CHAPTER-II

REVIEW OF RELATED LITERATURE

Mouly (1964) stated, "Man is the only animal that does not have to begin new in every generation but takes advantage of knowledge which he has accumulated through the centuries."

The review of the related study is nothing but a wide look into the past research work done by the researchers in the specified fields. Research work done in the past serves as solid base or foundation for the new investigations. A review of literature is an essential and important aspect of a research study. Review means to organize the knowledge of the specific area of research to evolve an edifice of knowledge to show that his/her study would be an addition to this field. Theories and concepts not only from similar areas of study but also from other studies might be useful in defining the problem in hand and in developing hypotheses.

According to Best (1995), “A familiarity with the literature in any problem helps the researcher to discover what is already known, what others have attempted to find out, what attacking methods have been promising and disappointing and what problems remain to be solved.”

The definition clearly indicates that review of related literature enables the researcher to define the limits of the research area. It gives a concise direction to make objectives for the research study.

One of important steps in the planning of any research study is a careful review of the research journals, books, dissertations, theses and other sources of information on the problem to be investigated. Review of related literature allows the researchers to acquaint himself/herself with the current knowledge in the field or area in which the researcher is going to conduct the research.

Good (1966) remarked, “The survey of related literature might provide guiding hypothesis, suggestive method of investigation, comparative data for interpretative purposes. Sometimes, text books and subjective insights and hypothesis may have a place in the survey of related literature.”

Review gives the following information to the researcher:

1) It gives the background information about the problem.
2) Theories and data that explain existence and seriousness of the problem and the possible connection between certain factors about the problem.

3) Findings and recommendations for further studies related to the problem.

The importance of related literature or related studies cannot be denied in any research. It gives a theoretical base for the research and helps the research to determine the nature of research. The importance of review of related literature is given below:

1) The review of related literature helps the researcher to learn how to improve the tools, the methods of data collection and data analysis.

2) It avoids the risk of duplication and wastage of time, money and human energy.

3) It enables the researcher to define and delimit his problem.

4) It brings the researchers up to date on the work which the others have done and thus to state the objectives clearly and concisely.

5) It helps avoid unfruitful and useless problem area. The research can select those areas in which positive findings are very likely to result and his endeavours would be likely to bring some result and add to the knowledge in a meaningful way.

6) It provides suggestions for possible modification in the research to avoid unanticipated difficulties.

7) It relates the finding to previous knowledge and suggests further research on the basis of insight gained from conducting the study and the study of literature reviewed.

Keeping all this in mind, this chapter has been devoted to the related study giving importance to the area of mathematical achievement, problem solving ability, mathematical attitude and mathematical anxiety.

This chapter presents the results of mathematical achievement in relation to problem solving ability, mathematical attitude and mathematical anxiety. Mathematical achievement is considered as a dependent variable and problem solving ability, mathematical attitude and mathematical anxiety as independent variables. This
chapter reviews mathematical achievement in relation to problem solving ability, mathematical attitude and mathematical anxiety and related literature as follow:

2.1 Studies related to Problem Solving Ability and Mathematical Achievement

2.2 Studies related to Mathematical Attitude and Mathematical Achievement

2.3 Studies related to Mathematical Anxiety and Mathematical Achievement

2.1 STUDIES RELATED TO PROBLEM SOLVING ABILITY AND MATHEMATICAL ACHIEVEMENT


Diseth (2003) compared intelligence and academic achievement of adolescent boys and girls of IX and XI class. The results of the study showed that there was no significant difference in students of class XI in their academic achievement among intellectually superior and intellectually very superior boys and girls; at other intellectual levels the academic achievement of girls was superior to that of boys. The intelligence test scores of boys were much higher than those for the girls. Boys showed very high correlation between intelligence test scores and academic achievement whereas in the case of girls there was an average correlation.

Roeyers and Armand (2003) conducted a study on attitude towards mathematics enhance mathematical problem solving. The effectiveness of attitude towards mathematics was assessed in an elementary school setting. Two hundred thirty-seven 6th grade children were randomly assigned. Study revealed that there is a positive correlation was found between attitude towards mathematics and problem solving ability and positive attitude towards mathematics enhanced mathematical problem solving.

Hill (2005) examined the effects of teachers’ mathematical knowledge for teaching on students’ achievement of first and third grade students and this study explored whether and how teachers’ mathematical knowledge for teaching contributes to gain in students’ mathematics achievement. The findings revealed that teachers’ mathematical knowledge was significantly related to students’ achievement gains in both first and third grade after controlling for key student and teacher-level covariates.
James and Marice (2005) found that gender as an important predictor variable for problem solving ability and significant gender difference in problem solving ability. Boys were found excel than girls in their problem solving ability. There was a significant relationship between problem solving ability and reasoning ability in science. Moreover students hailing from urban areas excelled than rural areas in their performance in problem solving ability.

Regina and Michael (2005) conducted a study on the effect of attitude towards mathematics towards the problem solving ability in mathematics in high school mathematics. The performance of a group of grade 9 mathematics students trained to use a self-explanation procedure during study of a new theorem in geometry was compared with that of students who used their usual study procedures. Finding revealed that there was a positive effect of attitude towards learning mathematics on problem solving ability.

Sanjaiganthi (2005) examined problem solving ability of higher secondary students. Major findings of the study showed that the problem solving ability of the higher secondary students was low and there was significant difference in the problem solving ability with respect to gender, locality of school, type of management and medium of instruction. There was no significant difference in the problem solving ability with respect to religion, community and type of family.

Antonym (2006) conducted a study of the relation between reasoning ability and academic achievement of ninth standard students in mathematics in Krishna district and found that there was a positive correlation between reasoning ability and academic achievement in mathematics. Education of the parents brought significant difference in achievement of the students of the mother is educated in general.

Gnanandevan (2006) conducted a study of problem solving ability of higher secondary students found out that the problem solving ability of higher secondary students was low. The male and female students and the students residing was rural and urban area differ significantly in their problem solving ability. The higher secondary students belonging to nuclear and joint family were not differing in their problem solving ability.

Rani (2006) found in his study of the effectiveness of the synthetic and Polya’s heuristic approaches on the acquisition of problem solving skills in mathematics that Polya’s method was successful in inculcating the required problem solving skills in
the students. The major findings of the study revealed that the level of problem solving ability was average.

**Sobar (2006)** examined problem solving ability in relation to family, stress and sex of higher secondary school student’s and revealed that:

1. There was no significant difference between boys and girls in problem solving ability.
2. There was no significant difference among the students having high and low stress in their problem solving ability.
3. There was no interactional difference on the basis of sex and family stress in the problem solving ability.

**Vijayalakshmi et al. (2006)** studied the relationship between stress and mathematics achievement with the objective to study the impact of gender, year of study, management, medium of instruction, parental educational qualification on mathematics achievement of students by taking a sample of 180 students and found that there existed a negative and low correlation between students stress and mathematics achievement; gender, year of study, management, medium of instruction and level of parental educational qualification do not had any effect on mathematics achievement; students studying in urban locality colleges were having higher mathematics achievement when compared to semi-urban and rural localities.

**Lindsany (2007)** conducted a study on attitude towards learning mathematics and mathematical problem solving. The purpose of this study was to explore the role of attitude towards learning mathematics in the solution of mathematics problems. Fifty seven students of 10th class who scored high or low on a spatial orientation test were asked to solve mathematics problems in individual interviews. The findings were that there was a positive correlation between attitude towards learning mathematics and problem solving.

**Maxin, Wilkins and Jesse (2007)** investigated a longitudinal study entitled ‘Mathematics Coursework Regulates Growth in Mathematics Achievement’. The researchers examined the extent to which students’ mathematics Coursework regulates the rate of growth in mathematics achievement during middle and high school. Graphical analysis showed that students who started middle school with higher achievement took individual mathematics courses earlier than those with lower achievement. Immediate improvement in mathematics achievement was observed.
right after taking particular mathematics courses (regular mathematics, Pre-algebra, Algebra, Trigonometry and Calculus). The study showed the following results:

1) All mathematics courses added significantly to growth in mathematical achievement, although this added growth varied significantly across students.

2) Regular mathematics courses demonstrated the least regulating power, whereas advanced mathematics courses (Trigonometry, Pre-calculus and Calculus) demonstrated the greatest regulating power.

Sharma (2007) conducted a study on problem solving ability and scientific attitude as determinant of academic achievement of higher secondary students. The results of the study revealed that there was no difference in problem solving ability of boys and girls. The present school science curriculum was able to develop only average level of scientific attitude and problem solving ability among higher secondary students. A positive relationship was found among achievement, problem solving ability and scientific attitude.

Singh (2007) investigated the impact of caste and habitat on achievement in mathematics at primary school level. The main objectives of the study were:

1) To study the impact of caste on achievement in mathematics in eighth grade students.

2) To study the impact of gender on achievement in mathematics in eighth grade students.

3) To study the impact of habitat on achievement in eighth grade students.

The findings of the study revealed that:-

1) There was no significant difference in mean achievement score of forward caste and backward caste students. The mean score of forward caste students was higher than backward caste.

2) There was significant difference in mean achievement scores of girl and boy students in mathematics. Boys showed higher achievement in mathematics than girls.

3) There was significant difference in mean achievement score of urban and rural students in mathematics. Urban students showed higher achievement in mathematics than rural students.

