SUMMARY

National Curriculum Framework (NCF-2005) stated, “Access to quality mathematics education is every child’s right and it should be affordable and enjoyable to every child”.

From ancient times to till date mathematics is regarded as a ‘Queen of Sciences’. It implies that mathematics is the foundation of all scientific knowledge. This knowledge has brought about a tremendous increase in industrial and technological growth, which has not only affected the mode of living, but also the thinking and culture. In our daily lives we use many mathematical concepts. Mathematics imparts a system in life because it deals with numbers. Our life rotates around numbers, as we need mathematics right from the early morning to the end of the day.

Etymologically, the word - mathematics comes from the Greek word ‘mathema’, which in the ancient Greek language, means what one learns, or what one gets to know.

Mathematics is a challenging and vibrant subject connected to the real world at every level. There is no sphere of life that runs devoid of mathematics. Mathematics is a subject that is appreciated, admired and held high by individuals. Mathematics provides a definite way of thinking. Children who study mathematics develop an attitude with which they learn to work systematically, regularly and properly. Mathematics also develops logical thinking in children. Mathematics provides opportunities for developing mental abilities of the child. It helps in character formation. It disciplines the child. The language of mathematics is universal.

Mathematical achievement plays an important role in the attainment of harmonious development of a student. Mathematical achievement refers to the degree or level of success or proficiency attained in mathematics. Mathematical achievement is the outcome of general and specific learning experiences. It is actually the competency shown by a student in the mathematics, which he has learnt in the educational institutions. Mathematics is not just for the gifted and talented. Each and every pupil needs to work for mathematical achievement.
It is important to note that mathematics is not just arithmetic. Besides numbers and number operations, due importance must be given to shapes, spatial understanding, patterns, measurement and data handling. The curriculum must explicitly incorporate the progression that learners make from the concrete to the abstract while acquiring concepts (National Curriculum Framework, 2005). Hence, learning of mathematics and a student’s performance in mathematics has an undeniable significance in academics.

Achievement in mathematics is the competency shown by the student in the subject. But, there are intra and inter differences among the individuals in the achievement of mathematics. These differences may be due to their attitude and problem solving ability in the subject. Problem solving has been observed as one of the principal causes of scholastic failure in areas of science such as mathematics, chemistry and physics (Perez & Terragosa, 1983). Problem solving ability is a complex cognitive ability that characterizes a human activity requiring intelligence. Problem solving is the frame-work or pattern within which creative thinking and reasoning take place.

Rangappa (1994) posits that a student’s view of their own abilities and willingness to accept responsibility in their learning can impact that students’ achievement. Many researches showed that less problem solving ability gave less mathematical achievement. Problem solving in mathematics requires an ability to understand mathematical ideas and apply them in a variety of situations. It also requires a positive attitude towards mathematics including confidence, enjoyment and perseverence (Dharmbir, 2010). The carefully selected sequence of problem solving activities that yields success stimulates students, leading them to a more positive attitude towards mathematics in general and mathematics in particular.

Students’ attitude about mathematics and their attitude about their ability in mathematics have been recognized as predictors of mathematical achievement (Micheli). Also, mathematical anxiety has great impact on mathematical achievement. Mathematical attitude is that attitude which deals with one’s confidence, anxiety, enjoyment, motivation to pursue mathematics in his/her personal and professional life. In general, attitudes, beliefs and emotions are the major descriptors of the affective domain in mathematics education, whereas knowledge and thinking are considered descriptors of the content and process of human mind (Mcleod, Brown and Broko, 1992). Positive attitude can be considered as the main cause in learning and
perceiving mathematics and acquiring good grades in exam. Similarly, negative attitude towards the subject may cause failure in the subject. Attitude is not fixed, it can be change. The prime motive of the current education system is to develop positive attitude in students and reduce negative attitude in them. So that they can acquire good knowledge of mathematics and score better. A negative mathematical attitude always develops a feeling of fear, tension, and nervousness in students. In short, we can say negative mathematical attitude develops mathematical anxiety in students which decreases their performance in mathematics. So, mathematical attitude is negatively related with mathematical anxiety. A positive attitude leads to low level of mathematical anxiety and negative mathematical attitude leads to high level of mathematical anxiety.

Mathematical anxiety is described as feeling of tension and anxiety that interferes with the manipulation of mathematical problems in a wide variety of ordinary life and academic situations. Mathematical anxiety is a phenomenon that is often considered when examining students’ problems in mathematics. It can also be called mathematical phobia. Mathematical anxiety is often defined as a feeling of tension, apprehension or fear that interferes with one’s performance in math (Ashcraft, 2002). Mathematical anxiety indicates tension and nervousness which reduces achievement in mathematics. It is necessary to motivate students to understand the value and beauty of mathematics so that they overcome the fear & anxiety and develop favourable attitude towards this subject and attain good problem solving ability. Mathematical anxiety is an emotional rather than intellectual problem. So it affects in great extent the performance of students in mathematics.

