CHAPTER V

SUMMARY, RESULTS, DISCUSSIONS AND SUGGESTIONS

5.1 Introduction

The researcher has carried out a survey on Influence of Metacognition and Critical Thinking on Academic Achievement of Higher Secondary Students. After the analysis of data it is necessary to sum up the important observations and findings. This chapter dishes out the major findings, interpretations, conclusions, recommendations and suggestions for further research.

5.2 Significance of the Study

The goals of education today is to equip young people with the knowledge, skills and other attributes needed for effective life-long participation in an evolving ‘digital knowledge society’. Schools are refocusing their operations to meet this goal, becoming more inclusive, flexible and dynamic. As society changes, the skills that students need to be successful in life also change. Basic literacy skills of reading, writing, arithmetic are no longer sufficient. Our students need to master those basic skills as well as read critically, write persuasively, think and reason logically and solve complex problems efficiently. A successful student must be adept at managing information, finding, evaluating, and applying new content understanding with great flexibility. This demands cognitive abilities and strategies. Metacognitive knowledge helps the student understand and believe about a subject matter or a task, and the judgements he/she makes in allocating cognitive resources as a result of that knowledge. Metacognitive controls include the approaches and strategies a student devises to achieve specific learning goals and the degree to which the learner organizes, monitors, and modifies those operations to ensure effective learning. Hence metacognitive strategies enable thinking processes and accelerate the thinking in the right direction to solve the problem easily; so this is needed for teachers as well as students.

The development of critical thinking is essential to equip the students to meet the challenges of modern times. Students who possess inquiry skills, discovery skills and critical thinking skills are capable of seeking out knowledge they need and apply it effectively for their use. So, it is essential for deeper learning. A critical thinker is able to deduce consequences from what he knows and he knows how to make use of
information to solve the problem, and seek the relevant sources of information. It is the ability to translate the thinking process into clear, persuasive, truthful language, which is carefully and logically crafted. Hence, it is of utmost importance that schools focus on the development of critical thinking skills among higher secondary students.

Academic achievement is commonly measured by examinations or continuous assessment but there is no general agreement on how it is best tested or which aspects are most important in procedural knowledge (skills) and declarative knowledge (facts). It is the outcome of education—the extent to which students have achieved their educational goals. It shows the achievement level of students. The term “academic achievement” refers to upward progress. From theoretical perspective, the term refers to the students’ average scores in achieving predetermined purposes from present condition toward ideal one. There are several effective factors on the students’ academic achievement. Indeed, learners with critical thinking and metacognitive skills learn many abilities and competencies which improve their effectiveness. Students can apply these skills directly to the particular subject being studied. This allows students to use the skills in a meaningful context and helps them learn the subject matter more deeply. Hence it is essential that teachers should apply their instructional strategies to integrate "learning to think" component into their curriculum which empower students to take responsibility for improving their thinking, learning and achievement.

So through this study, the investigator has proposed to determine the influence of metacognition and critical thinking on academic achievement of higher secondary students.

5.3 Title of the Study

The study under the investigation is stated as “Influence of metacognition and critical thinking on academic achievement of higher secondary students”.

5.4 Operational Definitions of the Terms

**Influence.** Influence refers to the impact of independent variables (metacognition and critical thinking) on dependent variable (academic achievement).

**Metacognition.** Metacognition is awareness and management of one’s own thinking process. It is about what one knows about one’s cognitive processes and how one uses these processes in order to learn and remember.
Critical thinking. Critical thinking is the ability to analyze and evaluate feelings and ideas in an independent fair-minded and rational manner.

Academic achievement. Academic achievement refers a specified level of one’s proficiency in academic work in school. An achievement test is essentially a tool or device of measurement that helps in ascertaining quantity and quality of learning attained in a subject of study or a group of subjects after a period of instruction by measuring the present ability of the individual concerned. In the present study, the investigator has delimits the academic achievement of students into only the biology achievement of XI standard higher secondary students.

Higher secondary students. Students studying in XI and XII standard are included in the higher secondary level of school education. Here the investigator has chosen only XI standard maths-biology and science group students studying in government schools, aided schools and unaided schools with state board syllabus.