Mehra et al. (2008) studied the effect of cooperative learning on achievement and retention in mathematics with different cognitive styles by taking a sample of 112
students of 7th grade and found that students when exposed to cooperative learning, yielded better mean gain on achievement and retention scores as compared to those taught through conventional group learning; field independent and dependent students yielded comparable mean gain on achievement scores but field independent students exhibited better retention than field dependent group of students; field independent and field dependent students yielded better mean gains on achievement and retention scores through cooperative learning than conventional group learning.

**Manoharan (2009)** conducted a study on problem solving ability in mathematics of IX standard students in Villupuram district. The objectives of the study were to identify the level of problem solving ability in mathematics of IX standard students and to find out the significant difference between the IX standard students in their problem solving ability regarding the background variables of sex, type of school, locality, subject group, extra coaching, community, parental educational qualification and parental occupation. The study revealed the following results:

1) Problem solving ability in mathematics of IX students was low. They did not possess the general ability of problem solving of any type in mathematics.

2) Type of school, locality, subject group and extra coaching had influence on problem solving ability in mathematics.

3) Sex had no influence on problem solving ability in mathematics.

4) Private schools, urban, computer science group students and students who went for tuition in mathematics had better problem solving ability in mathematics.

**Sisodia (2009)** conducted a study on the relationship between attitude towards mathematics and problem solving ability of 9th and 10th classes and suggested that there was no significant difference with respect to sex and locality in mathematical attitude in relation to problem solving ability.

**Tarim (2009)** investigated the effects of cooperative learning on preschool goers’ mathematics problem-solving ability. The study investigated the efficiency of cooperative learning on preschool goers’ verbal mathematics problem-solving abilities and to present the observational findings of the related processes and the teachers’ perspectives on the application of the programme. The study was an experimental study. The results of the study indicated that preschool goers in the experimental groups experienced more improvements in their problem-solving
abilities than those in the control group. Also, cooperative learning method can be successfully applied in teaching of verbal mathematics problem-solving skills during the preschool period. Preschool goers’ skills regarding cooperation, sharing, listening to the speaker and fulfilling individual responsibilities in group work improved. **Umadevi (2009)** studied the relationship between problem solving ability and academic achievement of secondary school students. The objectives of the study were to investigate the problem solving ability of IX standard students based on sex and type of school, to investigate the mean difference if any between the level of problem solving ability of IX standard students and their academic achievement and to investigate the relationship between problem solving ability and academic achievement of IX standard students. The findings indicated that there was no significant difference in problem solving ability of boys and girls. There was significant difference in problem solving ability of students studying in government and private schools and there was a significant relationship between academic achievement of students with high, moderate and low problem solving ability. **Ali (2010)** studied the effect of using problem solving method in teaching mathematics on the achievement of mathematics in students at elementary level. Pro test Post test design was used. Results were analyzed using mean, S.D. & t–test and from the findings it was observed that the use of problem solving method enhanced the achievement of students in mathematics. **Dharambir (2010)** conducted a study on attitude towards mathematics and problem solving ability of senior secondary school students of 10+1 and 10+2 and revealed that:

1) There was a significant positive relationship between attitude towards mathematics and problem solving ability of senior secondary school students.

2) There was a significant positive relationship between attitude towards mathematics and problem solving ability of senior secondary school boys and girls.

3) There was a significant positive relationship between attitude towards mathematics and problem solving ability of government and private senior secondary school students. **Mohd., Mahmood and Ismail (2010)** examined the level of patience and confidence towards problem solving and mathematics achievement of students in a technical
institute. The purpose of the study was to find out the relationship of the level of patience and confidence with problem solving and mathematical achievement among students from Malaysian institute of information technology. The research findings revealed that there was a significant relationship between the level of patience towards problem solving and mathematics achievement. The level of patience and confidence towards problem solving were medium. The findings also showed that there was no significant relationship between the level of confidence towards problem solving and mathematics achievement. Also, there was no significant relationship between overall level (patience and confidence) towards problem solving and mathematics achievement.

Parveen (2010) determined the effect of problem solving approach on academic achievement of students in mathematics at secondary level. The students of 10th class of a government girls’ high school, Rawalpindi, Pakistan were selected as a sample of study. The sample size consisted of 48 students who were equally divided into an experimental group and controlled group on the basis of pre-test. After the treatment, post test was used to see the effects of the treatment. A two tailed test was used to analyze the data which revealed that experimental group outscored the controlled group significantly on the post test. Problem solving approach thus had effect on academic achievement in mathematics.

Mohd. and Tengku (2011) studied the effect of attitude towards problem solving in mathematical achievements. The study aimed to find out the level of patience, confidence and willingness towards problem solving in mathematical achievement. The results showed that level of patience, confidence and willingness had impact on problem solving ability in mathematics. Also, there was significant contribution of overall attitude in problem solving to mathematical achievement. On the other hand, the finding showed that there was no significant relationship between gender & problem solving and mathematical achievement.

Nisha & Thomas (2011) conducted a study on problem solving ability and scholastic achievement of secondary school students. The findings revealed that there existed significant difference in the problem solving ability of secondary school students with respect to gender, locality and type of school. Boys showed higher problem solving ability than girls. Rural school students showed greater problem solving ability than the urban school students. Private school students showed higher problem solving
ability than government school students. Also, there existed high positive correlation between problem solving ability and scholastic achievement.

Jeotee (2012) examined reasoning skills, problem solving ability and academic achievement of final year university students. The purpose of the study was to investigate the influences of academic ability on reasoning skills and problem solving ability and vice versa. The data had been collected from 333 final year students. The result showed a significant relationship among reasoning skills, problem solving ability and academic achievement of final year university students.

Gupta (2012) studied problem solving in relation to sex and academic achievement and revealed that there were significant differences between problem solving among high and low achievers. The high achievers possessed higher level of problem solving ability in comparison to low achievers. The variables of sex and academic achievement were dependent on each other. There were significant differences in problem solving among high school students. Girls had higher academic achievement than boys.

Nizoloman (2013) conducted a study on relationship between mathematical ability and achievement among female secondary schools in Bayelsa state, Nigeria. This study was administrated on 262 female secondary students out of which 141 were female students from urban area and 141 students were from rural area. The findings of the study revealed that there was a positive and significant relationship between students’ mathematical ability and achievement in mathematics. Also, the students’ mathematical ability can significantly predict achievement in mathematics.

Bhat (2014) examined the effect of problem solving ability on the achievement in mathematics of high school students. Total 598 students of 10th grade were selected randomly from the different institutions of South Kashmir. The study focused on the following objectives:

1) To study the contribution of problem solving ability to achievement in mathematics of high school students.

2) To explore the contribution of problem solving ability to achievement in mathematics of high school male students.

3) To explore the contribution of problem solving ability to achievement in mathematics of high school female students.
The findings of the study revealed that 79% variance was contributed by the problem solving ability to achievement in mathematics. The study also revealed that 78.3% boys’ and 78.2% girls’ problem solving ability contributed to achievement in mathematics.

Nidhi & Singh (2014) studied problem solving ability and attitude towards mathematics as predictors of mathematical achievement. The study was intended to predict mathematical achievement of secondary school students on the basis of their problem solving ability and attitude towards mathematics. The sample of the study consisted of 200 students of 10th class from government schools of Ludhiana city. The results of the study showed significant positive relation between problem solving ability & mathematical achievement and between attitude towards mathematics & mathematical achievement. The prediction of mathematical achievement on the basis of problem solving ability and attitude towards mathematics was significant.

Stanly (2014) examined problem solving ability of IX standard students in Pondicherry region. The study revealed that no significant difference was found between the mean scores of problem solving ability of boys and girls students of IX standards. Mean scores of problem solving ability of government school students significantly differed from private school students of IX standards. The mean scores of problem solving ability of urban school students significantly differed from rural school students of IX standard. Also, the mean scores of problem solving ability of high achievers and low achievers differed significantly.

Gupta, Pasrija & Kavita (2015) investigated the effect of problem solving ability on academic achievement of high school students. The descriptive method was used to collect the data. A sample of 250 students (165 males and 85 females) studying in 10th class of high schools of Rohtak district was selected randomly. ANNOVA supplemented t-test was applied for data analysis. The findings of the study revealed that problem solving ability had a significant effect on academic achievement of high school students. Further the female students performed better than male students. Also, no interactional effect of problem solving ability and gender was found on academic achievement of high school students.

Pathak (2015) studied the relationship between problem solving ability and academic achievement of pupil teachers. The study was conducted in Jabalpur district of Madhya Pradesh. Normative survey method was used to collect the data. Only female
students studying in the B.Ed. colleges constituted the population of the study. The study revealed the following results:

1) Problem solving ability was significantly and positively correlated with academic achievement of pupil teachers.
2) There was significant difference between science and arts pupil teachers.
3) There was no significant difference between art-commerce and science-commerce pupil teachers.

Bala and Shaafiu (2016) investigated academic achievement of secondary school students in relation to their problem solving and examination anxiety. The present study was conducted on 200 students (100 male & 100 female) of 10 different schools of Maldives. Also the sample was selected randomly only from the 9\textsuperscript{th} class students. The main objectives of the present study were:

1) To explore the relationship between academic achievement and examination anxiety.
2) To explore the relationship between academic achievement and problem solving ability.
3) To explore the relationship between examination anxiety and problem solving ability.
4) To explore the difference between female and male students’ academic achievement, problem solving ability and examination anxiety.