JUSTIFICATION OF THE STUDY

Mathematics is an important part of school curriculum. The study of mathematics develops the ability of critical thinking and reasoning. The present era is called the age of science and information technology.

*Roger Bacon has well said*, “Mathematics is the gate way and key to all sciences.”

The aim of mathematics education is not to put burden on the students but to contribute to their mental development. Any person with average intelligence can master the science of mathematics with proper guidance and training (Devi, 2002). Appropriate teaching methodology should be provided by teacher to the students
which lead high achievement in mathematics. Mathematical achievement is always the great concern for students. Mathematical achievement is an important and significant topic in the field of education. A research in the area of mathematical achievement is of paramount importance all over the world and all the educators are very much concerned with enhancement of achievement in mathematics on the part of the learners. Mathematical achievement has been studied in relation to many variables like: mathematical attitude, reasoning ability, problem solving ability, home environment, creativity in mathematics, learning style, mathematical anxiety, test anxiety etc. and all these factors seem to be contributing factors to mathematical achievement. Out of all subjects, students are more anxious about their achievement in mathematics. High Problem solving ability and positive mathematical attitude in mathematics always help students to make high mathematical achievement. Students’ attitudes play a central role in mathematics learning and achievement (Mcleod, 1992). So, it is essential to develop students’ mathematical problem solving ability and reduce their mathematical anxiety for their high mathematical achievement.

Problem solving ability has a great importance in relation to mathematical achievement and these have been studied by many researchers. Lots of studies showed positive relationship between mathematical achievement and problem solving ability (Bhat, 2014, Mehra, 2017, Mohd. & Tengku, 2017). Problem solving is an integral part of mathematics learning.

National Curriculum Frame Work (NCF) 2005: suggests the development of children’s abilities for mathematics education. It defines narrow and higher aim of school mathematics as:

a) The narrow aim of school mathematics is to develop ‘useful’ capabilities, particularly to numerical: numbers, number operations, measurements, decimals and percentages.

b) The higher aim is to develop the ability in child to think and reason mathematically, to pursue assumptions to their logical conclusion and to handle abstraction. It includes a way of doing things, and the ability and the attitude to formulate and solve problems.

NCF-2005 points out that the aim of learning mathematics is not merely being able to develop abilities in the child that would improve her/his relationship with the world.
The NCF-2005 also emphasizes development in the children of logical abilities as well as abilities to comprehend space, spatial transformation and develop the ability to visualize both these. It recommends that mathematics needs to move slowly towards abstraction even though it starts from concrete experiences and models. Problem-solving is considered as the heart of mathematics learning because the skill is not only for learning the subject, but it emphasizes developing skill in thinking as well. Students can apply their knowledge and problem solving skills to be useful in daily life since the processes of solving the mathematical problem are similar to the general problem solving. It has been decided to study the relation of problem solving ability to mathematical achievement by selecting it as the one of the variable in the present study.

It is a long established belief that psychological elements like attitude and anxiety play a central role in learning mathematics.

The National Council for Teaching Mathematics (NCTM, 2000) states that developing a positive attitude toward learning mathematics is an important aspect of a student's learning experiences. Many studies have shown the importance of attitude leads to success in mathematics (Sliva, 2004).

**According to Fishbin and Ajzen (1979)**, “Maintenance of attitude may lead to behavioural intention which in turn may be correlated with actual behaviour. Attitude towards mathematics plays a greater role in mathematical achievement of the students.”

Mathematics has been a confusing, frightening and frustrating subject for learners of all ages till date. A single negative experience in mathematics in childhood is enough to create a pessimistic attitude towards mathematics in adulthood (Chowdhury, 2016). An important aim of mathematics education is to develop positive attitude towards mathematics in the students. It has been found in a number of studies (Nongsiej, 2013, Mehra, 2017, Mareesh, 2017) that students’ mathematical attitude is positively related to mathematical achievement. Positive attitude always encourages students to perform better in mathematics. Positive attitude develops students’ interest in mathematics. Mathematics offers opportunities for opening the mind to new lines of creative ideas and challenging thoughts. In spite of having all the benefits of learning mathematics, it has been experienced that generally students are afraid of studying mathematics.
Mathematical anxiety is associated with a host of negative outcomes including lower grades in mathematics, decreased enjoyment of mathematics and avoidance of mathematics (Hembree, 1990). Worldwide, mathematical anxiety is associated with decreased mathematical achievement (Lee, 2009). Math-anxious parent or teacher might affect a child’s mathematical success and math anxiety (Beilock, Gunderson, Ramirez, & Levine, 2010).

