5.01. INTRODUCTION:

The investigator has undertaken a study on Achievement in Mathematics, Metacognitive Awareness, Attitude towards Mathematics, and Problem Solving Ability among higher secondary students. On the basis of the analysis of data collected through distribution of Achievement in Mathematics, Metacognitive Awareness Scale, and Attitude towards Mathematics, Problem Solving Ability and to the samples of 1000 higher secondary students. The following findings have been arrived.

5.02. MAJOR FINDINGS OF THE STUDY

DESCRIPTIVE ANALYSIS

ACHIEVEMENT IN MATHEMATICS

- The Achievement in Mathematics of higher secondary students is average.
- The level of Achievement in Mathematics of higher secondary students with regard to subsamples is average.

METACOGNITIVE AWARENESS

- The Metacognitive Awareness of higher secondary students is average.
- The level of Metacognitive Awareness of higher secondary a student with regard to sub-samples is average.
ATTITUDE TOWARDS MATHEMATICS

- The Attitude towards Mathematics of higher secondary students is more favorable.
- The level of Attitude towards Mathematics of higher secondary students with regard to sub-samples is more favorable.

PROBLEM SOLVING ABILITY

- The Problem Solving Ability of higher secondary students is average.
- The level of Problem Solving Ability of higher secondary students with regard to sub-samples is average.

DIFFERENTIAL ANALYSIS

ACHIEVEMENT IN MATHEMATICS

- There is significant difference in the Achievement in Mathematics between the boys (30.14) and girls (30.90).
- There is significant difference in the Achievement in Mathematics between the rural (30.13) and urban (30.86) Residential Area of the students.
- There is significant difference in the Achievement in mathematics between the rural (30.24) and urban (30.86) Locality of the school.
- There is significant difference in the Achievement in Mathematics between the Tamil (30.25) and English (30.91) medium students.
- There is no significant difference in the Achievement in Mathematics based on Management of the school students.
There is no significant difference in the Achievement in Mathematics based on religion.

There is no significant difference in the Achievement in Mathematics based on community.

There is no significant difference in the Achievement in Mathematics based on Father’s Literary Level.

There is no significant difference in the Achievement in Mathematics based on Mother’s Literary Level.

There is no significant difference in the Achievement in Mathematics based on Father’s occupation.

There is no significant difference in the Achievement in Mathematics based on Mother’s occupation.

There is no significant difference in the Achievement in Mathematics between the joint family (30.29) and nuclear family (30.65).

**METACOGNITIVE AWARENESS**

- There is significant difference in the Metacognitive Awareness between the boys (172.43) and girls (172.88).
- There is significant difference in the Metacognitive Awareness between the rural (172.34) and urban (172.91) Residential Area of the students.
- There is significant difference in the Metacognitive Awareness between the rural (172.35) and urban (173.01) Locality of the school.
- There is significant difference in the Metacognitive Awareness based on Management of the school students.
• There is significant difference in the Metacognitive Awareness between the Government (172.03) and self finance (172.03) school students.
• There is significant difference in the Metacognitive Awareness between the Tamil (172.34) and English (172.07) medium students.
• There is significant difference in the Metacognitive Awareness based on Father’s Literary Level.
• There is significant difference in the Metacognitive Awareness between the students whose Father’s Illiterate (172.27) and College Education (172.19).
• There is no significant difference in the Metacognitive Awareness between the Government (172.03) and Aided (172.56) school students.
• There is no significant difference in the Metacognitive Awareness between the Aided (172.56) and self finance (172.03) school students.
• There is no significant difference in the Metacognitive Awareness based on religion.
• There is no significant difference in the Metacognitive Awareness based on community.
• There is no significant difference in the Metacognitive Awareness between the students whose Father’s are Illustrate (172.27) and School Education (172.68).
• There is no significant difference in the Metacognitive Awareness between the students whose Father’s School Education (172.68) and College Education (172.19).
• There is no significant difference in the Metacognitive Awareness based on Mother’s Literary Level.

• There is no significant difference in the Metacognitive Awareness based on Father’s occupation.