The study concluded that there existed no significant difference between male and female students in academic achievement, problem solving ability and examination anxiety. Also, there existed a positive correlation between academic achievement and problem solving ability and a negative correlation between examination anxiety and academic achievement. Also, a negative correlation between examination anxiety and problem solving ability was found.

Kannan, Sivapragasam, Senthilkumar (2016) examined problem solving ability in mathematics of IX standard students in Dindigul district, Tamil Nadu with respect to gender, type of school, locality of the student, extra coaching students, students of different communities, students whose parents had different educational qualifications and different occupations. A sample of 80 students of IX standard was selected randomly. The sample divided into government and private secondary schools. The findings of the study showed that the level of problem solving ability in mathematics
Chapter II

Review of Related Literature

of IX standard students was average. Significant difference in problem solving ability of IX standard students with respect to gender (boys & girls), locality of the student (urban & rural), extra coaching students (tuition & no tuition) was found and no significant difference between type of school (government & private) was found. Also, the results revealed significant differences in the problem solving ability in mathematics with respect to different communities, parents’ educational qualifications and occupations.

Darma (2017) studied improving mathematical problem solving ability through problem-based learning and authentic assessment of the students of Bali State Polytechnic. The research was conducted in Bali State Polytechnic, using the 2x2 experiment factorial design. The sample of this research was 110 students. The result of the analysis showed that the students facilitated with problem-based learning and authentic assessment models got the highest average scores compared to the other students, both in the concept understanding and mathematical problem solving. The result of the hypothesis test showed significantly: 1) there was difference of mathematical problem solving ability between the students facilitated with problem-based learning model and conventional learning model, 2) there was difference of mathematical problem solving ability between the students facilitated with authentic assessment model and conventional assessment model, and 3) there was interactional effect between learning model and assessment model on mathematical problem solving. In order to improve the effectiveness of mathematics learning, collaboration between problem-based learning model and authentic assessment model can be considered as one of the learning models in class.

Mareesh (2017) undertook the study meta-cognitive awareness in relation to attitude towards mathematics, problem solving ability and achievement in mathematics of higher secondary school students. The investigator had adopted normative survey method for the study. Random sampling technique was used to select the sample and 1000 higher secondary school students were selected randomly from 16 different schools of Cuddalore educational district of Tamilnadu as sample. The sample was drawn from different schools on the basis of some sub-variables such as gender, location and type of management of schools. The study revealed the following results:

1) The majority of higher secondary school students achieved average level of mathematical achievement. Majority of the girls, boys, urban, rural,
government, aided and self-financed higher secondary school students achieved average level of achievement in mathematics. There existed significant difference between mathematical achievement with respect to gender and there was no significant difference with respect to locality and management of school. Girls achieved more than boys in mathematics. Urban higher secondary school students achieved more than rural higher secondary school students in mathematics. And aided higher secondary school students achieved more than government and self-financed higher secondary school students in mathematics. Also, self-financed higher secondary school students achieved more than government higher secondary school students in mathematics.

2) The majority of higher secondary school students achieved average level of meta-cognitive awareness. Majority of the girls, boys, urban, rural, government, aided and self-financed higher secondary school students showed average meta-cognitive awareness. There existed significant difference between meta-cognitive awareness with respect to gender, locality and management of school. Girls showed more meta-cognitive awareness than boys of higher secondary school students. Urban higher secondary school students showed more meta-cognitive awareness than rural higher secondary school students. And self-financed higher secondary school students showed more meta-cognitive awareness than government and aided higher secondary school students. Also, aided higher secondary school students showed more meta-cognitive awareness than government higher secondary school students.

3) The majority of higher secondary school students had favourable attitude towards mathematics. Majority of the girls, boys, urban, rural, government, aided and self-financed higher secondary school students had favourable attitude towards mathematics. There existed no significant difference between attitude towards mathematics with respect to gender, locality and management of school. Girls showed more favourable attitude towards mathematics than boys. Urban higher secondary school students showed more favourable attitude towards mathematics than rural higher secondary school students. Aided higher secondary school students showed more favourable attitude towards mathematics than government and self-financed higher secondary
school students. Also, government higher secondary school students showed more favourable attitude towards mathematics than government higher secondary school students.

4) Majority of higher secondary school students achieved average level of problem solving ability. Majority of the girls, boys, urban, rural, government, aided and self-financed higher secondary school students achieved average level of problem solving ability. There existed significant difference between problem solving ability with respect to gender & management of school and no significant difference with respect to locality. Boys showed higher problem solving ability than girls. Urban higher secondary school students showed higher problem solving ability than rural higher secondary school students. And self-financed higher secondary school students showed higher problem solving ability than government and aided higher secondary school students. Also, aided higher secondary school students showed higher problem solving ability than government higher secondary school students.

5) Significant and positive relationship between achievement in mathematics and meta-cognitive awareness was found. All the sub-variables (boys, girls, urban, rural, government, aided and self-financing) showed positive and significant positive relationship between achievement in mathematics and meta-cognitive awareness.

6) Significant and positive relationship between achievement in mathematics and attitude towards mathematics was found. All the sub-variables (boys, girls, urban, rural, government, aided and self-finance) showed positive and significant relationship between achievement in mathematics and attitude towards mathematics.

7) Achievement in mathematics was significantly and positively correlated with problem solving ability. All the sub-variables (boys, girls, urban, rural, government, aided and self-finance) showed positive and significant positive relationship between achievement in mathematics and problem solving ability.

8) Significant and positive relationship between meta-cognitive awareness and attitude towards mathematics. All the sub-variables (boys, girls, urban, rural, government, aided and self-finance) showed positive and significant positive
relationship between meta-cognitive awareness and attitude towards mathematics.

9) Meta-cognitive awareness was significantly & positively correlated with problem solving ability and all the sub-variables (boys, girls, urban, rural, government, aided and self-financing) showed positive and significant positive relationship between meta-cognitive awareness and problem solving ability.

10) Significant and positive relationship existed between problem solving ability and attitude towards mathematics. All the sub-variables (boys, girls, urban, rural, government, aided and self-finance) showed positive and significant relationship between problem solving ability and attitude towards mathematics.

11) There was significant prediction by the variables (Meta-cognitive awareness, attitude towards mathematics and problem solving ability) about the achievement in mathematics.

12) There was significant prediction by the sub-variables (boys, girls, urban, rural, government, aided and self-financing) about the achievement in mathematics.

2.2 STUDIES RELATED TO MATHEMATICAL ATTITUDE AND MATHEMATICAL ACHIEVEMENT

Nicolaidou and Philippou (2001) conducted a study on attitude towards mathematics, self-efficacy and achievement in problem-solving of primary school students. The aim of the study was the exploration of the relationship between gender, students’ attitude towards mathematics, self-efficacy beliefs and their performance in problem-solving. The results of the study showed that there existed significant correlation among attitude towards mathematics, self-efficacy beliefs and problem-solving. However, the correlation between self-efficacy and performance in mathematics was stronger than correlation between attitude towards mathematics and performance in mathematics. It was also found that the male students reported higher self-efficacy, more positive attitude towards mathematics and problem solving than female students. But there was no significant difference between male and female students about attitude towards mathematics, self-efficacy and problem-solving.

Hannula (2002) examined the tendency of parents’ attitude towards mathematics. The findings of the study indicated that negative attitude towards mathematics was common among most of the parents and they believed mathematics to be hard to
understand and tried to avoid it for their children as far as possible. The study also revealed that performance in mathematics does not depend on sex difference; due to different factors at secondary school level boys perform better than girls and girls make more mistakes than boys at secondary school level. Female students frequently have lower perception of competence and lower performance in mathematics than male students.

**Githua & Mewing, (2003)** favoured a wide recognition that affective factors played critical role in teaching and learning of mathematics. Mathematics self-concept was one of the factor that influence students’ achievements in mathematics and this factor related to their motivation to learn mathematics. Besides these, mathematics anxiety was an influential variable among elementary to high school students. The researchers noted that parental involvement in school and home is important in motivating students to perform better in mathematics. Parents are good role models. The researchers also noticed that there existed a positive relationship between parental involvement and students’ motivation as students are encouraged by where they see their parents take active interest in school.

**Duetscher (2003)** supported that parents’ involvement in school activities is essential for the success of the school objectives. Parents have a lot to contribute to their children do their home work by providing proper study area, help them with their difficulties, supervising time for home work.

**Mehera (2004)** studied the achievement at secondary level with the objective to assess the students’ achievement in mathematics, the nature of major learning environment, scientific attitude and attitude towards the subject. The researcher conducted the present study on sample of 600 students of urban and rural areas of Burdwan district in West Bengal and found that achievement in mathematics was significantly related to the learning environment. Urban students showed significantly higher achievement in mathematics than the rural students. The study also revealed that better learning environment and better attitude towards mathematics led to good academic scores. There existed no significant difference in achievement of mathematics of male and female students.

**Ngailiankim (2005)** studied the attitude and study habits related to achievement in mathematics of IX class students in Shillong. The major finding of the study was that
there was no significant difference between the attitude towards mathematics of students grouped high, average and low in mathematics achievement.

**Vijayalakshmi (2005)** conducted a study on the relationship between attitude towards studying mathematics and mathematics achievement among intermediate students. The findings of the study were that 60% of the students are feeling high had positive attitude towards studying mathematics in the total sample. From the analysis it was concluded that there existed negative and low correlation between students’ attitude towards studying mathematics and mathematics achievement; male students had more positive attitude towards studying mathematics than female students; senior intermediate students had more positive attitude towards studying mathematics than junior intermediate students; management, medium of instruction and locality of the college did not have any effect on attitude towards studying mathematics; students having highly educated fathers had more positive attitude towards studying mathematics.