According to Ashraft and Ridley (2005), “Math anxious individuals not only have negative attitude towards the subject of math but also have negative attitude about themselves in relation to math.”

Mathematics anxiety is not an intellectual problem but an emotional problem, which can be overcome. Overcoming from the fear of mathematics is necessary for the students to be able to become successful in mathematics courses.

The National Curriculum Framework (2005) recommends that the children life at school must be linked to their life outside the school.

During the last few decades, mathematical achievement, problem solving ability, mathematical attitude and mathematical anxiety of students have assumed a great importance in the field of education. How to increase their mathematical achievement, problem solving ability, develop positive attitude and how to reduce mathematical anxiety, these are the important questions before the educationists, policy makers, curriculum planners and researchers. Therefore, to analyze critically these issues, the investigator became interested to undertake the present study.

The focus of the proposed study is to explore the impact of mathematical achievement in relation to mathematical attitude, problem solving ability and mathematical anxiety of secondary school students. It is evident from the above mentioned studies that the various studies have been conducted on mathematical achievement with regard to different related variables but there is dearth of studies in the field of mathematical achievement with relation to problem solving ability, mathematical attitude and mathematical anxiety in India. As regards the criterion of originality of the problem, the available survey and sources of research were reviewed. The investigator did not find any study in tandem with these four variables viz. mathematical achievement, problem solving ability, mathematical attitude and mathematical anxiety at particularly secondary stage. So, the investigator feels the need to conduct the study at
secondary school students on these variables i.e. mathematical achievement, problem solving ability, mathematical attitude and mathematical anxiety. Moreover the study will also have educational implications for students, teachers, curriculum framers etc. On this account the present study has been taken by the investigator.

STATEMENT OF THE PROBLEM

MATHEMATICAL ACHIEVEMENT IN RELATION TO PROBLEM SOLVING ABILITY, MATHEMATICAL ATTITUDE & ANXIETY OF SECONDARY SCHOOL STUDENTS

OPERATIONAL DEFINITIONS OF THE TERMS USED

A. Mathematical Achievement

Mathematical achievement is a measure of knowledge gained in formal educational levels viz. primary, secondary & higher and usually indicated by test scores or grade points.

In the present study, mathematical achievement refers the scores of secondary school students, obtained on Mathematical Achievement Test (MAT), standardized by Ali Imam and Tahira Khatoon (2011). The test includes the following areas: Squares and square roots, cubes and cube roots, Rational Exponents and Radicals, Compound interest, Algebraic Identities, Polynomials, Equations in one Variable, Parallel Lines, Types Of Quadrilateral, Circle, Areas, Surface Areas, Volumes, Statistics.

B. Problem Solving Ability

Problem solving ability is defined as an effort which includes strategies related to thinking, reasoning and judgment. It is higher order cognitive process that requires the modulation and control of more routine or fundamental skills.

In the present study problem solving ability means creative thinking, reasoning ability and intelligence while solving mathematical problems. Here, it measures the scores of secondary school students obtained on problem solving ability Test (PSAT) developed by L. N. Dubey (2011).

C. Mathematical Attitude

Mathematical attitude is generally indicated by an individual’s opinion, liking and disliking about mathematical concepts and mathematical problems.
In the present study, mathematical attitude is taken as emotions that an individual associates with mathematics, an individual’s beliefs towards mathematics and an individual’s behaviour towards mathematics. It is categorized as more favourable, moderate and less favourable by the researcher. Here, it measures the scores of secondary school students, obtained on Mathematical Attitude Scale (MATS) developed by P. S. Yadav (1984).

D. Mathematical Anxiety

Richardson & Suinn (1972), describe mathematical anxiety as involving feelings of tension and anxiety that interfere with the manipulating of numbers and the solving of mathematical problems in a wide variety of ordinary life and academic situations.

In the present study mathematical anxiety is defined as a state of uneasiness and distress about mathematics and the taking of mathematics tests. It is categorized as high, moderate and low by the researcher. Here, it measures the scores of secondary school students, obtained on Mathematical Anxiety Scale (MAS), developed by Sadia Mahmood and Tahira Khatoon (2012).

E. Secondary School Students

In the present study, the secondary school students refer to the students who are studying in IX standard of secondary schools affiliated to H.B.S.E.

OBJECTIVES OF THE STUDY

1) To study the demographical profile of the sample.
2) To study the level of mathematical achievement, problem solving ability and mathematical anxiety of the secondary school students.
3) To determine the mathematical attitude of the secondary school students.
4) To find out the relationship between mathematical achievement and problem solving ability of the secondary school students with regard to school type, gender and locality.
5) To find out the relationship between mathematical achievement and mathematical attitude of the secondary school students with regard to school type, gender and locality.
6) To find out the relationship between mathematical achievement and mathematical anxiety of the secondary school students with regard to school type, gender and locality.
7) To find out the relationship between problem solving ability and mathematical attitude of the secondary school students with regard to school type, gender and locality.