• There is no significant difference in the Metacognitive Awareness based on Mother’s occupation.

• There is no significant difference in the Metacognitive Awareness between the joint (172.59) and nuclear family (172.69).

**ATTITUDE TOWARDS MATHEMATICS**

• There is significant difference in the Attitude towards Mathematics based on Father’s occupation.

• There is significant difference in the Attitude towards Mathematics between the students whose Father’s coolie (226.30) and Government (225.05) employee.

• There is significant difference in the Attitude towards Mathematics between the students whose Father’s private (225.81) and Government (225.05) employee.

• There is no significant difference in the Attitude towards Mathematics between the boys (225.55) and girls (225.79).

• There is no significant difference in the Attitude towards Mathematics between the rural (225.33) and urban (225.95) Residential Area of the students.
• There is no significant difference in the Attitude towards Mathematics between the rural (225.51) and urban (225.86) Locality of the schools.

• There is no significant difference in the Attitude towards Mathematics based on Management of the school students.

• There is no significant difference in the Attitude towards Mathematics based on religion.

• There is no significant difference in the Attitude towards Mathematics based on community.

• There is no significant difference in the Attitude towards Mathematics based on Father’s Literary Level.

• There is no significant difference in the Attitude towards Mathematics based on Mother’s Literary Level.

• There is no significant difference in the Attitude towards Mathematics between the students whose Father’s coolie (226.30) and private (225.81) employee.

• There is no significant difference in the Attitude towards Mathematics based on Mother’s occupation.

• There is no significant difference in the Attitude towards Mathematics between the joint family (226.09) and nuclear family (225.48).
PROBLEM SOLVING ABILITY

- There is significant difference in the Problem solving ability between the boys (14.06) and girls (13.81).
- There is significant difference in the Problem solving ability between the rural (13.83) and urban (14.04) Locality of the schools.
- There is significant difference in the Problem solving ability based on Management of the school students.
- There is significant difference in the Problem solving ability between the Government (13.61) and Aided (14.04) school students.
- There is significant difference in the Problem solving ability between the Government (13.61) and self finance (14.12) school students.
- There is significant difference in the Problem solving ability between the Tamil (13.82) and English (14.07) medium students.
- There is significant difference in the Problem solving ability based on Father’s Literary Level.
- There is significant difference in the Problem solving ability between the students whose Father’s Illiterate (14.19) and School Education (13.85).
- There is no significant difference in the Problem solving ability between the rural (13.91) and urban (13.95) Residential Are of the students.
- There is no significant difference in the Problem solving ability between the Aided (14.04) and self finance (14.12) school students.
• There is no significant difference in the Problem solving ability based on religion.

• There is no significant difference in the Problem solving ability based on community.

• There is no significant difference in the Problem solving ability between the students whose Father’s Illiterate (14.19) and College Education (13.87).

• There is no significant difference in the Problem solving ability between the students whose Father’s School education (13.85) and College education (13.87).

• There is no significant difference in the Problem solving ability based on mother’s Literary Level.

• There is no significant difference in the Problem solving ability based on father’s occupation.

• There is no significant difference in the Problem solving ability based on mother’s occupation.

• There is no significant difference in the Problem solving ability between the joint family (13.86) and nuclear family (13.96).

**CORRELATIONAL ANALYSIS**

• There is significant positive relationship between the Achievement in Mathematics and Metacognitive Awareness.

• There is significant positive relationship between the sub-samples of Achievement in Mathematics and Metacognitive Awareness.
• There is significant positive relationship between the Achievement in Mathematics and Attitude towards Mathematics.

• There is significant positive relationship between the sub-samples of Achievement in Mathematics and Attitude towards Mathematics.

• There is significant positive relationship between the Achievement in Mathematics and Problem solving Ability.

• There is significant positive relationship between the sub-samples of Achievement in Mathematics and Problem Solving Ability.

• There is significant positive relationship between the Metacognitive Awareness and Attitude towards Mathematics.

• There is significant positive relationship between the sub-samples of Metacognitive Awareness and Attitude towards Mathematics.

• There is significant positive relationship between the Metacognitive Awareness and Problem Solving Ability.

