CHAPTER – I

INTRODUCTION

1.1 INTRODUCTION

Education and learning being the foremost of all human activities have always been the principal means of creating productive personalities and sustainable societies. While advancing through the threshold of the new millennium, we confront formidable challenges of adapting ourselves to the expanding demands of the society. Hence in the present world there have been considerable changes in the aims of education than in the past. The 21st century education mainly focuses at developing competencies in domains like self awareness, social awareness, self management, relationship management, effective communication, critical and creative thinking, digital age literacy and effective collaboration in learners to transform them to self directed learners and concerned citizens who can actively and confidently contribute to the progress of the global society. For attaining this, objective, innovative and evidence based practice in education appropriate to address the persistent problems of the past and provide the students with competencies right and proper to the demands of the modern information based global economy are inevitable. As educators, we need to challenge ourselves to foresee the evolving plethora of demands of the rapidly changing world and expand our educational horizons to empower students to overcome the hurdles and take advantage of the opportunities of the global world.

The demand of employment in global economy, the survival of democratic way of life and personal decision making in a complex and rapidly changing
society of the new millennium require people who can reason well and make good judgments. As a result, we want to educate citizens whose decisions and choices will be based on careful rational thinking and reflection. Hence education should focus on the prominence of teaching students how to think and the priority of education system should be to teach children how to learn and how to think (Robinson, 1987 & Shukor, 2001). This dire need to prepare students for future effective problem solving, thoughtful decision making and responsible citizenship demands constant attempts to promote thinking skills of the learners by redesigning pedagogic principles.

To develop the capacities that enable the future citizens to strive and survive in today’s economy presumably requires the participation of learners in some kind of educational practices involving them as ‘knowledge workers’ in constructing ‘knowledge products’. These Global trends for knowledge generation and construction replacing knowledge replication and repetition demands learners to take prominent and active role in the learning process. They need to take the responsibility of their own learning and the new premium is placed on higher order thinking, imagination, evaluation, and flexibility of the learner in contrast to drill and practice, rote learning, memorization and repetition. Now learning is considered much more than mere memorizing of facts, rather it is about understanding the content, constructing knowledge, transforming and retaining what we learnt as our own, applying it to cope with demands, challenges of future world and enabling lifelong learning. Individuals tend to learn best when they are actively involved in the process of learning by engaging in learning activities, talking about what they are learning, writing about it, reflecting it, asking relevant
questions, contributing to class discussions, relating to past experiences and utilizing it (Bonwell & Eison, 1991; Ghickering & Gamson, 1987; Bransford, 2000; Ueckert, 2007). Learning cannot be forced upon anyone; neither can it be extracted from the learner on command. Students must be willing to learn and they must be prepared to take the initiative and responsibility of learning. ‘This do-it-oneself’ principle implies that more the students are engaged in the purposeful learning activities, the more successful they are. Educational researches worldwide indicate that students tend to learn much better when they are actively engaged in their learning process. Hence in this age of new paradigm for teaching and learning (Campbell & Smith, 1997) teachers and students are required to pursue active and student centered learning that engages the students in the art and practice of thinking efficiently that will help them to achieve positive results in any field.

1.2 CONCEPT OF ACTIVE LEARNING

All learning is active in a certain sense, but some kinds of learning are more active than others. Active learning is a term generally used to denote teaching learning strategies that engage and involve students in their learning process. It is an umbrella term that refers to several models of instruction that shifts the emphasis from teaching to learning and focus the responsibility of learning on the learner. Active learning is anything course-related that all students in a class session are called upon to do other than simply watching, listening and taking notes. Here students are engaged in activities including discovering, processing, and applying information (Felder & Brent, 2009). Active learning includes approaches that have received a variety of labels in the pedagogy
literature: discovery learning, cooperative learning, collaborative learning, interactive engagement, team-based learning, peer-instruction etc. The term Active learning is used to encompass these and similar terms, focusing on active and participative learning as opposed to mere passive forms of learning (Hendrikson, 1996). This is the broadest and the most inclusive learning principle and it undergirds all other key learning processes.

