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Introduction

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CHAPTER-1
INTRODUCTION

1.1 Back ground of the Study

Education is a field where knowledge passes through all walks of life from person to person with varying degrees. It helps an individual to move towards the goal set and it may be said that people reach their goal by following clear cut paths. It also forms basis for civilization and cultural behaviour of the society.

Education brings much covetable intellectual impact to idiosynchronisation in thinking towards the framing of new parameters that governs a powerful future. It provides a solid foundation to seed the multidimensional development of information and communication skills, thinking and problem solving skills, interpersonal and self directional skills, entrepreneurial skills, and self direction to equip the learners to build a good career and leadership in the present globalize scenario. Youdel, (2011) reported that education is a state and societal endeavor with programme of study and recognizable modes of teaching, learning and assessment. As one of the most crucial factors in the development of a nation, education is expected to enrich people with the knowledge and skills to improve their lives and with the values and attitudes to live together. The goal of any education intervention is to ensure that the targeted beneficiaries participate in the programme and also achieve the expected literacy and numeric skills, higher order mental skills related to thinking and reasoning abilities; life skills, values and develop emotional intelligence (Sankar,2010).
Education plays a major role in shaping up the future of children. Proper education provided to children can, not only help them achieve good career but also help in the betterment of society. It is the quality education which can turn an ordinary child into an extraordinary individual. Education must aim not only to provide literacy but also in overall development of a child personality. Quality education must aim on fulfilling the special learning needs of children. Children need to be taught in a way they can enjoy learning. The education provided must boost child ability to reason and analyze. This can bring about an innovation in education. Education has purpose. A major role to play in shaping our future generation and achieving the dream, the goal of humankind has set for himself, i.e. to continuously excel and constantly achieving the better and satisfying the unfailing curiosity to know the outer universe and the inner of own consciousness. Knowledge can be categorized based on distinct kinds of concepts and meanings involved and processes of validation and justification. Each involves its own kind of ‘critical thinking’, its own way of verifying and authenticating knowledge, and its own kind of ‘creativity’. All knowledge is constantly gathered, experimented and applied to the welfare of humankind. And this mechanism of transferring knowledge and skills to the next generation is our system of education or education itself. As teachers, educationists, parents, administrators, mentors, must all continuously explore how our methodologies can be successful to educate our children and help them to germinate with values and wisdom. With the development of technology and changing social demands our mechanism i.e. education need to be contemplated and perpetually evolved to meet the new challenges of our daily life. Our former president A.P.J. Kalam stated that the Focus of the education system should be to train students to become autonomous learners. He further added that our education system should aim to generate enlightened
citizens that are a combination of learning and value systems by aligning the human thinking in harmony with the harmony of the universe.

Undoubtedly at the front end of discovering myriad ways to enrich and expand the thinking capacities which will unleash exponentially the ways of doing and constantly aspire for attainment of the pinnacle of knowledge and learning. In today’s accountability driven culture students need a profile of skills not only for managing this knowledge transition but for the development of higher order thinking skills which is the need of the hour. Instead of being arbiters of knowledge, educators provide contextual strategic scaffolding for learners to engage in automatic processing, dialectical reasoning, divergent thinking and critical understanding. Higher order thinking is imperative to progress. No explorer ever discovered anything new by following in the footsteps of those who had been there before. If lower order thinking skills seek to learn and commit to memory knowledge and know how that somebody else has already acquired then Higher Order Thinking allows for the interpretation and reconsideration of such information so that other application may be used and alternative conclusions drawn. This exposes further fields of knowledge and know, how which may again, be transferred, reapplied and collated to create a new and improved version.

Thinking is at the heart of all learning. Thinking makes things that have yet to be perceived possible, thinking facilitates and enhances one’s ability to perform and produce and pass on such vital information to others who would then do the same.

The National Curriculum Framework taking cues from ‘Learning without Burden’ (1993) and seeking guidance from the Constitutional vision of India as
a secular, egalitarian and pluralistic society, founded on the values of social justice and equality, identifies certain broad aims of education. These include independence of thought and action, sensitivity to others’ well being and feelings, learning to respond to new situations in a flexible and creative manner, pre-disposition towards participation in democratic processes and the ability to work towards and contribute to economic processes and social change. The Guiding Principles: The fact that learning has become a source of burden and stress on children is an evidence of a deep distortion in educational aims and quality. To correct this distortion, the present National Curriculum Framework proposes five guiding principles for curriculum development:

a. connecting knowledge to life outside the school;

b. ensuring that learning shifts away from rote methods;

c. enriching the curriculum to provide for overall development of children rather than remain textbook centric,

d. making examinations more flexible and integrated into classroom life

e. nurturing an over-riding identity informed by caring concerns within the democratic polity of the country.