8) To find out the relationship between problem solving ability and mathematical anxiety of the secondary school students with regard to school type, gender and locality.

9) To find out the relationship between mathematical attitude and mathematical anxiety of the secondary school students with regard to school type, gender and locality.

10) To predict mathematical achievement of secondary school students in relation to their problem solving ability, mathematical attitude and mathematical anxiety with regard to
   School type: a) Government
                b) Private
   Gender: a) Female
            b) Male
   Locality: a) Urban
             b) Rural

11) To compare mathematical achievement of secondary school students with regard to
   a) School type
   b) Gender
   c) Locality

12) To compare problem solving ability of secondary school students with regard to
   a) School type
   b) Gender
   c) Locality

13) To compare mathematical attitude of secondary school students with regard to
   a) School type
   b) Gender
   c) Locality

14) To compare mathematical anxiety of secondary school students with regard to
   a) School type
b) Gender

c) Locality

HYPOTHESES OF THE STUDY

1) There exists significant positive relationship between mathematical achievement and problem solving ability of the secondary school students with regard to school type, gender and locality.

2) There exists significant positive relationship between mathematical achievement and mathematical attitude of the secondary school students with regard to school type, gender and locality.

3) There exists significant negative relationship between mathematical achievement and mathematical anxiety of the secondary school students with regard to school type, gender and locality.

4) There exists significant positive relationship between problem solving ability and mathematical attitude of the secondary school students with regard to school type, gender and locality.

5) There exists significant negative relationship between problem solving ability and mathematical anxiety of the secondary school students with regard to school type, gender and locality.

6) There exists significant negative relationship between mathematical attitude and mathematical anxiety of the secondary school students with regard to school type, gender and locality.

7) Some measures of problem solving ability, mathematical attitude and mathematical anxiety would significantly predict mathematical achievement of secondary school students with regard to

   School type: a) Government 
                  b) Private

   Gender: a) Female 
              b) Male

   Locality: a) Urban 
               b) Rural

8) There exists significant difference in mathematical achievement with respect to

   a) School type
There exists significant difference in problem solving ability with respect to:
   a) School type
   b) Gender
   c) Locality

There exists significant difference in mathematical attitude with respect to:
   a) School type
   b) Gender
   c) Locality

There exists significant difference in mathematical anxiety with respect to:
   a) School type
   b) Gender
   c) Locality

**DELIMITATIONS OF THE STUDY**

Taking into consideration the feasibility of the investigation, the investigation was delimited to:

1) a total of four districts of Haryana viz. Karnal, Yamunanagar, Jind and Faridabad only.
2) a total of 20 Government and 20 private secondary schools affiliated to H.B.S.E. (Bhiwani), Haryana only.
3) a total of 800 secondary school students of IX class only.

**RESEARCH METHODOLOGY**

As per the objectives and hypotheses of the study the investigator decided to use descriptive survey method to study the mathematical achievement in relation to problem solving ability, mathematical attitude & anxiety of secondary school students.

**IDENTIFICATION OF THE VARIABLES**

**Independent variables:**

The independent variable is that factor which is manipulated and selected by experimenter to determine the relationship to an observed phenomenon. In present
study, problem solving ability, mathematical achievement and mathematical anxiety are considered as independent variables.

**Dependent Variable:**

The variable being affected or assumed to be affected by the independent variable is called Dependent Variable. In the present study, mathematical achievement is considered as dependent variables.

**POPULATION AND SAMPLE**

**Population**

The term ‘population’ in research is used in a broader sense than its common place meaning which is a population of people. The entire group from which the sample has been selected is called the population. That group or population may consist of persons, objects, educational institutions, time units, geographical areas, attributes, qualities, behaviour of people and animals, cities, families, answers to various items of a test etc.

In the present study all the secondary students studying in the Government and private schools affiliated to H.B.S.E. (Bhiwani) were considered as the population. There are four divisions in Haryana which has 21 districts.

**Sample**

In the present study, stratified random sampling was followed. Firstly, all the four divisions Haryana state were taken. Out of each of the four divisions one district was selected randomly through lottery method viz. Karnal district from Rohtak division, Yamunanagar district from Ambala division, Jind district from Hisar division, and Faridabad district from Gurgaon division. In each district 10 secondary schools (5 Government and 5 private) were selected randomly through lottery method.

After words, 200 secondary school students were taken randomly from 10 secondary schools in each district. In this way, total sample of 800 secondary school students of Karnal, Yamunanagar, Jind and Faridabad districts were selected randomly through lottery method.