Morable (2000) defines active learning as professor led, student centered, high involvement, practical learning strategies that can be used to strengthen any learning environment. Active Learning is the learning process which involves the students in doing things and in reflecting about things they are doing that gives the learner the responsibility of his/her learning and he/she is given the opportunity to make decisions about the dimensions of the learning process and perform self regulation.

The term ‘Active Learning’ has no common definition (Bonwell & Eison, 1991). Rather, it has been used in some literature to refer to instructional strategies that promote students active engagement in the learning activities. In other literature, it refers to the learner’s active role in constructing meaning and thinking about their learning (Bransford, 2004). However, according to Bonwell and Eison (1991) who popularized this approach to instruction, Active Learning is defined as instructional activities involving students in doing things and thinking about what they are doing.

1.2.1 Characteristics of Active Learning

Active learning is based on two premises: learning by its nature is an active process, and different people learn in different ways (Meyers & Jones, 1993).
Active learning demands that, during class time, students should be involved in behavior and activities other than listening and requires students to undertake higher-order thinking, forcing them to engage in analysis, synthesis and evaluation. Such active learning produces more lasting value to students who are better equipped to process new information and solve new problems within the context of their self-created knowledge. Knowles (1998) states that Active Learning is based on the assumptions that

- Significant learning takes place when subject matter is perceived by the student as relevant to his/her own purpose.
- Much significant learning is acquired through doing.
- Learning is facilitated by students’ responsible participation in the learning process and
- Self initiated learning involving the whole person’s feeling as well as intellect – is the most pervasive and lasting type of learning.

Active Learning is mainly characterized by students engaged in activities, students’ engagement with the content by meaningfully talking, listening, writing, reading and reflecting on the content, less emphasis on transmitting information and more on developing student skills, social interaction. In this method, students are involved in Higher order thinking such as analysis, synthesis and evaluation to build, test and revise their knowledge, emphasis on students exploration of their own attitudes and values (Bonwell & Eison, 1991; Felder & Brent, 2009; Prince, 2004; Bransford, 2000; Meyers & Jones, 1993). The most distinct feature of Active Learning is that it is learner centered. Students have to determine their levels of knowledge, skills and abilities and set learning outcomes. With the
guidance, students learn how to learn, develop self learning skills and take an important step in attaining lifelong learning ability.

Meyers and Jones (1993) have mentioned that Active learning consists of three factors that are interrelated. These are the

1. Basic elements,
2. Learning strategies and
3. Teaching resources.

The basic elements are speaking, listening, reading, writing and reflecting. These five elements involve cognitive activities that allow students to clarify the question, consolidate and assimilate new knowledge. The second factor of Active learning is learning strategies that are incorporated in the above five elements. There are small group, corporate work, case studies, simulated discussion, problem solving, journal writing etc. Third factor is teaching resources that the teacher uses to encourage students to interact and participate in the activities.

Active Learning is thus characterized by the learners perceiving the learning process as relevant to their purpose, determining their levels of prior understanding, setting desirable learning outcomes, engaging with the content, meaningfully participating in purposeful learning activities, reflecting on the context, activities and issues at hand, promoting physical and cognitive skills, exploring attitudes and values, learning how to learn, developing self learning skills, attaining independent and lifelong learning ability, articulating explanations to oneself, peers and teachers, improving social interaction and enhancing higher order thinking skills.
To sum up, in the process of Active Learning, Learners

- perceive the learning process as relevant,
- determine their levels of prior understanding,
- set desirable learning outcomes

- engage with the content, meaningfully participate in purposeful learning activities,
- reflect on the issues, articulate explanations to oneself, peers and teachers

- promote physical and cognitive skills, develop self learning skills, improve social
  interaction, explore attitudes and values, learn how to learn, attain independent and
  lifelong learning and enhance higher order thinking skills