• There is significant positive relationship between the Sub-samples of Metacognitive Awareness and Problem Solving Ability.

• There is significant positive relationship between the Attitude towards Mathematics and Problem Solving Ability.

• There is significant positive relationship between the sub-samples of Attitude towards Mathematics and Problem Solving Ability.
REGRESSION ANALYSIS

- There is significant prediction by the variables (Metacognitive Awareness, Attitude towards Mathematics and Problem solving ability) about the Achievement in Mathematics.
- There is significant prediction by the sub-samples about the Achievement in Mathematics.

5.03. DISCUSSION OF THE STUDY:

An attempt has been made to find out the level of Achievement in Mathematics, Metacognitive Awareness, Attitude towards Mathematics and Problem solving ability of higher secondary students in Cuddalore Districts. This study has also attempted to find out the relationship between Achievement in mathematics, Metacognitive Awareness, Attitude towards Mathematics and Problem solving ability with regard to the sub-samples. This study made an attempt to find out the effect of Metacognitive awareness, Attitude towards mathematics and Problem solving ability (Independent variables) on achievement in mathematics (Dependent variable).

- It is found that the level of Achievement in Mathematics of higher secondary students is average which is similar to the findings of Subrata Saha (2007) conducted a study on academic Achievement in Mathematics in relation to cognitive styles and attitude towards Mathematics, Usha (2003) make a study entitled as “A comparative study on school adjustment, self concepts
and achievement Mathematics of normal and hearing impaired higher secondary school students in the integrated system of education” and also similar to the findings of Prakash (2003) studied temperament and memory as determinants of Mathematics achievement and Shiny (2004) conducted a study of mental health and its relationship with achievement in Mathematics of higher secondary students.

- It is found that there is significant difference in Achievement in Mathematics with respect to gender, which is similar to the findings of Usha (2003) make a study entitled as “A comparative study on school adjustment, self concepts and achievement Mathematics of normal and hearing impaired higher secondary school students in the integrated system of education” and Alkatheeb (2001), Shiny (2004) conducted a study of mental health and its relationship with achievement in Mathematics of higher secondary students, and is contrast with the findings of Pandey et al. (2008).

- It is found that there is significant difference in Achievement in Mathematics with respect to locality, which is similar to the findings of Mittal (2008) studied academic achievement of secondary level students in relation to their mental health Usha (2003) and it is not agreed with the findings of Shiny (2004), Bhuvaneswari et al., (2004) studied the relationship between spatial ability and achievement in Science and Mathematics among high school children.

- It is found that there is no significant difference in Achievement in Mathematics with respect to family; residence which is similar to the
findings of Rajni (2006) conducted a study on Mathematics aptitude and Achievement in Mathematics and it is contrast with the findings of Soujanya Maya (2000).

- The present study revealed that the level of meta cognition awareness is average which is similar to the findings of Panda (2005) studied the effect of cognitive style and adjunct question on learning from connected discourse, Geetanjali (2006) studied the academic achievement in relation to cognitive style and hemispheric style at the secondary stage.

- It is found that there is significant difference in the Metacognitive awareness with respect to the gender, residence, locality of school, medium of instruction which is similar to the findings of Malathi et al. (2006) studied the learning style of higher secondary Geetanjali (2006) studied the academic achievement in relation to cognitive style and hemispheric style at the secondary stage and Panda (2005) studied the effect of cognitive style and adjunct question on learning from connected discourse, Albert (2004) conducted a study of the relationship between cognitive style, gender, intelligent quotient and academic achievement of high school students and it is contrast to the findings of Parikh (2004) studied the relationship of cognitive style and academic achievement, Aruna et al. (2006) studied the influence of cognitive style, intelligence and classroom climate.

- It is found that there is significant difference in the Metacognitive Awareness with respect to the type of school which is similar to the findings of Malathi et al. (2006) studied the learning style of higher secondary students.
The present study found that the higher secondary student have more favourable attitude towards mathematics which is similar to the findings of Vijayalakshmi (2005) conducted a study on relationship between attitude towards studying Mathematics and Mathematics achievement among intermediate students and contrast to the findings of Lawrence (2007) conducted a study on the relationship between attitude towards learning Mathematics and academic achievement of B.Sc. Maths students, Quek Khiok Seng (2009) inferred that Students’ Attitudes toward Mathematics and Mathematics Learning.