The further distribution of the sample is described through the sample design which is as follow:
TOOLS USED

1) Mathematical Achievement Test of Ali Imam and Tahira Khatoon (2011)
2) Problem Solving Ability Test of L. N. Dubey (2011)
3) Mathematical Attitude Scale of P. S. Yadav (1984)
4) Mathematical Anxiety Scale of Sadia Mahmood and Tahira Khatoon (2012)

DATA COLLECTION

It is necessary to adopt or evolve a systematic procedure to collect essential facts. After finalizing the tools and size of sample, the next step was to collect data from the selected sample. In order to fulfill this purpose, the investigator visited personally to different selected secondary private and government schools affiliated to H.B.S.E. (Bhiwani) with the prior permission of the her supervisor and chairperson, Department of Education, Kurukshetra University, Kurukshetra. Then the investigator met and discussed in detail the purpose of investigation with the Principals of selected schools and took permission to collect data from IX class students. The students were informed about the purpose behind this whole exercise and were assured that their responses would be kept confidential and would be used for research purpose of intended study only. The instructions were clearly explained and their doubts, if any, were removed. While distributing the tools to the students the investigator briefed the students on how to answer the questions and also assist them if they have any problems to understand the questions. The prescribed time in the tools were given to the students to answer the questions. After the completion of the test, questionnaires were collected from the students. Then the investigator made sure that all the questions had been responded and the respondents gave only single answer for each question. The researcher thanked the teachers and students for their cooperation.

STATISTICAL TECHNIQUES USED

To fulfill the objectives of the study, the obtained data was processed, analyzed and interpreted by the investigator by applying the following statistical measures:

1) To understand the level of various variables techniques of mean, standard deviation, range and percentage was used.
2) To check the normality of the data Q-Q plot was employed.
3) To find out the relationship between various variables Pearson's product moment co-efficient of correlation was employed.

4) Multiple regression equation was used to predict dependent variables from independent variables.

5) To find out the differences between school type, gender and locality with respect to different variables t-test was employed.

MAIN FINDINGS OF THE STUDY

FINDINGS BASED ON DESCRIPTIVE STATISTICS

Findings based on level of mathematical achievement of secondary school students with respect to school type, gender and locality

a) Majority of government and private secondary students showed average level of mathematical achievement.

b) Majority of female and male secondary students gained average level of mathematical achievement.

c) Majority of urban and rural secondary students achieved average level of mathematical achievement.

Findings based on level of problem solving ability of secondary school students with respect to school type, gender and locality

a) Majority of government and private secondary students showed average level of problem solving ability.

b) Majority of female and male secondary students showed average level of problem solving ability.

c) Majority of urban and rural secondary students achieved average level of problem solving ability.

Findings based on level of mathematical attitude of secondary school students with respect to school type, gender and locality

a) Majority of government and private secondary students showed moderate mathematical attitude.

b) Majority of female and male secondary students gained moderate mathematical attitude.
c) Majority of urban and rural secondary students achieved moderate mathematical attitude.

Findings based on level of mathematical anxiety of secondary school students with respect to school type, gender and locality

a) Majority of government and private secondary students showed moderate mathematical anxiety.

b) Majority of female and male secondary students gained moderate mathematical anxiety.

c) Majority of urban and rural secondary students achieved moderate mathematical anxiety.

FINDINGS BASED ON ANALYSIS OF NORMAL DISTRIBUTION OF THE SCORES

The Q-Q plot shows that the points were close to the diagonal line of the curve. Therefore, scores obtained by secondary school students in mathematical achievement test were normally distributed.

The Q-Q plot depicts that the points were close to the diagonal line of the curve. Therefore, scores obtained by secondary school students in problem solving ability test were normally distributed.

The Q-Q plot presents that the points were close to the diagonal line of the curve. Therefore, scores obtained by secondary school students in mathematical attitude test were normally distributed.

The Q-Q plot reveals that the points were close to the diagonal line of the curve. Therefore, scores obtained by secondary school students in mathematical anxiety test were normally distributed.

FINDINGS BASED ON ANALYSIS OF RELATIONSHIP

Finding based on relationship between mathematical achievement and problem solving ability of secondary school students

There was a significant positive relationship was found between mathematical achievement and problem solving ability. Mathematical achievement was positively associated with problem solving ability with regard to school type, gender and locality.
Finding based on relationship between mathematical achievement and mathematical attitude of secondary school students

A significant positive relationship was found between mathematical achievement and mathematical attitude. Further the findings revealed a significant positive correlation between mathematical achievement and mathematical attitude with regard to school type, gender and locality.

Findings based on relationship between mathematical achievement and mathematical anxiety of secondary school students

The coefficient of correlation indicated a significant negative relationship between mathematical achievement and mathematical anxiety. A significant negative correlation was found between mathematical achievement and mathematical anxiety with regard to school type, gender and locality.

