CHAPTER - I
INTRODUCTION AND CONCEPTUAL FRAMEWORK
‘I think therefore I am’ (Cognito ergo sum) – Rene Descrates

1.1 Introduction

Education gives a new and fine shape to man. It is through education imparted in schools where the desirable skills, attitudes and thinking patterns are promoted among children. Education is a never ending process of all round growth and development of children. It is an activity or a process which modifies the behaviour of a person from instinctive behaviour to human behaviour. It develops the thinking and reasoning power of an individual.

Developing children’s abilities is the main goal of education. Education is the glory and crown of an individual and it is the most powerful instrument they can bring about in the desirable changes in the social and economical and cultural, political spheres of life of the people. Hence each educational institution should produce educated, intelligent individuals who can think independently. To achieve this, the emphasis in education should shift from cramming information to stimulating critical thinking. Silberman (1970) rightly points out that ‘what tomorrow needs is not mass of intellectual men, but mass of educated men to feel and to act as well as to think’.

Rousseau (1761) speaks of the concept of education as acquisition of knowledge (cognition) and said that it is to facilitate the development of innate powers and capacities (wisdom of cognition). The knowledge and belief of the world i.e., cognition is only a means in education of mankind; it is not the end in itself as found in the modern education system. The outcome of education therefore is not acquisition of knowledge but the development of the self. This is truly the wisdom of cognition. Cognition means to know and refers to the mental activities involved in acquiring, processing and using knowledge (Boreham, 1994).

1.2 Cognition

Cognition is the process of discovering from impressions what is present in the world, and where it is. Cognition is information processing task. It is also defined as the power to sense environment and to respond to it. It is an important characteristic of living matter. It is a class of symbolic mental activities such as thinking, reasoning, problem solving and memory search. Cognition is simply ‘the act of knowing’. It is knowledge or belief about the world. This knowledge is stored in memory and it has

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an influence on how incoming stimuli are interpreted. This interpretation or change in behaviour thereby reflects the education of man.

Cognition is knowledge, knowledge is education and a man depicts in him the interrelation of the three. This relationship is defined through the present education system by applying ‘cognition’ as the word literally means and not by the ‘wisdom’ it stands for. However cognitive work is often invisible and cannot be directly observed. The challenge is helping students learn how to ‘go meta’ in regard to thought processes that are not directly visible in order to improve their cognitive performances. As children are life-long learners it is important to help them become aware of themselves as learners and to take control of their own activities.

Learning is a process developed within the individual throughout life. Learning is intuitive and everyone has the innate abilities to learn. Learning occurs when experiences cause a relatively permanent change in an individual’s knowledge or behaviour (Woolfolk, 1998). Learning assumes that there is a desired behaviour or knowledge or human performance that can be achieved through interaction with the environment. However, in order to be a successful learner, reflection, feedback and an awareness of one’s own knowledge is essential. If one is not aware of, or does not understand one’s learning process and studying strategies, it becomes difficult to handle and take control of one’s own learning. This awareness can be referred to as metacognition (Sasikumar, 2014). Students who are able to identify suitable learning strategies in the proper situation are using metacognition. Metacognition affects a student’s motivation to learn because it directly affects attribution and self-efficacy.

Effective learning is not just a matter of innate intelligence. Learning depends, in part, on the effective use of basic cognitive processes such as memory and attention, the activation of relevant background knowledge, and the deployment of cognitive strategies to achieve particular goals. To ensure that the basic processes are used effectively, that the activated knowledge is indeed relevant, and that appropriate strategies are being deployed, learners also need to have awareness and control of their cognitive processes. This higher level cognition is termed Metacognition. (Ramdiah and Corebima, 2014).

1.3 Metacognition

Metacognition is thoughtfulness. People engage themselves in metacognitive activities everyday. According to Flavell (1976), who coined the term, “metacognition” is a
regulatory system that includes (a) knowledge, (b) experiences, (c) goals and (d) strategies. It is the knowledge about cognition and control of cognition. It includes knowing when and where to use particular strategy for learning and problem solving as well as how and why to use specific strategies. It is the ability to use prior knowledge to plan a strategy for approaching a learning task; take necessary steps to problem solving, reflect on and evaluate the results, and modify one’s approach as needed. It helps learners to choose the right cognitive tool for the task and plays a critical role in successful learning.