The National Curriculum Framework, while placing the learner as the constructor of knowledge, emphasizes that curriculum, syllabus and textbooks should enable the teacher to organize classroom experiences in consonance with the child’s nature and environment, and providing opportunities for all children. Significant changes are recommended in all the curricular areas with a view to making education more relevant to the present day and future needs
in order to alleviate the stress that the children are coping with today. The NCF recommends the softening of subject boundaries so that children can get a taste of integrated knowledge and joy of understanding.

Mathematics is the pivot of all civilization. Mathematics is that subject which indisputably forms the very basis of entire world commercial system. It is the contributory factor in the prosperity of human race. There is no science, no art, and no profession where mathematics does not hold a key position. The accuracy and exactness of science is determined to a major extent by the amount of mathematics utilized in it.

Mathematics is defined as the science of quantity and space. It is systematized, organized and exact branch of science. “It is the numerical and calculation part of man’s life and knowledge.

Mathematics is absolutely necessary for solving problems of space flight, electronic computers, nuclear physics, cybernetics, and communication systems, large scale industrial organizations, large scale defence operations etc. Hence it called “the queen of sciences”. Mathematics has vast application and hence, an interpreter of physical phenomenon.

Even Nature embraces mathematics completely. Mathematics runs in the veins of natural sciences like physics and astronomy and is inextricably incorporated in all disciplines. The National policy of Education 1986 emphasis that “Mathematics should be visualized as the vehicle to train a child, tool to think, reason analyze and articulate logically apart from a being specific subject. It should be treated as concomitant to any subject involving analysis and reasoning”.

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“Accuracy, exactness, precision compose the beauty of mathematics”. The student learns to be accurate and appreciate and also to adopt it as principle of life. He learns to influence and command others by his accuracy.

In this modern age of Science and Technology, emphasis is given on Science such as Physics, Chemistry, Biology, Medicine and Engineering. Mathematics, which is a Science by any criterion, also is an efficient and necessary tool being employed by all these Sciences. As a matter of fact, all these Sciences progress only with the aid of Mathematics. So it is aptly remarked, "Mathematics is a Science of all Sciences and art of all arts."

Mathematics is a creation of human mind concerned chiefly with ideas, processes and reasoning. It is much more than Arithmetic, more than Algebra more than Geometry and much more than Trigonometry, Statistics, and Calculus, the branches of mathematics.

Mathematics includes all of them. Primarily mathematics is a way of thinking, a way of organizing a logical proof. As a way reasoning, it gives an insight into the power of human mind, so this forms a very valuable discipline of teaching-learning programmes of school subjects everywhere in the world of curious children. So the pedagogy of Mathematics should very carefully be built in different levels of school education.

In the pedagogical study of mathematics we mainly concern with two things; the manner in which the subject matter is arranged or the method the way in which it is presented to the pupils or the mode of presentation. Mathematics is intimately connected with everyday life and necessary to successful conduct of affairs. It is an instrument of education found to be in conformity with the needs of Mathematics
has its own distinctive concepts, such as prime number, square root, fraction, integer and function. It also has its own validation procedure, namely, a step-by-step demonstration of the necessity of what is to be established. The validation procedures of mathematics are never empirical, never based on observation of the world or on experiment, but are demonstrations internal to the system specified by an appropriate set of axioms and definitions. The Sciences, like the systems of mathematics, have their own concepts, often interconnected through theories, and are attempts to describe and explain the natural world. And also teaching of mathematics has its aims and objectives to be incorporated in the school curricula. If and when Mathematics is removed, the back-bone of our material civilization would collapse. So is the importance of Mathematics and its pedagogic. Developing children's abilities for mathematisation is the main goal of mathematics education. The narrow aim of school mathematics is to develop 'useful' capabilities, particularly those relating to numeracy–numbers, number operations, measurements, decimals and percentages. The higher aim is to develop the child's resources to think and reason mathematically, to pursue assumptions to their logical conclusion and to handle abstraction. It includes a way of doing things, and the ability and the attitude to formulate and solve problems.