Findings based on relationship between problem solving ability and mathematical attitude of secondary school students

There was a significant positive relationship was found between problem solving ability and mathematical attitude. Further the problem solving ability was negatively correlated with mathematical attitude with respect to school type, gender and locality.

Findings based on relationship between problem solving ability and mathematical anxiety of secondary school students

A significant negative relationship was found between problem solving ability and mathematical anxiety. Problem solving ability was negatively correlated with mathematical anxiety with regard to school type, gender and locality.

Findings based on relationship between mathematical attitude and mathematical anxiety of secondary school students

The coefficient of correlation showed that a significant negative relationship was found between mathematical attitude and mathematical anxiety. Further the findings showed negative correlation between mathematical attitude and mathematical anxiety with respect to school type, gender and locality.

FINDINGS BASED ON REGRESSION ANALYSIS

Findings related to prediction of Mathematical Achievement (dependent variable) in relation to Problem Solving Ability, Mathematical Attitude and Mathematical Anxiety (Independent Variable) of secondary school students
The ‘F’ value showed the significant prediction of problem solving ability, mathematical attitude and mathematical anxiety about the mathematical achievement overall and with respect to school type, gender and locality. The contribution of Problem solving ability on mathematics achievement was higher than mathematical attitude and mathematical anxiety overall and with respect to school type, gender and locality.

FINDINGS BASED ON ANALYSIS OF DIFFERENCES

Findings related to analysis of differences of Mathematical Achievement on the basis of the school type, gender and locality

a) A significant difference was found between mathematical achievement of Government and private secondary school students. Further, private secondary school students showed higher mathematical achievement than Government secondary school students.

b) A significant difference was found between mathematical achievement of male and female secondary school students. Further, male secondary school students showed higher mathematical achievement than female secondary school students.

c) Mathematical achievement of urban and rural secondary school students was not differed significantly. Further, both urban and rural secondary school students show almost similar level of mathematical achievement.

Findings related to analysis of differences of Problem Solving Ability on the basis of the school type, gender and locality

a) There was significant difference was found between problem solving ability of Government and private secondary school students. Further, private secondary school students showed higher problem solving ability than Government secondary school students.

b) There was significant difference was found between problem solving ability of male and female secondary school students. Further, male secondary school students showed higher problem solving ability than female secondary school students.

c) Urban and rural secondary school students did not differ significantly with respect to problem solving ability. Further, both urban and rural secondary school students show almost similar level of problem solving ability.
Findings related to analysis of differences of Mathematical Attitude on the basis of the school type, gender and locality

a) A significant difference between mathematical attitude of Government and private secondary school students. Further, private secondary school students showed higher mathematical attitude than Government secondary school students.

b) No significant difference between mathematical attitude of male and female secondary school students. Further, both male and female secondary school students show almost similar mathematical attitude.

c) No significant difference between mathematical attitude of urban and rural secondary school students. Further, both urban and rural secondary school students show almost similar mathematical attitude.

Findings related to analysis of differences of Mathematical Anxiety on the basis of the school type, gender and locality

a) A significant difference was found between mathematical anxiety of Government and private secondary school students. Further, Government secondary school students showed higher mathematical anxiety than private secondary school students.

b) No significant difference between mathematical anxiety of male and female secondary school students. Further, both male and female secondary school students show almost similar mathematical anxiety.

c) No significant difference between mathematical anxiety of urban and rural secondary school students. Further, both urban and rural secondary school students show almost similar mathematical anxiety.

EDUCATIONAL IMPLICATIONS

The aim of any research study is to find out some practical application in its concerned field. The findings of the present study have ample implications for school administrators, teacher educators, parents and other professionals in the field of education.
Implications for teachers

Teachers may need to take a more proactive role in encouraging students to become excited about math and see themselves as successful, confident, mathematical problem solvers. The present study has wide educational implications which are given below:

- Teachers’ mathematical knowledge and teaching proficiency are directly related to student’s achievement in mathematics. Teachers’ good knowledge & command over mathematical concepts and good teaching proficiency will automatically increase students’ confidence and ability in mathematics. Thus, teachers’ subject knowledge, command over mathematical concepts and good teaching proficiency are the basic requirements for good mathematical achievement of students. So, teachers must have subject knowledge and delivery of the concepts of the syllabus of mathematics.

- Teachers must also know how to use their knowledge in practice. Their knowledge must be applied in making teaching more useful. It should be clear to the teachers what is to be taught and how the lessons are to be prepared, conducted and assessed. How to reach the goals of learning expressed in the curriculum and how to use the resources available to help students to achieve those goals must also be clear to the teachers. It is necessary to organize the class and manage the lesson properly so that every learner is properly learning.