5.5 Method
The investigator has used survey method for the present investigation.

5.6 Population for the Study
In the present study population consists of all the higher secondary students studying in government schools, aided schools, private and unaided schools in Tirunelveli, Tuticorin and Kanyakumari districts.

5.7 Sampling Technique
In the present study random sampling technique is adopted to select the sample.

5.8 Sample for the Study
The sample consists of 1005 students studying XI standard maths and science group in higher secondary schools situated in Tuticori, Tirunelveli and Kanyakumari district in Tamilnadu.

5.9 Tools Used
The investigator has used the following tools for data collection.
1. Metacognition Inventory (MCI) developed by Govil (2003).
2. Critical Thinking Inventory (CTI) constructed and validated by Rani and Porgio (2009) was adopted for the study.
3. Biology Achievement Test (BAT) developed and validated by the investigator and guide (2013).

5.10 Description of the Tools

**Tool 1: Metacognition inventory.** Metacognition inventory was prepared and standardized by Govil in the year 2003. The inventory contains 30 items with two components; a) knowledge of cognition and b) regulation of cognition.

*Reliability.* The investigator used test-retest method for establishing reliability of the metacognition inventory. It was found to be 0.91.

**Tool 2: Critical thinking inventory.** In the present study, to measure the critical thinking of the higher secondary students, the investigator has used adopted version of ‘Critical Thinking Inventory’ constructed and validated by Rani and Porgio (2009). It consisted of 64 items.

*Content validity.* To establish content validity, the tool was given to experts in St. Xavier’s College of Education, Palayamkottai. It is evident from the assessment of the experts that the items of the scale are directly related to the concept of critical thinking. The suggestions and corrections given by the experts were implemented in the tool. Thus the content validity of the tool was established.

*Concurrent validity.* For establishing concurrent validity the adopted tool was compare to another standardized critical thinking dispositions assessment scale developed by Ricketts (2003). The correlation co-efficient between two sets of scores was found to be 0.79.

*Establishing reliability.* The investigator used test-retest method for establishing reliability of the critical thinking inventory. It was found to be 0.89.

**Tool: 3 Biology achievement test.** The achievement test was constructed and validated by the investigator to measure the achievement index of XI standard biology students. This test consisted of 50 multiple choice type items. These items scored by awarding one mark for each correct answer and zero marks for each wrong answer.

*Pilot study.* A pilot study was conducted among 100 higher secondary students from three schools in Tirunelveli district namely, St. Ignatius’ Convent Higher Secondary School, St. Xavier’s Higher Secondary School, St. John’s Higher
Secondary School, Palayamkottai. The responses collected from the students were scored by the investigator for the purpose of item analysis.

**Establishing validity.** To establish content validity, the questions were given to experts in this field. Some statements were deleted and some were modified according to the suggestions given by the experts. The tool was given to a panel of experts in St. Xavier’s Higher Secondary School, St. Xavier College of Education and St. Ignatius’ Convent Higher Secondary School, Palayamkottai. The comments, language, suggestions, corrections, opinions, suitability and relevance of the experts were implemented in the tool. Thus, the content validity of the tool was established.

**Establishing reliability.** The investigator used test-re-test method for establishing the reliability of the test. The finalized tool was administered to hundred higher secondary students. After 10 days the same tool was administered to the same set of students. Then both the responses were scored. The co-efficient of correlation between the two sets of scores was calculated. The reliability co-efficient was found to be 0.82 Thus the reliability of the tool was established by test-retest method.

**5.11 Statistical Techniques Used**

For analyzing the data, the following statistical techniques were used. a) Mean, b) Standard deviation, c) ‘t’-test, d) ANOVA, e) Post ANOVA (Waller-Duncon), f) Chi-square analysis, g) Correlation analysis, h) Regression analysis and i) Factor analysis.

**5.12 Objectives**

For the present study the investigator had framed the following objectives:

**1.12.1 General objectives.**

1. To find out the level of metacognition, critical thinking and academic achievement of the higher secondary students.

2. To find out the significant differences, if any, in metacognition of higher secondary students with reference to background variables.

3. To find out the significant differences, if any, in critical thinking of higher secondary students with reference to background variables.
4. To find out the significant differences, if any, in academic achievement of higher secondary students with reference to background variables.

5. To find out the relationship between; 1) metacognition and academic achievement, 2) critical thinking and academic achievement of higher secondary students.