Thus it is clear that Active learning is not merely activities. It is activity
with a clear purpose to engage in the learning process. Nor is active learning
necessarily overt. Covert activities such as listening carefully in seminars, reading,
writing, thinking etc. can also result in active learning. Active learning approach
does not mean that students have to learn all alone and the role of the teacher
disappears or is reduced to the level of mere process support. It rather implies that
an environment has to be designed so that different partners, learning resources,
content, roles and tasks have to specified, selected and executed to optimize the
learning outcomes of the learners. The learning process requires (1) motivation,
(2) mental transformation and manipulation of material and (3) matching the
strategy to the material being learned. Therefore, it is imperative to note that a real
active learning experience focused on the relevance and coherence of the teaching-
learning activities that happen in the classroom. Hence the role of the teacher is
crucial for instruction to be effective. Student activities need sufficient guidance
and scaffolding from the teachers. This makes the role of teachers more
challenging and demanding. More precisely, active learning environment means student taking active role in their learning and instructors moving beyond teacher centered instruction, trying to see themselves along with their students as a part of a learning community.

1.2.2 Significance of Active Learning in Science

Active learning as a pedagogical approach to teaching science has been embraced by many in the scientific community and continues to gain support. The current researches on instructional practices worldwide indicate that more active, constructivist approaches can increase student understanding of science concepts because they facilitate student learning processes (Michael, 2006; Prince, 2004). Over the past two decades, a series of influential reports and articles have called attention to the need for changes in approaches to science education in ways that promote meaningful learning, problem solving, and Critical Thinking for a diversity of students (Handelsman et al., 2004). In contrast to passive pedagogical pedagogies, Active learning methods emphasize interactions with peers and instructors and involve a cycle of activity and feedback where students are given consistent opportunities to apply their learning in the classroom. Most of the time in a typical classroom, students are involved only passively in the learning process. Research reveals that such passive involvement generally leads to limited retention of knowledge by students as indicated in the “cone of learning”.

8
By placing students at the centre of instruction, active learning approach shifts the focus from teaching to learning and promotes a learning environment more amenable to the metacognitive development necessary for students to become independent and critical thinkers (Bransford et al., 2000). A substantial number of studies have shown that active-learning instructional approaches can lead to improved student attitudes (Prince, 2004) and increased learning. Research also indicates that reorganizing or adapting the ways in which the teachers present the material to students can create an environment in which knowledge retention is significantly increased (Felder & Brent, 1997). According to Silberman, (1996) with the effective use of Active learning pedagogies, science instruction becomes fast-paced, fun, supportive, and personally engaging, bringing out higher levels of
energy, participation and greater learning. Yoder and Hochevar (2005) emphasise that encouragement in Active learning can improve student’s performance in examination and Sivan et al. (2000) report that various forms of Active Learning contributes to the qualities like Critical Thinking, problem solving, and the students become self managed learner.

Thus it is evident that active learning reinforces course content, develops team building skills, enhances student self esteem, promotes participative learning, allows creative problem solving, promotes concept of discovery learning, energizes and invigourates the participants, strengthen learner bonds, offers variety that accommodates diverse students learning styles, allows practical application of course content, enhances communication with diverse students, offers an enjoyable and exciting learning environment, helps to improve student retention, motivation and promotes fun (Morabio, 2000).

Active learning is vital because of these powerful impacts upon students’ learning. Moreover studies have shown that students prefer strategies promoting Active learning to traditional lectures. Active learning is also found to promote mastery of content and development of students’ skills in thinking and writing, increased involvement in learning process and improved interpersonal skills.

By considering all the listed benefits of Active learning, and more, the world Declaration and Education for All (EFA, 1990) stated that active and participatory instructional approaches are particularly valuable in assuring learning acquisition and allowing learners to reach their fullest potential. In a research based polity report published by World Bank, the editors Lockheed and Levin (1991) says that “emphasis on student learning is to shift from traditional passive
approach in which all knowledge is imparted from teachers and textbooks to an active approach in which student is responsible for learning”.

The world conference on Education for All (2000) published ‘The Dakar Framework’ which reiterated an international policy commitment to Active learning pedagogies and emphasized the need of well trained teachers and necessity of adopting active learning techniques in class rooms. UNESCO (2008) in its Global monitoring report highlights on the trend to reverse curriculum to make classroom interactive, more responsive and child centred. The report also asserts the fact that there is a move away from the Chalk and talk to more discovery based learning and greater emphasis on outcomes that are broader than basic recall of facts and information. According to UN convention of Rights of the child (1990), children have the right to seek information, right to question, to be listened to, to expression of thoughts, questions, feelings and opinion. Teaching learning process must respect these rights and these rights need to be embedded in the classroom and reflected in the pedagogy.