Metacognition refers to awareness of one’s own knowledge—what one does and doesn’t, one’s ability to understand, control and manipulate one’s cognitive process. It is “an appreciation of what one already knows, together with a correct apprehension of the learning task and what knowledge and skills it requires, combined with the ability to make correct inferences about how to apply one’s strategic knowledge to a particular situation, and to do so efficiently and reliably” (Peirce, 2003).

Metacognition is the process of planning, assessing and monitoring one’s own thinking; the pinnacle of mental functioning. It is an awareness of one’s own thinking, awareness of the content of one’s conceptions, an active monitoring of one’s cognitive processes, an attempt to regulate one’s cognitive processes in relationship to further learning, and an application of a set of heuristics as an effective device for helping people organize their methods of attack on problems in general (Mathew and Joseph, 2013).

The two elements of metacognition are metacognitive knowledge and metacognitive regulation (Flavell, 1979).
judgement about a claim or argument. Hence it is the process of analyzing, synthesising, and/or evaluating the authenticity, accuracy and/or worth of information and arguments gathered through observation, experience, reflection and logical
reasoning. It is the ability to make evaluations and judgements based on logic and ideas, rather than on intrinsic value (Passi and Misra, 2004).

It is a thinking process that explicitly aims at well-founded or sound judgment and hence utilises appropriate evaluation standards in the attempt to determine the truth, worth, merit or value of something. According to Fisher (2006), "Learning to think critically means: i) Learn how to question, when to question and what questions to ask. ii) Learn how to reason, when to use reasoning and what reasoning methods to use".

Cuceloglu (1995) describes critical thinking as an “individual’s active and organized mental process for understanding the events around as by applying knowledge previously learned and taking others’ opinions into consideration”. Critical disposition is a characteristic of an individual and indicates one’s willingness to think. It is a pervasive and self rectifying human phenomenon. Critical thinking is a decision making mechanism that is self-regulative and goal oriented and includes not only interpreting, analyzing, evaluating and drawing conclusions but also evidence based conceptual, methodological, criterion-related or contextual interpretations (Facione, 2011). Facione considers thinking as both a skill and a habit of mind and one must be disposed to think critically as well as have the skills to do so.

Critical thinking is “the mental processes, strategies and representations people use to solve problems, make decisions and learn new concepts” (Sternberg, 2007). It is the ability to make and assess conclusions based on evidence. It describes an approach to thinking rather than one specific thinking skill. It is a type of thinking that helps a person in stepping aside from one’s own personal beliefs, prejudices and opinions to sort out the facts and discover the truth even at the expense of one’s basic belief system. In this way it represents a challenging thought process which leads a person to new avenues of knowledge and understanding (Smitha, 2009).

1.8.1 Nature of critical thinking. Critical thinking cannot be separated from emotions, desires and traits of mind. Failure to recognize the relationship between thinking, feeling, wants and traits of mind can easily lead to various forms of self deception, both individual and collective. A person without intellectual traits of mind will have weak critical thinking ability whereas a person with fair mental traits will have a strong sense of critical thinking. Thus critical thinking requires intellectual
humility, empathy, integrity, courage, autonomy, confidence and other intellectual traits. A person who thinks critically can ask appropriate questions, gather information efficiently and creatively, sort out this information, reason logically from this information and come to reliable and trustworthy conclusions about the world that enables one to live and act successfully in it (Gurubasappa, 2013).

Critical Thinking may also involve logical reasoning and ability to separate facts from opinion, examine information critically with evidence before accepting or rejecting ideas and questions in relation to the issue at hand. In other words, it makes individuals to think, question issues, challenge ideas, generate solutions to problems and take intelligent decisions when faced with challenges (Semil, 2006). There are five basic characteristics of critical thinking. The first one is that critical thinking requires to be active, the other one is that critical thinking requires to be independent,
think poorly is to learn poorly and to think well is to learn well. That means to say that to learn science one must think scientifically or to learn history one should think historically.