**Gering and Natalie (2006)** investigated the factors that influenced attitude to mathematics of sixth grade students. They investigated current mathematics attitude of students and how these attitudes correlated to personal mathematics achievement and identified intelligence domain. On the basis of their study they discovered that nineteen percent students had a negative attitude towards the subject of mathematics. As a result of their research, they clearly saw the need for gifted students to be shown important connections between mathematics and its utility outside the context of school. They suggested supplementing the curriculum of school education with activities that actively engage students in mathematical interpretation and creative problem solving.

**Guru (2006)** conducted a study on attitude towards studying mathematics of higher secondary students. The findings of this study were that attitude of higher secondary students towards studying mathematics was low; male and female higher secondary students differed significantly in their attitude towards studying mathematics; higher secondary students studying in government and private schools did not differ significantly in their attitude towards studying mathematics; higher secondary students studying in rural and urban schools differed significantly in their attitude towards studying mathematics.
Nirmala (2006) tried to find out the contributing factors and optimizing variables of academic achievement in mathematics. A sample of 900 students from higher secondary classes was selected randomly. The study showed that mathematics information processing skill, decision making skill and attitude towards mathematics had a significant contribution the academic achievement in mathematics. Among the five factors of information processing skill, surface disintegration and strategic study played a significant role in getting maximum aggregate marks in mathematics. All the five factors of decision making i.e. approach, internal, external, avoidance and quick, played a prominent role in maximizing the aggregate performance in mathematics.

Akpan (2007) examined attitude towards learning mathematics and problem solving for secondary school students. The objective of the study was to investigate attitude towards learning mathematics and problem solving. The subjects of the study were 820 junior secondary school students (512 males and 308 females) randomly selected from 20 schools in the 2006- 07 academic year. The major finding of the study was that there was a significant relation between attitude towards learning mathematics and problem solving for secondary school students.

Subratasaha (2007) conducted a study on academic achievement in mathematics in relation to cognitive styles and attitude towards mathematics. Results showed that the boys and girls differed significantly on all the three measures under consideration. The field independent boys excelled the field dependent boys significantly in their achievement in mathematics. Similarly, field independent girls also excelled the field dependent girls significantly.

Farooq and Shah (2008) undertook a study on students’ attitude towards mathematics. The researchers took 10th class in Lahore (Pakistan) for their study. They revealed that there existed no significant difference between male and female 10th grade school students in relation to confidence, usefulness and teacher perception in mathematics.

Noorjehan (2009) studied factors affecting academic achievement of IX standard students in mathematics. The study showed that factors like mathematical creativity, attitude towards mathematics, achievement motivation and a low level of anxiety influenced the academic achievement in mathematics at secondary stage.

Rajni (2009) examined mathematical attitude and cross gender identity in young adult males and females. The study aimed to investigate the relationship between
cross gender identity and mathematical attitude. A sample of 425 students (236 males and 189 females) was selected randomly. The study revealed that highly masculine females exhibited low mathematical attitude as compared to low masculine females. There was no significant difference between high and low feminine males on mathematical attitude.

Moenikia & Babelan (2010) undertook a study of simple and multiple relations between mathematics attitude, academic motivation and intelligence quotient with mathematical achievement. The statistical population involved the entire Ardabil province high schools students in 2008 (N = 33982). Out of these, 1670 students were selected as sample by using multiple cluster sampling. The results of the study showed that all of the variables correlates with each other significantly. Mathematical attitude, academic motivation, and intelligence quotient were statistically significant predictor of mathematical achievement.

Yee (2010) investigated students’ attitude towards mathematics and its relationship with achievement in Singapore. For this, mathematics achievement and attitude of 984 students were measured. The results indicated that students had positive attitude towards mathematics but lacked intrinsic motivation to do mathematics.

Mohamed and Waheed (2011) explored secondary level students’ attitude towards mathematics in selected schools of Maldives. A total of 200 secondary level students were selected randomly. The study revealed that the performances of the students in mathematics was low but the students’ attitude towards mathematics positively correlated with achievement in mathematics. The study also showed that there was no significant difference between male and female students’ attitude towards mathematics.

Arslan, Canlt and Sabo (2012) conducted a study on the effect of attitude, achievement and gender on mathematics education. The study revealed the following results:

1) There existed significant difference between attitude towards mathematics education of male and female students of 8th grade. Female students showed more positive attitude towards mathematics education than female students.

2) There existed no significant difference between attitude towards mathematics education of male and female students of 6th and 7th grade.
3) There existed significant difference between achievement in mathematics of male and female students of 7th and 8th grade. Female students had higher achievement in mathematics course than male students.

Mahanta and Islam (2012) conducted a study on 1057 secondary school students of Kampur district of Assam and the study revealed that attitude towards mathematics and achievement in mathematics were positively correlated.

Mohamed, Mustafa and Hamdan (2012) examined the factors that influence students’ achievement in mathematics: A case for Libyan students. This study was conducted to know about the key factors influencing Libyan students’ achievement in mathematics. The analysis of the study indicated that four factors: teaching practice, teacher attribution, classroom climate, students’ attitude towards mathematics influenced students’ achievement in mathematics. This study revealed that the highest correlation was found between teacher attribution and their characteristics and mathematical achievement. This implied that when teacher attribution and their characteristics improved, especially the experience of teachers, achievement of the students also rose. The result also showed that teaching practices positively influenced the students’ achievement. It was also indicated that the lowest but positive correlation was found between students’ achievement in mathematics and students’ attitude towards mathematics. There was a low level of negative relationship between students’ attitude towards mathematics and students’ anxiety in mathematics.

Mensah, Okyere & Kuranchie (2013) undertook a study students’ attitude towards mathematics and their performance: Does the teachers’ attitude matter? The study aimed to find out the influence of teachers’ attitude on students’ attitude. The sample for the study was 100 students and 4 mathematics teachers. The students were randomly selected while the teachers were purposively sampled. The study revealed a significant relationship between teachers’ attitude and students’ attitude toward mathematics. The study favoured that teachers’ positive attitude radiated confidence in students and hence made them develop positive attitude towards the learning of mathematics.

Michelli (2013) examined the relationship between attitude and achievement in mathematics among fifth grade students. This study was administered on 266 students. The study revealed that their existed a positive relationship between mathematical attitude and achievement. The study revealed the following results:
1) The most significant trait affecting achievement was extroversion; extroverted students were more outgoing and confident. Extroverted students had more confidence and they got higher score.

2) There existed positive relationship between extroverted students and their achievement in mathematics.

3) There existed significant difference between mean attitude scores of boys and girls in mathematics. The girls showed higher mean value about attitude towards mathematics.

4) There existed no significant difference between mean achievement scores of boys and girls in mathematics. Here also a significant difference was between scores of girls and boys as girls showed higher mean value about academic achievement in mathematics than boys.

5) Both girls and boys had positive correlation between attitude and academic achievement in mathematics.

Marchis (2013) conducted a study on relation between students’ attitude towards mathematics and their problem solving skills. The study aimed to know about the relation between primary school students’ attitude towards mathematics and their problem solving skills. The study revealed that there was quite a strong positive correlation between students’ attitude towards mathematics and their problem solving skills. Also, the results showed the necessity of developing a positive attitude towards mathematics among pre-service primary school teachers.

Mubeen, Saeed and Arif (2013) examined the attitude towards mathematics and academic achievement in mathematics among secondary level boys and girls. This study was conducted on 9th and 10th class secondary level students. The sample of the study consisted of 500 students (300 girls and 200 boys). The sample was selected randomly from two girls and two boys’ schools of Wah Cantt (Pakistan).

The main objectives of the study were as follow:

1) To examine gender differences in attitude towards mathematics and academic achievement in mathematics.

2) To find out the relationship between attitude towards mathematics and academic achievement in mathematics.

The results revealed no significant gender difference with respect to attitude towards mathematics and achievement in mathematics. The study also revealed that a positive
relationship was found between attitude towards mathematics and achievement in mathematics.

**Nongsiej (2013)** undertook a study on attitude towards mathematics in relation to the achievement of class XI students in Shillong. This study was based on descriptive method. Total 226 students of XI including 128 boys and 98 girls were selected randomly from 6 different higher secondary schools in Shillong town of Meghalaya state. The aim of the study was to explore the relationship between attitude towards mathematics in relation to the achievement. The results of the study depicted that no significant difference was found between girls and boys’ mathematical attitude and boys showed higher mathematical attitude than girls. Non-tribal students presented higher mathematical attitude than tribal students. Private unaided school students showed higher mathematical attitude than government school students. But there existed no significant difference between private unaided and private aided school students. Also, a positive correlation was found between mathematical attitude and mathematical achievement of class XI students of Shillong.

**Rai (2013)** investigated the attitude towards mathematics and study habits in relation to mathematical achievement of class X students in east and south Sikkim. The study was conducted in the east and south districts of Sikkim; 15 secondary and 12 senior secondary schools were selected randomly from east and south districts respectively. Total 820 students studying in class X were selected randomly. The results of the study depicted that:

1) The majority of students (male & female) had favourable attitude towards mathematics. The difference between mean scores of male and female students was negligible. High achievers in mathematics showed favourable attitude towards mathematics as compared to low achievers.