Following these worldwide efforts to respect the Rights of child and the call for participatory pedagogic practices, the educational system in India also witnessed several drastic revolutions in this field. NCF (2005) has proposed a shift in rote learning approaches in teaching and learning and outlined the need to institute Active leaning pedagogies in the classroom. NCF (2005) signifies the need to encourage students to ask question, interact freely and develop in depth thinking capacities which in turn will lead to the development of higher order abilities and autonomous life long teaching in the learners. Hence it is imperative
to employ participatory pedagogic practices that will promote the active learning in the learners.

The number of active learning tasks is limitless and the call to promote active learning is not new. However, passive learning environment of teacher centered lectures remains the predominant practice in the classrooms (Modell, 1996). Effective teaching method based on how people learn are known, but are not often applied in regular classroom (Miller, 2008). The cornerstone of Active Learning Strategies are based on active engagement of students in the acquisition of knowledge, skills and attitudes. A number of techniques are discussed in the context of class content that promotes learner activity and achievement. It is the duty of teachers to select appropriate strategies suitable for the context of learners and their learning by controlling the level of risk and complexity of exercises to encourage active learning among the learners. Hence, Active learning calls for extraordinary dedication of teachers as facilitators of learning, motivators of curiosity and mentor for discovery learning. Therefore, it is important to keep in mind that science teachers engaged in an active learning environment is equipped with striking characteristics that set them apart from those in a traditional milieu. Students, as the central stakeholder in active learning, also play a very crucial role in their learning.

(a) Role of a Science Teacher Engaged in Active Learning

- Creates learning environments where students are active participants as individuals and as members of collaborative groups.
- Motivates students and nurtures their desire to learn in a safe, healthy and supportive environment that develops compassion and mutual respect.
• Encourages students to accept responsibility for their own learning and accommodates the diverse learning needs of all students.
• Displays effective and efficient classroom management.
• Provides students equitable access to technology, space, tools and time.
• Creates an environment where student work is valued and appreciated.

(b) Role of student engaged in Active Learning
• Accepts responsibility for his/her own learning.
• Actively participates and is authentically engaged in learning activities.
• Collaborates with other students.
• Exhibits a sense of accomplishment and confidence.
• Takes educational risks in class.
• Practices and engages in safe, responsible and ethical use of technology.

1.3 ACTIVE LEARNING STRATEGIES

Active Learning Strategies developed out of the works of an earlier group of theorists who promoted discovery learning (Meyer, 2004). Discovery learning, problem based learning, experiential learning and Inquiry training instruction are most cited forms of Active Learning Strategies (Krishner, Sweller & Clarke, 2006). All these strategies assume that learning process is learner driven, but it does not mean that instructor can dispense guidance. They must provide challenge, encourage risk taking, correct errors and provide context, because learning without a mentor is slow and frustrating. Adopting Active Learning Strategies does not mean following highly structured methods or even completely eliminating the lecture format (Bonwell & Eison, 1991). Activities that encourage student involvement can be incorporated in the lessons. The ‘Active’ activities includes
class discussions, small group discussions, debate, posing questions, think-pair-share activities, short written activities and polling the class (Bonwell & Eison, 1991). Felder and Brent (2009) noticed Think/Pair/Share, concept tests, think aloud, pair problem solving as some effective Active Learning Strategies. Collaborative learning groups, student led review sessions, keeping journals or logs, problem based learning, mind maps, context based learning, brainstorming, concept mapping, using graphic organizers etc. are also certain effectively used Active Learning Strategies as mentioned in literature on learning. Strategies like problem based learning, case based learning, cooperate/collaborative learning, Group works of all kinds, T/P/S, Peer instruction, Conceptual change strategies, Inquiry based leaning Discovery learning, Technology enhanced leaning, Class discussion, Debate, questioning, Short written activities, Poll up the class, Scaffolding reading tasks, Assignments with tutorial review, Platform of e-learning, etc. were identified by many researchers (Olivera and Olivera, 2006; Aknioglu and Tandogan, 2007; De Bogart, 2009; Bonwell and Edison, 1991; Michael and Modell, 2003) as Active Learning Strategies. Literature review shows that there is no common agreement about the strategies that could be considered as Active Learning Strategies. Anything that the students do in the classroom other than merely listening to the lectures passively can be considered as active learning and any strategy that enables the learner to do so can be active learning strategy.