It should be coherent in the sense that the variety of methods and skills available Piece meal (in arithmetic, algebra, geometry) cohere into an ability to address problems that come from domains such as science and social studies in high school. It should be important in the sense that students feel the need to solve such problems, that teachers and students find it worth their time and energy to address these problems. The twin concerns of the Mathematics curriculum are: what can mathematics education do to engage the mind of every student, and how can it strengthen the student's resources? As mathematics is a compulsory subject at the
Looking in the present era new approach to the whole process of learning seems to be necessary. The whole world is now technology based society. It is essential to give emphasis more on how to learn and develop skills than what to learn. Hence the need of the hour is rejuvenation of our educational aims from the point of view of a better society. The primary goal of education should be the intellectual development of the individual. Hence, the task of mathematics teacher is to achieve the above objectives by providing suitable learning experiences in the classroom. This implies a good exercise of thinking skills.

Learning is considered as the behavioural change among the individual. It takes place in namely cognitive, affective and psychomotor domain. The basic domain cognitive perspective includes knowledge, understanding, skill, application, analysis, synthesis and evaluation. Even knowing its valuable application the children find it difficult subject and it is unfortunate to note that mathematics in general is disliked by the students.

So such a useful subject is not being taken care of properly at secondary stage. Hence there is a need to work for enhancing the critical thinking ability of the students for improving the mathematics achievement.

Any system of education becomes meaningful to the extent if it affords an opportunity to the individual student to unfold his abilities which are creative in nature. How this can be developed? Is the question that has to be answered? The answer is through thinking. Thinking makes a man to process the information that it has already present in him. It helps to understand the knowledge in a better way. It leads a helping hand in solving problems. It tries to project multidimensional
aspects of a single situation and shows manly ways to cognize it, so as to modify, if necessary to adjust to his environment. Recently, much stress has been laid on the area of cognitive skill.

To mention a few who have worked in this cognitive area are Edward de bano, Guilford, Torrance, etc. In addition to teaching the prescribed syllabus the activities involving critical thinking should be encouraged. For this a free and fearless environment should be provided. Planning and structured activities help for developing better thinking and reasoning ability. Reasoning and critical thinking concern the analysis and evaluation of arguments, where “arguments” refers to the process of proving that one idea is true by appealing to another set of ideas as evidence. Reasoning and critical thinking are commonly understood as one aspect of the field of logic when considered broadly.

In modern times logic is often equated with formal logic, which doesn’t concern itself with truth or falsity of the evidence sited in an argument, focusing instead upon the logical connection between the evidence and the idea whose truth is allegedly established by the evidence such connection are called “inferences”.

In a novel problem situation, some students do not know immediately what series of action to perform in order to achieve the desired goal because they have not been taught an efficient algorithmic procedure in tackling the situation (English, 1987). Outside the schools, students repeatedly encounter situations in purchasing goods, relating to others in social organizations and in other activities, where skilful thinking is critical to their success. Many educators assume that students learn how to think while processing information that they are trying to learn. However, lessons that keeps the focus on subject matter, obscure the nature of the
thinking processes involved in manipulating the information that students fail to learn to understand these processes .(Bayer,1987).

Helping students learn how to control and direct their own thinking and developing the disposition that support and motivate thinking are essential aspects of the teaching of thinking. Without engaging in Meta cognition and dispositions that drive skilful thinking, individuals are not inclined to the full potential the thinking skills learned. Without such conscious control of their own thinking, they cannot transfer the thinking skills learned from one setting to another. Valuing the use of credible sources other points of view and search for alternatives motivate thinking and enhance its effectiveness.

Why should we be concerned about students’ adaptness in critical thinking in the classrooms? Obviously we want to educate our students whose decisions and choices will be based upon a multitude of creative ideas that span across a wide range of school of thought. Maintaining a high level of productivity in today’s modern society requires one to be critical in generating ideas as well as capability in utilizing a number of different styles of thinking.

Raymond .S. Nickerson (1985) an authority on critical thinking has given the characteristics of a thinker such as 1. Uses evidence skillfully and impartially. 2. Organizes thoughts and articulates them concisely and coherently. 3. Distinguishes between logically valid and invalid inferences. 4. Sees similarities and analogies which are not apparent.

According to Guilford Thinking is of two types convergent and divergent. Convergent thinking implies the rigid approach to an issue or conforming the traditional way of thinking. On the contrary divergent thinking is departure from
the beaten track and is unusual way of thinking. It stimulates a questioning frame of mind and is open to listening to a variety of approaches.

Cohen suggests at least four different complex thinking process. They are problem solving, decision making, critical thinking and creative thinking. These are considered to be the most essential thinking skills.