2) A large number of students (male & female) had good study habits. High achievers in mathematics showed that they had better study habits as compared to low achievers.

3) The majority of students (male & female) had average level of achievement. High achievers in mathematics showed more favourable attitude towards mathematics with respect to the wider applicability of mathematical concepts as compared to the low achievers.
4) There existed significant relationship between attitude towards mathematics and achievement in mathematics. This indicated that more favorable the attitude towards mathematics the higher will be the achievement in mathematics and the more unfavorable attitude towards mathematics, the lower will be the achievement in mathematics.

5) A significant relationship was revealed between study habits and achievement in mathematics. It indicated that the better the study habits, the higher will be the achievement in mathematics and the poorer the study habits lower will be the achievement in mathematics.

Abebe (2014) studied students’ attitude towards mathematics, mathematics achievement and factors affecting their learning mathematics in Adama city government secondary schools. There were three government secondary schools in this city. A sample of 346 students of grade 9 & 10 and 39 mathematics teachers from these schools was selected randomly. The findings of the study showed that there was significant difference on students’ attitude towards mathematics between government schools and private schools while no significant difference was observed between male and female students on attitude. On the other hand, there existed significant difference in mathematics achievement among the schools, between male and female in both grades 9 and 10. There was significant difference on factors affecting students’ learning mathematics among schools but family’s economic status, teaching method, peer pressure, sequence of content were some common problems that were observed in these schools.

Rao (2014) investigated academic achievement in mathematics in relation to cognitive style and attitude towards mathematics of upper primary school students. The study aimed:

1) To study the significance of gender differences in academic achievement in mathematics, cognitive style and attitude towards mathematics.

2) To study the gender-wise differences in mean scores of academic achievement in mathematics between the field dependent cognitive style and field independent cognitive style.

3) To study the gender-wise difference in mean scores of academic achievement in mathematics between the students with favourable attitude and unfavourable attitude towards mathematics.
The findings revealed that:

1) There were significant gender differences in academic achievement in mathematics cognitive style and attitude towards mathematics.

2) There was significant difference between boys having field independent cognitive style and boys having field independent cognitive style towards their academic achievement in mathematics.

3) There was significant difference between girls having field independent cognitive style and girls having field dependent cognitive style towards their academic achievement in mathematics.

4) There was significant difference between boys having favourable attitude towards mathematics and boys having unfavourable attitude towards mathematics based on their academic achievement in mathematics.

5) There was significant difference between girls having unfavourable attitude towards mathematics based on their academic achievement in mathematics.

Muthulakshmi and Veliappan (2014) conducted a study on high school student’s attitude towards mathematics. The objectives of study were to find out whether there were any significant differences in attitude towards mathematics of high school students with respect to gender, locality of students and type of school. The sample of the study was 120 IX standard students from six schools of Triunelveli district. The study revealed that there was no significant difference in attitude towards mathematics of high school students with respect to gender. The result also indicated that female students showed more favourable attitude towards mathematics than male students. Also, there was no significant difference in attitude towards mathematics of high school students with respect to locality and urban students showed more favourable attitude towards mathematics than rural students. There was no significant difference in attitude towards mathematics of high school students with respect to type of school; government high school students showed more favourable attitudes towards mathematics than non-government school students.

Deep (2015) studied problem solving ability and mathematical attitude as determinants of mathematics achievement. The study was conducted in Jagraon Tehsil of Ludhiana district. The study was based on descriptive survey method. The sample comprised 200 studentst of 10+1 class (100 boys and 100 girls) of government senior secondary schools of Jagraon. The study showed a significant positive
relationship between problem solving ability & mathematics achievement and mathematical attitude & mathematics achievement. Problem solving ability and mathematical attitude significantly predict mathematics achievement. Also, conjointly prediction of mathematics achievement significantly higher as compared to their separate prediction for adolescents.

Lee & Anderson (2015) explored the gender differences in mathematics attitudes in coeducational and single sex secondary schools. Data were collected from students in a single-sex boys’ school, a single-sex girls’ school and a coeducational school. Total 1229 students (706 males & 523 females) were taken as sample. The study revealed that attitudes towards mathematics were clearly divided into three distinct groups. The most positive group was the single-sex girls’ school, followed by the single sex boys’ school and the coeducational school. The differences between each of these groups were statistically significant. When the coeducational school was split into two further divisions of girls and boys, it was found that the coeducational boys were similar to (albeit slightly more negative than) the single-sex boys, while the coeducational girls had significantly more negative attitudes than the coeducational boys. When the sample was taken as a whole, boys and girls had very similar attitudes towards mathematics. Students in single-sex settings had more favourable attitudes towards mathematics than those in coeducational settings.

Soni & Kumari (2015) studied the role of parental mathematical attitude in their childrens’ mathematics achievement. The purpose of the study was to investigate whether children’s’ mathematical attitude serves as an underlying pathway between parental mathematical attitude and their children’s mathematics achievement. A total of 482 students (251 females and 231 males) of the age ranging from 10 to 15 years (5th to 10th grade) and one of their parents (mother/ father) were selected as sample in the study. The results of the study indicated that fathers’ mathematical attitude contributed positively to their sons’ mathematical attitude and mathematics achievement as compared to mothers’ math attitude. On the contrary, mothers’ mathematical attitude positively influenced their daughters’ mathematical attitude and mathematics achievement in comparison with fathers’ mathematical attitude.

Zulekha & Aqil (2015) investigated mathematical achievement of 9th standard student in relation to their gender and attitude towards mathematics. The main aim of the study was to find out the attitude of students towards mathematics and also to see
the influence of gender and medium of instruction on mathematical achievement. The sample of the study consisted of 200 students of 9th standard divided equally among both genders and medium of instruction. The results showed that no significant difference was found between male & female and English medium & Hindi medium students of 9th standard on mathematical achievement. Also, no significant difference was found between CBSE & UP Board and favourable and unfavourable attitude towards mathematics among students of 9th standard on mathematical achievement.

Bhowmik & Banerjee (2016) explored the relationship between achievement in mathematics and attitude towards mathematics of secondary school students. The descriptive type methodology was employed in this study. The participants of this study consisted of 394 secondary (class ten) students from six different high schools. The findings of the study showed that in gender difference there existed significant difference in the students’ attitude towards mathematics, though there was not so significant difference in achievement in mathematics. Also, there was a significant positive correlation between attitude towards mathematics and achievement in mathematics.

Soleymani & Rekabdar (2016) examined the relationship between students’ self-efficacy in mathematics, mathematical achievement and having attitudes towards mathematics. Statistical population of this study was the students of Islamic Azad University, Abadan branch, in the field of Chemistry engineering, who registered for basic mathematics in the spring semester, 2015. A sample of 142 students (101 male and 41 female) were selected using cluster sampling method. The findings of the research showed that there was no relationship between attitude towards mathematics and mathematics achievement. There was a positive relationship between self-efficacy in mathematics and mathematical achievement.

Ajisuksmo & Saputri (2017) tried to find out the influence of attitudes on mathematics and meta cognitive awareness on mathematical achievement of high school students. In addition, this study examined gender differences on mathematical achievement. The respondents of this study were 103 students of a senior high school in Tangerang, Indonesia. The results of the study revealed that attitudes towards mathematics were significantly and positively correlated with students’ mathematical achievement. No significant correlations were found between meta cognitive skills &
mathematical achievement and between attitude towards mathematics & meta cognitive skills. The regression model was fit in predicting the contribution of attitudes towards mathematics and meta cognitive skills on mathematical achievement. However, looking at the p value of the t test, it was shown that the attitude towards mathematics contributed to the model, but not the meta cognitive skills. No significant difference was found on mathematical achievement.

Karjanto (2017) examined attitudes towards mathematics in relation to achievement in mathematics among the students of foundation year programme at Nazarbayev University. A sample of 108 students (55 males and 53 females) was selected randomly. The study revealed positive relationship between achievement in mathematics and attitude towards mathematics. Also, there was no significant difference between male and female students in terms of their attitude towards mathematics and achievement in mathematics.

Mohar-Schroeder, Jackson & Cavalcanti (2017) conducted a study on parents’ attitude towards mathematics: A quantitative study. The purpose of the study was to investigate parents’ attitude towards mathematics, their students’ attitude towards mathematics and the influence of parents’ attitude towards mathematics. Data analysis revealed statistically significant positive correlation between parents’ attitude and students’ attitude towards mathematics. Additionally, parents’ attitude towards mathematics significantly predicted students’ attitude towards mathematics. By understanding the influence of parents’ attitude on students’ attitude towards mathematics, school efforts can be geared towards fostering favourable attitude towards mathematics.

Simegu & Asfaw (2017) studied assessing the influence of attitude towards mathematics on achievement of grade 10 and 12 female students in comparison with their male counterparts in Wolkite, Ethiopia. The participants of the study were 240 grade 10 and 127 grade 12 students of general secondary and preparatory school in Wolkite Town. These students were selected using stratified random sampling technique. The results, showed that:

1) In both grade levels, the students had positive attitude towards mathematics but at medium level, however, the level of female students was less than males.
2) In both grade levels, no significant gender differences were found in attitudes towards mathematics but females showed greater decline in attitudes in terms of grade level.
3) Attitude towards mathematics and students’ achievement were significantly correlated in both 10 and 12 grade students.
4) Significant gender differences were found in achievement.
5) The regression models were fit in predicting the contribution of components of attitude towards mathematics scales on students’ achievement.