Present study found that there is significant influence of male and female and rural, urban students in their attitude towards mathematics which is similar to the findings of Jiangming (2003) conducted a study on the attitude towards Mathematics and Mathematics Achievement, Hussain Waheed (2008) conducted a study on Secondary Students’ Attitude towards Mathematics in a Selected School of Maldives, Guru (2006) conducted a study on a study of attitude towards studying Mathematics of higher secondary students.

Guru (2006) conducted a study on a study of attitude towards studying Mathematics of higher secondary students and found that higher secondary students studying in government and private school do not differ significantly in their attitude towards studying Mathematics which is agreed with the present study findings.

Present study found that the level of problem solving ability among higher secondary students is average which is coincide with the findings of Rani
found in his study of the effectiveness of the synthetic and Polya’s Heuristic approaches on the acquisition of problem solving skills in Mathematics and contrast to the findings of Gnanandevan (2006) conducted a study of Problem Solving Ability of Higher Secondary Students found out that the problem solving ability of higher secondary students is low. Sanjaiganthi (2005) made a study on problem solving ability of higher secondary students.

- It is found that gender, locality of school, type of management and medium of instruction made significant effect in problem solving ability which is coincide with the findings of Vermeer (2000) conducted a study of motivation and gender difference sixth grade students in Mathematical problem solving behavior. Sanjaiganthi (2005) made a study on problem solving ability of higher secondary students, Gnanandevan (2006) conducted a study of Problem Solving Ability of Higher Secondary Students and contrast to the findings of of Sanjaiganthi (2005) made a study on problem solving ability of higher secondary students.

5.04. EDUCATIONAL IMPLICATIONS

The findings of the present study form the basis of some significant educational implications. The major finding of the study indicates that the Achievement in Mathematics of higher secondary students is average. So efforts must be taken to improve the Achievement in Mathematics. In order to achieve this, improved techniques of instruction need to be adopted. This can be in the form of
giving task-oriented assignments to students rather than subjecting them to the
dreary exposition of the subject which varies from one to another in this direction,
laying a strong foundation in standard XI especially in Mathematics and it becomes
very essential. In order to achieve this goal, more intensive training in the
methodology of teaching Mathematics is to be provided for teachers of
Mathematics so that there will be overall improvement in Achievement in
Mathematics.

Further girls are having higher level of Achievement in Mathematics than
their counterparts which implies that girls’ students work harder than boys. Urban
locality of school and urban locality students are having higher level of
achievement than rural students which shows that urban locality students work hard
and concentrate more on Achievement in Mathematics than rural students. English
medium students are having higher level of Achievement in Mathematics than
Tamil medium students which shows English medium students may grasp the
theoretical background very clearly than Tamil medium students.

Today in schools, there is little opportunity for systematizing skills and
construct theory from their knowledge. There is little encouragement and
assistance for such efforts. Thus, many students are unable to explain their
cognitive performance or to plan effectively. Students find it difficult to construct
meaningful theories of their own cognition. Providing learners with Metacognitive
knowledge and regulatory skills is important in many effective educational
programmes. However, the programmes in higher secondary schools should assist
students to understand the structure of theories and to use theories to systematize self-knowledge and apply that knowledge to self-regulation. In order to achieve that, teacher should find ways and means to model their own knowledge about their proficiency and how they regulate their performance.

Metacognitive Awareness and Metacognitive theorizing should be in parallel to the basic skills in instruction. By the age of four, children are able to theorize about their own cognition (Flavel et al., 1993; Montgomery, 1992). The depth and breadth of their theorizing continue to develop throughout their adulthood (Kuhn, 1989; Kung and Kitchener, 1994). There, reasonable degree of emphasis on Metacognition is needed from the time trainee joins the institute regardless of the level of competency.

