   If 25 is multiplied by 8, we get 200.
   So if 25 is multiplied by 80, answer is 2000.
   There are 36 two thousands in 72000.
   Hence breadth is 36 centimeters.
4. To multiply 80 by 25,

   If 25 is multiplied by 8 using standard algorithm and zero from 80 is added, we get 2000.

   To divide 72000 by 2000,

   If 72 is divided by 2 using standard algorithm, quotient is 36.

   So breadth is 36 centimeters.
5. If 72000 is first divided by 80 using standard algorithm, quotient is 900
   If this 900 is divided by 25 using standard algorithm, quotient is 36.
   Breadth is 36 centimeters.
6. If 80 is multiplied by 25 using standard algorithm, product is 2000.
   If 72000 is divided by 2000 using standard algorithm, quotient is 36.
   Breadth is 36 centimeters.

   There are possibilities of more strategies according to the methods used by students to multiply and divide.

<u>Step 2:Justification of Solution Strategies</u>

Teacher asks questions to students according to the different strategies presented and continues questioning as per the answers provided by students. Also gives other students opportunity to clarify doubts if any.

<u>Step 3: Analysis of Solution Strategies</u>

Teacher consolidates the different strategies utilized by students. Discuss each procedure. Teacher writes steps for each strategy, for more clarity, on blackboard if necessary and helps students to understand the similarities and differences among different strategies.

Follow up Activity

A tank in a home has inside length 150 centimeters and breadth 90 centimeters. If it can hold 1080 liters of water, how many centimeters is its height?

LESSON TRANSCRIPT-9

Name of Teacher	:	Sunitha T.P			
Name of School	:	GMHSS CU Campus, AUPS Velimukku	Class	:	VI
Subject:	:	Mathematics	Division	:	F/A
Unit	:	Volume	Time	:	40 mts
Topic	:	Rain and Volume			

Learning Objectives

1. To understand that one cubic meter is equal to 100000 cubic centimeters.
2. To understand about measurement of rain water.
3. To solve mathematics problems related to rain water and volume.

Concept

1. One cubic meter is equal to 1000000 cubic centimeters
2. Rate of rainfall is measured in centimeters.

Previous Knowledge

1. Capacity of a rectangular prism shaped object is product of its dimensions.
2. One meter is equal to 100 centimeters.

Phase 1: Presentation of the Problem

Teacher : Do you listen to news related to weather?

Students : Yes

Teacher : Have you heard in it about the amount of rainfall

Students : Yes

Teacher : In what unit is rainfall expressed?

Students : In centimeters

Teacher : Today we are going to solve mathematics problems related to amount of rainwater. Do you know, what does it mean if we say the amount of rainfall in a locality was 6 centimeters?

Students : No.

Teacher : It means the height of water filled in a vessel kept in an open space is 6 centimeters.

We are measuring the amount of rainfall in a particular place. The dimensions of large spaces are expressed in meters.

How many centimeters is one meter?

Students : 100 centimeters

Teacher : Then how many cubic centimeters will be the volume of a rectangular prism shaped object of length, breadth and height one meter each?

(Students calculate with the help of teacher)

Students : Ten lakhs cubic centimeters

Teacher : What if volume is expressed in relation to the number of cubes?

Students : Ten lakhs cubes of length, breadth and height one centimeter each can be stacked inside a cube of length, breadth and height one meter.

Activity

The terrace of a house has rectangular shape with length 14 meters and breadth 11 meters. If there was a rain of 7 centimeters, what will be the amount of water that fills in the terrace?

Teacher : Note that, here length and breadth are given in meters and height is in centimeters.

Phase 2: Finding Solution to the Problem

Students calculate the amount of rain water on their own. Teacher provides necessary guidance. Checks the answers of students who have calculated the amount of water and asks necessary questions.

Phase 3: Discussion of Solution Strategies

Step 1: Sharing of Solution Strategies

Teacher asks one student each who has calculated the amount of water using different strategies to present procedures adopted to find out the answer.

Possible Strategies

14 meters are equal to 1400 centimeters. 11 meters are equal to 1100 centimeters.

1. To calculate the product of 14, 11 and 7
   11 multiplied by 7 is 77

   To multiply 77 by 14, if 77 is multiplied by 10 from 14 we get 770
   To multiply 77 by 4 from 14, if 70 is multiplied by 4, we get 280. If 7 from 77 is multiplied by 4, we get 28.

   To add 770, 280, and 28,
   If 200 is added to 770 we get 970.
   To add 80 from 280 to 970,
   If 30 is added to 970 we get 1000,
   If remaining 50 is added we get 1050.
   If 1050 and 28 are added together we get 1078.

   Volume is 10780000 cubic centimeters.
   In 10780000 there are 10780 thousands.
   So the amount of rain water is 10780 liters.

2. To multiple 14 by 11,
   If 14 is multiplied by 10, we get 140

   If 14 more is added to it, 154.

   To multiply 154 by 7,

   Multiply 150 by 7, then multiply 4 by 7

   If 100 from 150 is multiplied by 7, we get 700

If 50 from 150 is multiplied by 7, we get 350.

If 700 and 350 are added together, 1050.

That is the product of 150 and 7 is 1050.

Product of 4 and 7 is 28.

So the product of 14, 11 and 7 is the sum of 1050 and 28 which is 1078.

Volume is 10780000 cubic centimeters.

One thousand cubic centimeters are 1 liter.

So the amount of water is 10780 liters.

3. Volume 10780000 cubic centimeters by finding out the product of 14, 11 and 7 using standard algorithm.
   Amount of water is 10780 liters.
4. If the product of 1400, 1100 and 7 is found out by using standard algorithm, then product is 10780000.
   That is, volume is 10780000 cubic centimeters.
   To calculate the amount of water in liters, if 10780000 is divided by 1000 using standard algorithm, answer is 10780 liters.

There are possibilities of more strategies according to the various methods used by students to multiply and divide numbers.

Step 2: Justification of Solution Strategies

Teacher asks necessary questions when students explain their solution procedures. If needed, writes necessary steps on the blackboard as the students explain so as to help to give more clarity to explanations. Teacher gives other students also opportunity to ask questions.

Step 3: Analysis of Solution Strategies

Teacher and students together compare and discuss each procedure. Discuss which method is easier; which method is applicable in all situations etc.

Follow-up Activity

1. What is the amount of water that fills in a ground of 24 meters length and 13 meters breadth if there is a rainfall of 9 centimeters?

LESSON TRANSCRIPT-10

Name of Teacher	:	Sunitha T.P			
Name of School	:	GMHSS CU Campus/ AUPS Velimukku	Class	:	VI
Subject:	:	Mathematics	Division	:	F/A
Unit	:	Volume	Time	:	40 mts
Topic	:	Volume and Price			

Learning Objectives

1. To understand the relationship between volume and price.
2. To solve mathematics problems related to volume and price.

Concept

1. By relating the volume of objects with their price, it is possible to decide which one is more profitable.

Previous Knowledge

1. Volume of a rectangular prism is the product of its length, breadth and height.

Phase 1: Presentation of the Problem

Teacher after wishing the students discusses about the relationship between volume and price along with students.

Facts to be discussed

- Real life situations in which volume and price are related.
- Necessity of deciding which object is more profitable by comparing the volume and price of objects.

Activity

The price of a cube shaped cake of side 10 centimeters is Rs. 20. The price of another cake of same shape and side 20 centimeters is Rs. 120. Buying which one is more profitable? Why?

Teacher divides the students in to small groups and asks each group to find out the answer on their own.

Phase 2: Finding solution to the problem

Each group finds out the answer. Teacher monitors activities of each group and gives necessary guidance. It is not compulsory to find out the answer in a particular way.

Phase 3: Discussion of Solution Strategies

Step 1: Sharing of Solution Strategies

Teacher asks each group to present their answers and the procedure adopted by them to find out the answer.

Possible Solution Strategies

1. Volume of the cube with side 10 centimeters is 1000 cubic centimeters.

   Price of 1000 cubic centimeters is Rs. 20.

   Price of 100 cubic centimeters is Rs. 2

   Volume of the cube with side 20 centimeters is 8000 cubic centimeters.

   Price of 8000 cubic centimeters is Rs. 120

   Price of 800 cubic centimeters is Rs. 12

   Price of 400 cubic centimeters is Rs. 6

   Price of 200 cubic centimeters is Rs. 3

   Price of 100 cubic centimeters is Re. 1 and 50 paise

   Second cake is more profitable.

2. Second cake has double the length, breadth and height of the first cake.

   So the volume of the second cake will be 8 times the volume of the first cake.

   Price of first cake is Rs. 20

   8 times 20 is Rs. 160

   Price of second cake is Rs. 120.

So the second cake is more profitable.

3. After finding out the volumes of first cake and second cake, finds out the price of one cubic centimeter by dividing price by corresponding volume using standard algorithm. Then using the price of one cubic centimeter, decides which cake is more profitable.

   Price of one cubic centimeter of first cake is 2 paise and that of second cake is 1.5 paise.

   So the second cake is more profitable.

<u>Step 2: Justification of Solution Strategies</u>

Teacher asks each group questions about their answer and procedures adopted by them and also give other students opportunity to ask questions.

<u>Step 3: Analysis of Solution Strategies</u>

Teacher and students compare and discuss each method. Teacher helps students to understand the differences and similarities among different strategies.

Follow-up Activities

1. The Mysore pack of Venus bakery has length 6 centimeters, breadth 4 centimeters, and height 2 centimeters. Each one coasts Rs. 4. If length, breadth and height of each Mysore pack are reduced to halves and are sold in half cost, which Mysore pack is more profitable to the consumers.

2. A wood plank has length 60 centimeters, breadth 40 centimeters, and thickness 2 centimeters. If the price of the plank is Rs. 960, what is the price of one cubic centimeter of wood?

LESSON TRANSCRIPT-11

Name of Teacher	:	Sunitha T.P			
Name of School	:	GMHSS CU Campus/ AUPS Velimukku	Class	:	VI
Subject:	:	Mathematics	Division	:	F/A
Unit	:	Decimal Numbers	Time	:	40 mts
Topic	:	Different Forms of Decimal Numbers			

Learning Objectives

1. To understand decimal and fractional forms of a number.
2. To compare numbers in different forms.
3. To solve mathematics problems related to equal sharing.

Concept

1. A decimal number has different forms.
2. There are various life situations involving equal sharing of objects.

Previous Knowledge

1. Place value of counting numbers

Phase 1: Presentation of the Problem

Teacher presents students the activity and asks them to find out the answers.

Activity

Saleena has 84 small balls. 10 balls can be filled in a bag. If all balls are filled in bags, how many bags of balls does she possess?

Phase 2: Finding solution to the Problem

Students calculate the number of bags. Teacher gives necessary guidance. Teacher checks the answer of students and asks questions. Ask those students, who have calculated the answer using standard algorithm, try to find the answer in some other way also.

Phase 3: Discussion of solution strategies

Step 1: Sharing of Solution Strategies

Teacher asks students who have utilized different procedures to calculate the number of bags, to present their procedure.

Possible Solution Strategies

1. Since there are 8 ten in 84 there are 8 bags of ball. If the remaining 4 balls are placed in another bag, $\frac{4}{10}$ of that bag will be filled

   That is $\frac{2}{5}$ of that bag will be filled. So there are $8\frac{2}{5}$ bags.
2. If 84 is divided by 10, quotient is 8 and remainder is 4.

   So $8\frac{4}{10}$ bags
3. If 84 is divided by 10 using standard algorithm, quotient is 8.4

   So 8.4 bags

Step 2: Justification of Solution Strategies

Teacher asks students questions about the procedures utilized by them

Probing Questions

1. How did you find out the number of bags?
2. Why did you use this method?
3. How did you know that this way you will get answer?

Step 3: Analysis of Solution Strategies

Teacher and students discusses different procedures and compares each procedure. Then discusses about how the answers are related, whether the answers are equivalent etc.

The teacher repeats the activity after increasing the number of balls.

Follow up Activities

1. In a cottage industry, one day 359 cup cakes were baked. If all the cup cakes are packed in packets of 10 each, how many packets of cupcakes will be there?
2. If one day 529 cup cakes are baked and packed in packets of 100 each, how may packets of cupcakes will be there?
3. A pencil factory makes pencils a day. They put the pencils into box with -------- pencils in each box. How many boxes of pencil do they make in one day? (3875,10) (3875,100)

LESSON TRANSCRIPT-12

Name of Teacher	:	Sunitha T.P			
Name of School	:	GMHSS CU Campus/ AUPS Velimukku	Class	:	VI
Subject:	:	Mathematics	Division	:	F/A
Unit	:	Decimal Numbers	Time	:	40 mts
Topic	:	Fractional and Decimal Forms of Metric Units			

Learning Objectives

1. To write metric units in fractional and decimal forms
2. To convert one metric unit into another unit.
3. To get more acquainted with decimal numbers

Concepts

1. Metric units can be expressed in fractional and decimal forms.

Previous Knowledge

1. Different metric units
2. Conversion of metric units

Phase 1: Presentation of the Problem

Teacher after wishing the students discuss about different metric units.

Facts to be discussed

- Different metric units.
- Relationship between meter and centimeter
- Relationship between liter and milliliter

Activity

Covert 8 centimeter 5 millimeter into meter, centimeter and millimeter

Teacher divides students into small groups and asks them to find out the answer.

Phase 2: Finding Solution to the Problem

Students convert the given measure into meter, centimeter and millimeter. Teacher gives necessary guidance. Students understand the change in number form with the change in metric unit.

Phase 3: Discussion of Solution Strategies

<u>Step 1: Sharing of Solution Strategies</u>

Teacher asks each group to present solution and the procedure adopted to find the solution.

850 millimeter, 8.5 centimeters, $8\frac{5}{10}$ centimeters,

8 ½ centimeters, 0.850 meters, $\frac{850}{1000}$ meters, $\frac{85}{100}$ meters etc. are discussed.

Students get acquainted with fractional and decimal form of different numbers. Students understand that it is possible to write the same metric unit in different forms.

Each group presents the procedure adopted by them to find the answer. There are possibilities of many procedures according to students' knowledge of metric units.

<u>Steps 2: Justification of Solution Strategies</u>

Teacher asks questions to each group about their procedures. Teacher understands about students' knowledge related to metric units. At the same time, students understand that it is possible to write metric units in different forms and there are different methods for doing it.

<u>Step 3: Analysis of Solution Strategies</u>

Discuss various methods of finding answer. Teacher repeats the activity using different measures.

Follow-up Activities

1. Write the following measures after converting into milliliters and liters.
   a) 3 liters 200 milliliters
   b) 250 milliliters
2. Write the following measures after converting into grams, milligrams and kilograms.
   a) 2 kilograms 250 grams
   b) 750 grams

LESSON TRANSCRIPT-13

Name of Teacher	:	Sunitha T.P			
Name of School	:	GMHSS CU Campus/ AUPS Velimukku	Class	:	VI
Subject:	:	Mathematics	Division	:	F/A
Unit	:	Decimal Numbers	Time	:	40 mts
Topic	:	Equal Sharing Problems			

Learning Objectives

1. To calculate the number of tenths in a number
2. To solve mathematics problems involving equal sharing.

Concept

1. It is possible to calculate the number of tenths in a number

Previous Knowledge

1. Knowledge of fractional numbers

Phase 1: Presentation of the problem

Teacher presents an activity

Activity

Julie has 6 large chocolate bars. If she eats $\frac{1}{10}$ chocolate bar each day, how many days will it take to finish all the chocolate bars?

Teacher divides the students into small groups and asks to find out the number of days.

Phase 2: Finding Solution to the Problem

Each group finds out the answer. Teacher monitors the activities of each group, asks questions and gives necessary guidance. Students find out the answer by drawing pictures or doing calculations.

Phase 3: Discussion of Solution Strategies

Step 1: Sharing of Solution Strategies

Teacher asks each group to explain their answer and way of finding the answer.

Possible solution strategies

1. Draws a rectangle, divides it into 10 equal parts and understands that it will take 10 days to finish one chocolate bar. So it will take 60 days to consume 6 chocolate bars.
2. If $\frac{1}{10}$ is added 10 times we get $\frac{10}{10}$. That is equal to one. So it will take 10 days to finish one chocolate bar.
   To finish 6 chocolate bars, 60 days
3. Ten tenths added together gives one. So it will take 10 days to finish 1 chocolate bar and 60 days to finish 6 chocolate bars.
4. We will get answer if 6 is divided by $\frac{1}{10}$

   To divide 6 by $\frac{1}{10}$, multiply by reciprocal. Then product is 60

   So 60 days.