- The study revealed that private secondary school students showed high level of mathematical achievement & problem solving ability and more positive attitude Government than secondary school students. So, teachers should understand the ability, attitude and capacity of the students especially of government school students in mathematics and accordingly he/she should prepare lesson plans which help to increase student’s mathematical achievement. Also, teachers should use innovative teaching methods to stimulate and sustain the interest of the students in mathematics. So that student’s positive attitude can be increased and anxiety can be reduced.
Teachers should have positive attitude towards mathematics to reduce mathematical anxiety among students as teacher’s attitude towards mathematics has great influence on student’s mathematical anxiety.

Teachers should provide suitable, comfortable and stress free classroom environment to students so that students can easily ask about their quarries and clear their doubts which promote student’s mathematical achievement.

Teachers can promote cooperative and peer learning in the classroom situations and motivate high achievers to help the average or low achievers to perform better.

Teachers can make mathematics enjoyable for their students, for this they can use play way method to teach students while mathematics.

Mathematics club should be organized by a mathematics teacher in the school. It provides to students to learn mathematics with interest and involvement. It also helps to improve their problem solving abilities.

The study showed government secondary school students showed higher mathematical anxiety than private secondary school students. So, to reduce student’s anxiety in mathematics teachers should involve students in various creative activities to develop their interest in mathematics. For this, teachers can conduct creativity test, giving them mathematical puzzles to solve etc.

Teacher can create interest in students in mathematics by teaching them through proper teaching aids like: models, charts, online tutorials and multimedia packages etc.

Immediate feedback in mathematical problems should be provided by teachers to the students which regulate student’s performance in mathematics.

Teacher can use pedagogical strategy for foster problem solving ability in students.

Teaching methodology and technique may need to be revised to increase the problem solving ability of students.

Teacher should use drill and practice to fix up the mathematical concepts for better learning.
Teachers must encourage students to adopt a reasonable risk-taking attitude while solving mathematical problems. Risk-taking attitude leads the students to overcome anxiety while solving mathematical problems.

A teacher must interpret student’s written work, analyze their reasoning and respond to the different methods they might use in solving a problem.

The use of ICT in teaching mathematics can make the teaching process more effective as well as enhance the students’ abilities in understanding basic concepts. Some examples of ICT use in mathematics include: portables, graphic calculators and computerized graphing, specialized software, programmable toys or floor robots, spreadsheets and databases. Studies have shown that a range of portable devices exist which allow pupils to collect data, and manipulate it using spreadsheets and databases for work in numeracy. Some portable equipment also enables the study of mathematics to move out of the classroom and to incorporate fieldwork investigations.

Programmable toys or floor robots controlled by instructions in programming languages (usually Logo) are one of the earliest applications of ICT to mathematics and that have significant changes in mathematics teaching. Logo encourages pupils to develop problem-solving skills, leads them to develop higher levels of mathematical thinking as well as learn geometric concepts. ICT supports constructivist pedagogy, which allows students to explore and reach an understanding of mathematical concepts. This approach promotes higher order thinking and better problem solving strategies. Teachers can maximize the impact of ICT in mathematics teaching by using ICT as a tool in achieving towards learning objectives. So, teachers do not only need to have competent knowledge of teaching mathematics but also need to be competent in the pedagogical use of ICT.

The integration of information and communication technologies can help to revitalize teachers and students. This can help to improve and develop the quality of education by providing curricular support in difficult concepts of mathematics. For this purpose, teachers have to be involved in collaborative
projects and development of intervention change strategies, which would include teaching partnerships with ICT as a tool.

- Students’ performance should be assessed properly. By the assessment which is formative and continuous, teachers come to know about the needs of each student and where to improve a lesson
- Giving students an incentive to complete their academic tasks can be very effective. Giving classroom incentive help both in better performance and building individual and group responsibility and in this way a positive classroom climate is also nurtured.

Implications for students

- The research suggests that students should do their home work, project works etc. by own without any cheating.
- The research also suggests that students in their leisure time should practice more and more mathematical problems which help in developing positive attitude and reducing anxiety in them about mathematics.
- Students should use proper use of ICT in their studies.

Implications for parents

- Parents should provide moral support on the failure in the exams of their children and help them in their homework, assignment, projects and preparation in the exams.
- Parents should identify their children’s attitude about mathematics at early stage of learning so that a positive attitude can be generated in children at the beginning of the school.
- Parents need to be aware about their own emotional state and attitude while dealing with children in their academic matters. Children’s academic performance is affected by the interaction between parents and children. The mother and the father play an equal role in shaping the personality and overall development of children. So to reduce mathematical anxiety among students, parents must have a positive attitude towards their academics particularly mathematics.
Parents must connect mathematics to everyday life and help their children to understand how mathematics influences them (i.e., shapes of traffic signs, walking distance to school, telling time etc.). Family should play mathematics games together that add excitement such as checkers, junior monopoly, math bingo etc. This will help to reduce children’s fear and anxiety about mathematics.