Critical thinking is an excellent tool for the teacher to help the students learn how to think rather than just what to think and is a tool that teachers can use to offer a new dimension of education to their student: that of thinking about questioning and exploring the concepts in the curriculum. Critical thinking is closely related to perception of practical intelligence, personal skills and competence whereas critical thinking skills are an important life skill for the gifted and talented leaner. By developing critical thinking skills on student learning, they will be made more compatible in every challenging and complicated situation in both learning and their life. When it becomes an integral part of a teaching-learning process, children learn to apply thinking skills throughout the curriculum as well as in their daily lives. Hence educational institutions should pave the way to promote critical thinking skills for higher academic achievement.

NCF 2005 also emphasised the importance of critical thinking skills to deal with the demands and challenges of every-day life. So instruction in the classroom should be geared toward developing these skills. Teachers have to develop their 'teaching for thinking' approaches and integrate them into everyday teaching to create thinking classroom and developing whole school policies to create thinking schools. (Singh and Rath, 2010).

Frequent use of open-ended questions during classroom discussions, allowing learners time to ponder the questions and group interaction-all encourage the development of critical thinking skills. This systematic approach to critical thinking presents a more organized method of managing a situation or learning experience that requires implementation of critical thinking skills. The thinker/learner can employ a system of skills and attitudes that allow the thinker to arrive at a sound conclusion.
The thinking classroom is all about the teaching of thinking. It is a place where critical and creative thinking counts. The thinking classroom holds that the quality of students learning depends on how well students who consistently tend to connect ideas to things they know about seek hidden explanation or think about the strengths and weakness in their thinking will help deeper understanding of subjects across the curriculum (Cherian, 2013).

1.10 Strategies for Developing Critical Thinking Skills

To develop good critical thinking skills, it is necessary to internalise principles and apply them to everyday situations. Suggested strategies for developing critical thinking skills are given below;

- set purposes for learning
- focus attention on the topic.
- knowledge and understanding is not gained through memorization.
- knowledge is constructed through thinking critically.
- monitor personal thinking.
- provide a context for understanding new ideas.
- summarize and interpret the main ideas.
- share opinion and make personal responses.

1.11 Elements of Critical Thinking

Critical thinking is thinking that assesses itself. It examines the elements of thought and is based on intellectual values that transcend the frame of reference of the thinker and the subject matter, purpose, implications and consequences of thinking. Scriven and Paul (1992) say that critical thinking has two elements. That is, i) a set of skills to process and generate information and ii) the habit of using those skills to guide behaviour.

1.12 Critical Thinking and Metacognition: An Indispensable Life Factors for Success

Critical thinking is correct thinking in the pursuit of relevant and reliable knowledge about the world. It includes all possible process of relative upon a tangible or intangible item or in order to form a solid judgement that reconciles scientific
evidence with common sense. It obviously is based on concepts and principles not on hard and fast procedures. Critical thinking is the ability to i) identify and formulate important questions and problems; ii) gather and assess information; iii) test proposed conclusions against relevant criteria and standards; iv) think within alternative systems of thought, assessing their assumptions, implications and practical consequences; and v) communicate effectively, without appealing to logical fallacies or manipulating others.

Critical thinking plays an important role in cooperative reasoning and constructive tasks to evaluate and improve one’s creative ideas. It helps to acquire knowledge, improve one’s own theories and strengthen argument which enhances work process and improve social institutions. It also gives the ability to not only understand what they have already read or been shown but also to build upon that knowledge without incremental guidance. It interrelates subject matter and cognitive strategies and skills, because it cannot be done meaningfully unless the student knows certain concepts and facts related fundamentally to the question under consideration. A successful critical thinker is also aware of differences in criteria and evidence used to justify prepositions in different subjects such as biology, history, economics and geography.