Students logical and critical thinking abilities have been of interest to scholars who study self-directed learning (Garrison 1997). Self directed learning occurs when students make informed decisions regarding each part of the learning process including what to learn, why to learn it, how to learn it and how to assess the validity and value of the learning. Garrison discussed the important arguing that insight and intuition are part of critical and self directed learning arguing that insight and intuition are part of critical thinking which is needed for self directed learning to take place. This idea is shared also by Brookfield (1997) who considers the ability to envision alternatives a key feature of creativity to be an essential component of critical thinking.

Critical thinking is reasonable, reflective thinking that is focused on deciding what to believe or do. Critical thinking uses basic thinking processes to analyze arguments and generate insight into particular meaning and interpretations: develop cohesive, logical reasoning patterns and understand assumptions a biases underlying particular positions: attain a credible, concise and convincing style of presentation.

There are many definitions of critical thinking. Richard Paul (1988, 49) calls it the ability to reach sound conclusions based on observation and information. Barry Beyer (1983) describes it as assessing the authencity, accuracy and worth of knowledge claims, beliefs, or arguments. Stephen Norris (1985, 40-45) says it
helps students to apply everything they already know and feel, to evaluate their own thinking, especially to change their behaviour.

1.1 Need for the study:

Education is the life long process of acquiring new knowledge and skills through the formal and informal exposure to information, ideas and experiences, through which education develops the wholesome personality of an individual in all the fields and aspects making him intelligent, learned, goal oriented and also contributes to the growth and development of the society. In this context, There are various subjects which are infused in the curriculum of secondary education which helps in developing the Critical Thinking Ability such as to analyze, to interpret, problem solving to their life situation and meet the challenges of the society and also contribute to the all-round development of the children. One such subject which helps in developing thinking skills is Mathematics. Mathematics is the pivot of all civilization. Mathematics is that subject which indisputably forms the very basis of entire world commercial system. It is the contributory factor in the prosperity of human race. There is no science, no art, and no profession where mathematics does not hold a key position. The accuracy and exactness of science is determined to a major extent by the amount of mathematics utilized in it.

Mathematics is an abstract subject and solving problems in mathematics is the framework of patterns within which critical thinking, and reasoning takes place. Because mathematics is exact and true, it always demands originality for its learning.

Mathematics has always occupied an important place in school curriculum. It helps in training and disciplining the mind as well as developing the power of thinking
and reasoning. It has been said that the higher the achievement in the field of mathematics, the greater will be the nation’s development.

Mathematics is essentially a process of thinking that involves building and applying abstract, logically connected networks of ideas. These ideas often arise from the need to solve problems in science, technology, and everyday life—problems ranging from how to model certain aspects of a complex scientific problem to how to balance a checkbook. It is this knowledge that provides the basis for solving problems, making decisions, understanding the world, and learning more.

According to Courant and Robbins “Mathematics as a mind reflects the active will, the contemplative reason and the desire for aesthetic perfection, its basic elements are logic and intuitions, analysis and construction, generality and individuality “

Majority of pupils feel that mathematics is a difficult subject and it can be understood and follow the new methods of instruction which appeals to different senses of students in schools, Hence there is a need among teachers to make use of array of media and attractive techniques of teaching mathematics for a better understanding and application of knowledge of mathematics.

In 1983, the National Commission on Excellence in Education (NCEE ) reported in ‘A Nation at Risk’ that, the United States educational system needs to reform its classroom environment so that all students acquire high level skills in order to become critical thinking skills produces intellectual and socially competent citizens who effectively cooperate with other people and challenge real world problems (Glaser-1985).

In 1989, the National Council of teachers of Mathematics (NCTM) released the Curriculum and Evaluation Standards for School Mathematics is an effort to
empower students to become critical consumers of information. NCTM emphasized that our society has been transformed into an information age, where knowing how to access and use information is more important than memorizing information. The organization declared that “a climate should be established in the classroom that places critical thinking in the heart of instruction”. The proposed changes were an effort to promote mathematical literacy, including “the ability to apply mathematical ideas to problem situations and work with others to set up and solve problems” (Confrey). Since that time, many mathematics educators have been transforming their instruction and curricula to meet the societal need of establishing critical thinkers as suggested in the NCTM standards. For this kind of transformation to occur, teachers have been changing their classroom environments and searching for tools that promote problem solving, reasoning communication, and representation.