Step 2: Justification of Solution Strategies

Teacher asks questions about their solution strategies to each group. Asks questions like how did you find out the answer, how did you understand that you will get answer this way and continues questioning according to the answers given by students. Other students are also given opportunity to ask questions.

Step 3: Analysis of Solution Strategies

Teacher and students discuss each solution strategy. If necessary teacher writes the steps corresponding to each solution strategy and compares the strategies.

Follow up Activity

1. Mother has $3\frac{7}{10}$ packets of payasam mix. To make one cup of payasam, $\frac{1}{10}$ of a packet of payasam mix is required. Then how many cups of payasam can be prepared using payasam mix that mother possess?

LESSON TRANSCRIPT-14

Name of Teacher	:	Sunitha T.P			
Name of School	:	GMHSS CU Campus/ AUPS Velimukku	Class	:	VI
Subject:	:	Mathematics	Division	:	F/A
Unit	:	Decimal Numbers	Time	:	40 mts
Topic	:	Equivalence and Ordering of Decimal Numbers			

Learning Objectives

1. To convert decimal numbers into fractional form
2. To compare decimal numbers

Concept

1. Decimal numbers can be converted into fractional form.

Previous Knowledge

1. Knowledge of counting number and fractional numbers.

Phase 1: Presentation of the Problem

Teacher : In the previous classes we have done activities related to decimals and fractions. Right?

Students : Yes

Teacher : Do you remember what we have done?

Students : Yes

Teacher : What we have learned first?

Students : To share various objects equally in counts of 10 and 100

Teacher : After that?

Students : Wrote metric units in various forms.

Teacher : What about the previous class?

Students : Calculated the number of tenths in different numbers.

Teacher : Now we are going to learn more about decimal numbers.

What is the meaning of $\frac{3}{10}$?

Students : 3 divided by 10, 3 tenths….

Teacher : We can write this number as 0.3. Then do you know how to write 0.03 as fraction?

Students : No

Teachers : $\frac{3}{100}$

That is 3 times hundredths, the number got after dividing 3 by 100, the share one person gets if 3 things are shared equally among 100 persons, 3 parts of a thing if it is divided into 100 equal parts.

Like this, what is the meaning of 1.3?

Students : $1\frac{3}{10}, \frac{13}{10}$, one and 3 tenths, share of one person if 13 things are shared equally among 10 persons.

Teacher : It also means one whole thing and its 3 parts if it is divided into 10 equal parts.

Activity

Write equivalent fractional numbers of the below given decimal numbers.

a) 0.27 b) 1.23 c) 2.731 d) 7.003

Divides the students into small groups and asks them to find the answer.

Phase 2: Finding Solution to the Problem

Students write different fractions. Teacher gives necessary guidance. The fractions written by students may differ according to the meaning they attach to decimals.

Phase 3: Discussion of Solution Strategies

Step 1: Sharing of Solution Strategies

Teacher asks each group to explain the fractions written by them and the procedure adopted by them to find the fractions.

Step 2: Justification of Solution Strategies

As per the answers given by students teacher asks students questions like why did they write the fraction in this form, is it possible to write it in any other form.

Step 3: Analysis of Solution Strategies

Teacher tabulates various fractions written by each group on the black board. Discuss the procedures used by each group.

Then, discuss about which decimal numbers given in the activity are larger, smaller. Students write the numbers in ascending or descending order.

Follow up Activities

1. Write the following decimal numbers in the order of their size.
   1.05, 1.5, 1.25
2. Write equivalent fractions for the below given decimal numbers.
   0.90, 0.900, 0.09, 0.009, 2.30, 305

LESSON TRANSCRIPT-15

Name of Teacher	:	Sunitha T.P			
Name of School	:	GMHSS CU Campus/ AUPS Velimukku	Class	:	VI
Subject:	:	Mathematics	Division	:	F/A
Unit	:	Decimal Numbers	Time	:	40 mts
Topic	:	Place Values in Decimal Numbers			

Learning Objectives

1. To understand the place value system of decimal numbers.
2. To identify the digits in particular places of decimal numbers.

Concept

1. Decimal numbers also have place values as in counting numbers.

Previous Knowledge

1. Place values in counting numbers.

Phase 1: Presentation of the Problem

After wishing the students teachers conducts a discussion on place values in counting numbers and decimal numbers.

Activity

What is the number of tenths in the decimal number 3.2?

Teacher asks students to find out the answer.

Phase 2: Finding Solution to the Problem

Students find out the number of one tenths. Teacher gives necessary guidance. It is necessary for students to understand the difference between the number of tenths in a number and the digit in the tenths place.

Phase 3: Discussion of Solution Strategies

Step 1: Sharing of Solution Strategies

Teacher asks students who have found the answer in different ways to explain their procedure. Besides asks which is the digit in the tenth place.

Possible Strategies

Digit in the tenths place is 2

1. 10 times tenth is 1
   30 times tenth is 3
   0.2 has 2 tenths
   Total 32 tenths
2. 3 can be written as $\frac{30}{10}$
   So 30 tenths
   0.2 can be written as $\frac{2}{10}$
   So 2 tenths
   Total 32 tenths
3. 3.2 can be written as $\frac{32}{10}$
   Total 32 tenths

Step 2: Justification of Solution Strategies

Teacher asks necessary questions about the procedure used to find out the answer. Other students are also given opportunity to clarity their doubts.

Step -3: Analysis of Solution Strategies

Teacher and students together discuss about each procedure. Besides, students understand that the digit 3 is in one's place and 2 is in tenths place, in this particular decimal number.

Follow-up Activity

1. Write the digits in places of ten, one, tenths, hundredths and one thousandths in the below given decimal numbers.

   a) 4.5 b) 3.25 c) 24.28 d) 24.736

LESSON TRANSCRIPT-16

Name of Teacher	:	Sunitha T.P			
Name of School	:	GMHSS CU Campus/ AUPS Velimukku	Class	:	VI
Subject:	:	Mathematics	Division	:	F/A
Unit	:	Decimal Numbers	Time	:	40 mts
Topic	:	Addition of Decimal Numbers			

Learning Objectives

1. To solve mathematics problems related to addition of decimal numbers.
2. To understand different procedures for carrying out addition of decimal numbers.

Concept

1. Decimal numbers can be added together

Previous Knowledge

1. Place value of decimal numbers
2. Addition of counting numbers

Phase 1: Presentation of the Problem

Teacher : We are going to learn how to add two decimal numbers.

Activity

If a stick of 8.3 centimeters and another stick of 2.6 centimeters lengths are placed end to end, what is the total length?

Teacher asks students to find out the answer.

Phase 2: Finding Solution to the Problem

Students find out the answer. Teacher gives necessary guidance. Students are not required to find out the answer in a specific way. Those students who are trying to calculate the answer using standard algorithm are required to understand the necessity of properly aligning the numbers according to place values.

Phase 3: Discussion of Solution Strategies

Step 1: Sharing of Solution Strategies.

Teacher asks students, who have calculated the answers in different ways, to explain their procedures.

Possible Solution Strategies

1. Adding 8 centimeters and 2 centimeters together we get 10 centimeters.
   Adding 3 millimeters from 8.3 centimeters and 6 from 2.6 centimeters we get 9 millimeters. That is 10.9 centimeters.
   Total 10 centimeters 9 millimeters
   That is 10.9 centimeters.
2. If 8 and 2 are added we get 10
   If 3 and 9 are added we get 9
   Total 10.9 centimeters
3. 8.3 can be written as $\frac{83}{10}$
   2.6 can be written as $\frac{26}{10}$
   If 83 and 26 are added using standard logarithm we get 109.
   Answer is $\frac{109}{10}$=10.9 centimeters.
4. If 8.3 and 2.6 are added using standard logarithm and decimal point is adjusted according to place value,
   we get 10.9 centimeters.

Step 2: Justification of Solution Strategies

Teacher asks questions to students, who have found out the answer using different ways, necessary questions.

Step 3: Analysis of Solution Strategies

Compares the each procedure. Ask students to adopt the procedure that make sense to them.

Teacher repeats the activity after changing the numbers in this problem.

Follow-up Activities

1. The rain falls in a locality in two different days were 2.85 inch and 0.48 inch. Then what is the total rainfall in these two days?
2. The sides of a triangle are 12.4 centimeters, 8.3 centimeters and 15.9 centimeters respectively. What is its perimeter?
3. The length of a rectangle is 4.5 meters and breadth is 2.5 centimeters. What is its perimeter?
4. The length of a rectangular shaped vegetable garden is 20.4 meters and breadth is 18.7 meters. It has to be fenced with wire. What will the length of the wire required for one round?

LESSON TRANSCRIPT-17

Name of Teacher	:	Sunitha T.P			
Name of School	:	GMHSS CU Campus/ AUPS Velimukku	Class	:	VI
Subject:	:	Mathematics	Division	:	F/A
Unit	:	Decimal Numbers	Time	:	40 mts
Topic	:	Subtraction of Decimal Numbers			

Learning Objectives

1. To solve various mathematical problems related to subtraction of decimal numbers.
2. To understand different procedures used to carry out subtraction of decimal numbers.

Concept

1. One decimal number can be subtracted from another decimal number.

Previous Knowledge

1. Place values in decimal numbers
2. Subtraction of counting numbers

Phase 1: Presentation of the Problem

Teacher : In the previous class we learned, how to add decimal numbers. Right?

Students : Yes

Teacher : Today we are going to learn how to subtract one decimal number from another decimal number.

Activity

Two children participated in a long jump competition. First child jumped 7.22 meters and the second child jumped 5.1 meters. How much longer did the first child jump than the second child?

Teacher asks students to find out the answer.

Phase 2: Finding Solution to the Problem

Students calculate the answers. Teacher provides necessary guidance. It is necessary for those students, who are trying to calculate the answer using standard algorithm, to understand that the numbers are to be arranged according to place values.

Phase 3: Sharing of Solution Strategies

Step 1: Sharing of Solution Strategies

Teacher asks those students who have calculated the answer using different strategies to present the procedure adopted by them.

Possible Solution Strategies

1. If 5 meters are subtracted from 7 meters we get, 2 meters.
   If 10 centimeters are subtracted from 22 centimeters, we get, 12 centimeters.
   Answer is 2 meters 12 centimeters.
   That is 2.12 meters
2. If 5 is subtracted from 7, we get 2
   If is 10 subtracted from 22, we get 12
   Answer is 2.12 meters.
3. 7.22 can be written as $7\frac{22}{100}$
   5.1 can be written as $5\frac{1}{10}$ and
   $\frac{10}{100}$ is equal to $\frac{1}{10}$
   So $5\frac{1}{10}$ is equal to $5\frac{10}{100}$
   If 5 is subtracted from 7, we get 2.
   If $\frac{10}{100}$ is subtracted from $\frac{22}{100}$ we get $\frac{12}{100}$
   That is 0.12
   Answer is 2.12 meters
4. If 5.1 is subtracted from 7.22 using standard algorithm and decimal point is adjusted according to place values, the answer is 2.12 meters.

Step 2: Justification of Solution Strategies

Teacher asks, student who have presented, questions about different strategies. Other students are also given opportunity to ask questions.

Step 3: Analysis of Solutions Strategies

Teacher and students together discuss about each procedure.

Teacher repeats the activity by changing the numbers in the given problem.

Follow-up Activities

1. If a piece of length 9.1 centimeters is cut off from a stick of length 16.8 centimeters, what is the length of the remaining piece?
2. When mother checked her weight with baby in hand, she weighted 54 kilograms. When she checked her weight alone, the weight was 50.05 kilograms. What is the weight of the baby?
3. In a village, a road of length 24.375 kilometers is to be tarred. Tarring of 18.43 kilometers is complete. What is the length of the remaining part of the road to be tarred?
4. The perimeter of a triangle is 29.6 centimeters, and the lengths of two sides are 11.8 centimeters and 9.4 centimeters. What is the length of the third side?

LESSON TRANSCRIPT-18

Name of Teacher	:	Sunitha T.P			
Name of School	:	GMHSS CU Campus/ AUPS Velimukku	Class	:	VI
Subject:	:	Mathematics	Division	:	F/A
Unit	:	Decimal Numbers	Time	:	40 mts
Topic	:	Multiplication of Decimal Numbers			

Learning Objectives

1. To solve mathematics problems involving multiplication of decimal numbers
2. To understand various methods of finding out the product of decimal numbers.

Concepts

1. Decimal numbers can be multiplied by counting numbers.
2. Decimal numbers can be multiplied by decimal numbers.

Previous Knowledge

1. Place value in decimal numbers
2. Multiplication of counting numbers.

Phase 1: Presentation of the Problem

Teacher : Today we are going to learn multiplication of decimal numbers.

Activity

For preparing a painting 0.1 jar of paint is required. Then how many jars of paint are required to prepare 25 paintings?

Teacher asks students to find out the answer.

Phase 2: Finding Solution to the Problem

Students find out the answer using methods they know. Teacher monitors the activities of the students and provides necessary guidance. Checks answers of students who have found the answers and asks them questions to understand their way of thinking.

Phase 3: Discussion of Solution Strategies

Step 1: Sharing of Solution Strategies

Teacher asks those students who have found out the answer in different way to present the procedure used to find out the answer.

Possible Solution Strategies

1. For 1 painting 0.1 jar
   For 10 paintings 1 jar
   For 20 paintings 2 jars
   For 5 paintings 0.5 jar
   Total 2.5 jars of paint are required.
2. For 1 painting 0.1 jar
   0.1 is equal to $\frac{1}{10}$
   For 1 painting $\frac{1}{10}$ jar
   For 5 paintings $\frac{5}{10}=\frac{1}{2}$ jar
   For 10 paintings 1 jar
   For 20 painting 2 jars
   Total 2 ½ jars
   That is 2.5 jars
3. We get the answer if 25 is multiplied by $\frac{1}{10}$.
   0.1 is equal to $\frac{1}{10}$
   $25\times\frac{1}{10}=\frac{25}{10}=2.5$
   2.5 jars of paint is required

Step 2: Justification of Solution Strategies

Teacher asks necessary questions to students who have presented the solution strategies. Other students are also given opportunity to ask questions.

Step 3: Analysis of Solution Strategies

Teacher along with students discuss different procedures and compares the strategies.

Repeats the activity after taking 364 instead of 25 in the given problem and then repeats the activity after changing both the numbers in the given problem.

Follow up Activities

1. What is the perimeter of a rectangle of length 6.3 meters and breadth 5 meters?
2. If one kilogram of beans costs 13.5 rupees, what is the cost of 3.5 kilograms of beans?
3. The government acquired a rectangular plot for construction of Airport. It has length 6.25 kilometers and breadth 4.5 kilometers. What is the perimeter of this plot?
4. The length of one kilogram of a specific type of plastic rope is 11.5 meters. One person bought 3.5 kilograms of that type of plastic rope. What will be the length of this rope?

LESSON TRANSCRIPT-19

Name of Teacher	:	Sunitha T.P			
Name of School	:	GMHSS CU Campus, AUPS Velimukku	Class	:	VI
Subject:	:	Mathematics	Division	:	F/A
Unit	:	Decimal Numbers	Time	:	40 mts
Topic	:	Division of Counting Numbers by a Decimal Number			

Learning Objectives

1. To solve mathematics problems involving division of a counting number by a decimal number.
2. To understand different methods of dividing a counting number by a decimal number.

Concept

1. A counting number can be divided by a decimal number.

Previous Knowledge

1. For fundamental operations on counting numbers.

Phase 1: Presentation of the Problem

Teacher presents the activity and asks students to find out the answer.

Activity

Pet dog of Raju eats 0.2 of a packet of dog food each day. Then how many days it will take to eat 145 packets of dog food?

Phase 2: Finding Solution to the Problem

Students calculate the number days. Teacher monitors the activities of students and gives necessary guidance. Teacher checks the answers of students and asks them questions necessary to help them solve the problem and to understand their ways of thinking.

Phase 3: Discussion of Solution Strategies

Step 1: Sharing of Solution Strategies

Teacher asks those student who have calculated the answers in different way to present their procedure.