1.3.1 Fink’s Model of Active Learning

Dee L. Fink’s Model (proposed in 1999 and revised in 2003) suggests that all learning activities involve some kind of experience or some kind of dialogue. The two main kinds of experience are Observing and Doing. The two main kinds of dialogue are Dialogue with Self and Dialogue with Others.
Figure 1.2: Fink’s Model of Active Learning

Adopted from Fink, L.D., A Model for Active Learning, 1999.

Observing occurs whenever a learner listens to someone else or watches others doing something that is related to what they are learning about. The act of observing may be direct or vicarious.

Doing refers to any learning activity where the learner actually does something. Doing may also be direct or vicarious.

Dialogue with Self happens when a learner thinks reflectively about a topic, i.e., they ask themselves what they think, what they should think or what they feel about the topic, issue etc. This is ‘thinking about my own thinking’.

Dialogue with Others can come in many forms. In traditional teaching, when students read a textbook or listen to a lecture, they are listening to another person. This can perhaps be viewed as partial dialogue. A much more dynamic and active form of dialogue occurs when a teacher creates an intense small group discussion on a topic. Sometimes teachers can also find creative ways to involve students in dialogue situations with people other than students, either in class or outside the class.
According to L.D. Fink (2003) two principles should guide the choice of active learning activities. First, an effective set of learning activities is one that includes activities from each of the following three components of active learning: information and ideas, experience, and reflective dialogue. Second, we should try to find direct kinds of learning activities, whenever possible. Indirect, or vicarious, forms may be necessary in some cases. But when we can find direct ways of providing active learning, the quality of student learning expands. Learning activities should reflect the instructor’s judgment of how effectively they address the learning goals of the class. Learning is enhanced and made more permanent when students reflect on the learning experience and its meaning to them. This can be done individually using journals, diaries etc. or with others like, discussions with teacher or in small groups. When students reflect on what they are learning and how they are learning, it is valued more and they appreciate their own learning.

**Figure 1.3: Components of Active Learning**

Those learning activities that include all the aspects of active learning discussed above will provide rich learning experiences to the learners that will in turn result in enhanced and meaningful learning which is permanent.

1.3.2 Active Learning Strategies Suitable for Teaching High School Physics

Knight (2004) has compiled a list of research based Active Learning Strategies most suitable for teaching Physics in his book ‘Five Easy Lessons: Strategies for Successful Physics Teaching’. The following are the list of different approaches to teaching that are designed to improve student learning. The list was compiled on the basis of offering practical assistance to novice high school teachers and some of the strategies listed below are found to be highly effective in improving high school students’ learning.

1. Small group processes
   - Cooperative Learning
   - Problem Based Learning
   - Inquiry-Oriented Lab Activity
   - White Boarding

2. Whole Group processes
   - Peer Instruction
   - Think-Pair-Share
   - Socratic Dialoging
   - Questioning
   - Discussion
   - Brainstorming
   - Interactive Demonstration
   - Problem of the Day
3. Individualized processes

- Home work
- Tutoring

The Active Learning Strategies selected for teaching Physics in the present study are

1. Group Investigation (GI)
2. Think-Pair-share (T/P/S)
3. K-W-L
4. Concept mapping (CM)
5. One minute papers (OMP)

I. Group Investigation

This is one of the strategies included in cooperative learning strategies. In group investigation, students get grouped and investigate the desired goal. In group investigation, Students work in small groups and within groups, students decides what information to gather, how to organize it, and how to present what they have learned as a group project to classmates (Sharan & Sharan, 1992).