In NCTM’ Principles and Standards for School Mathematics (2000), the World Wide Web is noted as a source that can potentially enhance students’ learning opportunities by utilizing data and resources in ways that promote graphing, visualizing, and computing, Web resources such as data sets and databases, predictions, simulations, and dynamic environments utilize these capabilities to provide unique ways of exploring mathematics. Emergence of Constructivist theory of learning led to the development of new constructivist learning models and instructional strategies for the teaching of mathematics. Constructivism promotes thinking strategies to facilitate mathematical activity in children’s learning activities. Thinking strategies are also valued as being a primary goal of teaching mathematics. Thinking strategies replace mechanical computation and lead naturally into mathematical reasoning.
Cooperative learning stands for some flexible instructional techniques and strategies for approaches for teaching mathematics. As Slavin (1983) confirmed, these approaches mostly aim at the development of cognition which includes thinking, problem solving and logical reasoning in general. Particularly in mathematics cooperative learning is organized and managed group work in which students work cooperatively in small groups of achieve academic excellence in mathematics. Research also suggests that cooperative learning may lead to gains in thinking skills (Johnson & Johnson, 1990; Qin, Johnson, & Johnson, 1995). Therefore, constructivist and cooperative learning techniques have the potential for mathematics education. For classroom organization and instructional methods these two techniques will enhance the thinking skills.

Teaching methods in recent times have been moved from predominantly teacher oriented and teacher controlled approach to pupil interactive system. Such a system requires a number of changes in the instructional procedure and the material used for effective teaching. In formal education system the use of interactive multimedia is very useful for the classroom teaching.

Multimedia technology as a teaching media has mesmerized students. Students are interested in new methods of communication and learning (Baharuddin Aris and Maizah Hura Ahmad, 1995), since they are being exposed to the new media in the home. From a very early age they are access to various media so as to enable them to read critically, listen critically and observe critically (Taggart, 1975).

A number of applications have been developed which embed real interactivity, that is interactivity to engage the user in active learning and real time feed backs as opposed to interactivity through ‘point and click’. Examples are projects undertaken by Cairncross and Mannion in 1999 and Roggers and Sciaffe, dealing
with engineering and ecosystem respectively. The Key is to design learning activities which cognitively engage the learner to think about the ideas that are generated and its relevance to the problem at hand as a result about the ideas that are generated and its relevance to the problem at hand as a result of thinking critically in a broad perspective. The process of real time feed backs and hints in the form of dialogues provide the backbones for a verbal mapping network which encourage reflective thinking and a deeper understanding of the situation at hand (Mayes, 1993). As such interactive multimedia provides for reflection and supports collaborative learning in an open environment.

At present, majority of mathematics teachers follows the traditional methods of instructions in schools. What is required is learner centered approach to enable them to work. In this context a wide variety of multimedia appeal to the sense of learning ad vision and are used in the classrooms for presentations for abstract information. The American commission has defined the multimedia approach as follows “methodology based n the principles that a variety of interactive multimedia strategies and experiences reinforce and motivate the creative and critical thinking abilities among the students. Critical thinking is important in education because it enables one to analyze, evaluate and explain concepts. Critical thinking also has a deeper impact to the overall learning process.

Everyone thinks at some level, it is the nature to do so: however, undirected thinking is often biased distorted and non productive. Students have been using undirected thinking they often feel or know to be thinking. The main challenge is to demonstrate the students that they can acquire thinking abilities in mathematics. Specially teaching critical thinking skills in mathematics or any other discipline is to improve. The use of multimedia in industries has been extensive, as it has been effective in increasing productivity and retention rates, where research has shown
that people remember 20% of what they see, 40% of what they see and hear, but about 75% of what they see and hear and do simultaneously (Lindstrom, 1994). Multimedia is now permeating the educational system as a tool for effective teaching and learning. With multimedia, the communication of information can be done in a more effective manner and it can be an effective instructional medium for delivering information.

The thinking skills of students and thus preparing better to succeed in their achievement in mathematics. Critical thinking skills cannot be developed mechanically in maths and science; these two subjects symbolize correct and logical thinking.

Developing children’s abilities for mathematization is the main goal of mathematics education. The higher aim is to develop the child’s resources to think and reason mathematically, to pursue assumptions to logical conclusions and to handle abstractions, the cognitive abilities like open mindedness, problem solving, establishing cause and effect relationship, creative and critical thinking are not given enough emphasis in mathematics and science teaching. Students who have difficulty in mathematics are often those who cannot use critical thinking to improve their reasoning. They usually need help to improve their ability to solve problems and to think critically is a valuable asset in enhancing higher cognitive abilities.