Computers + math = fun! There are great computer math games available on the internet that parents can discover with their child. This creates interest in mathematics in children.

Parents should talk with teachers of their wards about difficulties he/she may be experiencing. When teachers and parents work together, it will be highly beneficial to children in achieving good scores in mathematics.

When parents provide frequent help in doing homework and exhibit highly-math-anxious behavior, then their children learn significantly less mathematics and have more math anxiety by school-year’s end.

There are a number of research-based strategies that can be very useful in helping children and parents deal with their mathematics anxiety. Expressive writing strategy is one of them which is simple, inexpensive, and very effective to reduce mathematical anxiety. To use this strategy, students simply have to write about their worries regarding an upcoming mathematics test for about seven minutes before they take the test. This straightforward act of writing helps the parents to find the actual causes of their children low performance in mathematics test and anxiety while facing mathematics test. On the basis of these causes parents may provide proper remedies to their children.

Success in mathematics requires more than just ability. It is also about developing the right attitude. While school holidays, parents should take their children for a trip. This trip gives parents great opportunities to engage their children in different types of activities which used mathematical thinking. Some activities are: - Working out how many kilometers you will travel is an easy way to practice computation skills and develops an interest in map
Another calculation might be how far you can travel on one tank of fuel, then finding a place on the map to stop and fill up. Small children have a liking to get dirty and play in a garden. This enthusiasm of children can be developed by parents while adding plants to the garden, spatial awareness is used. When holes are dug for plants, estimating skills are used. The depth of the holes is calculated through guess and check, which is an identified problem solving strategy.

- Parents should guide their children in homework; project work, assignments etc at least up to secondary level.
- Present study stresses the importance of parental involvement in children’s early education, especially kindergarten entry, in order to improve children’s mathematics scores, because mathematics learning skills and habits are developed at an early stage and will not only affect children’s current math scores, but also later ones.

**Implications for schools, educational bodies and curriculum planners**

- Schools should provide a variety of mathematical resources to teachers to increase interest, ability and positive attitude and reduce anxiety in students.
- Schools should arrange and maintain mathematical lab in the school where different models on different topics can be placed. These models help the students to understand the concepts easily.
- Schools should provide time to time the facility of guidance and counseling to the students to understand their problems in mathematics and also provide them suitable solutions of their problems.
- The study revealed that private school, urban and male students performed better in mathematics then government, rural and female students. So, for good performance in mathematics, equal facilities for learning mathematics should be provided by the Government schools.
- To reduce mathematical anxiety schools should host co-curricular activities in mathematics like mathematical club activities, quiz, conducting exhibitions, mathematical Olympiads etc. which promote students interest in mathematics.
The implication of this study suggested that students can be provided with a school environment which is suitable according to their behavior so that their attitude and problem solving ability may be flourished.

Proper pupil-teacher ratios and class sizes should be followed by schools as prescribed by the government.

Interesting curricular and co-curricular programmes should be provided to the students by the schools time to time to improve their performance in mathematics.

Computer labs should remain open all the time so that students during their free period can have access to the labs.

The curriculum should be developed in such a way through which learner can acquire meaningful acquisition of concepts. If the curriculum aims to be learner centered then learners’ characteristics and their predisposition should be a major determinant in planning and development of curriculum. Moreover curriculum should be flexible in nature.

Topics related to problem solving should be included in the curriculum at every stage of schooling.

Educational bodies like: HBSE, NCERT, UGC etc should sponsor workshops, seminars, expert’s lectures, etc. and the same be arranged by the schools, colleges and Universities for in-service teachers to train them the basic skills of teaching mathematics, so that positive attitude can be developed in students.

The programmes for the preparation and professional development of teachers must give a challenge to teachers so that they develop, apply and analyze that knowledge in the context of their teaching to make knowledge and practice are integrated.

SUGGESTION FOR FURTHER RESEARCHES

1) The present study can be conducted on higher and lower levels of classes.

2) A similar study can be conducted on some other variables like: home environment, constructivist approach in mathematics, mathematical retention, mathematical aptitude, learning style in mathematics etc.
3) A similar study can be conducted on different type of schools such as schools affiliated to C.B.S.E. and convent schools, aided schools.

4) A similar study can be conducted in other subjects like: English, science, social science etc.

5) Present study confined only 800 secondary school students. A similar study can be conducted on large sample to get better and more authentic results.

6) Present study also confined to Haryana state only. A similar study can be conducted to other states.

7) An experimental study can be conducted on the same variables.