The modern consumerist trend has gained its influence over the extrinsic motivation. It is essential that teachers should have courage, and exert influence on developing intrinsic motivation so that it will be enduring.

Learning of skill is the ability to use one’s knowledge effectively and readily in the execution of doing any particular activity competently. The need of the hour is to have students with multiple competencies. School programme should be embedded with lot of opportunities to enhance and sharpen their skills.

The finding of the present study reveals that Metacognitive awareness of the higher secondary students is average. This may be due to the lack of interest of
students and lack in the process of helping the students to aware of their thinking process.

Further girls students are having higher level of Metacognitive awareness than their counterparts which implies that girls students aware more about their Metacognitive level than male students. Urban locality of school and urban locality students are having higher level of Metacognitive awareness than rural students which shows that urban locality of school and urban locality students work hard and concentrate more on their Meta cognitive ability than rural students. Self-finance and English medium students are having higher level of Metacognitive awareness than their counterparts which shows self-finance and English medium students may grasp the theoretical background very clearly because of their meta cognitive awareness than Tamil medium government and aided school students.

The finding of the present study reveals that attitudes towards mathematics are more favorable among higher secondary students. Even though attitude is more favorable, that is not very much influence in the students’ performance. This may be due to the lack of interest in Mathematics. There may be deficiency in the Mathematics curriculum which fails to develop the Problem solving ability among higher secondary students.

Further, coolie fathers occupation students are having more favorable attitude towards Mathematics than their counterparts which implies that coolie father occupational are students mostly more eager to study well and work hard
which motivate them to have more favorable attitude towards Mathematics than their counterparts.

The finding of the present study reveals that Problem solving ability of the higher secondary students is average. This may be due to the lack of interest in Mathematics. There may be deficiency in the Mathematics curriculum which fails to develop the problem solving ability among higher secondary students.

Further, boys students are having higher level of Problem solving ability than girls students which implies that boys students having ability to solve a problem in a different way and use logical way for solving the problem. Urban students are having higher level of Problem solving ability than rural students which shows that urban locality students work hard and concentrate more on Achievement in Mathematics than rural students. Self-finance, English medium and illiterate father literary level students are having higher level of Problem solving ability which shows these students may grasp the theoretical background very clearly and apply the theoretical in apt manner.

5.05. RECOMMENDATIONS

On the basis of the findings from the analysis, the following recommendations are given below:

ACHIEVEMENT IN MATHEMATICS

In the present study, the level of Achievement in Mathematics of higher secondary students was studied by the investigator. The results showed that the
higher secondary students have average level of Achievement in Mathematics. Based on the research experience and findings of the study the following recommendations were given to improve the level of Achievement in Mathematics.

- The study reveals that achievement differs significantly in selected variables. Based on the achievement the teacher classifies the achievers and accordingly suitable remedial measures could be undertaken.

- Students should be allowed to clarify their doubts in mathematics and discuss about the difficult topics in the syllabus.

- Teacher should relate mathematics to real-life problems.

- The concepts of probability can be taught by using concrete manipulative methods.

- While teaching Mathematics, the teacher should use reference books in addition to the text books so that the students can get clarity about the concepts.

- Appropriate intervention programmes should be provided to enhance students’ performance and minimize their difficulties in learning.

- The ministry of education both at the centre and state level should take initiatives to provide adequate facilities like ideal class rooms, appropriate teaching aids, good library, fully equipped laboratory and adequate financial assistance to enhance the level of Achievement in Mathematics.

- Suitable techniques like team teaching should be adopted to increase the level of Achievement in Mathematics among students.

- Teaching method should be student-centered method.