Davadas and lay (2018) investigated factors affecting students’ attitude towards mathematics: A structural equation modeling approach. The purpose of the research was to examine the inter-relationships between parental influences, teachers’ affective support and classroom instruction and effects of these factors on attitude towards mathematics using a partial least squares-structural equation modeling approach. A survey was carried out with a sample of 318 students from Sabah, Malaysia. The results showed that the structural model has moderate predictive relevance but the inter-relationships of the constructs in the structural model were significant. Teachers’ affective support and classroom instruction predicted attitude towards mathematics more than parental influences.

2.3 STUDIES RELATED TO MATHEMATICAL ANXIETY AND MATHEMATICAL ACHIEVEMENT

Funer and Berman (2002) listed accommodations for teachers to use, to help, prevent or reduce mathematical anxiety. An interesting point that study addressed was that of teachers overcoming their own math anxieties. The results of the study revealed that if teachers showed less mathematical anxiety then their students will be less mathematically anxious. Along with positive teacher support, in mathematical anxiety positive parental involvement also plays an important role. The more the parents are involved, the better the success rate of the students.

Sherman and David (2003) conducted a study on mathematical anxiety and mathematics achievement. The purpose of the study was to attempt to establish that mathematical anxiety does cause a deterioration of mathematical achievement. The researchers took five-year longitudinal study to know the relationship between mathematical anxiety and mathematical achievement. The study revealed that mathematical anxiety does not cause a deterioration of mathematical achievement.
There were some other factors like small working memory capacity, cognitive style etc. that were responsible for poor mathematical achievement.

Woodward (2004) examined the effect of mathematical anxiety on post-secondary adolescent students as related to achievement, gender and age. Woodward said that Students who are math-anxious complain of such things as nervousness, inability to concentrate, a black mind and a feeling of sickness when they are confronted with taking mathematical test. The study showed the following results:

1) There existed significant relationship between mathematical anxiety & achievement, between mathematical anxiety & gender and between mathematical anxiety & age. Also, the study revealed a significantly low relationship between examination scores and mathematical anxiety test scores. This indicated that as mathematical anxiety score increases, achievement score decreases.

2) There was no significant difference between mathematical anxiety with respect to gender. The results also indicated that female students had more mathematical-anxious than male students.

3) No significant difference was found between mathematical anxiety of traditional-aged students (greater than 25) and nontraditional-aged students (less than 25).

Brady and Bowd (2005) conducted a study on 238 primary pre-service teachers which indicated that the confidence of the pre-service teachers in teaching mathematics was related to their mathematical anxiety and their prior mathematics learning experiences at school level.

Ken Shores (2005) described how a mild case of mathematics avoidance can quickly turn into a severe case of mathematics anxiety. The researcher explained how the cycle begins with mathematics-anxious students, convinced of their inability to do mathematics. Such students might avoid the subject or put forth little effort, leaving significant gaps in their mathematics development. Difficulty mounts as the students confront more advanced skills, causing further anxiety and avoidance. Shores stated that unless mathematics anxiety is confronted, it can turn into a permanent block. Shores believed that in addition to the help and support from the students’ families, teachers can help chip away at this block by helping the students approach math with confidence.
Pan & Tang (2005) studied students’ perception on factors of statistics anxiety and instructional strategies. The study explored students’ experiences in a statistics class to investigate what factors contributed to students’ anxiety and how instructional strategies helped students learn statistics effectively. The study was conducted on graduate students studying in Midwest University. The study revealed that there were many factors like mathematics phobia, lack of connection to daily life, piece of instruction and the instructor’s attitude which contributed to statistics anxiety. Ensuring that multidimensional instructional method was used and that the instructor was paying attention to students’ anxiety were found helping in reducing students’ anxiety.

Bursal & Paznokas (2006) examined mathematical anxiety and pre-service elementary teachers’ confidence to teach mathematics and science. The sample consisted of 65 pre-service elementary teachers. The results indicated that low mathematics anxious pre-service teachers were more confident to teach elementary mathematics and science than their peers having higher levels of mathematical anxiety. Pre-service teachers’ mathematics anxiety was negatively correlated to their confidence scores to teach elementary mathematics. Also, pre-service teachers’ mathematics anxiety was negatively correlated to their confidence scores to teach elementary science. Personal mathematics and science teaching self-efficacy scores of the participants were found to be correlated.

Iossi (2007) conducted research to find out some strategies which could reduce anxiety considerably. It revealed that (a) strategies which are curricular, like retesting, self-paced learning, distance education, single-sex classes and mathematics anxiety courses (b) strategies which are instructional, like manipulation, technology, self-regulation techniques & communication and (c) strategies which are non-instructional, like relaxation therapy and psychological treatment were included among such anxiety reducing strategies. To prevent and reduce mathematics anxiety, some alternative instructional formats like problem solving, co-operative and process-oriented learning have been suggested. Methods which are based on constructivist models of learning like problem-based learning, inquiry-based learning and guided discovery learning are being tried to replace the behaviorist paradigm in the teaching of mathematics.
Shores and Shannon (2007) investigated the relationships between motivation, anxiety, self-regulated learning, attributions and achievement in mathematics of fifth and sixth grade students. A total sample of 761 students from fifth and sixth grade mathematics classrooms in Alabama was selected. The results of the study revealed that significant contributions were made by motivation and anxiety to mathematics grade of fifth grade students as well as sixth grade students. Specific factors such as self-efficacy, worry and failure were related to academic performance while failure attribution was significantly related to mathematics grade of fifth grade students. As for sixth grade students, specific factors such as intrinsic value, self-efficacy and worry significantly predicted motivation, anxiety, academic performance and mathematics grade.

Ganihar and Wajiha (2008) studied factors affecting academic achievement of IX standard students in mathematics and revealed that:

1) There was no significant difference between boys and girls’ mathematical achievement, mathematical anxiety and attitude towards mathematics. Girls showed higher anxiety than boys. But boys were higher in mathematical creativity achievement and attitude towards mathematics than girls.

2) English medium students showed better achievement in mathematics, mathematical creativity, attitude towards mathematics and achievement motivation as compared to Kannada medium students.

3) There was significant difference in achievement in mathematics, mathematical creativity, test anxiety, mathematical achievement and achievement motivation between students studying in aided, private schools and government schools. Aided and private school students showed higher scores than government school students.

4) Students of unaided schools showed higher mathematical creativity than aided school students.

5) Students of aided schools showed higher attitude towards mathematics as compared to students of unaided schools.

Hafner (2008) explored the relationship between mathematical self-efficacy, mathematical anxiety and achievement among a sample of eighth grade students. The main purpose of this study was to examine the mediating role that mathematical self-efficacy plays in the relationship between mathematical anxiety and achievement.
among eighth grade students. A correlation design was utilized in order to examine these relationships. Two self-reports were administered to the students in order to quantify levels of mathematical anxiety and math self-efficacy. The students’ most current grades in the subject of math were also incorporated into this study as the criterion variable. It was demonstrated that all the three variables i.e. mathematical anxiety, mathematical self-efficacy and achievement were significantly correlated. Regression analysis also revealed that mathematical anxiety was a significant predictor of achievement but mathematical self-efficacy mediated the relationship between mathematical anxiety and achievement.

**Sahin (2008)** investigated influence of gender, grade level, liking mathematics class, liking mathematics teacher, success in mathematics, achievement level in mathematics and mathematical anxiety level of Turkish school students of 4th and 5th grade. The results of the study indicated that the Turkish students of 4th and 5th grade had significantly different mathematical anxiety according to their gender, liking mathematics class, liking mathematics teacher and achievement level in mathematics. Female students showed higher level of mathematics anxiety than male students. Students who liked their mathematics teacher and mathematics class showed significantly lower mathematical anxiety and also successful students in mathematics reported a lower degree of mathematical anxiety.

**Jian-hua (2008)** conducted a study on correlative factors of math anxiety of the middle school students and revealed that mathematical anxiety had a great influence on mathematical achievement. Students with serious mathematical anxiety were usually led to psychological obstacles or psychological abnormality. Mathematical anxiety of middle school students was much negatively related to mathematical achievement. He also found that students of 2nd grade in junior high school had more serious mathematical anxiety than the students of other grades.

**Yuksel (2008)** studied mathematics anxiety among fourth and fifth grade Turkish elementary school students. The study investigated whether students’ mathematics anxiety differed significantly according to a group of variables. The sample consisted 249 students. Independent samples t-tests and one way analysis of variance were used for analysis of the data. The study revealed that students who liked mathematics class and those who liked their mathematics teachers had lower mathematics anxiety. Also,
students who had higher achievement in mathematics reported lower degrees of mathematical anxiety.

**Zakaria and Nordin (2008)** examined the effects of mathematical anxiety on matriculation students as related to motivation and achievement. The study included 88 students of matriculation who were at the end of their second semester of study. The result showed that the mean achievement scores and motivation scores of low, moderate and high anxiety were significantly different. A low but significant correlation was found between mathematical anxiety and achievement. Also, a strong, significant and negative correlation was found between mathematical anxiety and motivation. The study also revealed a significantly low positive correlation between motivation and achievement.

**Karimi and Venkatesan (2009)** conducted a study on mathematical anxiety, mathematics performance and academic hardiness in high school students and revealed that:

1) Significant relationship was found between mathematical anxiety and mathematics performance of 8th class students.

2) Significant relationship was found between mathematical anxiety and academic hardiness of 8th class students.

3) Academic hardiness was significantly correlated with mathematics performance of 8th class students.