Metacognition is awareness of one’s own thoughts, one’s own knowledge concerning one’s own cognitive process related to them. Metacognition relies on fair amount of abstract thinking. The skills engaged are often highly representative and internalised. Metacognitive knowledge can be used to control cognitive processes. Students whose metacognitive skills are well developed are better problem-solvers, decision makers and critical thinkers, are more able and more motivated to learn, and are more likely to be able to regulate their emotions even in difficult situations, and cope with conflicts. Although metacognitive skills, once they are well-learned, can become habits of mind that are applied in a wide variety of contexts, it is important for even the most advanced adult learners to “flex their cognitive muscles” by consciously applying appropriate metacognitive skills to new knowledge and in new situations. Hence the metacognitive knowledge can enhance students’ performance on critical thinking and problem solving.

1.13 Need of Critical Thinking in Learning
Children learn in a variety of ways through experience, discussion, making and doing things, asking, thinking, reflecting and expressing oneself through speech or writing, listening and interacting with environment. Many students habitually fail to reflect on the reliability of the information to which they are exposed in everyday life, let alone pursue dissection of scientific literature. In such a situation students need critical thinking to evaluate it meaningfully. Critical thinking is so central to sound reasoning that it deserves special attention. It must be actively and skilfully applied. Practising critical thinking prompts thoughtful examination of the role of science in society. This is an important outcome of education and brings us closer to addressing the ‘Socratic dictum’. A good starting point in the development of critical thinking skills are authentic examples for meaningful learning to the student.

1.14 Significance of Science Curriculum in School Education

Effective science education is the need of the hour. Human thirst to acquire more knowledge for better life has been encouraging research in various branches of science and the results, discoveries and inventions in the twentieth century have been eye openers for humanity. Science, particularly biological science, assumes high importance. In India, there have been persistent efforts in this direction from the latter part of the twentieth century. Beginning from the Kothari commission 1964-66, every effort has been made to develop and upgrade science curricula. In the National Policy on Education (NPE) 1986, the National Curriculum Framework (NCF) for School Education-2000 and the NCF-2005 all have emphasised the need to promote science education. Biological science at the higher secondary school level occupies a significant place along with physical science. It requires a differential treatment so as to create genuine curiosity in learners towards the living world.

The scientific policy resolution of the government of India (1958) stated that “the dominating feature of the contemporary world is the intense cultivation of science on a large scale, and its application to meet the country’s requirements”. The primary goal of education should be the intellectual development of the individual. With its accelerating importance in our society science has become an increasingly important part of general knowledge. Science education is fostered as a part of general emphasis on intellectual activity. Science has become a compulsory subject in the school
curriculum because of its multifarious value to the individual as well as the society (Sharma, 2003).

1.15 Academic Achievement

In our society, academic achievement is considered as a major criterion to judge one’s potentialities and capacities. As such academic achievement occupies a pivotal role in education as well as in learning process. It is considered as a key criterion to judge a one’s total potentialities and capabilities. Therefore it is most pressing for the students to have high academic achievement. It represents performance, outcome that indicates the extent to which a person has accomplished specific goals that were the focus of activities in instructional environments, specifically in school, college and university. It is a key mechanism through which adolescents learns about their talents, abilities and competencies which are an important part of developing career aspirations (Lent, Brown and Hackett, 2000). In general, assessing student’s progress means identifying what he/she has achieved. Good (1973) defined academic achievement as “knowledge attained or skills developed in the school subjects, usually designated by test scores or by marks assigned by teachers, or by both”.

1.16 Science Education and Academic Achievement

Science education occupies an important place in an educational system. Science has its own discipline. It sharpens one’s intellect and makes one intellectually honest, and enables one to make critical observations and reasoning. It is a subject which broadens the horizon of the individual and develops various skills and provides opportunity for the professional growth of the individual. Science occupies an important position in teaching as well as research activities throughout the world.

Science education enables students to think critically, examine and evaluate their own reasoning processes and increase their base of information and life experience for success in a future career. Hence academic achievement occupies utmost importance in one’s life. Academic achievement is a very broad term which generally indicates the learning outcomes of the pupils in various subjects of
curriculum. In this process of achievement, there is change in behaviour; one cannot say that all pupils react at the same level of change during the same span of time. It is common practice to promote students from one class to another on the basis of academic achievement. It helps in declaring students successful or unsuccessful, choosing students for various courses and selecting students for different jobs. It is the level of learning in a particular area of subject in terms of knowledge, understanding, skill and application usually evaluated by teachers in the form of test scores in their annual examination. Out of a number of factors affecting academic achievement, metacognition and critical thinking are considered more crucial than others.