Possible Solution Strategies

1. 0.2 can be written as $\frac{2}{10}$

   1 packet finish in 5 days

   5 packets finish in 25 days

   10 packets finish in 50 days

   40 packets finish in 200 days

   100 packets finish in 500 days

   Total 500 + 200 + 25 = 725 days

2. 0.2 is $\frac{2}{10}$

   $\frac{2}{10}+\frac{2}{10}+\frac{2}{10}+\frac{2}{10}+\frac{2}{10}=\frac{10}{10}=1$

   I packet will be finished in 5 days

   To finish 145 packets,

   145 x 5 days

   100 multiplied by 5 is 500

   40 multiplied by 5 is 200

   5 multiplied by 5 is 25

   Total 500 + 200 + 25 = 725 days

3. 0.2 is equal to $\frac{2}{10}$ which is 2 tenths.

   In 145 there are 1450 tenths.

   If one day 0.1 of a packet is eaten, it will take 1450 days to finish all packets.

   But it is eating 0.2 of a packet one day

   So it will take half of 1450 days.

   That is 725 days

4. To get total number of days, divide 145 by 0.2

   0.2 is $\frac{2}{10}$

   To divide 145 by $\frac{2}{10}$, multiply it by reciprocal.

   If 1450 is divided by 2 using standard algorithm, 725 days

Step 2: Justification of Solution Strategies

Teacher asks necessary questions to students who have presented their procedures and helps them to give necessary explanations to clearly understand each procedure. If needed, write steps on the blackboard. Other children are also given opportunity to ask questions.

Step 3: Analysis of Solution Strategies

Teacher and students together discuss each procedure and compares each procedure. Make sure that each procedure is clearly understood by students.

Teacher repeats the activity after changing the number.

Follow-up Activities

Answer the following

a) 240 ÷ 0.2 = ...

b) 84 ÷ 0.5 = ...

c) 28 ÷ 0.02 = ...

d) 35 ÷ 0.03 = ...

LESSON TRANSCRIPT-20

Name of Teacher	:	Sunitha T.P			
Name of School	:	GMHSS CU Campus/ AUPS Velimukku	Class	:	VI
Subject:	:	Mathematics	Division	:	F/A
Unit	:	Decimal Numbers	Time	:	40 mts
Topic	:	Division of Decimal Numbers			

Learning Objectives

1. To solve mathematics problems involving division of decimal numbers
2. To understand different methods of carrying out division of decimal numbers.

Concept

1. One decimal number can be divided by another decimal number.

Previous Knowledge

1. Place values in decimal numbers
2. Four fundamental operations on counting numbers

Phase 1: Presentation of the Problem

Teacher presents the activity and asks students to find out the answer.

Activity

One gold fish eats 0.2 parts of a packet of food one day. If there are a total of 8.4 packets of fish food, for how many days would it last?

Phase 2: Finding Solution to the Problem

Students find out the number of days. Teacher gives necessary guidance and asks students questions to help them and to understand their ways of thinking.

Phase 3: Discussion of Solution Strategies

Step 1: Sharing of Solution Strategies

Teacher asks those students who have solved the problem in different way, to present their procedure.

Possible Solution Strategies

1. 0.2 is equal to $\frac{2}{10}$

   5 times $\frac{2}{10}$ is $\frac{10}{10}$, and is 1.

   Eats one packet in 5 days

   Eats 8 packets in 40 days

   The remaining 0.4 is equal to $\frac{4}{10}$ eats it in 2 days

   Total 42 days

2. One day 0.2 part

   Then one packet finishes in 5 days.

   If 8.4 is multiplied by 5, we get the total number of days.

   If 8 is multiplied by 5, we get 40

   0.4 is $\frac{4}{10}$

   If $\frac{4}{10}$ is multiplied by 5 we get 2.

   Total 42 days.

3. In 8, there are 80 tenths

   0.2 is equal to $\frac{2}{10}$

   $\frac{2}{10}$ is equal to 2 tenths

   In 8 there are 40 number of $\frac{2}{10}$

   So 40 days

   0.4 is $\frac{4}{10}$, which is 2 times $\frac{2}{10}$

   So 2 days

   Total 42 days.

4. $8.4 = \frac{84}{10}$

   $0.2 = \frac{2}{10}$

   In 8.4 there are 42 number of 2 tenths.

   So 42 days

5. If 8.4 is divided by 0.2 we get the answer.

   $\frac{8.4}{0.2} = \frac{84}{10} \div \frac{2}{10}$

   For division, if multiplied by reciprocal, we get $\frac{840}{20}$

   If 840 is divided by 20 using standard algorithm, answer is 42.

   Total 42 days

Step 2: Justification of Solution Strategies

Teacher asks questions to students who have presented different procedures and helps them to explain properly so that other students are able to understand each procedure clearly. Teacher writes the steps of the procedures on the blackboard if necessary. Other students are also given opportunity to ask questions.

Step 3: Analysis of Solution Strategies

Teacher and students together discuss each procedure and compare different procedures.

Teacher repeats the activity after changing the numbers in the activity.

Follow up Activities

1. Answer the following
   a) 8.45 ÷ 2.2 = ...
   b) 8.04 ÷ 2.2 = ...
2. 5 pens cost 42.50 rupees. What is the price of one pen?
3. Area of a rectangle is 3.4 square centimeters. If the length of one side is 1.5 centimeters, what is the length of the other side?

Appendix C1

DEPARTMENT OF EDUCATION
UNIVERSITY OF CALICUT

LESSON TRANSCRIPT ON EXISTING METHOD OF TEACHING

Dr. M.N. Mohamedunni Alias Musthafa — Assistant Professor

Sunitha. T.P — Research Scholar

Name of Teacher	:	Sunitha T.P.	
Name of School	:	GMHSS C U Campus/ AUPS Velimukku	
Subject	:	Mathematics	Class : VI
Unit	:	Volume	Division: B/D
Topic	:	Volume of Rectangular Prism	Duration: 40 mts.

പ്രശ്നമേഖല	:	ശാസ്ത്രീയമായ ജലവിഭവ മാനേജ്മെന്റിന്റെ അഭാവം
പഠനപ്രമേയം	:	ഘനരൂപങ്ങളുടെ വ്യാപ്തം
പഠനലക്ഷ്യങ്ങൾ	:	1) ചതുരക്കട്ടയുടെ ആകൃതിയിലുള്ള വസ്തുക്കളുടെ വ്യാപ്തം കണ്ടെത്തുന്നതിന്. 2) നിത്യജീവിതത്തിൽ വ്യാപ്തം ഉൾപ്പെടുന്ന പ്രശ്നങ്ങൾ തിരിച്ചറിയുന്നതിനും പരിഹരിക്കുന്നതിനും.
ആശയങ്ങൾ/ ധാരണകൾ	:	1) ഒരു ചതുരക്കട്ടയുടെ വ്യാപ്തം എന്നത് അത് എത്ര യൂണിറ്റ് സമചതുരക്കട്ടകൾ ചേർന്നതാണ് എന്നതിന് തുല്യമാണ്. 2) വ്യാപ്തത്തിന്റെ യൂണിറ്റ് ഘനസെന്റീമീറ്റർ ആണ്. 3) ചതുരക്കട്ടയുടെ വ്യാപ്തം അതിന്റെ നീളം, വീതി, ഉയരം എന്നീ അളവുകളുടെ ഗുണനഫലമാണ്.
മുൻധാരണകൾ	:	ചതുരത്തിന്റെ പരപ്പളവ് കണ്ടുപിടിക്കുന്ന രീതി
വിഭവങ്ങൾ	:	ചതുരക്കട്ടകളുടെ ചിത്രങ്ങൾ, മാതൃക, സോപ്പ് കഷണങ്ങൾ, സമചതുരത്തിന്റെ ചിത്രങ്ങൾ.
ഉൽപന്നങ്ങൾ	:	1) നീളവും, വീതിയും, ഉയരവും 1 സെ.മീ. ആയ സമചതുര ക്കട്ടകൾ. 2) ഏതൊരു ചതുരക്കട്ടയുടെയും വ്യാപ്തം കാണാനുള്ള കഴിവ്.
മൂല്യങ്ങൾ/ മനോഭാവങ്ങൾ	:	1) ആശയങ്ങൾ സ്വീകരിക്കാനും പങ്കുവെക്കാനുമുള്ള മനോ ഭാവം. 2) കൃത്യതയോടും സൂക്ഷ്മതയോടും കൂടി നിർമാണ പ്രവർത്തനങ്ങളിൽ ഏർപ്പെടാനുള്ള മനോഭാവം 3) ഗണിത ക്രിയകൾ കൃത്യതയോടും സൂക്ഷ്മതയോടും കൂടി നിർവഹിക്കാനുള്ള മനോഭാവം.

പ്രക്രിയകൾ	പ്രതികരണങ്ങൾ
മുന്നൊരുക്കം: ഒരാൾ വീടുണ്ടാക്കുന്നതിനായി ഇഷ്ടിക വാങ്ങാൻ പോയി. കടയിൽ രണ്ട് വ്യത്യസ്ത തരം ഇഷ്ടികകൾ ഉണ്ട്. ഒരു തരം നീളം കൂടി പരന്നിരിക്കുന്നു, രണ്ടാമത്തെ തരം നീളം കുറഞ്ഞ് ഉയർന്നിരിക്കുന്നു. കാഴ്ചയിൽ ഏതിനാണ് വലിപ്പം കൂടുതലെന്ന് മനസ്സിലാകുന്നില്ല. ഏതിനാണ് വലിപ്പം കൂടുതലെന്ന് എങ്ങിനെ കൃത്യമായി കണ്ടുപിടിക്കും? വിവിധ സാധ്യതകൾ ചർച്ച ചെയ്യുന്നു. സാധ്യതകളിൽ പ്രായോഗികമായി വരുന്ന ബുദ്ധിമുട്ടുകൾ ചർച്ച ചെയ്യുന്നു. അതിനാൽ പ്രായോഗികമായ, കൃത്യമായ ഒരു രീതി ആവശ്യമാണെന്ന് മനസ്സിലാക്കുന്നു.	കുട്ടികൾ വിവിധ സാധ്യതകൾ പറയുന്നു. കട്ടകളുടെ എണ്ണം നോക്കുക, വെള്ളത്തിലിട്ടു നോക്കുക തുടങ്ങിയവ.
ടീച്ചർ: ഒരു ചതുരത്തിന്റെ പരപ്പളവ് കണ്ടുപിടിച്ചതോർമ്മയുണ്ടോ?	പരപ്പളവ് എന്നത് നീളവും, വീതിയും 1 സെന്റിമീറ്റർ ആയ സമചതുരങ്ങൾ എത്രയെണ്ണം നിറയ്ക്കാം എന്നതാണ്.
5 സെ.മീ. നീളവും 4 സെ.മീ. വീതിയും ഉള്ള ചതുരത്തിന്റെ ചിത്രം കാണിക്കുന്നു. പരപ്പളവ് കണ്ടുപിടിക്കാൻ ആവശ്യപ്പെടുന്നു.	പരപ്പളവ് = 5 x 4 = 20 ചതുരശ്ര സെന്റിമീറ്റർ
ഇതുപോലെ കൃത്യമായി 5 സെ.മി. നീളവും 4. സെ.മീ. വീതിയും, 3 സെ.മീ. ഉയരവുമുള്ള ചതരുക്കട്ടയുടെ വലിപ്പമളക്കുന്നതെങ്ങിനെ?	
ചർച്ച ചെയ്യുന്നു	കുട്ടികൾ വിവിധ ഉത്തരങ്ങൾ പറയുന്നു.
1 സെ.മീ. നീളം, 1 സെ.മീ. വീതി, 1 സെ.മീ ഉയരവുമുള്ള സമചതുരക്കട്ടകൾ (Cubes) എത്രയെണ്ണം അടുക്കിയാൽ ഈ ചതുരക്കട്ട കിട്ടുമെന്ന് നോക്കിയാൽ മതി എന്ന് മനസിലാവുന്നു.	

പര്യവേക്ഷണം

പ്രവർത്തനം-1

കുട്ടികളെ ഗ്രൂപ്പുകളാക്കി തിരിക്കുന്നു. ഓരോ ഗ്രൂപ്പിനും ഒരു കഷണം സോപ്പ് നൽകി നീളം, വീതി, ഉയരം എന്നിവ 1 സെ.മീ. വീതമുള്ള സമചതുരക്കട്ടകൾ നിർമിക്കാൻ ആവശ്യപ്പെടുന്നു.

കുട്ടികൾ 1 സെ.മീ അളവുകൾ ഉള്ള സമചതുരക്കട്ടകൾ നിർമിക്കുന്നു.

ഇത്തരം സമചതുരക്കട്ടയുടെ വലിപ്പത്തെക്കുറിച്ച് കുട്ടികൾക്ക് ധാരണ ലഭിക്കുന്നു.

പ്രവർത്തനം -2

ഓരോ ഗ്രൂപ്പിനും വ്യത്യസ്ത അളവുകളുള്ള ചതുരക്കട്ടയുടെ ചിത്രം നൽകി, 1 സെ.മി. നീളവും, വീതിയും ഉയരവുമുള്ള എത്ര സമചതുരക്കട്ടകൾ ഉണ്ടാകുമെന്ന് കണ്ടുപിടിയ്ക്കാൻ ആവശ്യപ്പെടുന്നു. ചർച്ചയ്ക്കായി താഴെ തന്നിട്ടുള്ള ചോദ്യങ്ങൾ ഉപയോഗിക്കുന്നു. ഒരു അടുക്കിൽ എത്ര കട്ടകൾ ഉണ്ട്? ആകെ എത്ര അടുക്കുകൾ ഉണ്ട്? ആകെ എത്ര സമചതുരക്കട്ടകൾ ഉണ്ട്?

കുട്ടികൾ ഉത്തരം കണ്ടെത്തുന്നു.

- ഇങ്ങനെ അളക്കുന്ന വലിപ്പത്തിന് വ്യാപ്തം (Volume) എന്ന് പറയുന്നു.
- നീളവും, വീതിയും, ഉയരവുമെല്ലാം 1 സെന്റീമീറ്റർ ആയ സമചതുരക്കട്ടയുടെ വ്യാപ്തം 1 ഘനസെന്റീമീറ്റർ ആണ് (Cubic Centimeter)
- ചതുരക്കട്ടയുടെ വ്യാപ്തം ഘന സെന്റീമീറ്ററിൽ ആണ് പറയുന്നത്.

ആയതിനാൽ 5 സെ.മീ. നീളവും, 4 സെ.മീ. വീതിയും 3 സെ.മീ. ഉയരവുമുള്ള ചതുരക്കട്ടയുടെ വ്യാപ്തം 60 ഘന സെന്റീമീറ്റർ ആണ്. വിവിധ ഗ്രൂപ്പുകളുടെ ചതുരക്കട്ടയുടെ വ്യാപ്തങ്ങൾ ക്രോഡീകരിക്കുന്നു.

ഓരോ വ്യാപ്തവും ഘനസെന്റീമീറ്ററിൽ രേഖപ്പെടുത്തുന്നു.

ചർച്ചയിലൂടെ നീളം, വീതി, ഉയരം എന്നിവയുടെ അളവുകളും, വ്യാപ്തവും തമ്മിലുള്ള ബന്ധം കണ്ടെത്തുന്നു.

നീളത്തിന്റെയും ഉയരത്തിന്റെയും, വീതിയുടെയും ഗുണനഫലമാണ് ആകെ കട്ടകളുടെ എണ്ണം.

ചതുരക്കട്ടയുടെ വ്യാപ്തം = നീളം x വീതി x ഉയരം

സമാഹരണം/പ്രയോഗം

കടയിലെ രണ്ടുതരം ഇഷ്ടികകളുടെ വലിപ്പം കാണുന്നതിന്, നീളം, വീതി, ഉയരം, എന്നിവ കണ്ടുപിടിച്ച് ഗുണന ഫലം കാണുക. അങ്ങിനെ ഏതാണ് വലുതെന്ന് തീരുമാനിക്കാം.

തുടർപ്രവർത്തനം

താഴെ കൊടുത്തിരിക്കുന്ന അളവുകൾ ഉള്ള ചതുരക്കട്ടകളുടെ വ്യാപ്തം കാണുക.

1) നീളം = 6 സെ.മീ., വീതി= 5 സെ.മി., ഉയരം = 3 സെ.മീ.
2) നീളം = 4 സെ.മീ.,നന വീതി= 8 സെ.മി., ഉയരം = 5 സെ.മീ.

Appendix C2

DEPARTMENT OF EDUCATION
UNIVERSITY OF CALICUT

LESSON TRANSCRIPT ON EXISTING METHOD OF TEACHING

Dr. M.N. Mohamedunni Alias Musthafa — Assistant Professor

Sunitha. T.P — Research Scholar

Name of Teacher	:	Sunitha T.P.	
Name of School	:	GMHSS C U Campus/ AUPS Velimukku	
Subject	:	Mathematics	Class : VI
Unit	:	Volume	Division: B/D
Topic	:	Volume of Rectangular Prism	Duration: 40 mts.