4) Significant difference was found between boys and girls in mathematical anxiety in relation to mathematics performance and academic hardiness of 8th class.

**Olatunde (2009)** explored the relationship between mathematical anxiety and students’ academic achievement in selected schools in South-Western Nigeria. A sample of 1750 senior secondary school students was selected from two secondary schools in each of the senatorial districts in South-western part of Nigeria. The Descriptive Survey method was used to collect the data. The findings of the study revealed that many of the students with respect to gender, locality and school administration were afraid of mathematics because of fear of mathematics subject and the fear of failing tests in mathematics. Significant difference was found between mathematical achievement and mathematical anxiety with respect to gender, locality
and school administration. The findings also showed that the majority of the students did not know how to study for mathematics test.

**Beilock, Gunderson, Ramirez and Levine (2010)** examined a study on female teachers’ mathematical anxiety which affects girls’ mathematics achievement in the U.S.A. and researchers found that mathematics anxiety behaviour of elementary teachers negatively affected mathematics achievement of girls’ students. In the United States at the stage of early elementary school more than 90% school teachers were female and researchers provided evidence that these female teachers’ anxiety related to girls’ mathematical achievement and girls’ beliefs about who is good at mathematics. They measured these teachers’ anxiety and mathematical achievement of these teachers’ classrooms students. They also found that at the beginning of the school year there was no relation between teachers’ anxiety and their students’ mathematics achievement but at the end of the school year there existed significant relationship between teachers’ math anxiety and their girl student’s achievement

**Hoffman (2010)** conducted a study on ‘I think I can, but I am afraid to try: the role of self-efficacy beliefs and mathematical anxiety in mathematics problem solving ability’. The study explored the role of self-efficacy beliefs, mathematical anxiety and working memory capacity in problem solving accuracy (the ratio of problem solving accuracy to response time). The results of the study showed that there existed a significant relationship between self-efficacy and mathematics achievement related to efficacy outcomes. Mathematical anxiety was significantly and negatively correlated with problem solving ability.

**Sarsani et al. (2010)** studied achievement in mathematics of secondary school students with the objective to find out the differences in mathematics scholastic achievement test in relation to gender, caste, type of school, nativity and medium of instruction at secondary school level. The researcher took a sample of 480 students and found that girls performed better than boys in mathematics scholastic achievement test. Also caste did not influence the performance in mathematics scholastic achievement test. The study also showed that type of school, medium of instruction of school and locality influenced the performance in mathematics scholastic achievement test of secondary school students.
Hadley and Dorward (2011) found out the relationship among elementary teachers’ mathematics anxiety, mathematics instructional practices and students’ mathematics achievement. The results of the study were as follows:

1) There was a positive relationship between mathematical anxiety and anxiety about teaching mathematics. When elementary teachers were anxious about mathematics they showed more anxiety about teaching mathematics.

2) High anxiety about teaching mathematics was related to students’ low mathematics achievement.

3) Mathematics instructional practices and anxiety about mathematics were also significantly related. Teachers who were anxious about teaching mathematics tended to teach in traditional manner.

Mahmood and Khatoon (2011) conducted a study on the influence of school and students factors on mathematics achievement. This study examined the effect of school type, gender and mathematics anxiety on mathematics achievement. The result of the study showed that among the three independent variables: school type, gender and mathematics anxiety, school type had the greatest influence on mathematics achievement; mathematics anxiety came second in order while gender showed no significant influence. Also, the students of Missionary and Aligarh Muslim University’s schools had highest mathematics achievement in comparison to government and government-aided school students. Moreover, male students reported higher mathematics achievement than female students. The findings also revealed that there existed a negative correlation between mathematics achievement and mathematics anxiety.

Merritt (2011) investigated mathematics anxiety as it relates to mathematics achievement, gender and race in Mississippi district of South United State. This study was conducted on 7th grade students and revealed that mathematics anxiety and mathematics achievement were negatively related. As mathematics anxiety increased, measures of mathematics achievement decreased. The result of this study also suggested that mathematics anxiety is a general concern for all students. There were no significant differences in measures of mathematics anxiety of boys and girls and black and white students. This study also suggested that teachers should take time to identify students who have mathematics anxiety so they can assist the students by
implementing strategies and techniques to eliminate mathematics anxiety for those students who may benefit by higher mathematics achievement.

**Manisha (2012)** examined mathematical anxiety among secondary school students of Karnal district and revealed that the percentage of male and female students of government schools showed moderate to high level of mathematical anxiety as compared to percentage of male and female students of non-government schools. Female students showed more mathematical anxiety than the male students. Also government school students showed more mathematical anxiety than the non-government school students. The study also revealed that there was no significant difference in mathematical anxiety scores of male and female students of government and non-government schools.

**Ovez (2012)** conducted a study on the relation between mathematics anxiety and achievement of 5th, 6th, 7th and 8th grade. The researcher found that there were no significant differences between 5th, 6th, 7th and 8th grade students’ anxiety level for mathematics and also there was a negative relationship between mathematics achievement scores and mathematics achievement of 5th, 6th, 7th and 8th grade students.

**Rajashekar, Prathima and Swamy (2012)** studied achievement in mathematics of IX standards students in relation to locus of control and test anxiety and revealed that:

1) There were significant relationships between achievement in mathematics and locus of control & between achievement in mathematics and test anxiety of IX standard students.

2) There were no significant differences in achievement in mathematics between boys and girls, between government and aided schools, between government and unaided schools and between aided and unaided schools studying IX standard students.

3) There were no significant differences in achievement between low and high test anxiety, between low and moderate test anxiety and between low and moderate test anxiety of IX standard students.

4) There were no significant differences in achievement in mathematics between low and high locus of control, between low and moderate locus of control, between high and moderate locus of control of IX standard students.
Yaratan and Kasapoglu (2012) examined eighth grade students’ attitude, anxiety and achievement pertaining to mathematical lessons. The study aimed to investigate differences in attitudes, anxiety, and mathematical achievement due to gender, and school location; and to depict how well anxiety and attitudes towards mathematics determine students’ mathematical achievement controlling gender and school location. Attitude and anxiety scales were administered to 188 eighth grade students and the data collected was analyzed using t-test and multiple regression analyses. The results revealed significant differences in attitude, and in mathematics scores, but no significant differences in the anxiety scores with respect to gender, and location of schools. The regression model was considered as significant, and all of the predicting variables, the location of schools, gender, anxiety score and attitude score had significant contributions to the regression equation for mathematical achievement.

Zakira, Zain and Ahmad (2012) conducted a study on mathematics anxiety and achievement among secondary school students. The present study was conducted on 195 secondary school students of Malaysia. The researchers found there was no significant difference in the level of mathematics anxiety according to sex. There were significant differences in mathematics achievement between high and moderate anxiety, between high and low anxiety and between moderate and low anxiety.

Ajogbeje, James, Tunde and Borisade (2013) examined the effects of gender, mathematics anxiety and achievement motivation on college students’ achievement in mathematics. The study examined the relationship between college of education students’ math anxiety & achievement motivation, achievement motivation & mathematics achievement and mathematics anxiety & mathematical achievement. The findings of the study showed that a significantly low and negative correlation was found between mathematics anxiety and achievement motivation. Also, a positive and significant correlation was found between achievement motivation and mathematical achievement.

Memon (2013) explored the relationship between mathematics anxiety and mathematics achievement of grade 10 students across gender in single gendered government secondary schools in district Khairpur Mirs‘, Sindh. The study was conducted on 6 government girls’ secondary schools and 6 government boys’ secondary schools in district Khairpur Mirs‘, Sindh. The results of the study indicated that there was no significant difference in mathematics anxiety of male and female
students. But, male students showed higher level of attitudinal anxiety as compared to female students and female students showed higher level of cognitive anxiety as compared to male students. Also, in mathematical achievement test male students showed higher scores than female. Mathematical achievement was not significantly correlated with mathematical anxiety. However, female students had higher level of mathematics cognitive anxiety, which might had negatively influenced their mathematics achievement.

Mondal, Mondal and saha (2013) investigated achievement differences in mathematics at secondary level in Birbhum district and the result of the study revealed that there existed significant difference in achievement in mathematics between male and female students of secondary level. The study also revealed that there existed significant difference in achievement in mathematics between urban and rural male students of secondary level. Also, there existed significant differences in achievement in mathematics of urban and rural female students of secondary level.

Sarah, Erick and Menon (2013) undertook a study on mathematics achievement and anxiety and their relation to internalizing & externalizing behaviour in a group of 366 second and third grade students. Mathematics achievement was not significantly correlated with internalizing behavior. There was a significant difference between mathematical achievement and externalizing behavioural problems with respect to gender. Girls showed stronger relation between mathematics achievement and externalizing behavioural problems than boys. Mathematical achievement was not correlated with mathematics anxiety. But, there was a negative correlation between mathematical achievement and mathematics anxiety. Children classified as mathematics learning disabled, low achieving and typically developing showed higher mathematics anxiety and low mathematics achievement as compared to normal children.

Mishra (2014) examined the relationship of academic achievement with teaching aptitude, attitude and anxiety in M.Ed. students. Teaching is a wholesome activity. The teacher’s personality factors are equally responsible for his/her effectiveness in the teaching and learning process. Much emphasis is given to the academic achievement of teachers there by ignoring the personality parameters. A sample of 296 M.Ed. students from the department and colleges of Education affiliated to Dr. Babasaheb Ambedkar Marathwada University, Aurangabad was selected randomly.
The study explored that teaching aptitude level and anxiety were significant predictors of the academic achievement score in M.Ed. students. A negative relationship was found between anxiety and academic achievement. 