Critical thinking in mathematics can be interpreted in a variety of ways. Some consider it in an evaluative sense that is used to determine the quality of a decision or an argument. Others use the term in a generative sense that places emphasis on the creativity and skill in designing a product or creating a solution to a problem. Critical thinking in mathematics is the ability and disposition to incorporate prior
knowledge, mathematical reasoning, and cognitive strategies to generalize, prove, or evaluate unfamiliar mathematical situations in a reflective manner.

Teaching for understanding means helping students to get the habit of thinking mathematically, solving problems scientifically, reasoning historically, seeing artistically, reading critically and communication clearly, if these habits are to be acquired, educators need not to incorporate into their lessons, critical thinking may be stressed when pupils separate facts from opinions, fantasy from reality, relevant from irrelevant, as well as accurate from inaccurate information.

However, indicated the attempts made to develop the level of critical thinking skills on it has been found that school teachers generally do not make effective use of necessary teaching skills in the classroom situation it is evidenced from the studies conducted by (Misra 1968, Pilli 1914 Khajuria 1981, Panday 1981 and Kumar 1982). Now the part of the teacher roles is fostering critical thinking skills abilities for building understanding of the concepts, skills and processes of the various disciplines and their methods for constructing and evaluating knowledge.

The researchers also indicate that the effective use of the teaching skills in the classroom enhances academic achievement and retention of the subject. Matter among the learner (Chakkraborty 1998, Massey 1981, Schuck 1981, Sharma 1987, Laporte & voss 1975, Koul and Bhadural 1986) studies also hav the achievement through the teaching of mathematics. Recently few studies are available where in integrating critical thinking skills in the teaching of mathematics (Melinda 1999, Braugh 2002) Attempts have also been made to develop critical thinking skills package and finding its impact on the achievements of students in science (Swamy 1995).
The objective of transmitting the methods of correct investigation, understanding and evaluation of all this scientific data (critical thinking) was not achieved. This situation prevails especially in primary and secondary education. During the last decades there has been a decline in the maths and science ability of our students. The term “multimedia” is a relatively new word that is used to describe a combination of different media, all being used to best describe or explain something. The four stages of Design for Multimedia Learning (DML) model are brainstorming cooperative group learning using synchronous media, lateral-thinking collaborative learning using asynchronous media, hypothesis testing in a collaborative synchronous manner, and experiential learning in cooperative synchronous media. Interactive multimedia in education, this can be a very powerful learning tool when used in the right way. Here are just some of the possibilities for the interaction. The Use Multimedia in Education facilitates student-centered learning allowing choice in the pathways for learning and the rate at which new material is introduced, multimedia address several learning styles and modalities -- providing a rich variety of instructional approaches which can teach in most of the ways that students learn best. Multimedia motivates student interaction, experimentation, and cooperative learning and also promotes the "constructivist" view of learning.

According to Shen, Wang, and Pan (2008), Interactive multimedia enable, "teachers and students to fully engage in the process of learning through frequent interaction and collaboration"(p.1075) The infusion of Information Communication Technology (ICT) and, in particular, multimedia technology into education has created a significant impact on the instructional content development and the methods of communicating information to learners. This leads to the evolution of new concepts and innovative teaching techniques in the instruction-learning process, changing the way teachers teach and students learn. This changing
landscape of education focuses on learning, rather than on teaching and pedagogy, curriculum and instruction. It seeks to create a generation of learners whose learning is defined as "the ability to retain, synthesize, and apply conceptually complex information in meaningful ways" (Lambert & McCombs, 1998). It also encourages better student learning through the learning objectives of project-based learning, or learning by doing (Schank, Berman and Macpherson, 1999), and to enable problem-solving, analysis, creativity and communication to take place in the classroom (Bates, 2000). In addition to these, multimedia technology has been shown to affect students’ motivation and self-esteem levels, as well as allow them to become creative and self-directed thinkers (Agnew, Kellerman & Meyer, 1996).

Studies have shown that using multimedia in the classroom increases students' test scores when compared to the same course taught without using multimedia. (Shen, Wang, & Pan, 2008) (Frear & Hirschbuhl, 1999). One of the main reasons why we lack critical thinking is learner’s lack of deep understanding of the topic they study. Many students are unable to give evidence which requires more than mere superficial understanding of the concepts, and are unable to apply knowledge they have acquired to real world problems. This is due to superficial teaching methods that fail to engage students in thinking deeply and critically about the topics they are studying and teacher inability to exercise and promote higher-order thinking skills.