6. To find out the influence of metacognition and critical thinking on academic achievement of higher secondary students.

7. To find out the significant factor with positive loading of the variables namely metacognition, critical thinking and academic achievement of higher secondary students.

1.12.2 Specific objectives.

1.1 To find out the level of metacognition of higher secondary students.

1.2 To find out the level of critical thinking of higher secondary students.

1.3 To find out the level of academic achievement of higher secondary students.

5.13 Hypotheses of the Study

2. There is no significant difference in metacognition of higher secondary students with regard to 1) gender, 2) optional subject, 3) medium of instruction, 4) location of school, 5) type of family, 6) habit of reading newspaper, 7) internet users, 8) participating in cultural events, 9) type of school, 10) nature of school, 11) father’s education, 12) mother’s education, 13) father’s occupation, 14) mother’s occupation, 15) parental annual income and 16) hobbies.

3. There is no significant difference in critical thinking of higher secondary students with regard to 1) gender, 2) optional subject, 3) medium of instruction, 4) location of school, 5) type of family, 6) habit of reading newspaper, 7) internet users, 8) participating in cultural events, 9) type of school, 10) nature of school, 11) father’s education, 12) mother’s education, 13) father’s occupation, 14) mother’s occupation, 15) parental annual income and 16) hobbies.

4. There is no significant difference in academic achievement of higher secondary students with regard to 1) gender, 2) optional subject, 3) medium of instruction,
4) location of school, 5) type of family, 6) habit of reading newspaper, 7) internet users, 8) participating in cultural events, 9) type of school, 10) nature of school, 11) father’s education, 12) mother’s education, 13) father’s occupation, 14) mother’s occupation, 15) parental annual income and 16) hobbies.

5.1. There is no significant relationship between metacognition and academic achievement of higher secondary students.

5.2. There is no significant relationship between critical thinking and academic achievement of higher secondary students.

6.1. There is no significant influence of metacognition and critical thinking on academic achievement of higher secondary students.

7.1. There is no significant factor with positive loading of the variables namely metacognition, critical thinking and academic achievement of higher secondary students.

5.14 Delimitations of the Study

1. The present study is limited to higher secondary schools in Kanyakumari, Tirunelveli and Tuticorin districts.

2. The investigator studied only two dimensions of metacognition namely, knowledge of cognition and regulation of cognition.

3. The investigator studied only seven dimensions of critical thinking namely, analyticity, self confidence, inquisitiveness, maturity, open mindedness, systematicity and truth seeking only.

4. In the present study, the investigator has delimits the academic achievement of students into only the biology achievement of XI standard higher secondary students.

5.15 Results and Discussions

metacognition (102.38). This may be due to the fact that rural students have more exposure to real life problems than urban students. They have to use their own skills and strategies to solve their problems and attain their goals. This may help them
improve their knowledge of cognition. Moreover, their intimate contact with their family and group members, understanding oneself and others and their real world connections help them to organize their strategic knowledge effectively. This may help them to develop their cognition and metacognition. Similar to this result, Devaki and Pushpham (2011) found that rural school students had higher metacognitive ability than urban school students. But this finding is in contradiction to the study conducted by Rani and Govil (2013) and Titus and Annaraja (2011) which revealed that urban students were better in their knowledge of cognition, regulation of cognition and metacognition than their counterparts. Opra (2011) found that students who were taught using inquiry teaching method in the urban schools had better metacognitive skills than rural schools. The study conducted by Minikutty and Gopinath (2014) found that student teachers studying in teacher education college situated in rural areas and urban areas had equal level of metacognitive awareness in teaching.

2.5 There is no significant difference between nuclear and joint family higher secondary students in their knowledge of cognition, regulation of cognition and metacognition as a whole.

2.6 There is no significant difference between those who have the habit of reading newspaper and others who do not have the habit of reading newspaper higher secondary students in their knowledge of cognition, regulation of cognition and metacognition as a whole.

2.7 There is significant difference between internet users and non-users higher secondary students in their knowledge of cognition, regulation of cognition and metacognition as a whole. Further it is observed that, internet non-user are better than internet user higher secondary students in their knowledge of cognition (Mean=50.84), regulation of cognition (Mean=51.40) and metacognition (Mean=102.24). This may be due to the fact that large amount of information freely available on internet may handicap children’s genuine nature of reflection and thinking. Non-internet users use their cognitive skills to remember, recall and retain quickly and fairly. This may help them to have more metacognitive skills than their counterparts.