**Mutodi (2014)** conducted a study to explore students’ mathematics anxiety levels at a selected tertiary institution in South Africa. The researcher examined the differences in mathematics anxiety levels according to gender, age and home language. The study involved 120 respondents (84 male and 36 female) selected randomly. The findings of the study showed that the respondents had high level of mathematics anxiety. Female students reported higher levels of mathematics anxiety than males.

**Andrews and Brown (2015)** explored the effects of mathematical anxiety on 80 freshmen students at a University in the southeastern United States. The researchers conducted an observational study using pre existing data from the Freshman Orientation Survey. The results of the study indicated that standardized test scores and mathematical anxiety had a moderate and negative relationship.

**Geist (2015)** examined training teachers’ attitude towards mathematics and try to find out how mathematics anxiety affects teachers while assessing their ability at mathematics. The study indicated that the teachers who were more confident were likely to use developmentally appropriate methods of teaching mathematics. The study also suggested that in-service training should take place to add a focus on teachers’ confidence in mathematics to enhance the mathematics outcomes for children and their ability and enjoyment of mathematics.

**Mutawah (2015)** investigated the influence of mathematics anxiety in relation to mathematical achievement of middle and high school students. The study aimed to investigate if there was a relationship between anxiety and underachieving in mathematics in Bahrain. Total 1352 participants from 14 middle and high schools of grades 8, 9, 10 and 11 were selected for the study. The results explored that grade 11 students had the highest mean mathematics anxiety score. The study found negative correlations between the level of mathematics anxiety and students’ perceived achievement. This means that the level of mathematics anxiety increases as the students’ mathematical achievement decreases. Also, the anxiety was the highest among those who perceived themselves as low achievers.

**Siebers (2015)** studied the relationship between mathematics anxiety and students achievement in middle schools. A sample of 381 middle school students was selected.
randomly from Northern Colorado. Further the sample was distributed as 116 students from 6th grade, 105 students from 7th grade and 160 from 8th grade. The result of this quantitative study showed there existed significant difference between mathematics anxiety and achievement. Students, who had high mathematics anxiety, had low mathematical achievement and vice-versa. Further, the result also showed the following findings:

1) 6th grade students showed less mathematical anxiety than 7th grade students.
2) 7th grade students had a higher level of mathematical anxiety compared to 8th grade students.
3) 6th grade students had the highest mathematics achievement across the middle school grades.
4) 8th grade students showed the lowest mathematics achievement compared to sixth and seventh grade.

Dagaylo-AN & Tancinco (2016) investigated the relationship between the level of mathematical anxiety and academic performance of the freshmen college students of the Naval State University. The study was conducted on 200 student-respondents. More than three-fourths of the students involved in the study aged between 16 and 18 years old. A total of 88 students were selected from the College of Engineering (COE) and College of Arts and Sciences (CAS). The remaining 112 students were selected from the College of Industrial Information and Communication Technology (CIICT) and College of Maritime Education (COME). The study indicated that almost one-half of the students were good at mathematics, 86 percent had favourable attitude towards mathematics and more than one-half of the students had average level of anxiety. On the part of the teachers, the study showed that, majority of the teachers was democratic in their approach in teaching mathematics. None of the teachers from the CIICT department used autocratic approach. Other teachers from other colleges sometime used democratic approach, sometimes used autocratic approach and sometimes used a combination of both.

Puteh & Khalin (2016) examined mathematical anxiety and its relationship with the achievement of secondary students in Malaysia. This study aimed to identify mathematics anxiety and its relationship with the achievement of Form Four Students in Perak Tengah district, Malaysia. The design of the study used quantitative method. A total of 190 Form Four students were selected as a research sample. The results
showed that the level of mathematics anxiety of the students were at moderate level. There existed no significant difference between the levels of mathematics anxiety of female students compared to the male students. A significant and negative relationship existed between students’ achievement and their mathematics anxiety. 

**Ramirez, Chang, Maloney & others (2016)** conducted a study on the relationship between mathematical anxiety and mathematical achievement in early elementary school: The role of problem solving strategies. The sample of the study was 564 students. Further the sample was divided as 256 students (139 girls and 117 boys) of first grade and 308 students (167 girls and 141 boys) of second grade. The results of the study showed that at elementary level students also felt anxiety about mathematics. They were found nervous some times. Mathematical anxiety negatively affected students’ mathematical achievement. The students who had higher working memory used advanced problem solving strategies. A compared to those who had higher math anxiety was negatively correlated to use advanced problem solving strategies. The researcher suggested that it is important for students to overcome their anxiety about mathematics and to make them comfortable about mathematical problems and also to motivate them to use a variety of problem solving strategies.

**Cargnelutti, Tomasetto & Passolunghi (2017)** undertook a study ‘how is anxiety related to math performance in young students? : A longitudinal study of grade 2 and grade 3 children’. The study was based on longitudinal analysis. The study investigated the early association between math anxiety and math performance in grades 2 and 3, by accounting for general anxiety and by further inspecting the prevalent directionality of the anxiety–performance link. The study revealed that link between anxiety-performance was significant in grade 3, with a prevalent direction from math anxiety to performance, rather than the reverse. An indirect effect of math anxiety in grade 2 on subsequent math performance in grade 3 was also found. Overall, the findings highlighted the importance of monitoring anxiety from the early stages of schooling in order to promote proficient academic performance.

**Kalsia (2017)** studied mathematical achievement of senior secondary school students in relation to academic anxiety. The present study was carried out to investigate the significance of relationship between mathematical achievement and academic anxiety of senior secondary school students. A sample of 200 students of 11th (Non-Medical) class from government/ government aided senior secondary schools of Ludhiana.
district from the state of Punjab was selected randomly. The results of the study revealed that an inverse relationship was found between mathematical achievement and academic anxiety of senior secondary school students. More specifically, as the level of academic anxiety increases, mathematical achievement decreases and vice-versa.

**Vakili & Pourrazavy (2017)** compared mathematical anxiety of secondary school female students in groups (Science and Mathematical Physics) Public Schools, district 2, city of Sari. The sample size was considered 320 secondary school female students in groups (Science and Mathematical Physics) Public Schools, district 2, city of Sari. Simple random sampling method was used to select research sample. Data collection methods included library and observation. The statistical technique used in the research included Kolmogorov-Smirnov test and Pearson correlation and t-value of two independent groups. The results showed a difference between mathematical anxiety among students of mathematics and science. According to the average score of students' mathematical anxiety, the researchers found out that students’ mathematical anxiety in science was more than in mathematics. There was an inverse relationship between mathematical anxiety and students’ achievement. Students, who had high mathematical anxiety, had lower achievement.

**Gunderson, Park, Erin & others (2018)** investigated reciprocal relations among motivational frameworks, mathematical anxiety and mathematical achievement in early elementary school. The study was conducted on 1st and 2nd grade’s 634 students. The investigators assessed motivational framework, mathematical achievement and mathematical anxiety 2 times in 6 months’ duration. The study was an experimental study. The investigators found a negative relationship between mathematical anxiety & mathematical achievement and motivational frameworks & mathematical achievement. Motivational frameworks predicted higher mathematical anxiety. High mathematical achievement was a particularly strong predictor of lower mathematical anxiety and less motivational frameworks.

**Shishigu (2018)** investigated the prevalence of mathematics anxiety and its effect on students’ current mathematics achievement. The study was conducted on five randomly selected public secondary schools of East Shoa Zone in Oromia region. Mathematics anxiety was measured using a validated instrument called Math Anxiety Rating Scale (MARS), whereas students’ current mathematics achievement was
measured using achievement test. Structural model was developed to examine causal relationship of the variables treated in the study. The finding revealed that there was a significant negative relationship between mathematics anxiety and achievement. There was also a statistically significant gender difference in mathematics anxiety and current mathematics achievement.

The conclusion of the above researches reviewed helped the researcher to formulate hypotheses and determine the methodology for the present study. The researcher reviewed survey based studies in the context of mathematical achievement of secondary school students as a dependent variable by taking problem solving ability, mathematical attitude & anxiety of secondary school students as independent variables. Also, the literature was reviewed about the dependent variable and independent variables in the context of some moderating variables like sex, locality and school type. The review showed that problem solving ability, mathematical attitude & anxiety had great impact on mathematical achievement. The majority of studies showed significant positive relation of mathematical achievement with problem solving ability and mathematical attitude. Also, all over the world a negative or neutral relation of mathematical achievement with mathematical anxiety was revealed. Mathematical anxiety caused low mathematical achievement; on the other hand, problem solving ability and mathematical attitude greatly supported mathematical achievement with respect to all the moderating variables. On the basis of the review, it can be said that good & practical teaching methods, good evaluation tools, giving projects to the students, group work etc. help reduce mathematical anxiety and promote mathematical achievement of the students.

After reviewing the literature, the researcher could not find many studies on secondary school level students with the variables: mathematical achievement, problem solving ability, mathematical attitude and mathematical anxiety. Therefore, there was a need to carry out this study on secondary school students. Keeping in view the problems of the students regarding performance in mathematics, the researcher selected this problem to study.

The present study was attempted to fill the gap that had not been investigated by the other researchers’ i.e. mathematical achievement in relation to problem solving ability, mathematical attitude & anxiety of secondary school students.