Issue Domain	:	Lack of scientific land-water management
Theme	:	Volume of Solids
Learning Objectives	:	3) To find out the volume of rectangular prism shaped objects. 4) To identify and solve problems in real life situations related to volume.
Concepts/ Ideas	:	4) Volume of a rectangular prism is equal to the total number of unit cubes contained in it. 5) The unit of volume is cubic centimeter. 6) Volume of a rectangular prism is equal to the product of its length, breadth and height.
Previous Knowledge	:	The method of finding the area of a rectangle
Resources	:	Pictures and model of rectangular prisms, Pieces of Soap, Pictures of Rectangle
Products	:	3) Cubes with length, breadth and height 1 centimeter each. 4) Ability to find volume of any rectangular prism
Values/ Attitudes	:	4) Positive attitude towards receiving and sharing of ideas. 5) Positive attitude towards carrying out mathematical calculations with accuracy 6) Positive attitude of involving in constructive activities with accuracy.

Processes	Responses
Preparation:	
A man went to a brick shop to buy bricks for constructing house. That shop has two types of bricks. One type is longer and flatter while the other is shorter in length but has more height. It is not possible to tell which one is bigger just by seeing. How can we find out accurately which type of brick is bigger?	Students share different possibilities, To count the no. of small rectangular prisms included, to put it in water etc.
Different possibilities are discussed.	
Practical applications and difficulties of the emerged different possibilities are discussed.	
Then the necessity of a practical and more accurate way of calculating size is understood.	
Teacher: Do you remember how we calculated the area of a rectangle?	Area of a rectangular is the total number of squares with length and breadth 1 cm that can be included in it.
Picture of a rectangle with length 5 cm and breadth 4 cm is displayed. Students are told to find the area of the rectangle.	Area = 5 x 4 = 20 square centimeters
Similarly, how can we find out the size of a rectangular prism of length 5 cm, breadth 4 cm and height 3 cm.	Students give various answers
Discusses	Students give various answers
It is understood that it is	

sufficient to find out how many cubes, with length 1 cm, breadth 1 cm, and height 1 cm, can be stacked in the given rectangular prism.	
Exploration	
Activity 1	
Students are divided into groups. Each group is given a piece of soap and the students are instructed to construct cubes with length, breadth and height 1 cm each.	Students make cubes of required dimensions
From this activity students become aware of the size of a cube with length, breadth and height 1 cm each.	
Activity -2	
Distributes pictures of different rectangular prisms of different dimensions to each group. Then tells them to find out the total number of cubes of length, breadth and height 1 cm each that can be stacked in the given rectangular prism. Students find the answers based on the answers to the below given discussion points.	
How many cubes are in a layer? How many layers are there? What is the total no of cubes?	Students find the answers
• The size of an object calculated like this is called 'volume' • Volume of a cube with length, breadth and height 1 cm each is 1 cubic centimeter. • Volume of a rectangular prism is measured in cubic centimeter.	

So the volume of the rectangular prism with length 5 cm, breadth 4 cm and height 3 cm is 60 cubic centimeters.

Consolidates the volumes of rectangular prisms calculated by different groups.

Then the volumes are expressed and recorded in cubic centimeters.

Through discussion of the obtained value of volumes of different rectangular prisms, finds out the relationship between volume and the respective dimensions.

The total number of cubes equals the product of length breadth and height of the rectangular prism

Volume of a rectangular prism = Length x Breadth x Height

Consolidation/Application

To find out the size of the two types of bricks in the shop, find out the lengths, breadth and height of each type and then find product. then we can find out which type is bigger

Follow up Activity

Find out the volume of the rectangular prisms with the following dimensions.

3) Length = 6 cm, Breadth = 5 cm, Height = 3 cm
4) Length = 4 cm, Breadth = 8 cm, Height = 5 cm

Appendix D1

DEPARTMENT OF EDUCATION
UNIVERSITY OF CALICUT
TEST OF ACHIEVEMENT IN MATHEMATICS

(DRAFT)

Dr. M.N. Mohamedunni Alias Musthafa
Assistant Professor

Sunitha. T.P
Research Scholar

Std. VI *Max. Score: 70*

നിർദ്ദേശങ്ങൾ

ഗണിതത്തിൽ 'വ്യാപ്തം', 'ദശാംശരീതി' എന്നീ പാഠഭാഗങ്ങളുമായി ബന്ധപ്പെട്ട 70 ചോദ്യങ്ങൾ ആണ് ഈ ടെസ്റ്റിൽ ഉൾപ്പെടുത്തിയിട്ടുള്ളത്. ആദ്യത്തെ 66 ചോദ്യങ്ങളിൽ ഓരോ ചോദ്യത്തിനും A, B, C, D എന്ന് രേഖപ്പെടുത്തിയ നാല് ഉത്തരങ്ങൾ വീതം നൽകിയിരിക്കുന്നു. ഓരോ ചോദ്യവും ശ്രദ്ധാപൂർവ്വം വായിച്ച് ശരിയായ ഉത്തരം നിങ്ങൾക്ക് തന്നിരിക്കുന്ന ഉത്തരക്കടലാസിൽ '✓' ചിഹ്നമുപയോഗിച്ച് രേഖപ്പെടുത്തുക. അവസാനത്തെ 4 ചോദ്യങ്ങൾക്കുള്ള ഉത്തരങ്ങൾ അതതു ചോദ്യനമ്പറിനു നേരെ എഴുതുക. എല്ലാ ചോദ്യങ്ങൾക്കും ഉത്തരം കണ്ടെത്തുക. ചോദ്യക്കടലാസിൽ ഒന്നും തന്നെ എഴുതുകയോ, വരക്കുകയോ ചെയ്യരുത്.

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1. $\frac{5}{10}$ ന്റെ ദശാംശസംഖ്യാരൂപമേത്?

   A) 0.05 B) 0.5 C) 0.005 D) 5.0

2. 1 ലിറ്റർ = ------ ഘന സെന്റീമീറ്റർ

   A) 100 B) 1000 C) 500 D) 10

3. 0.18 ന് തുല്യമായ ഭിന്നസംഖ്യ ഏത്?

   A) $\frac{18}{100}$ B) $\frac{18}{10}$ C) $\frac{18}{1000}$ D) 18

4. വശങ്ങളുടെ നീളം 1 സെ.മീ. ആയ ക്യൂബിന്റെ വ്യാപ്തമെത്ര?

   A) 1 ച.സെ.മീ B) 1 ഘ.സെ.മീ
   C) 3 ച.സെ.മീ D) 3 ഘ.സെ.മീ

5. 72 സെ.മീ. എത്ര മീറ്ററാണ്?

   A) 7.2 മീ B) 0.72 മീ C) 0.072 മീ D) 720 മീ

6. ഒരു ക്യൂബിന്റെ വശത്തിന്റെ അളവുകൾ 2 മടങ്ങായാൽ വ്യാപ്തം എത്ര മടങ്ങാകും?

   A) 8 B) 2 C) 4 D) 27

7. 9 $\frac{1}{10}$ സമാനമായ ദശാംശസംഖ്യയേത്?

   A) 91.0 B) 9.1 C) 9.01 D) 0.91

8. 1 സെ.മീ. വശമുള്ള ക്യൂബിന്റെ ഉള്ളളവേത്?

A) 1 ലിറ്റർ B) 2 ലിറ്റർ C) 1 മില്ലിലിറ്റർ D) 2 മില്ലിലിറ്റർ

9. 0.25 ന് തുല്യമായ ദശാംശസംഖ്യയേത്?

A) 0.025 B) 2.5 C) 2.05 D) 0.250

10. 4.26 എന്ന ദശാംശസംഖ്യയിലെ പത്തിലൊന്നിന്റെ സ്ഥാനത്തെ അക്കമേത്?

A) 6 B) 4 C) 2 D) 0

11. 10 പത്തിലൊന്നുകൾ ചേർന്നാൽ എത്ര?

A) 1 B) 10 C) 100 D) 0.1

12. 8 പത്തുകൾ +9 ഒന്നുകൾ +5 പത്തിലൊന്നുകൾ എന്നതിന്റെ ദശാംശസംഖ്യാരൂപ മേത്?

A) 0.895 B) 8.95 C) 89.5 D) 89.05

13. താഴെ കൊടുത്തിരിക്കുന്ന പാറ്റേണിലെ വിട്ടുപോയഭാഗത്തുള്ള സംഖ്യകളേവ?
0.8, 0.9, 1.0,----, ----, 1.3

A) 1.0, 1.1 B) 11, 12 C) 0.11, 0.12 D) 1.1, 1.2

14. 1 സെ.മീ. നോട് ഏറ്റവും അടുത്തതേത്?

A) 0.4 സെ.മീ. B) 1.5 സെ.മീ. C) 1.2 സെ.മീ. D) 0.9 സെ.മീ.

15. താഴെ കൊടുത്തിരിക്കുന്നവയിൽ ഒരു ക്യൂബിന്റെ അളവേത്?

A) 2 സെ.മീ., 2 സെ.മീ., 2 മീ.

B) 5 സെ.മീ., 2 സെ.മീ., 3 സെ.മീ.

C) 4 സെ.മീ., 4 സെ.മീ., 3 സെ.മീ.

D) 8 സെ.മീ., 8 സെ.മീ., 8 സെ.മീ.

16. 4 പാത്രങ്ങളിൽ ഉള്ള വെള്ളത്തിന്റെ അളവ് കൊടുത്തിരിക്കുന്നു. ഏത് പാത്രത്തി ലാണ് ഏറ്റവും കുറവ് വെള്ളമുള്ളത്?

പാത്രം	വെള്ളത്തിന്റെ അളവ്
No. 1	12 ഘ.സെ.മീ.
No. 2	1 ഘ.മീ
No. 3	1100 ഘ.മില്ലിമീറ്റർ
No. 4	0.01 ഘ.മീറ്റർ

A) No. 1 B) No. 2 C) No. 3 D) No. 4

17. ഒരു ചതുരപ്പെട്ടിയുടെ നീളം 6 സെ.മീ., വീതി 4 സെ.മീ., ഉയരം 2 സെ.മീ. അതിന്റെ വ്യാപ്തത്തെ സൂചിപ്പിക്കുന്നതേത്?

A) 6+4+2 B) 6 + 4 x 2 C) 6 x 4 ÷ 2 D) 6 x 4 x 2

18. 4.3 + 5.6 = -----

A) 9.09 B) 9.36 C) 9.9 D) 5.63

19. 7.4 + 5.73 = ----

A) 13.13 B) 12.77 C) 12.473 D) 14.43

20. 8.7 - 5.2 = ----

A) 3.2 B) 3.5 C) 4.5 D) 4.7

21. 6.08 - 5.3 = ----

A) 1.05 B) 0.87 C) 1.87 D) 0.78

22. 720 ഘ.സെ.മീ. ന് തുല്യമായതേത്?

A) 7.2 ലിറ്റർ B) 72 മില്ലി ലിറ്റർ C) 720 മില്ലി ലിറ്റർ D) 720 ലിറ്റർ

23. താഴെ കൊടുത്തിരിക്കുന്നവയിൽ നീളം 11 സെ.മീ., വീതി 6 സെ.മീ., ഉയരം 10 സെ.മീ., ആയ ചതുരക്കട്ടയുടെ വ്യാപ്തമേത്?

A) 60 ഘ.സെ.മീ. B) 66 ഘ.സെ.മീ. C) 110 ഘ.സെ.മീ. D) 660 ഘ.സെ.മീ.

24. 25.64 × 10 = ----

A) 256.40 B) 2.5640 C) 25.640 D) 25640

25. ഒരു ചതുരക്കട്ടയുടെ നീളം 8 സെ.മീ., ഉയരം 3 സെ.മീ., വ്യാപ്തം 120 ഘ.സെ.മീ. അതിന്റെ വീതിയെത്ര സെ.മീ.?

A) 3 B) 5 C) 6 D) 4

26. ഒരു വശത്തിന്റെ അളവ് 8 സെ.മീ. ആയ ക്യൂബിന്റെ വ്യാപ്തമെത്ര?

A) 64 ഘ.സെ.മീ. B) 420 ഘ.സെ.മീ. C) 512 ഘ.സെ.മീ. D) 186 ഘ.സെ.മീ.

27. 10 സെ.മീ. നീളവും, 8 സെ.മീ. വീതിയും, 6 സെ.മീ. ഉയരവുമുള്ള ഒരു ചതുരപാത്രത്തിന്റെ ഉള്ളളവ് എത്ര?

A) 480 മില്ലി ലിറ്റർ B) 360 മില്ലി ലിറ്റർ C) 480 ലിറ്റർ D) 360 ലിറ്റർ

28. 6.13 × 3.7 = ----

A) 2.2681 B) 22.755 C) 22.681 D) 20.68

29. 5.44 ÷ 8

A) 6.8 B) 68 C) 0.68 D) 0.78

30. 95.75 × 0.2554 എന്നതിന്റെ ഉത്തരത്തിൽ ദശാംശം കഴിഞ്ഞ് എത്ര അക്കങ്ങൾ ഉണ്ടായിരിക്കും?

A) 7 B) 6 C) 5 D) 4

31. ഒരു സ്കൂളിൽ 100ൽ 54 വിദ്യാർത്ഥികൾ ആൺകുട്ടികളാണ്. എങ്കിൽ ആൺകുട്ടികളുടെ എണ്ണത്തെ സൂചിപ്പിക്കുന്ന ദശാംശസംഖ്യയേത്?

A) 0.54 B) 0.46 C) 5.4 D) 54

32. ഒരു ഹൈജമ്പ് മത്സരത്തിൽ 4 പേർ 1.89 മീ., 1.48 മീ., 1.75 മീ., 1.69 മീ., എന്നീ ഉയരങ്ങളിൽ ചാടി. വിജയിച്ച ആൾ ചാടിയ ഉയരമേത്?

A) 1.89 മീ. B) 1.48 മീ. C) 1.75 മീ. D) 1.69 മീ.

33. ഒരു ഓട്ടമത്സരത്തിൽ അനു 1.5 മിനിട്ടുകൊണ്ടും, രമ്യ 2.2 മിനുട്ടുകൊണ്ടും ഫിനിഷ് ചെയ്തു. അനുവിന് രമ്യയേക്കാൾ എത്ര മിനുട്ട് വേഗതയുണ്ട്?

A) 1.3 B) 0.7 C) 3.7 D) 0.3

34. ഫാത്തിമ 15.5 സെ.മീ. നീളമുള്ള ഒരു റിബണിൽ നിന്നും 12.65 സെ.മീ. നീളമുള്ള ഒരു ഭാഗം മുറിച്ചുമാറ്റി. ബാക്കിയുള്ള റിബണിന്റെ നീളം എത്ര സെ.മീ.?

A) 3.85 B) 2.40 C) 2.85 D) 3.15

35. ഒരു പാവാട തയ്ക്കാൻ 2.5 മീറ്റർ തുണി ആവശ്യമാണ്. 8 പാവാടകൾ തയ്ക്കാൻ എത്ര മീറ്റർ തുണി വേണം?

A) 20 B) 25 C) 200 D) 24.5

36. 20 സെ.മീ. ഉയരമുള്ള ക്യൂബ് ആകൃതിയിലുള്ള പാത്രത്തിൽ എത്ര ലിറ്റർ വെള്ളം കൊള്ളും?

A) 20 B) 80 C) 10 D) 8

37. നാല് ചതുരക്കട്ടകളുടെ നീളം, വീതി, ഉയരം എന്നിവ തന്നിരിക്കുന്നു. ഏറ്റവും വലിയ ചതുരക്കട്ടയേത്?

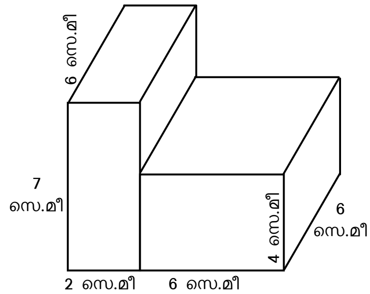
A) 4 സെ.മീ., 3 സെ.മീ., 2 സെ.മീ.

B) 8 മി.മീ., 10 മി.മീ., 15 മി. മീ.

C) 1 മീ., ½ മീ., ¾ മീ.