By providing suitable interactive multimedia strategies, it is possible to improve one’s thinking and also the degree of improvement in thinking can also be assisted. Much thrust is being laid on developing on thinking skills among students, since it helps them in taking proper decision even in complex situation. There are a quite a number of research findings indicates that the novel of practical method of teaching thinking skills based on different components.
Mathematics which gives logical progression of thought when taught by teachers by using multimedia strategies which enhance critical thinking ability and achievement in mathematics. What impact it may cause on the students achievement? Is it better to teach to students through infused programmes or separate curricula? How to breakdown students critical thinking skills into discrete activities? What may be the influence of variables like gender, intelligence and on the achievement of students taught with this approach?

Answer for these questions are the real concern of the present investigation. In view of these the present investigation has been undertaken which will help to determine the extent to which the effective use of interactive multimedia strategies integrating with mathematics teaching in classroom situation affect the academic achievement of secondary school students and develop critical thinking ability in the mathematics hence the present study.

1.3 Statement of the problem: “The Effectiveness of Interactive Multimedia Strategies on Achievement in Mathematics and Critical Thinking Ability of Standard IX students”.

1.4 Operational definitions:

1. **Interactive Multimedia Strategies (IMMS)**: The Strategies which were used to teach the selected topics of Standard IX Mathematics using array of Multimedia such as Charts, Flip over Charts, Models, videos, Graphic Organizers, Power Point Presentations and other Teaching Aids.

2. **Treatment**: The researcher varied the method of teaching during experimentation in order to find out the effectiveness of Interactive Multimedia Strategies (IMMS).
The investigator taught the experimental group with IMMS which was developed and validated by the researcher and the control group was taught by the traditional method of teaching.

3. **Interactive:** The Strategies were planned under IMMS for the interaction between the teacher and pupil in the classroom in teaching of Mathematics.

4. **Achievement:** According to Carter V. Good (1973), achievement means accomplishment or proficiency or performance in a given skill or body of knowledge, helps in declaring the examinee successful or unsuccessful, choosing the students for various professional and academic courses and selecting the candidates for different jobs”.

Achievement in Mathematics means the extent to which a student have achieved something, acquire certain information, demonstrated proficiency in certain skills usually as a result of instruction in the subject of mathematics. In the present study, it is represented by the scores of students in the achievement test in Mathematics prepared and validated by the researcher.

5. **Intelligence:** Intelligence is the person’s ability to form perceptual relations to reason by analogy independent of languages and formal schooling. In the present study, the Intelligence of the students is represented by the scores of Standard Progressive Matrices (SPM) prepared by Raven.(1998)

6. **Critical Thinking Ability (CTA):** According to Scriven (1996): “Critical thinking is the intellectually disciplined process of actively and skillfully conceptualizing, applying, analyzing, synthesizing, and/or evaluating information gathered from, or generated by, observation, experience, reflection, reasoning, or communication, as a guide to belief and action”.

From the above definition **CTA** is defined as “the means drawing favorable judgment and encouraging a person to think deeply, to seek clarification or
understand objects, involves a collection of thinking operations which help a person to determine the merit and demerits of an object”. It is represented by the scores of CTA developed and validated by the researcher.

1.5 **Objectives of the study**: The present study was designed keeping the following objectives in view:

1. To develop the Interactive Multimedia Strategies (IMMS) based on selected topics of Standard IX Mathematics Syllabus.

2. To study the effect of Interactive Multimedia Strategies (IMMS) on the Achievement in Mathematics of the students of Standard IX.

3. To study the effect of IMMS on the Critical Thinking Ability (CTA) of Students of Standard IX.

4. To find the relationship between Critical Thinking Ability (CTA) and Achievement in Mathematics (AIM) of the Students of Standard IX.

5. To find the differential effect of IMMS on the post test scores of AIM of a) Students of Standard IX with high and low Intelligence.

b) Boys and girls of the Standard IX

6. To find the differential effect of IMMS on the gain scores of CTA of a) Students of Standard IX with high and low Intelligence.

b) Boys and girls of the Standard IX

7. To find out the Interaction effect of Gender and Intelligence on the post test means scores AIM of students of Standard IX.
8. To find out the Interaction effect of Gender and Intelligence on the Gain Scores of CTA of students of Standard IX.

9. To find out the Interaction effect of boys and girls on the post test means scores of AIM of students of Standard IX.

10. To find the effect of IMMS on AIM of experimental group after delayed post test.

11. To find the Effect of the IMMS on the gain scores of CTA of experimental group after delayed post test.

1.6 Hypotheses:

Based on the objectives of the study the researcher formulated the following hypotheses in the present study.