2.8 There is no significant difference between higher secondary students who are participating in cultural events and others who do not participate in cultural events in their knowledge of cognition, regulation of cognition and metacognition as a whole.
2.9 There is significant difference among boys, girls and co-education school higher secondary students in their knowledge of cognition, regulation of cognition and metacognition as a whole. While comparing the mean scores of schools, girls school students (Mean=50.42) are better than boys school students (Mean=48.17) in their knowledge of cognition. Further it is observed that, girls (Mean=51.66) and co-education school students (Mean=50.04) are better than the boys school students (Mean=47.61) in their regulation of cognition. Girls (Mean=101.78) and co-education school students (Mean=100.46) are better than the boys school students (Mean=95.78) in their metacognition.

3.7 There is significant difference between internet user and internet non-user higher secondary students in their analyticity, self confidence, inquisitiveness, maturity, open mindedness, systematicity, truth seeking and critical thinking as a whole. Further it is observed that, internet users are better than internet non-users in their analyticity (M=51.79) self confidence (M=51.30) inquisitiveness (M=52.73) maturity (M=51.75), open mindedness (M=51.25) systematicity (M=51.19), truth seeking (M=50.86) and critical thinking (M=360.87).

This may be due to the fact that children who access internet at home and outside which provides them with these wide range of educational, entertainment and social opportunities. Surfing in internet for learning provides wider knowledge. This may help them correlate and co-ordinate concepts and apply them in a meaningful way. This enables them to make learning more concrete, effective, interesting and vivid. Such kind of exposure provides a platform to improve their power of imagination and creativity. This may help them to be good at critical thinking skills.

3.8 There is significant difference between higher secondary students who are participating in cultural events and others who do not participate in cultural events in their analyticity, self confidence, inquisitiveness, open mindedness, and critical thinking as a whole. But there is no significant difference between higher secondary students who are participating in cultural events and others who do not participate in cultural events maturity, systematicity, and truth seeking. Further it is observed that, higher secondary students who are participating in cultural events are better than students who do not participate in cultural events in their analyticity (M= 50.66), self
confidence (M=50.57) inquisitiveness (M=50.66), open mindedness (M=50.49) and critical thinking (M=353.05).

This may be due to the fact that, participating in sports and cultural events opens a new avenue to develop their physical, social, emotional and cognitive skills. It gives an opportunity for children to interact with their peers, and an environment that can foster social support, security and self esteem. This may help them to be more self confident. Further, children who are participating in cultural events have a higher social competence, exert more social control and greater well being than their counterparts which improves their analyticity and inquisitiveness. Moreover, participating in cultural events develops teamwork, creative expression, self awareness, leadership, communication skills and social skills. This may help them to be open-minded and think critically.

3.9 There is significant difference among boys, girls and co-education school higher secondary students in their inquisitiveness. But there is no significant difference among boys, girls and co-education school higher secondary students in their analyticity, self confidence, maturity, open mindedness, systematicity, truth seeking and critical thinking.

While comparing the mean scores of girls (Mean=48.19), co-education (Mean=49.91) and boys (Mean=52.83) school higher secondary students in their inquisitiveness, boys school students are better than the girls and co-education school students. This may be due to the fact that the free atmosphere of the boy’s school stimulates to enjoy the complexities around them. And they are motivated to contrast and compare, analyze and dissect the day to day events. This exposure helps them have more inquisitiveness than their counterparts.

3.10 There is significant difference among government, aided and unaided school higher secondary students in their analyticity, self confidence, inquisitiveness and critical thinking. But there is no significant difference among government, aided and matriculation school higher secondary students in their maturity, open mindedness, systematicity, and truth seeking.

Further it is observed that, the aided (Mean=51.08) and unaided school students (Mean=50.85) are better than government school students (Mean=47.80), in
their analyticity. The aided (Mean=50.84) and unaided school students (Mean=50.13) are better than government school students (Mean=48.64) in their self confidence. The unaided (Mean=51.39) and aided school students (Mean=50.49) are better than the government school students (Mean=48.31) in their inquisitiveness. The unaided (Mean=353.53) and aided school students (Mean=353.45) are better than the government school students (Mean=342.38) in their critical thinking.