1.17 Significance of the Study

The goals of education today is to equip young people with 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. 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. Usually in classrooms some students are active, self directed learners who know how they learn and are able to apply what they know to various learning situations. Others may be average students who work hard and who have awareness of their learning strengths and weaknesses, but who may not adequately regulate their learning. Still others may be passive learners who have little awareness of how they learn and how to regulate their learning. In essence, teachers are faced with classrooms full of students who come to them with various levels of metacognitive skills. In such situation metacognitive awareness has pivotal role in learning.

Metacognition is generally the activity of monitoring and controlling one’s cognition. It stands what one knows about one’s cognitive processes and how one use these processes in order to learn and remember. Metacognitive awareness is the knowledge and beliefs about thinking and factors affecting thinking which regulate
the articulation of strategy and knowledge’ (Pressley, 2000). It enables the students to be able to work independently and flexibly. 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. Metacognition 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.

Metacognitive strategies are sequential processes to control cognitive activities and to ensure that a cognitive goal is achieved. It enables learners to play active role in the process of learning, to manage and direct their own learning and eventually to find the best ways to practice and reinforce what they have learned. This puts them in a privileged position to process and store new information and leads to better test performance, learning outcome, and better achievement (Zimmerman and Schunk, 2001). 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.

Today, where the focus of education is preparing global students, it is unfortunate that our classroom practices have remained as traditional as ever. This requires to be changed. Teacher should focus on student development and the understanding of their own thought process. The quality of learning is enhanced if students are taught to think critically. Development of critical thinking ability is essential for the students of science as it helps them in their future career in engineering, medicine, research and such other fields that have application of science. At the school level, science education can be improved by adopting suitable teaching methods that promote scientific attitude, knowledge of cognitive process and critical thinking.

Critical thinking makes students not only have sufficient knowledge or information about their area or expertise but also make decisions about society, politics, changing global issues and ethical challenges of daily life in the complex world. It provides precise and accurate solution to them. Hence the acquisition of critical thinking has become more than ever an undeniable necessity in the job market delinking with the physical and spiritual questions, evaluating ideas, people, policies,
institutions and ultimately facing social problems. The development of critical thinking skills produces intellectual and social competent citizens who effectively cooperate with other people and challenge real world problems (Glaser, 1985).

The notion of critical thinking raises more general questions about the nature of knowledge and reasoning. On the other hand, thinking and reasoning can be seen as highly embedded in knowledge and disciplinary contexts such that it is only worthwhile assessing critical thinking as it relates to particular knowledge areas such as psychology, history, science, mathematics, and art. Critical thinking is effective in that it avoids common pitfalls, such as seeing only one side of an issue, discounting new evidence that disconfirms one’s ideas, reasoning from passion rather than logic, failing to support statements with evidence, and so on. Critical thinking is novel in that one doesn’t simply remember a solution or a situation that is similar enough to guide the individual.

The development of critical thinking is essential to equip the students to meet the challenges of the 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 problems, and seek the relevant sources of information to inform him. 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 proposed to determine the influence of metacognition and critical thinking on academic achievement of higher secondary students.

1.18 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”.

1.19 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.

Higher secondary students. Students who are 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, aided and unaided schools with the state board syllabus.
1.20 Objectives

For the present study the investigator has framed the following objectives.

1.20.1 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, 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; a) metacognition and academic achievement, b) 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.

1.20.2 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.

1.21 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 user, 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 user, 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 user, 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 academic achievement and metacognition of higher secondary students.

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

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

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

1.22 Delimitations of the Study

1. The present study is limited to higher secondary schools in Tuticorin, Tirunelveli and Kanyakumari districts.
2. The investigator studied only two dimensions of metacognition namely, knowledge of cognition and regulation of cognition.

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

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.