- Special techniques like Abacus classes should be conducted in schools.
METACOGNITION AWARENESS:

In the present study, the level of Meta cognitive awareness of higher secondary students was studied by the investigator. The results showed that the higher secondary students have average level of Metacognitive Awareness. Based on the research experience and findings of the study the following recommendations were given to improve the level of Metacognitive awareness

- Educational activities and curriculum should be framed in such a way that it fulfills the needs of trainees. Thus, they become self motivated in teaching.
- Lesson plan format should be modified in the light of modified version of taxonomy of instructional objectives.
- Multiple skill development should be emphasized in demonstration classes.
- Though Metacognition begin from childhood and it continues to adulthood, it lacks clarity in the application of Metacognitive strategies in learning. Guide teachers should be well aware of the Metacognitive strategies in learning and acquisition of Metacognitive skills. And they should properly motivate the trainees.
- Measures should be taken for increasing the intrinsic motivation in teaching.
- Every effort should be made by training institutions to develop certain level of teaching competencies in teacher trainees.
- Adequate preparations and appropriate plan should be made before teaching practice so that every teacher trainee will be observed and evaluated by the guide teacher.
Teachers should provide opportunities for their students to become aware of cognition and to use their ability.

Educational activities and curriculum should be framed in such a way that it fulfills the needs of trainees. Thus, they become self motivated in teaching.

**ATTITUDE TOWARDS MATHEMATICS**

The results of this research indicated that the higher secondary students have more favorable Attitude towards Mathematics. So, the higher secondary students must be motivated and be given desirable atmosphere to develop more favorable Attitude towards Mathematics.

- The school may conduct seminars, group discussion and essay competitions on Mathematics to develop high attitude among higher secondary school students.
- Mathematics club and Mathematics association should be established in schools through which we can be committed towards the Mathematics by celebrating the days of Mathematicians that will create interest to make high achievement and favorable Attitude towards Mathematics.
- The ministry of education both at the centre and state level should take initiatives to provide adequate facilities like ideal class rooms, appropriate teaching aids, good library, and fully equipped laboratory to fostering the level of Attitude towards Mathematics.
- Suitable techniques like team teaching should be adopted to increase the level of Attitude towards Mathematics.
PROBLEM SOLVING ABILITY

The results of this research indicated that the higher secondary students have average level of problem solving ability. So, the higher secondary students must be trained to attain the ability to solve problems of higher level of difficulty.

❖ Teachers should provide opportunities for their students to become aware of using natural ability to solve the problem like puzzles, Sudoku, and fill in the blanks. Find the odd one should be conducted.

❖ Efforts to mastery the problem solving skills should be planned and implemented by the government through the modified curriculum.

❖ The problem solving ability of the students can be improved by conducting sufficient practice sessions to learn and master the ability to present solutions in a logical way and practicing the students to use the correct terminologies and accurate symbols.

❖ Teaching and learning Mathematics should not only emphasize basic knowledge and skills. Students should be exposed and taught problem solving directly through teaching and learning activities in the classrooms.

❖ The problem solving topic should be included in the mathematics curriculum.

❖ Problem solving ability should be developed right from the kindergarten stage of education.

❖ Development of the goals of school-based curriculum should imply the techniques that develop skilled problem solvers.

❖ Multiple skill development should be emphasized in demonstration classes.
5.06. SUGGESTIONS FOR FURTHER RESEARCH

The research suggests the following topics for further research.

- This study is limited to 1000 XI standard students Cuddalore educational district of region only. It can be extended to some other classes.
- This study has done on Achievement in Mathematics among higher secondary students in Cuddalore educational district only. It can be extended to other district also.
- This study was carried out by consider the achievement in Mathematics as a dependent variable and Metacognitive Awareness, Attitude towards Mathematics and Problem solving Ability are independent variables so, researcher may be carried out with some other independent variable.
- Effect of Metacognition and academic performance may be studied. Performance goal of teacher educators and their Metacognitive abilities may be attempted.
- Comparison of teacher trainee’s motivational skills may be investigated.
- Gap analysis of competencies of teacher trainees in government and private teacher training colleges could be done.

5.07. CONCLUSIONS

The present investigation pointed out that there is a high positive relationship between Achievement in Mathematics, Metacognitive Awareness, Attitude towards Mathematics and Problem Solving Ability. The level of higher secondary students’ level of Achievement in Mathematics, Metacognitive Awareness, Attitude towards Mathematics and Problem Solving Ability were average. The educationist, curriculum developer should make the curriculum students-centered. It should be life-centered and teachers may take a step ahead for betterment of the students’ performance in the academic Achievement in Mathematics.