D) 2 സെ.മീ., 2 സെ.മീ., 1 മീ.

38. 2 ചതുരക്കട്ടകൾ ചേർത്ത് വച്ചാൽ കിട്ടുന്ന രൂപം താഴെ തന്നിരിക്കുന്നു. ഈ രൂപത്തിന്റെ വ്യാപ്തത്തെ സൂചിപ്പിക്കുന്നതേത്?



A) (2 x 7x 6) + (6 x 6 x 4) B) (2 x 6 x 6) + (7 x 6 x 4)

C) (8 x 7x 6) + (8 x 6 x 4) D) (6 x 6 x 6) + (2 x 7 x 4)

39. 220 ഘ.സെ.മീ. വ്യാപ്തമുള്ള ഒരു ചതുരക്കട്ടയുടെ നീളം, വീതി, ഉയരം എന്നിവ സൂചിപ്പിക്കുന്ന സെറ്റേത്?

A) 6 സെ.മീ., 10 സെ.മീ., 5 സെ.മീ.

B) 4 സെ.മീ., 5 സെ.മീ., 11 സെ.മീ.

C) 7 സെ.മീ., 5 സെ.മീ., 6 സെ.മീ.

D) 10 സെ.മീ., 2 സെ.മീ., 5 സെ.മീ.

40. 5 സെ.മീ. മഴ ലഭിച്ച ഒരു സ്ഥലത്ത് 2500 ച.സെ.മീ. പരപ്പളവുള്ള ചതുരാകൃതിയിലുള്ള ഒരു സ്ഥലത്ത് പെയ്ത മഴയുടെ അളവെത്ര?

A) 125 ലിറ്റർ B) 12500 ലിറ്റർ C) 12.5 ലിറ്റർ D) 1.25 ലിറ്റർ

41. ഒരു റോഡിന്റെ 200 മീ. നീളമുള്ള ഭാഗം കോൺക്രീറ്റ് ചെയ്യണം. റോഡിന്റെ വീതി 8 മീ. ആണ്. 6 സെ.മീ. കനത്തിൽ കോൺക്രീറ്റ് ചെയ്യണമെങ്കിൽ എത്ര ഘ. സെ.മീ. കോൺക്രീറ്റ് വേണ്ടിവരും?

A) 96 B) 9600 C) 960000 D) 96000000

42. 52.5 സെ.മീ. നീളമുള്ള ഒരു കയറിൽ നിന്നും 1.2 സെ.മീ. നീളമുള്ള എത്ര കഷണങ്ങൾ മുറിച്ചെടുക്കാം?

A) 14 B) 5 C) 24 D) 43

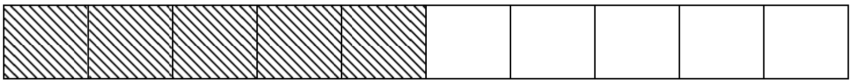
43. പനിയ്ക്കുള്ള ഒരു ഗുളികയുടെ വില 2.70 രൂപയാണ്. രാജുവിന്റെ കൈയിൽ 30 രൂപയുണ്ടെങ്കിൽ എത്ര ഗുളികകൾ വാങ്ങിക്കാം?

A) 10 B) 11 C) 9 D) 15

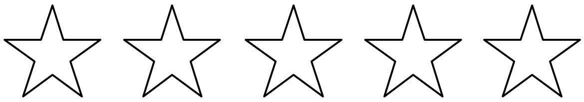
44. ഒരു സമചതുരത്തിന്റെ ചുറ്റളവ് 14 സെ.മീ. ആണ്. അതിന്റെ പരപ്പളവ് എത്ര ച. സെ.മീ. ആണ്?

A) 14 B) 12.25 C) 13.50 D) 7.0

45. താഴെ കൊടുത്തിരിക്കുന്ന ചിത്രത്തിലെ ഷേയ്ഡ് ചെയ്ത ഭാഗം ഒരു ദശാംശത്തെ സൂചിപ്പിക്കുന്നു.



ഇതേ ദശാംശസംഖ്യയെ സൂചിപ്പിക്കണമെങ്കിൽ എത്ര നക്ഷത്രത്തിൽ ഷേയ്ഡ് ചെയ്യണം?



A) 5 B) 4 C) 3 D) 2

46. ഒരു ലോറിയിൽ ചതുരക്കട്ടയുടെ ആകൃതിയിൽ നിറച്ചിരിക്കുന്ന ഒരു ലോഡ് മണ്ണിന്റെ നീളം 6 മീ., വീതി 2 മീ., ഉയരം 50 സെ.മീ., 8 ലോഡ് മണ്ണിറക്കിയാൽ എത്ര ഘ.സെ.മീ. മണ്ണുണ്ടാകും?

A) 4800 B) 480000 C) 48000000 D) 48

47. രമേശ് ഓരോ പെൻസിലും 4.50 രൂപയ്ക്ക് വാങ്ങി 5 രൂപയ്ക്ക് വിൽക്കുന്നു. ഇങ്ങനെ 16 പെൻസിൽ വിറ്റാൽ എത്ര രൂപ ലാഭം കിട്ടും?

A) 7.50 B) 9.50 C) 16 D) 8

48. രണ്ട് പേർ കൂടി 62.50 ച.മീ. പരപ്പളവുള്ള ഒരു മതിൽ പെയിന്റ് ചെയ്യുകയാണ്. ഒന്നാമത്തെ ആൾ $\frac{1}{4}$ ഭാഗം പെയിന്റ് ചെയ്ത് കഴിഞ്ഞു. ഇനി എത്ര ച.മീ. പെയിന്റ് ചെയ്യാൻ ബാക്കിയുണ്ട്?

A) 15.625 B) 44.675 C) 25.652 D) 46.875

49. താഴെ കൊടുത്തിരിക്കുന്നവയിൽ ഏറ്റവും ചെറിയ സംഖ്യ ഏത്?

A) 0.1 + 0.02 B) 1 ÷ 2 C) 0.1 × 0.2 D) 0.04

50. ഒരു ചതുരക്കട്ടയുടെ വ്യാപ്തം 24 ഘ.സെ.മീ. ആണെങ്കിൽ ഈ ചതുരക്കട്ടയുടെ അളവാകാൻ സാധ്യതയില്ലാത്ത സംഖ്യയേത്?

A) 3 B) 4 C) 5 D) 6

51. 8 മീ. നീളവും, 1 മീ വീതിയും, 20 സെ.മീ. കനവുമുള്ള ഒരു മതിൽ പണിയാൻ 1200 ഘ.സെ.മീ. വ്യാപ്തമുള്ള എത്ര ഇഷ്ടികകൾ വേണ്ടിവരും?

A) 6200 B) 8000 C) 7800 D) 4000

52. 2 മീ. നീളവും, 1 മീ. വീതിയും, ½ മീ. ഉയരവുമുള്ള ഒരു ടാങ്കിൽ നിറച്ച് വെള്ളമുണ്ട്. ഇതിൽ നിന്നും 350 ലിറ്റർ വെള്ളം ഉപയോഗിച്ച് തീർന്നാൽ ബാക്കി എത്ര ലിറ്റർ വെള്ളമുണ്ടാകും?

A) 999650 B) 75000 C) 650 D) 9650

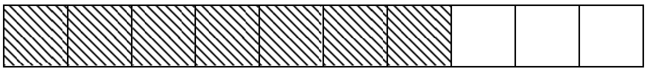
53. 20 സെ.മീ. വശമുള്ള ക്യൂബ് ആകൃതിയിലുള്ള ഒരു കേക്കിൽ നിന്നും 5 സെ.മീ. വശമുള്ള എത്ര ക്യൂബ് കഷണങ്ങൾ മുറിച്ചെടുക്കാം?

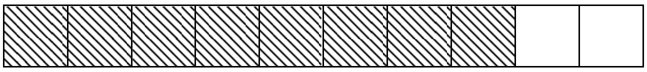
A) 4 B) 16 C) 64 D) 20

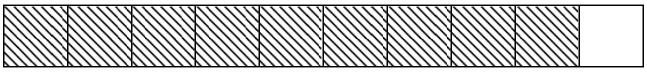
54. ഒരാൾക്ക് ഒരു ദിവസം 100 ലിറ്റർ വെള്ളം ആവശ്യമാണ്. 3 മീ. നീളവും, 2 മീ. വീതിയും, 1 മീ. ഉയരവുമുള്ള ഒരു ടാങ്കിൽ എത്ര ആളുകൾക്ക് ഒരു ദിവസത്തേയ്ക്ക് ആവശ്യമായ വെള്ളമുണ്ട്?

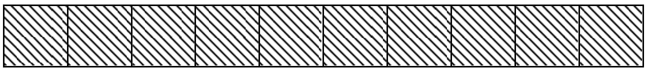
A) 60 B) 600 C) 6000 D) 60000

55. താഴെ കൊടുത്തിരിക്കുന്നവയിൽ ഏതാണ് 0.7 എന്ന ദശാംശസംഖ്യയെ സൂചിപ്പിക്കുന്നത്?

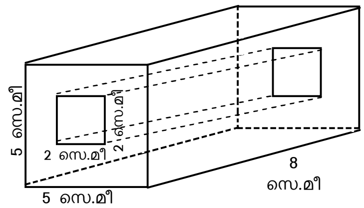
A) 

B) 

C) 

D) 

56.



5 സെ.മീ. വീതിയും, 5 സെ.മീ. ഉയരവും, 8 സെ.മീ. നീളവുമുള്ള ഒരു മരക്കട്ടയുടെ നടുഭാഗത്തു നിന്നും 2സെ.മീ. വീതിയും, 2 സെ.മീ. ഉയരവുമുള്ള ഒരു ചതുരക്കട്ട മുറിച്ച് പുറത്തെടുത്താൽ ബാക്കിയുള്ള ഭാഗത്തിന്റെ വ്യാപ്തമേത്?

A) (5 x 5 x 8) - (2 x 2 x 8) B) (5 x 5 x 2) - (2 x 2 x 8)

C) 3 x 3x 8 D) 3 x 3 x 1

57. ഒരു പാത്രത്തിൽ 3600 മില്ലിലിറ്റർ വെള്ളമുണ്ട്. പാത്രത്തിന്റെ നീളം 25 സെ.മീ., വീതി 16 സെ.മീ., ഉയരം 36 സെ.മീ. എങ്കിൽ പാത്രത്തിൽ എത്ര ഉയരത്തിലാണ് വെള്ളമുള്ളത് ?

A) 10 സെ.മീ. B) 36 സെ.മീ. C) 15 സെ.മീ. D) 9 സെ.മീ.

58. 29.29, 0.29, 29.92, 0.029 എന്നീ സംഖ്യകളെ ചെറുതിൽ നിന്ന് വലുതിലേയ്ക്ക് എന്ന ക്രമത്തിൽ ആക്കിയാൽ മൂന്നാമതായി വരുന്ന സംഖ്യയേത്?

A) 29.29 B) 29.92 C) 0.29 D) 0.029

59. 25.521, 25.251, 25.125, 25.215 എന്നീ സംഖ്യകളെ വലുതിൽ നിന്ന് ചെറുതിലേയ്ക്ക് എന്ന ക്രമത്തിൽ എഴുതിയാൽ രണ്ടാമതായി വരുന്ന സംഖ്യയേത്?

A) 25.521 B) 25.125 C) 25.251 D) 25.215

60. ഒരു നീന്തൽ കുളത്തിന്റെ നീളം 12 മീ., വീതി 5 മീ., താഴ്ച്ച 5 മീ. ഈ കുളത്തിൽ 3 മീ. ഉയരത്തിൽ വെള്ളം നിറയ്ക്കാൻ എത്ര ലിറ്റർ വെള്ളം വേണം?

A) 240 B) 180 C) 240000 D) 180000

61. ചതുരാകൃതിയിലുള്ള ഒരു കമ്പോസ്റ്റ് കുഴിയ്ക്ക് നീളം 3മീ., വീതി 2 മീ., ആഴം 1 മീ. വേണം. കുഴിയുണ്ടാക്കാൻ എത്ര ഘനമീറ്റർ മണ്ണു മാറ്റണം എന്നു കണ്ടുപിടിയ്ക്കാൻ രാജു 3, 2, 1 എന്നിവ ഗുണിച്ച് ഉത്തരം 8 ഘ.മീ. എന്നെഴുതി. എങ്കിൽ ശരിയായ പ്രസ്താവന ഏത്?

A) ഉത്തരവും കണ്ടെത്തിയ രീതിയും ശരിയല്ല

B) ഉത്തരം ശരിയാണ്, കണ്ടെത്തിയ രീതി ശരിയല്ല

C) ഉത്തരം ശരിയല്ല, കണ്ടെത്തിയ രീതി ശരിയാണ്

D) ഉത്തരവും കണ്ടെത്തിയ രീതിയും ശരിയാണ്

62. 28 × 46 = 1288, 19×24= 456 എങ്കിൽ (2.8×0.46) + (1.9 × 2.4) ന് തുല്യമായതേത്?

A) $12.88 + 4.56$ B) $\frac{1288}{100} + \frac{456}{100}$ C) 5.848 D) $128.8 + 45.6$

63. 2.54 × 0.12 കണ്ടു പിടിക്കുന്നതിന് മുഹമ്മദ് 254 × 12= 3048 എന്ന് കണ്ടു പിടിച്ചതിന് ശേഷം ഉത്തരം 2.54 × 0.12= 30.48 എന്നെഴുതി. എങ്കിൽ ശരിയായ പ്രസ്താവന ഏത്?

A) ഉത്തരവും, ഉത്തരം കണ്ടെത്തിയ രീതിയും ശരിയാണ്.

B) ഉത്തരം ശരിയാണ് കണ്ടെത്തിയ രീതി ശരിയല്ല

C) ഉത്തരവും, കണ്ടെത്തിയ രീതിയും ശരിയല്ല

D) ഉത്തരം ശരിയല്ല, കണ്ടെത്തിയ രീതി ശരിയാണ്.

64. ഒരു വാട്ടർ ടാങ്കിന്റെ നീളം 4 മീറ്ററും, വീതി 3 മീറ്ററും, ആണ്. 18000 ലിറ്റർ വെള്ളം കൊള്ളണമെങ്കിൽ ടാങ്കിന്റെ ഉയരം എത്ര വേണം എന്നു കണ്ടുപിടിക്കുന്നതിനുള്ള ശരിയായ രീതി ഏത്?

A) $\frac{18000}{4 \times 3}$ B) $\frac{18000}{400 \times 300}$ C) $\frac{180000}{400 \times 300}$ D) $\frac{18000000}{400 \times 300}$

65. 9.24 ÷1.1 ന് ഉത്തരം കണ്ടെത്താൻ മനു ഉപയോഗിച്ച സ്റ്റെപ്പുകൾ താഴെ കൊടുത്തിരിക്കുന്നു.

സ്റ്റെപ്പ് 1 : $9.24 \div \frac{11}{10}$

സ്റ്റെപ്പ് 2 : $\frac{9.24 \times 10}{11}$

സ്റ്റെപ്പ് 3 : $\frac{924}{11}$

ഏത് സ്റ്റെപ്പിൽ ആണ് തെറ്റുള്ളത്?

A) സ്റ്റെപ്പ് 1 B) സ്റ്റെപ്പ് 2 C) സ്റ്റെപ്പ് 3 D) തെറ്റൊന്നുമില്ല

66. ഒരു വീടിന്റെ ടെറസിന് 15 മീ. നീളവും, 12 മീ. വീതിയും ഉള്ള ചതുരാകൃതിയാണ്. 8 സെ.മീ. മഴ പെയ്താൽ നിറയുന്ന വെള്ളത്തിന്റെ അളവെത്ര എന്നതിന് ഉത്തരം കണ്ടെത്തുന്നതിന് റസിയ എഴുതിയ സ്റ്റെപ്പുകൾ കൊടുത്തിരിക്കുന്നു.

സ്റ്റെപ്പ് 1 : വെള്ളത്തിന്റെ അളവ് = 1500 X 1200 X 8

സ്റ്റെപ്പ് 2 : 1500 X 1200 X 8 = 14400000 ഘ.സെ.മീ

സ്റ്റെപ്പ് 3 : വെള്ളത്തിന്റെ അളവ് = 14400 ലിറ്റർ

താഴെ കൊടുത്തിരിക്കുന്നതിൽ ശരിയായ പ്രസ്താവന ഏത്?