Aided and unaided school students are better than government school students in their analyticity and self confidence. This may be due to fact that aided schools management is laying emphasis on development of multiple competencies and take all possible efforts towards scholastic achievement of the students. Moreover, the teachers are forced to perform well and motivate their students to achieve their goals. This may help them improve their analyticity and self confidence. Unaided school students are better than government school students in their inquisitiveness and critical thinking. This may be due to the fact that unaided schools organize various programmes such as seminars, workshops, quiz contests and word puzzles frequently in the academic year. These brain storming sessions provide ample opportunity to develop their inquisitiveness and critical thinking.

3.11 There is significant association between fathers’ education and analyticity, inquisitiveness, maturity, systematicity, and truth seeking of higher secondary students. But there is no significant association between fathers’ education and self confidence, open mindedness and critical thinking of higher secondary students.

This may be due to the fact that children’s educational outcomes such as cognitive skills, grades and achievement are closely linked to their parents’ education. Educated fathers are being able to examine all the sides of an issue. Their greater flexibility in analyzing things and communicating them in a constructive way may encourage their wards’ inquisitiveness. Moreover, educated fathers’ enhanced household income; send their children to better schools and creating a supportive learning atmosphere at home may induce the critical thinking skills of their wards.

3.12 There is significant association between mothers’ education and analyticity, self confidence, inquisitiveness, maturity, open mindedness, systematicity, truth seeking and critical thinking of higher secondary students. This may be due to the fact that educated mothers have more enthusiasm about the career of their wards. Hence they
extend more involvement in their children’s learning in a consistent, organized and meaningful way. Their consultation in planning, implementation and evaluation of their educational programmes and activities may help their children perceive more critical thinking skills than their counterparts.

3.13 There is significant association between fathers’ occupation and inquisitiveness, maturity, systematicity, and critical thinking as a whole of higher secondary students. But there is no significant association between fathers’ occupation and analyticity, self confidence, open mindedness, and truth seeking of higher secondary students.

This may be due to the fact that parents in coveted positions can provide intrinsic motivation to their wards. They have high aspiration about their wards to achieve better lifestyle. So they are encouraging better home atmosphere to achieve the learning goals of their wards. Their conscious attempt, planned and purposeful strategy to arrive at a solution for everyday problems may influence and inspire their wards to acquire more critical thinking skills rather than their counterparts.

3.14 There is significant association between mothers’ occupation and analyticity, inquisitiveness, maturity, systematicity, truth seeking and critical thinking of higher secondary students. But there is no significant association between mothers’ occupation and self confidence and open mindedness of higher secondary students.

This may be due to the fact that most of the working mothers are competent, capable and skillful than their counterparts. They have better parenting skills too. Their critical outlook on various issues and finding solutions to them may influence their wards’ critical thinking skills.

3.15 There is significant association between annual income of parents and analyticity, self confidence, inquisitiveness, systematicity, truth seeking and critical thinking of higher secondary students. But there is no significant association between annual income of parents and maturity and open mindedness of higher secondary students.

This may be due to the fact that parents who have higher annual income may give much attention to the learning activities of their wards. They are willing to pave the way for extra-curricular activities outside the school to improve their children’s skills and abilities in a unique way. The exposure from such activities and volunteered initiative behaviour of their parents may enhance the critical thinking skills. This study
is in contradiction to Mary and Selvakumar (2013), pointed out parental monthly income did not influence critical thinking dispositions, except its dimension innovativeness. Karagoil and Bekmezci (2015) in their findings showed critical thinking of teacher candidates did not differ according to income level of parents.

3.16 There is significant association between hobbies and self confidence and inquisitiveness of higher secondary students. But there is no significant association between hobbies and analyticity, maturity, open mindedness, systematicity, truth seeking and critical thinking of higher secondary students.

This may be due to the fact that hobbies are the way to spend leisure hours in a meaningful and productive way. Spare time activities provide satisfaction for students’ curiosity and gregariousness. They collect new information, imitate and construct ideas during leisure time activities. This may improve their self confidence and inquisitiveness.