**Hypothesis -1**

There is no significant difference between of mean Post test scores of Achievement in Mathematics of experimental and control group.

**Hypothesis-2**

There is no significant difference between the mean gain scores of Critical Thinking Ability of experimental group and control group.

**Hypothesis-3**

There is no significant relationship between Critical Thinking Ability and Achievement in Mathematics of the students of Standard IX of Bangalore city.

**Hypothesis-4**

There is no significant difference between post test mean scores of Achievement in Mathematics of students having high and low Intelligence.
Hypothesis-5(a)
There is no significant difference between students of Standard IX having high and low intelligence in their mean post test scores of Achievement in Mathematics

Hypothesis-5(b)
There is no significant difference between boys and girls of Standard IX in their mean post test scores of Achievement in Mathematics.

Hypothesis-6(a)
There is no significant difference between students of Standard IX having high and low intelligence in their mean post test scores of CTA

Hypothesis-6(b)
There is no significant difference between boys and girls of Standard IX in their mean Post test scores of CTA

Hypothesis-7
There is no significant interaction effect of gender and intelligence on the post test mean scores of AIM of students of Standard IX.

Hypothesis-8
There is no significant interaction effect of gender and intelligence on the gain scores of CTA of students of Standard IX.

Hypothesis-9
There is no significant difference between boys and girls on post test mean scores of AIM of standard IX

Hypothesis-10
There is no significant difference between the post test mean scores of delayed post test with respect to AIM of the experimental group of standard IX

Hypothesis-11
There is no significant difference between the post test mean scores of delayed post test with respect to CTA of the experimental group of standard IX
1.7. **Population:** All the students of standard IX located in Bangalore city constitute the population of the study.

**Sample:** The sample of the study primarily consists of 160 students at secondary school level. There was one experimental group & one control group in both the schools, under study i.e., two private schools.

1.8 **Tools for collecting data**

1. Achievement test in mathematics would be developed and validated by the researcher.

2. Tools to assess the critical thinking ability would be developed and validated by the researcher.

1.9. **Statistical techniques for analysis of data**

1. Co-efficient of correlation

2. t-test.

3. ANOVA is used to analyze and interpret the data.

1.10 **Scope of the Study**

The prime focus of the study was to develop Interactive Multimedia Strategies to empower the pupils at secondary school level to enhance Achievement in Mathematics and Critical Thinking Ability which would provide guidelines to classroom teachers to achieve various objectives of teaching school mathematics. The use of multimedia make students to think mathematically and to help in the acquisition of critical thinking in mathematics will enhance the academic capabilities of the learners. The study was conducted in intact classrooms within
the framework of regular school work. Hence it is hoped that the teachers may easily modify their teaching strategies based on the results of this study.

In the present study the researcher had used array of media which appeals to the various senses of students with individual differences and enhance their achievement capabilities and critical thinking ability among Standard IX Students and how these strategies helped them in applying critical thinking abilities into their day to day life.

Hence the scope of the present study is restricted to access Critical Thinking Ability administering through pretest and later providing them with interactive multimedia strategies further ascertain the change on the significant difference between initial and final level of Critical Thinking Ability through a post test and a post test is also conducted to access a significant difference on the Achievement in Mathematics. If there is any difference between these levels then it will show the impact of the programme also the scope is extended to find the impact of the variables like Gender and Intelligence on Critical Thinking Ability and Achievement in Mathematics of Standard IX Students.

1.11 Delimitations of the study.

1. Two schools were only selected for the study.

2. The Interactive Multimedia Strategies was based on the selected topics of IX Standard State Board Mathematics Syllabus.

1.12 The overview of the chapters

The present study is organized as follows

Chapter I: Introduction
This chapter signifies the background and rationale of the study. It also describes the statement of the problem, definition of the key terms, objectives, hypothesis and delimitation of the study in brief.

**Chapter II: Theoretical Background of the Study**

The theoretical milieu of the study is presented in this chapter.

**Chapter III: Review of related literature**

This chapter discusses the pertinent studies and articles that shape the major orbits of the study.

**Chapter IV: Methodology**

The pathways of the investigation adopted in a comprehensive manner are detailed in this chapter.

**Chapter V: Analysis and Interpretation**

This section reports the statistical procedures adopted for analyzing the data procured and the relevant results and interpretation emerged.

**Chapter VI: Summary and conclusion**

The summary of findings and conclusion derived along with the implications, recommendations and limitations of the study are discussed in this chapter.