A) സ്റ്റെപ്പ് 1ൽ തെറ്റുണ്ട്

B) സ്റ്റെപ്പ് 2ൽ തെറ്റുണ്ട്

C) സ്റ്റെപ്പ് 3ൽ തെറ്റുണ്ട്

D) തെറ്റൊന്നുമില്ല

Appendix D3

DEPARTMENT OF EDUCATION
UNIVERSITY OF CALICUT

TEST OF ACHIEVEMENT IN MATHEMATICS-DRAFT

Scoring Key

Ques. No.	Answer	Ques. No.	Answer	Ques. No.	Answer
1	B	25	B	49	C
2	B	26	C	50	C
3	A	27	A	51	B
4	B	28	C	52	C
5	B	29	C	53	C
6	A	30	B	54	A
7	B	31	A	55	A
8	C	32	A	56	A
9	D	33	B	57	D
10	C	34	C	58	A
11	A	35	A	59	C
12	C	36	D	60	D
13	D	37	C	61	C
14	D	38	A	62	C
15	D	39	B	63	D
16	C	40	C	64	D
17	D	41	D	65	C
18	C	42	D	66	D
19	A	43	B	67	0.124
20	B	44	B	68	3 numbers whose product is 6000
21	D	45	C	69	850.3
22	C	46	C	70	3 numbers whose product is 40
23	D	47	D		
24	A	48	D		

Appendix D4

DEPARTMENT OF EDUCATION
UNIVERSITY OF CALICUT

TEST OF ACHIEVEMENT IN MATHEMATICS-DRAFT

Response Sheet

Name.. Male/Female

Class.................................. Div........................... Roll No................................

School..

Sl. No.	A	B	C	D
1				
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Sl. No.	A	B	C	D
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Sl. No.	A	B	C	D
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70				

67. 4, 1, 2, 0 എന്നീ സംഖ്യകൾ ഉപയോഗിച്ച് സംഖ്യകൾ ആവർത്തിക്കാതെയും, ഒഴിവാക്കാതെയും എഴുതാവുന്ന ഏറ്റവും ചെറിയ ദശാംശസംഖ്യയേത്?

68. 6000 ഘ.സെ.മീ. വ്യാപ്തമുള്ള ഒരു ചതുരക്കട്ടയുടെ നീളം, വീതി, ഉയരം എന്നിവ എഴുതുക.

69. 0, 3, 5, 8 എന്നീ സംഖ്യകൾ ആവർത്തിക്കാതെ ഉപയോഗിച്ച് എഴുതാവുന്ന ഏറ്റവും വലിയ ദശാംശസംഖ്യയേത്?

70. 40000 ലിറ്റർ വെള്ളം സംഭരിക്കാവുന്ന ഒരു വാട്ടർ ടാങ്കിന്റെ നീളം, വീതി, ഉയരം എന്നിവ മീറ്ററിൽ എഴുതുക.

Appendix D2

DEPARTMENT OF EDUCATION
UNIVERSITY OF CALICUT

TEST OF ACHIEVEMENT IN MATHEMATICS

(DRAFT)

Dr. M. N. Mohamedunni Alias Musthafa — Assistant Professor

Sunitha T. P. — Research Scholar

Std. VI — *Max. Score: 70*

Instructions

This test contains 70 questions on the units 'Volume' and 'Decimal Numbers'. For the first 66 questions, four choices A, B, C, D are provided. Read each question carefully and mark your answer in the response sheet provided using '✓' mark. For the last four questions, write your answer in the space provided against each question number. Answer all questions. Do not write or draw anything on the question paper.

---

1. Which is the decimal form of $\frac{5}{10}$?

   A) 0.05 B) 0.5 C) 0.005 D) 5.0
2. 1 litre = ------------ cubic centimeter

   A) 100 B) 1000 C) 500 D) 10
3. Which fraction is equivalent to 0.18?

   A) $\frac{18}{100}$ B) $\frac{18}{10}$ C) $\frac{18}{1000}$ D) 18
4. What is the volume of a cube of side 1 cm?

   A) 1 square centimeter B) 1 cubic centimeter

   C) 3 square centimeter D) 3 cubic centimeter
5. How many meters are 72 centimeters?

   A) 7.2 m B) 0.72 m C) 0.072 m D) 720 m
6. If the sides of a cube are doubled, how many times would the volume be?

   A) 8 B) 2 C) 4 D) 27
7. Which is the decimal equivalent to $9\frac{1}{10}$?

   A) 91.0 B) 9.1 C) 9.01 D) 0.91

8. Which is the capacity of a cube of side 1 centimeter?
   A) 1 L B) 2 L C) 1 ml D) 2 ml
9. Which is the decimal equivalent to 0.25?
   A) 0.025 B) 2.5 C) 2.05 D) 0.250
10. Which is the digit in the tenths place in 4.26?
    A) 6 B) 4 C) 2 D) 0
11. Which is equal to 10 tenths?
    A) 1 B) 10 C) 100 D) 0.1
12. Which is the decimal form of 8 tens + 9 ones + 5 tenths?
    A) 0.895 B) 8.95 C) 89.5 D) 89.05
13. Complete the following pattern
    0.8, 0.9, 1.0,------, ------, 1.3----
    A) 1.0, 1.1 B) 11, 12 C) 0.11, 0.12 D) 1.1, 1.2
14. Which is closest to 1 centimeter?
    A) 0.4 -cm B) 1.5 cm C) 1.2 - cm D) 0.9 - cm
15. Which of the following is the dimension of a cube?
    A) 2 cm, 2 cm, 2 m
    B) 5 cm, 2 cm, 3 c m
    C) 4 cm, 4 cm, 3 cm
    D) 8 cm, 8 cm, 8 cm
16. 4 vessels are filled with water. Which holds the least quantity?

Vessels	**Quantity of water**
No. 1	12 cubic centimeters
No. 2	1 cubic meter
No. 3	1100 cubic millimeter
No. 4	0.01 cubic meter

    A) No. 1 B) No. 2 C) No. 3 D) No. 4
17. The dimensions of a rectangular box are: length 6 cm, breadth 4 cm, height 2 cm. which of the following indicates its volume?
    A) 6+4+2 B) 6 + 4 x 2 C) 6 x 4 ÷ 2 D) 6 x 4 x 2
18. 4.3 + 5.6 = ---------
    A) 9.09 B) 9.36 C) 9.9 D) 5.63
19. 7.4 + 5.73 = --------
    A) 13.13 B) 12.77 C) 12.473 D) 14.43
20. 8.7 - 5.2 = -----
    A) 3.2 B) 3.5 C) 4.5 D) 4.7

21. 6.08 - 5.3 = -----

A) 1.05 B) 0.87 C) 1.87 D) 0.78

22. Which of the following is equal to 720 cubic centimeters?

A) 7.2 L B) 72 ml C) 720 ml D) 720 L

23. Which of the following is the volume of a rectangular prism with length 11cm, breadth 6 cm, height 10cm?

A) 60 cubic centimeters B) 66 cubic centimeters

C) 110 cubic centimeters D) 660 cubic centimeters

24. 25.64 × 10 = -----

A) 256.40 B) 2.5640 C) 25.640 D) 25640

25. What is the breadth of a rectangular prism with length 8 cm, height 3 cm and volume 120 cubic centimeters?

A) 3 B) 5 C) 6 D) 4

26. What is the volume of a cube with side 8 cm?

A) 64 cubic centimeters B) 420 cubic centimeters

C) 512 cubic centimeters D) 186 cubic centimeters

27. What is the capacity of a rectangular vessel of length 10 cm, breadth 8 cm and height
6 cm?

A) 480 ml B) 360 ml C) 480 L D) 360 L

28. 6.13 × 3.7 = -------

A) 2.2681 B) 22.755 C) 22.681 D) 20.68

29. 5.44 ÷ 8

A) 6.8 B) 68 C) 0.68 D) 0.78

30. How many decimal places would be there in the product of 95.75 × 0.2554

A) 7 B) 6 C) 5 D) 4

31. In a school, 54 out of 100 students are boys. Then which among the following decimals represent the number of boys?

A) 0.54 B) 0.46 C) 5.4 D) 54

32. In a high jump competition 4 contestants recorded 1.89 m, 1.48 m, 1.75 m and 1.69 m. What is the height attained by the winner?

A) 1.89 m B) 1.48 m C) 1.75 m D) 1.69 m

33. Anu finished a running race in 1.5 minutes and Remya finished in 2.2 minutes. How many minutes faster did Anu finish than Remya?

A) 1.3 B) 0.7 C) 3.7 D) 0.3

34. Fathima cut a ribbon of 12.65 cm from a ribbon of 15.5 cm. How many centimeters of ribbon are left out?

A) 3.85 B) 2.40 C) 2.85 D) 3.15

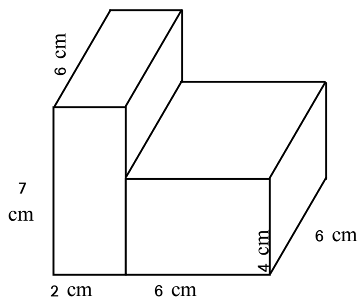
35. 2.5 m of cloth is required to stitch a skirt. How many meters of cloth are required to stitch 8 such skirts?

A) 20 B) 25 C) 200 D) 24.5

36. How many liters of water can a cubic vessel of height 20 cm hold?
A) 20 B) 80 C) 10 D) 8

37. Given are the length, breadth and height of four rectangular prisms. Which is the largest?
A) 4 cm, 3 cm, 2 cm
B) 8 mm, 10 mm, 15 mm
C) 1 m, ½ m, ¾ m
D) 2 cm, 2 cm, 1 m

38. Given is the shape obtained by placing 2 rectangular prisms side by side. Which of the following indicates its volume?



A) (2 x 7x 6) + (6 x 6 x 4) B) (2 x 6 x 6) + (7 x 6 x 4)
C) (8 x 7x 6) + (8 x 6 x 4) D) (6 x 6 x 6) + (2 x 7 x 4)

39. Which of the following set indicates the length, breadth and height of a rectangular prism of volume 220 cubic centimeters?

A) 6 cm, 10 cm, 5 cm
B) 4 cm, 5 cm, 11 cm
C) 7 cm, 5 cm, 6 cm
D) 10 cm, 2 cm, 5 cm

40. How much will it rain in a rectangular place of area 2500 square centimeters if the average rain fall in the place is 5cm?
A) 125 L B) 12500 L C) 12.5 L D) 1.25 L

41. How many cubic centimeters of concrete mix is required to concrete a road of length 200 m and breadth 8 m up to a thickness of 6 cm?

A) 96 B) 9600 C) 960000 D) 96000000

42. How many pieces of 1.2 cm can be cut out of a rope of length 52.5 cm?

A) 14 B) 5 C) 24 D) 43

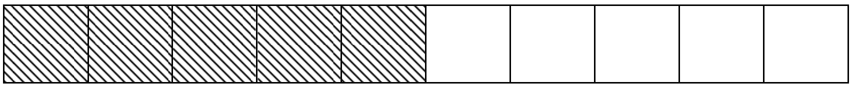
43. A tablet for fever costs Rs. 2.70. If Raju has Rs. 30, how many tablets could be bought with it?

A) 10 B) 11 C) 9 D) 15

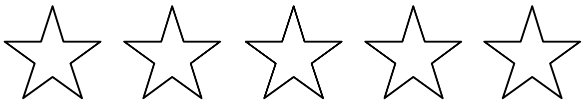
44. The perimeter of a square is 14 cm. How many square centimeters is its area?

A) 14 B) 12.25 C) 13.50 D) 7.0

45. The shaded portion of the below given picture represents a decimal.



How many stars are to be shaded to represent the decimal?



A) 5 B) 4 C) 3 D) 2

46. In a truck, a load of mud is filled in the shape of a rectangular prism of length 6m, breadth 2m and height 50cm. How many cubic centimeters of mud would be there, if 8 loads are unloaded?

A) 4800 B) 480000 C) 48000000 D) 48

47. Ramesh bought 16 pencils for Rs. 4.50 each. How much will be the profit, if he sells each of them for Rs. 5?

A) 7.50 B) 9.50 C) 16 D) 8

48. Two workers are painting a wall of surface area 62.50 square centimeters. If the first worker has painted one fourth of the wall, how much square centimeters of wall is left to paint?

A) 15.625 B) 44.675 C) 25.652 D) 46.875

49. Which among the following is the smallest number?

A) $0.1 + 0.02$ B) $1 \div 2$ C) 0.1×0.2 D) 0.04

50. If the volume of a cube is 24 cubic centimeters, which among the following cannot be a dimension of that cube?

A) 3 B) 4 C) 5 D) 6

51. How many bricks of volume 1200 cubic centimeters are required to build a wall of length 8 m, breadth 1 m and thickness 20 cm?

A) 6200 B) 8000 C) 7800 D) 4000

52. If 350 liters of water from a tank of length 2 m, breadth 1 m and height ½ m is used up, how many liters of water would remain in the tank?

    A) 999650 B) 75000 C) 650 D) 9650

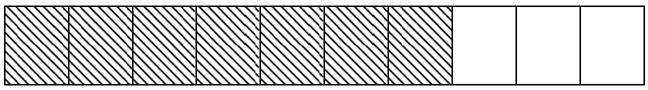
53. How many cubic shaped pieces of side length 5 cm can be cut out of a cube shaped cake of side length 20 cm?

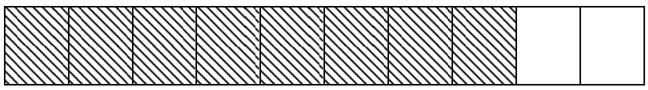
    A) 4 B) 16 C) 64 D) 20

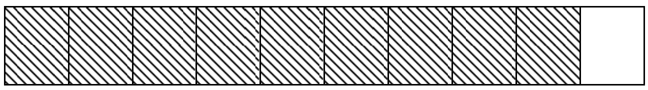
54. If 100 liters of water is required per head, for how many people could a tank of length 3 m, breadth 2 m and height 1m hold water for a day?

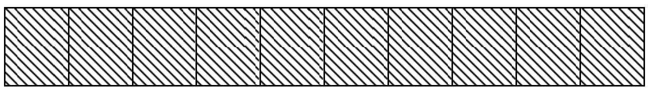
    A) 60 B) 600 C) 6000 D) 60000

55. Which among the following represent the decimal 0.7?

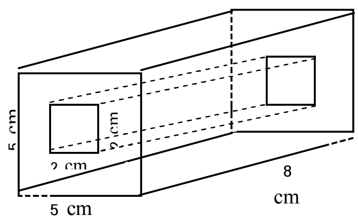
A) 

B) 

C) 

D) 

56.



If a rectangular prism of breadth and height 2 cm is cut out of a wooden block of length 8 cm, breadth and height 2cm, what would be the volume of the remaining wooden block?

A) (5 x 5 x 8) - (2 x 2 x 8) B) (5 x 5 x 2) - (2 x 2 x 8)

C) 3 x 3x 8 D) 3 x 3 x 1

57. A container of length 25 cm and breadth 16 cm holds 3600 ml of water. What is the height of water column?

    A) 10 cm B) 36 cm C) 15 cm D) 9 cm

58. Which would be the third number if 29.29, 0.29, 29.92, 0.029 are arranged in ascending order?

A) 29.29 B) 29.92 C) 0.29 D) 0.029

59. Which would be the third number if 25.521, 25.251, 25.125, 25.215 are arranged in descending order?

A) 25.521 B) 25.125 C) 25.251 D) 25.215

60. A swimming pool has length 12m, breadth 5 m and height 5m. How many liters of water is required to fill water up to 3 meters height?

A) 240 B) 180 C) 240000 D) 180000

61. Raju multiplied 3, 2, 1 and wrote the answer as 8 cubic centimeters for the volume of mud that needs to be removed to make a compost pit of length 3m, breadth 2m and depth 1 m. Which of the following statements holds well?

A) Answer and the method, both are erroneous

B) Write answer, wrong method

C) Wrong answer, right method

D) Both answer and method are right

62. If 28 × 46 = 1288, 19×24= 456, then what is equivalent to (2.8×0.46) + (1.9 × 2.4)?

A) 12.88 + 4.56 B) $\frac{1288}{100}+\frac{456}{100}$ C) 5.848 D) 128.8 + 45.6

63. To calculate 2.54 × 0.12, Muhammed found 254 × 12= 3048 and wrote the answer as 2.54 × 0.12= 30.48. Which of the following statements holds well?