The Group Investigation Model, developed by Sharan and Sharan (1992) detailed the six stages of implementation of group investigation. In the group investigation, teachers take students through these six stages of discovery.

- First, the teacher poses a multi-faceted problem to the students. This can either be planned or unplanned.
- Second, in their groups, the students plan their investigations into the posed problem.
- Third, the group investigates the problem as planned.
Fourth, within the group, they combine what they have learned and prepare it to be presented in the class.

Fifth, the groups present their information to the class.

Finally, the teacher and students assess what has been presented and draw a conclusion.

II. Think-Pair-Share

Think-Pair-Share was developed as an instructional strategy by Augustine, Gruber and Hanson (1989/1990). In this strategy,

- The teacher provokes students’ thinking with a question or prompt or observation. The students should take a few moments (probably not minutes) just to think about the question.
- Using designated partners, nearby neighbours, or a desk-mate, students pair up to talk about the answer each came up with. They compare their mental or written notes and identify the answers they think are best, most convincing, or most unique.
- After students talk in pairs for a few moments (again, usually not minutes), the teacher calls on pairs to share their thinking with the rest of the class. She can do this by going around in round-robin fashion, calling each pair; or she can take answers as they are called or as hands are raised. Often, the teacher or a designated helper will record these responses on the board.

III. KWL Strategy

KWL is a graphic organizer used to help students predict and connect new information with prior knowledge (Ogle, 1986). The letters KWL are the acronym for ‘what we know’, ‘what we want to know’, and ‘what we learned’.
The K-W-L strategy consists of a multi-step procedure: brainstorming and categorizing, purpose-setting through questioning, and examining answers to those questions.

- In the first step students have to tell or write what they already know about the topic in the first column, the K column.
- In the second step they have to generate a list of questions that reflect what the student wants to know about the topic. This list then becomes a guide for the upcoming learning.
- In the last step they have to list the information they learned about the topic. The students might have discovered answers to all the questions asked, or may have some more to be answered still.

The KWL chart can look like:

<table>
<thead>
<tr>
<th>K</th>
<th>W</th>
<th>L</th>
</tr>
</thead>
<tbody>
<tr>
<td>What I know</td>
<td>What I want to know</td>
<td>What I learned</td>
</tr>
<tr>
<td>Write the information about what the students know in this space</td>
<td>Write the information about what the students want to know in this space.</td>
<td>After the completion of the lesson or unit, write the information that the students learned in this space.</td>
</tr>
</tbody>
</table>

There are many advantages of using KWL charts in the classroom.

- KWL chart activates students’ prior knowledge of the text or topic to be studied. By asking students what they already know, students are thinking about prior experiences or knowledge about the topic.
- KWL charts set a purpose for the unit. Students are able to add their input to the topic by asking them what they want to know. Students then have a purpose for participating and engaging in the topic.
• Using a KWL chart allows students to expand their ideas beyond the text used in the classroom. Thus KWL chart is a great tool that can be used to drive instruction.

IV. Concept Maps

Concept maps are graphical tools for organizing and representing knowledge that was developed by Joseph. D. Novak (1970). They include concepts, usually enclosed in circles or boxes of some type, and relationships between concepts indicated by a connecting line linking two concepts. Words on the line, referred to as linking words or linking phrases, specify the relationship between the two concepts.

Concept maps are typically hierarchical, with the subordinate concepts stemming from the main concept or idea. The concept positions on a map can continuously change, while always maintaining the same relationship with the other ideas on the map. To draw a concept map

• Start with a main idea, topic, or issue to focus on.

• Then determine the key concepts

• Finish by connecting concepts--creating linking phrases and words

Concept mapping serves in helping students brainstorm and generate new ideas, encouraging students to discover new concepts and the propositions that connect them, allowing students to more clearly communicate ideas, thoughts and information, helping students integrate new concepts with older concepts and enabling students to gain enhanced knowledge of any topic and evaluate the information.
A concept map is also not just a learning tool, but an ideal evaluation tool for educators to measure the growth and to assess student learning. As students create concept maps, they reiterate ideas using their own words and help identify incorrect ideas and concepts; educators are able to see what students do not understand, providing an accurate, objective way to evaluate areas in which students do not yet grasp concepts fully.