4. **Academic achievement of higher secondary students**

4.1 There is significant difference between boys and girls of higher secondary schools in their knowledge, understanding, application and academic achievement as a whole. Further it is observed that, girls are better than boys in their knowledge (M=22.70), understanding (M=19.67), application (M=18.40) and academic achievement (M=60.78). This may be due to the fact that girls are more apt to plan ahead, set academic goals and take effort towards achieving these goals.
students. These results are similar to those of Sasikumar (2014), Vijakumari and D’Souza (2014) and Jayaprabha and Kanmani (2014). The finding is further supported by Manivannan (2006) and Saroja (2012), who revealed that significant relationship exists between cognitive strategies and academic achievement of students.
at secondary level. Moreover, the findings of the study are supported by Yurdabakan (2011) who observed meaningful differences between both achievement and metacognitive knowledge levels of self- and peer assessment methods on students’ learning.

The finding of the study is in contrast to that of Antonyraj and Amalraj (2011), who found no significant relationship between cognitive style and academic achievement of outgoing undergraduate male students.

Hashemi (2014) revealed that meta-cognitive self-regulation strategy and the regulation of effort and academic achievement had a significant relationship. Devaki and Pushpham (2011) in their findings showed that there exists a positive correlation between metacognitive ability and academic achievement of chemistry of XI standard students. Narang and Saini (2013) in their findings showed that metacognition was significantly associated with academic achievement of adolescents.

**Relationship between Academic achievement and Critical Thinking of Higher Secondary Students.**

5.2 There is
All the findings in the present investigation point to the three variables namely Metacognition, Critical Thinking and Academic Achievement. Metacognition contributes to the excellent memory power and regulation knowledge for the higher secondary students. It may be noted that since the critical thinking is high, it leads to better content knowledge and highly impressive positive attitude towards students. Hence the academic achievement of higher secondary students will certainly vary with their metacognition and critical thinking.

5.16 Recommendations

On the basis of the findings the investigator has made the following recommendations:

1. It is found that a positive correlation exits between critical thinking and academic achievement of students. Hence the teacher should internalize critical thinking competencies among all sections of the students which will make them more self-directed, self-disciplined and self-monitored thinkers.

2. Teacher should implement the strategy ‘Think aloud’. It is an effective strategy for teaching and learning as students are encouraged to verbalize their inner speech while they think their way through a problem. This gives an opportunity to teachers to understand the thinking of students and observe how they process ideas, assimilate information, and the strategies they use while problem solving. It reveals valuable insights into student’s metacognition.

3. Regulation of cognition has a high correlation with academic achievement. Teachers can use Scaffolding technique which would provide support when first introducing a pupil to a concept, then reduce the support to ensure that the pupil continues to manage their learning autonomously.

4. Teacher should foster self reflection of students during and after learning experience. Encourage learners to critically analyse their own assumptions and how
this may have influenced their learning. It will help them to improve their knowledge of cognition.

5. Foster independent learning by asking learners to generate their own questions and answer them to enhance comprehension. This will help to improve their knowledge of cognition.

6. Special attention needs to be paid at home and in school to train the children for essential metacognitive ability. These are the skills that will help students learn how to learn.

7. Metacognition is the strong predictor of academic success. Teacher should provide sufficient opportunities for students to see how newly acquired skills can apply in their own learning process.

9. Teacher should create free and open learning situations which will allow the learners to learn by self-planning, self-monitoring, self-regulation and self-evaluation.

10. Teachers can adopt problem based learning and activity based learning in the classroom to improve the metacognitive skills.

11. For all age groups, metacognitive knowledge is crucial for efficient independent learning so teacher should pay more attention to forethought and self-reflection of students.

12. Teachers should give metacognitive training to their students; it will increase students’ critical self confidence and a sense of personal responsibility for their own development.

13. Create a metacognitive environment in schools and colleges. In such an environment teachers monitor and apply their knowledge, deliberately modeling metacognitive behaviour to assist students in becoming aware of their own thinking.

14. Teachers can implement collateral learning in the classroom. It helps to create a positive attitude on the part of students and can rely on the application of their knowledge and problem solving abilities rather than on memorized formulas.

15. To improve inquisitiveness, encourage students to participate in all aspects of class by