A) Both answer and method are right

B) Right answer, wrong method

C) Both answer and method are erroneous

D) Wrong answer, right method

64. Which is the right method to find out the height of a water tank of length 4 m and breadth 3 m so that it could hold 18000 liters of water?

A) $\frac{18000}{4\times3}$ B) $\frac{18000}{400\times300}$ C) $\frac{180000}{400\times300}$ D) $\frac{18000000}{400\times300}$

65. Following are the steps by step calculations Manu had attempted to find the answer of 9.24 ÷1.1

Step 1 : $9.24 \div \frac{11}{10}$

Step 2 : $\frac{9.24 \times 10}{11}$

Step 3 : $\frac{924}{11}$

Which of the steps is erroneous?

A) Step 1 B) Step 2 C) Step 3 D) No error

66. Raziya wrote the following steps while calculating the volume of water filled in a terrace of length 15m and breadth 12m if it rained 8 cm.

Step 1: Amount of water = 1500 x 1200 x 8

Step 2: 1500 x 1200 x 8 = 14400000 cubic centimeters

Step 3: Amount of water = 14400 liters

Which of the statements holds well?

A) Error in step 1

B) Error in step 2

C) Error in step 3

D) No error

67. Which is the smallest decimal number that can be written using 4, 1, 2 and 0 without repeating any digit?

68. Write the length, breadth and height of a rectangular prism of volume 6000 cubic centimeters.

69. Which is the largest decimal number that can be written using 0, 3, 5 and 8 without repeating any digit?

70. Write the length, breadth and height in meters of a water tank that can hold 4000 liters of water.

Appendix D5

DEPARTMENT OF EDUCATION
UNIVERSITY OF CALICUT
TEST OF ACHIEVEMENT IN MATHEMATICS

(FINAL)

Std. VI Max. Score: 40

Dr. M.N. Mohamedunni Alias Musthafa **Sunitha. T.P**
Assistant Professor Research Scholar

നിർദ്ദേശങ്ങൾ

ഗണിതത്തിൽ 'വ്യാപ്തം', 'ദശാംശരീതി' എന്നീ പാഠഭാഗങ്ങളുമായി ബന്ധപ്പെട്ട 40 ചോദ്യങ്ങൾ ആണ് ഈ ടെസ്റ്റിൽ ഉൾപ്പെടുത്തിയിട്ടുള്ളത്. ആദ്യത്തെ 38 ചോദ്യങ്ങളിൽ ഓരോ ചോദ്യത്തിനും A, B, C, D എന്ന് രേഖപ്പെടുത്തിയ നാല് ഉത്തരങ്ങൾ വീതം നൽകിയിരിക്കുന്നു. ഓരോ ചോദ്യവും ശ്രദ്ധാപൂർവ്വം വായിച്ച് ശരിയായ ഉത്തരം നിങ്ങൾക്ക് തന്നിരിക്കുന്ന ഉത്തരക്കടലാസിലെ ചോദ്യനമ്പറിനു നേരെ യോജിച്ച അക്ഷരത്തിനു താഴെ '✓' ചിഹ്നം കൊണ്ട് രേഖപ്പെടുത്തുക. അവസാനത്തെ 2 ചോദ്യങ്ങൾക്കുള്ള ഉത്തരങ്ങൾ ചോദ്യനമ്പറിനു നേരെ നൽകിയിട്ടുള്ള സ്ഥലത്ത് എഴുതുക. എല്ലാ ചോദ്യങ്ങൾക്കും ഉത്തരം രേഖപ്പെടുത്തുക. ചോദ്യക്കടലാസിൽ ഒന്നും തന്നെ എഴുതുകയോ, വരക്കുകയോ ചെയ്യരുത്.

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1. വശങ്ങളുടെ നീളം 1 സെ.മീ. ആയ ക്യൂബിന്റെ വ്യാപ്തമെത്ര?
   A) 1 ച.സെ.മീ B) 1 ഘ.സെ.മീ
   C) 3 ച.സെ.മീ D) 3 ഘ.സെ.മീ
2. ഒരു ക്യൂബിന്റെ വശത്തിന്റെ അളവുകൾ 2 മടങ്ങായാൽ വ്യാപ്തം എത്ര മടങ്ങാകും?
   A) 8 B) 2 C) 4 D) 27
3. $9\frac{1}{10}$ സമാനമായ ദശാംശസംഖ്യയേത്?
   A) 91.0 B) 9.1 C) 9.01 D) 0.91
4. 0.25 ന് തുല്യമായ ദശാംശസംഖ്യയേത്?
   A) 0.025 B) 2.5 C) 2.05 D) 0.250
5. 4.26 എന്ന ദശാംശസംഖ്യയിലെ പത്തിലൊന്നിന്റെ സ്ഥാനത്തെ അക്കമേത്?
   A) 6 B) 4 C) 2 D) 0
6. 8 പത്തുകൾ +9 ഒന്നുകൾ +5 പത്തിലൊന്നുകൾ എന്നതിന്റെ ദശാംശസംഖ്യാരൂപമേത്?
   A) 0.895 B) 8.95 C) 89.5 D) 89.05
7. താഴെ കൊടുത്തിരിക്കുന്ന പാറ്റേണിലെ വിട്ടുപോയഭാഗത്തുള്ള സംഖ്യകളേവ?
   0.8, 0.9, 1.0,----, ----, 1.3
   A) 1.0, 1.1 B) 11, 12 C) 0.11, 0.12 D) 1.1, 1.2

8. ഒരു ചതുരപ്പെട്ടിയുടെ നീളം 6 സെ.മീ., വീതി 4 സെ.മീ., ഉയരം 2 സെ.മീ. അതിന്റെ വ്യാപ്തത്തെ സൂചിപ്പിക്കുന്നതേത്?

   A) 6+4+2 B) 6 + 4 x 2 C) 6 x 4 ÷ 2 D) 6 x 4 x 2

9. 4.3 + 5.6 = -----

   A) 9.09 B) 9.36 C) 9.9 D) 5.63

10. 7.4 + 5.73 = ----

    A) 13.13 B) 12.77 C) 12.473 D) 14.43

11. 8.7 – 5.2 = ----

    A) 3.2 B) 3.5 C) 4.5 D) 4.7

12. 6.08 – 5.3 = ----

    A) 1.05 B) 0.87 C) 1.87 D) 0.78

13. താഴെ കൊടുത്തിരിക്കുന്നവയിൽ നീളം 11 സെ.മീ., വീതി 6 സെ.മീ., ഉയരം 10 സെ.മീ., ആയ ചതുരക്കട്ടയുടെ വ്യാപ്തമേത്?

    A) 60 ഘ.സെ.മീ. B) 66 ഘ.സെ.മീ. C) 110 ഘ.സെ.മീ. D) 660 ഘ.സെ.മീ.

14. ഒരു വശത്തിന്റെ അളവ് 8 സെ.മീ. ആയ ക്യൂബിന്റെ വ്യാപ്തമെത്ര?

    A) 64 ഘ.സെ.മീ. B) 420 ഘ.സെ.മീ. C) 512 ഘ.സെ.മീ. D) 186 ഘ.സെ.മീ.

15. 10 സെ.മീ. നീളവും, 8 സെ.മീ. വീതിയും, 6 സെ.മീ. ഉയരവുമുള്ള ഒരു ചതുരപാത്രത്തിന്റെ ഉള്ളളവ് എത്ര?

    A) 480 മില്ലി ലിറ്റർ B) 360 മില്ലി ലിറ്റർ C) 480 ലിറ്റർ D) 360 ലിറ്റർ

16. ഒരു സ്കൂളിൽ 100ൽ 54 വിദ്യാർത്ഥികൾ ആൺകുട്ടികളാണ്. എങ്കിൽ ആൺകുട്ടികളുടെ എണ്ണത്തെ സൂചിപ്പിക്കുന്ന ദശാംശസംഖ്യയേത്?

    A) 0.54 B) 0.46 C) 5.4 D) 54

17. ഒരു ഹൈജമ്പ് മത്സരത്തിൽ 4 പേർ 1.89 മീ., 1.48 മീ., 1.75 മീ., 1.69 മീ., എന്നീ ഉയരങ്ങളിൽ ചാടി. വിജയിച്ച ആൾ ചാടിയ ഉയരമേത്?

    A) 1.89 മീ. B) 1.48 മീ. C) 1.75 മീ. D) 1.69 മീ.

18. ഒരു ഓട്ടമത്സരത്തിൽ അനു 1.5 മിനിട്ടുകൊണ്ടും, രമ്യ 2.2 മിനുട്ടുകൊണ്ടും ഫിനിഷ് ചെയ്തു. അനുവിന് രമ്യയേക്കാൾ എത്ര മിനുട്ട് വേഗതയുണ്ട്?

    A) 1.3 B) 0.7 C) 3.7 D) 0.3

19. ഫാത്തിമ 15.5 സെ.മീ. നീളമുള്ള ഒരു റിബണിൽ നിന്നും 12.65 സെ.മീ. നീളമുള്ള ഒരു ഭാഗം മുറിച്ചുമാറ്റി. ബാക്കിയുള്ള റിബണിന്റെ നീളം എത്ര സെ.മീ.?

    A) 3.85 B) 2.40 C) 2.85 D) 3.15

20. ഒരു പാവാട തയ്ക്കാൻ 2.5 മീറ്റർ തുണി ആവശ്യമാണ്. 8 പാവാടകൾ തയ്ക്കാൻ എത്ര മീറ്റർ തുണി വേണം?

    A) 20 B) 25 C) 200 D) 24.5

21. നാല് ചതുരക്കട്ടകളുടെ നീളം, വീതി, ഉയരം എന്നിവ തന്നിരിക്കുന്നു. ഏറ്റവും വലിയ ചതുരക്കട്ടയേത്?

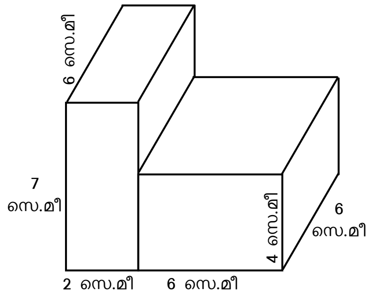
    A) 4 സെ.മീ., 3 സെ.മീ., 2 സെ.മീ.

    B) 8 മി.മീ., 10 മി.മീ., 15 മി. മീ.

    C) 1 മീ., ½ മീ., ¾ മീ.

    D) 2 സെ.മീ., 2 സെ.മീ., 1 മീ.

22. 2 ചതുരക്കട്ടകൾ ചേർത്ത് വച്ചാൽ കിട്ടുന്ന രൂപം താഴെ തന്നിരിക്കുന്നു. ഈ രൂപത്തിന്റെ വ്യാപ്തത്തെ സൂചിപ്പിക്കുന്നതേത്?



A) (2 x 7x 6) + (6 x 6 x 4) B) (2 x 6 x 6) + (7 x 6 x 4)
C) (8 x 7x 6) + (8 x 6 x 4) D) (6 x 6 x 6) + (2 x 7 x 4)

23. 220 ഘ.സെ.മീ. വ്യാപ്തമുള്ള ഒരു ചതുരക്കട്ടയുടെ നീളം, വീതി, ഉയരം എന്നിവ സൂചിപ്പിക്കുന്ന സെറ്റേത്?

A) 6 സെ.മീ., 10 സെ.മീ., 5 സെ.മീ.
B) 4 സെ.മീ., 5 സെ.മീ., 11 സെ.മീ.
C) 7 സെ.മീ., 5 സെ.മീ., 6 സെ.മീ.
D) 10 സെ.മീ., 2 സെ.മീ., 5 സെ.മീ.

24. ഒരു റോഡിന്റെ 200 മീ. നീളമുള്ള ഭാഗം കോൺക്രീറ്റ് ചെയ്യണം. റോഡിന്റെ വീതി 8 മീ. ആണ്. 6 സെ.മീ. കനത്തിൽ കോൺക്രീറ്റ് ചെയ്യണമെങ്കിൽ എത്ര ഘ. സെ.മീ. കോൺക്രീറ്റ് വേണ്ടിവരും?

A) 96 B) 9600 C) 960000 D) 96000000

25. 52.5 സെ.മീ. നീളമുള്ള ഒരു കയറിൽ നിന്നും 1.2 സെ.മീ. നീളമുള്ള എത്ര കഷണങ്ങൾ മുറിച്ചെടുക്കാം?

A) 14 B) 5 C) 24 D) 43

26. രമേശ് ഓരോ പെൻസിലും 4.50 രൂപയ്ക്ക് വാങ്ങി 5 രൂപയ്ക്ക് വിൽക്കുന്നു. ഇങ്ങനെ 16 പെൻസിൽ വിറ്റാൽ എത്ര രൂപ ലാഭം കിട്ടും?

A) 7.50 B) 9.50 C) 16 D) 8

27. രണ്ട് പേർ കൂടി 62.50 ച.മീ. പരപ്പളവുള്ള ഒരു മതിൽ പെയിന്റ് ചെയ്യുകയാണ്. ഒന്നാമത്തെ ആൾ $\frac{1}{4}$ ഭാഗം പെയിന്റ് ചെയ്ത് കഴിഞ്ഞു. ഇനി എത്ര ച.മീ. പെയിന്റ് ചെയ്യാൻ ബാക്കിയുണ്ട്?

A) 15.625 B) 44.675 C) 25.652 D) 46.875

28. ഒരു ചതുരക്കട്ടയുടെ വ്യാപ്തം 24 ഘ.സെ.മീ. ആണെങ്കിൽ ഈ ചതുരക്കട്ടയുടെ അളവാകാൻ സാധ്യതയില്ലാത്ത സംഖ്യയേത്?

A) 3 B) 4 C) 5 D) 6

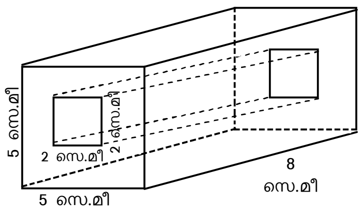
29. 8 മീ. നീളവും, 1 മീ വീതിയും, 20 സെ.മീ. കനവുമുള്ള ഒരു മതിൽ പണിയാൻ 1200 ഘ.സെ.മീ. വ്യാപ്തമുള്ള എത്ര ഇഷ്ടികകൾ വേണ്ടിവരും?

A) 6200 B) 8000 C) 7800 D) 4000

30. 2 മീ. നീളവും, 1 മീ. വീതിയും, ½ മീ. ഉയരവുമുള്ള ഒരു ടാങ്കിൽ നിറച്ച് വെള്ള മുണ്ട്. ഇതിൽ നിന്നും 350 ലിറ്റർ വെള്ളം ഉപയോഗിച്ച് തീർന്നാൽ ബാക്കി എത്ര ലിറ്റർ വെള്ളമുണ്ടാകും?

A) 999650 B) 75000 C) 650 D) 9650

31.



5 സെ.മീ. വീതിയും, 5 സെ.മീ. ഉയരവും, 8 സെ.മീ. നീളവുമുള്ള ഒരു മരക്കട്ട യുടെ നടുഭാഗത്തു നിന്നും 2സെ.മീ. വീതിയും, 2 സെ.മീ. ഉയരവുമുള്ള ഒരു ചതുരക്കട്ട മുറിച്ച് പുറത്തെടുത്താൽ ബാക്കിയുള്ള ഭാഗത്തിന്റെ വ്യാപ്തമേത്?

A) (5 x 5 x 8) - (2 x 2 x 8) B) (5 x 5 x 2) - (2 x 2 x 8)

C) 3 x 3x 8 D) 3 x 3 x 1

32. ഒരു പാത്രത്തിൽ 3600 മില്ലിലിറ്റർ വെള്ളമുണ്ട്. പാത്രത്തിന്റെ നീളം 25 സെ.മീ., വീതി 16 സെ.മീ., ഉയരം 36 സെ.മീ. എങ്കിൽ പാത്രത്തിൽ എത്ര ഉയരത്തിലാണ് വെള്ളമുള്ളത് ?

A) 10 സെ.മീ. B) 36 സെ.മീ. C) 15 സെ.മീ. D) 9 സെ.മീ.

33. 29.29, 0.29, 29.92, 0.029 എന്നീ സംഖ്യകളെ ചെറുതിൽ നിന്ന് വലുതിലേയ്ക്ക് എന്ന ക്രമത്തിൽ ആക്കിയാൽ മൂന്നാമതായി വരുന്ന സംഖ്യയേത്?

A) 29.29 B) 29.92 C) 0.29 D) 0.029

34. 25.521, 25.251, 25.125, 25.215 എന്നീ സംഖ്യകളെ വലുതിൽ നിന്ന് ചെറുതിലേയ്ക്ക് എന്ന ക്രമത്തിൽ എഴുതിയാൽ രണ്ടാമതായി വരുന്ന സംഖ്യയേത്?

A) 25.521 B) 25.125 C) 25.251 D) 25.215

35. ചതുരാകൃതിയിലുള്ള ഒരു കമ്പോസ്റ്റ് കുഴിയ്ക്ക് നീളം 3മീ., വീതി 2 മീ., ആഴം 1 മീ. വേണം. കുഴിയുണ്ടാക്കാൻ എത്ര ഘനമീറ്റർ മണ്ണു മാറ്റണം എന്നു കണ്ടുപിടി യ്ക്കാൻ രാജു 3, 2, 1 എന്നിവ ഗുണിച്ച് ഉത്തരം 8 ഘ.മീ. എന്നെഴുതി. എങ്കിൽ ശരിയായ പ്രസ്താവന ഏത്?

A) ഉത്തരവും കണ്ടെത്തിയ രീതിയും ശരിയല്ല

B) ഉത്തരം ശരിയാണ്, കണ്ടെത്തിയ രീതി ശരിയല്ല

C) ഉത്തരം ശരിയല്ല, കണ്ടെത്തിയ രീതി ശരിയാണ്

D) ഉത്തരവും കണ്ടെത്തിയ രീതിയും ശരിയാണ്

36. 28 × 46 = 1288, 19×24= 456 എങ്കിൽ (2.8×0.46) + (1.9 × 2.4) ന് തുല്യമായതേത്?

A) $12.88 + 4.56$ B) $\frac{1288}{100}+\frac{456}{100}$ C) 5.848 D) $128.8 + 45.6$

37. 2.54 × 0.12 കണ്ടു പിടിക്കുന്നതിന് മുഹമ്മദ് 254 × 12= 3048 എന്ന് കണ്ടു പിടിച്ചതിന് ശേഷം ഉത്തരം 2.54 × 0.12= 30.48 എന്നെഴുതി. എങ്കിൽ ശരിയായ പ്രസ്താവന ഏത്?

A) ഉത്തരവും, ഉത്തരം കണ്ടെത്തിയ രീതിയും ശരിയാണ്.

B) ഉത്തരം ശരിയാണ് കണ്ടെത്തിയ രീതി ശരിയല്ല

C) ഉത്തരവും, കണ്ടെത്തിയ രീതിയും ശരിയല്ല

D) ഉത്തരം ശരിയല്ല, കണ്ടെത്തിയ രീതി ശരിയാണ്.

38. ഒരു വീടിന്റെ ടെറസിന് 15 മീ. നീളവും, 12 മീ. വീതിയും ഉള്ള ചതുരാകൃതിയാണ്. 8 സെ.മീ. മഴ പെയ്താൽ നിറയുന്ന വെള്ളത്തിന്റെ അളവെത്ര എന്നതിന് ഉത്തരം കണ്ടെത്തുന്നതിന് റസിയ എഴുതിയ സ്റ്റെപ്പുകൾ കൊടുത്തിരിക്കുന്നു.

സ്റ്റെപ്പ് 1 : വെള്ളത്തിന്റെ അളവ് = 1500 X 1200 X 8

സ്റ്റെപ്പ് 2 : 1500 X 1200 X 8 = 14400000 ഘ.സെ.മീ

സ്റ്റെപ്പ് 3 : വെള്ളത്തിന്റെ അളവ് = 14400 ലിറ്റർ

താഴെ കൊടുത്തിരിക്കുന്നതിൽ ശരിയായ പ്രസ്താവന ഏത്?

A) സ്റ്റെപ്പ് 1ൽ തെറ്റുണ്ട്

B) സ്റ്റെപ്പ് 2ൽ തെറ്റുണ്ട്

C) സ്റ്റെപ്പ് 3ൽ തെറ്റുണ്ട്

D) തെറ്റൊന്നുമില്ല

39. 4, 1, 2, 0 എന്നീ സംഖ്യകൾ ഉപയോഗിച്ച് സംഖ്യകൾ ആവർത്തിക്കാതെയും, ഒഴിവാക്കാതെയും എഴുതാവുന്ന ഏറ്റവും ചെറിയ ദശാംശസംഖ്യയേത്?

40. 6000 ഘ.സെ.മീ. വ്യാപ്തമുള്ള ഒരു ചതുരക്കട്ടയുടെ നീളം, വീതി, ഉയരം എന്നിവ എഴുതുക.

Appendix D6

DEPARTMENT OF EDUCATION
UNIVERSITY OF CALICUT
TEST OF ACHIEVEMENT IN MATHEMATICS

(FINAL)

Dr. M. N. Mohamedunni Alias Musthafa — Assistant Professor

Sunitha T. P. — Research Scholar

Std. VI *Max. Score: 40*

Instructions

This test contains 40 questions on the units 'Volume' and 'Decimal Numbers'. For the first 38 questions, four choices A, B, C, D are provided. Read each question carefully and mark your answer in the response sheet provided using '✓' mark. For the last two questions, write your answer in the space provided against each question number. Answer all questions. Do not write or draw anything on the question paper.

---

1. What is the volume of a cube of side 1 cm?
   A) 1 square centimeter B) 1 cubic centimeter
   C) 3 square centimeter D) 3 cubic centimeter
2. If the sides of a cube are doubled, how many times would the volume be?
   A) 8 B) 2 C) 4 D) 27
3. Which is the decimal equivalent to $9\frac{1}{10}$?
   A) 91.0 B) 9.1 C) 9.01 D) 0.91
4. Which is the decimal equivalent to 0.25?
   A) 0.025 B) 2.5 C) 2.05 D) 0.250
5. Which is the digit in the tenths place in 4.26?
   A) 6 B) 4 C) 2 D) 0
6. Which is the decimal form of 8 tens + 9 ones + 5 tenths?
   A) 0.895 B) 8.95 C) 89.5 D) 89.05
7. Complete the following pattern
   0.8, 0.9, 1.0,------, ------, 1.3----
   A) 1.0, 1.1 B) 11, 12 C) 0.11, 0.12 D) 1.1, 1.2
8. The dimensions of a rectangular box are: length 6 cm, breadth 4 cm, height 2 cm. which of the following indicates its volume?
   A) 6+4+2 B) 6 + 4 x 2 C) 6 x 4 ÷ 2 D) 6 x 4 x 2

9. 4.3 + 5.6 = ---------

   A) 9.09 B) 9.36 C) 9.9 D) 5.63

10. 7.4 + 5.73 = --------

    A) 13.13 B) 12.77 C) 12.473 D) 14.43

11. 8.7 - 5.2 = -----

    A) 3.2 B) 3.5 C) 4.5 D) 4.7

12. 6.08 - 5.3 = -----

    A) 1.05 B) 0.87 C) 1.87 D) 0.78

13. Which of the following is the volume of a rectangular prism with length 11cm, breadth 6 cm, height 10cm?

    A) 60 cubic centimeters B) 66 cubic centimeters

    C) 110 cubic centimeters D) 660 cubic centimeters

14. What is the volume of a cube with side 8 cm?

    A) 64 cubic centimeters B) 420 cubic centimeters

    C) 512 cubic centimeters D) 186 cubic centimeters

15. What is the capacity of a rectangular vessel of length 10 cm, breadth 8 cm and height
    6 cm?

    A) 480 ml B) 360 ml C) 480 L D) 360 L

16. In a school, 54 out of 100 students are boys. Then which among the following decimals represent the number of boys?

    A) 0.54 B) 0.46 C) 5.4 D) 54

17. In a high jump competition 4 contestants recorded 1.89 m, 1.48 m, 1.75 m and 1.69 m. What is the height attained by the winner?

    A) 1.89 m B) 1.48 m C) 1.75 m D) 1.69 m

18. Anu finished a running race in 1.5 minutes and Remya finished in 2.2 minutes. How many minutes faster did Anu finish than Remya?

    A) 1.3 B) 0.7 C) 3.7 D) 0.3

19. Fathima cut a ribbon of 12.65 cm from a ribbon of 15.5 cm. How many centimeters of ribbon are left out?

    A) 3.85 B) 2.40 C) 2.85 D) 3.15

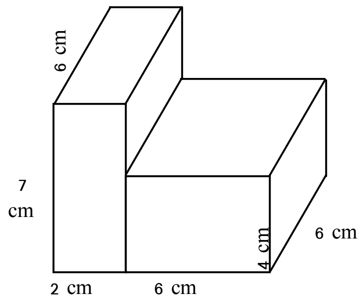
20. 2.5 m of cloth is required to stitch a skirt. How many meters of cloth are required to stitch 8 such skirts?

    A) 20 B) 25 C) 200 D) 24.5

21. Given are the length, breadth and height of four rectangular prisms. Which is the largest?

    A) 4 cm, 3 cm, 2 cm
    B) 8 mm, 10 mm, 15 mm
    C) 1 m, ½ m, ¾ m
    D) 2 cm, 2 cm, 1 m

22. Given is the shape obtained by placing 2 rectangular prisms side by side. Which of the following indicates its volume?



    A) (2 x 7x 6) + (6 x 6 x 4)   B) (2 x 6 x 6) + (7 x 6 x 4)
    C) (8 x 7x 6) + (8 x 6 x 4)   D) (6 x 6 x 6) + (2 x 7 x 4)

23. Which of the following set indicates the length, breadth and height of a rectangular prism of volume 220 cubic centimeters?

    A) 6 cm, 10 cm, 5 cm
    B) 4 cm, 5 cm, 11 cm
    C) 7 cm, 5 cm, 6 cm
    D) 10 cm, 2 cm, 5 cm

24. How many cubic centimeters of concrete mix is required to concrete a road of length 200 m and breadth 8 m up to a thickness of 6 cm?

    A) 96   B) 9600   C) 960000   D) 96000000

25. How many pieces of 1.2 cm can be cut out of a rope of length 52.5 cm?

    A) 14   B) 5   C) 24   D) 43

26. Ramesh bought 16 pencils for Rs. 4.50 each. How much will be the profit, if he sells each of them for Rs. 5?

    A) 7.50   B) 9.50   C) 16 D) 8

27. Two workers are painting a wall of surface area 62.50 square centimeters. If the first worker has painted one fourth of the wall, how much square centimeters of wall is left to paint?

    A) 15.625   B) 44.675   C) 25.652   D) 46.875

28. If the volume of a cube is 24 cubic centimeters, which among the following cannot be a dimension of that cube?

    A) 3   B) 4   C) 5   D) 6

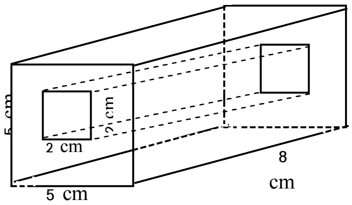
29. How many bricks of volume 1200 cubic centimeters are required to build a wall of length 8 m, breadth 1 m and thickness 20 cm?

A) 6200 B) 8000 C) 7800 D) 4000

30. If 350 liters of water from a tank of length 2 m, breadth 1 m and height ½ m is used up, how many liters of water would remain in the tank?

A) 999650 B) 75000 C) 650 D) 9650

31.



If a rectangular prism of breadth and height 2 cm is cut out of a wooden block of length 8 cm, breadth and height 2cm, what would be the volume of the remaining wooden block?

A) (5 x 5 x 8) - (2 x 2 x 8) B) (5 x 5 x 2) - (2 x 2 x 8)
C) 3 x 3x 8 D) 3 x 3 x 1

32. A container of length 25 cm and breadth 16 cm holds 3600 ml of water. What is the height of water column?

A) 10 cm B) 36 cm C) 15 cm D) 9 cm

33. Which would be the third number if 29.29, 0.29, 29.92, 0.029 are arranged in ascending order?

A) 29.29 B) 29.92 C) 0.29 D) 0.029

34. Which would be the third number if 25.521, 25.251, 25.125, 25.215 are arranged in descending order?

A) 25.521 B) 25.125 C) 25.251 D) 25.215

35. Raju multiplied 3, 2 and1, then wrote the answer as 8 cubic centimeters for the volume of mud that needs to be removed to make a compost pit of length 3m, breadth 2m and depth 1 m. Which of the following statements holds well?

A) Answer and the method, both are erroneous
B) Write answer, wrong method
C) Wrong answer, right method
D) Both answer and method are right

36. If 28 × 46 = 1288, 19×24= 456, then what is equivalent to (2.8×0.46) + (1.9 × 2.4)?

A) 12.88 + 4.56 B) $\frac{1288}{100}+\frac{456}{100}$ C) 5.848 D) 128.8 + 45.6

37. To calculate 2.54 × 0.12, Muhammed found 254 × 12= 3048 and wrote the answer as 2.54 × 0.12= 30.48. Which of the following statements holds well?

A) Both answer and method are right
B) Right answer, wrong method
C) Both answer and method are erroneous
D) Wrong answer, right method

38. Raziya wrote the following steps while calculating the volume of water filled in a terrace of length 15m and breadth 12m if it rained 8 cm.

Step 1: Amount of water = 1500 x 1200 x 8
Step 2: 1500 x 1200 x 8 = 14400000 cubic centimeters
Step 3: Amount of water = 14400 liters
Which of the statements holds well?

A) Error in step 1
B) Error in step 2
C) Error in step 3
D) No error

39. Which is the smallest decimal number that can be written using 4, 1, 2 and 0 without repeating any digit?

40. Write the length, breadth and height of a rectangular prism of volume 6000 cubic centimeters.

Appendix D7

DEPARTMENT OF EDUCATION
UNIVERSITY OF CALICUT

TEST OF ACHIEVEMENT IN MATHEMATICS-FINAL

Scoring Key

Ques. No.	Answer	Ques. No.	Answer
1	A	21	C
2	A	22	A
3	B	23	B
4	D	24	D
5	C	25	D
6	C	26	D
7	D	27	D
8	D	28	C
9	C	29	B
10	A	30	C
11	B	31	A
12	D	32	D
13	D	33	A
14	C	34	C
15	A	35	C
16	A	36	C
17	A	37	D
18	B	38	C
19	C	39	0.124
20	A	40	3 numbers whose product is 6000

Appendix D8

DEPARTMENT OF EDUCATION
UNIVERSITY OF CALICUT

TEST OF ACHIEVEMENT IN MATHEMATICS-FINAL

Response Sheet

Name.. Male/Female

Class.................................. Div............................ Roll No................................

School..

Sl. No.	A	B	C	D
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Sl. No.	A	B	C	D
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Appendix E

DEPARTMENT OF EDUCATION
UNIVERSITY OF CALICUT

Verbal Group Test of Intelligence

RESPONSE SHEET

പേര്.. ക്ലാസ്...............വയസ്സ്..................

സ്കൂൾ: ഗവൺമെന്റ്/പ്രൈവറ്റ്...............ഡിവിഷൻ......ആൺകുട്ടി/പെൺകുട്ടി.........

ക്രമനമ്പർ	ഉത്തരം Test I				ക്രമനമ്പർ	ഉത്തരം Test I				ക്രമനമ്പർ	ഉത്തരം Test I				ക്രമനമ്പർ	ഉത്തരം Test I				ക്രമനമ്പർ	ഉത്തരം Test I			
1	A	B	C	D	1	A	B	C	D	1	A	B	C	D	1	A	B	C	D	1	A	B	C	D
2					2					2					2					2				
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20					20					20					20					20				

Appendix F

STANDARD PROGRESSIVE MATRICES
SETS A, B, C, D & E

RESPONSE SHEET

Name:...Ref. No.....................

Place:..Date..........................

Age...Birth Day.................

Test begun...Test ended................

A		B		C		D		E	
1		1		1		1		1	
2		2		2		2		2	
3		3		3		3		3	
4		4		4		4		4	
5		5		5		5		5	
6		6		6		6		6	
7		7		7		7		7	
8		8		8		8		8	
9		9		9		9		9	
10		10		10		10		10	
11		11		11		11		11	
12		12		12		12		12	

Time	Total	Grade

Appendix G

DETAILS OF PUBLICATION

Sl. No	Name of Article	Authors	Details
1	*Relationship between Academic Procrastination and Mathematics Anxiety among Secondary School Students*	Sunitha T.P. & Dr. Mohamedunni Alias Musthafa, M.N	Available online at http://www.ijepr.org *International Journal of Education and Psychological Research* (IJEPR), Vol. 2, Issue, 2, pp.101-105, April, 2013 Peer reviewed Indexed ISSN No: 2279-0179