V. One Minute Papers

The “One Minute Paper”, developed by Weaver and Cottrell (1985), modified by Wilson (1986) and popularized by Angelo and Cross (1993) provide excellent additions to our repertoire of assessment techniques. The one minute paper is completed by the students at the end of the class and as the name suggests, students are given a minute or two to complete the exercise. Two questions are asked: 1. What is the most significant thing you learned today? 2. What question(s) do you still have? The papers may be anonymous or signed.

Use of the one minute paper provides a number of benefits to the students:

• They summarize and synthesize the concepts covered by describing them in their own words.

• They review and focus on the most important ideas covered.

• They practice writing across the curriculum.

• They are asked to articulate what they do not understand. This helps them identify areas for further study and review.

• Using a nonverbal approach, they can communicate their concerns, identify problems, ask for specific help, explain what is working for them and make suggestions for improving the class processes.
The benefits to the teachers are:

- They can determine whether students have understood the concepts covered in the class.
- They can identify the problems of the individuals and whether they are widespread or individualized.
- A line of communication is opened between the teacher and students.
- Student responses can provide ideas for improving instruction or call attention to a need for a review of material.
- Responding to students verbally and in writing personalizes the process of teaching.
- Teachers get to know their students much better.

This technique can be used in large classes to obtain quick feedback in a short period with limited effort well before using an exam. Some possible questions for One Minute Paper may include

- What was the most important thing you learned in today’s class?
- Is there anything that is still unclear to you?
- What doubts do you have about the material covered in today’s class?
- List the key concepts from today’s class
- What examples did I use today that helped you the most?

1.4 CONCEPT OF CRITICAL THINKING

The word “critical” comes from the Greek word “kritikos” which means to question, to make sense of and to analyze or to donate the persons who have the ability to discern or decide. Different people have attempted to define Critical Thinking differently and the definitions have changed remarkably during the past years in breadth or inclusiveness.
Dewey (1938) defined Critical Thinking as reflective thinking which is thinking deeply and giving serious thought to a certain issue or task.

According to Robert H. Ennis (1996) Critical Thinking is reflective and reasonable thinking that is focused on deciding what to believe or do.

By Critical Thinking, Schafersman (1991) means correct thinking in the pursuit of relevant and reliable knowledge about the world.

Facione and Facione (1996) in the Delphi report defined Critical Thinking as purposeful, self-regulatory judgment which results in interpretation, analysis, evaluation and inference, as well as explanation of the evidential, conceptual, methodological, criteriological or contextual considerations upon which that judgment is based.

Halpern (1998) viewed Critical Thinking as thinking that is purposeful, reasoned and goal directed involved in solving problems, formulating inferences, calculating likelihood, and making decisions.

Browne and Stuart (2004) argued that Critical Thinking consists of an awareness of a set of interrelated critical questions, plus the ability and willingness to ask and answer them at appropriate times.

Duron, Limbach, and Waugh (2006) stated that Critical Thinking is the ability to analyze and evaluate information.

The review of literature on Critical Thinking reveals that there is no universal agreement upon a definition for Critical Thinking and therefore a wide range of views exist as to what Critical Thinking is. The definition of Critical Thinking varies because of its abstract characteristics. Pascarella and Terenzini (2005) relate that most attempts to define Critical Thinking operationally focus on
an individual’s capability to accomplish some or all of several dimensions of Critical Thinking. Those dimensions include (a) identify central issues and assumptions in an argument, (b) recognize important relationships, (c) make correct inferences from the data, (d) deduce conclusions from information or data provided, (e) interpret whether conclusions are warranted based on given data, (f) evaluate evidence or authority, (g) make self-corrections, and (h) solve problems. Based on the definitions of Critical Thinking, it can be concluded that, the process of Critical Thinking, firstly, requires knowledge to think critically to solve a problem. Secondly, it requires cognitive abilities such as evaluating the premises and thinking deductively or inductively (Critical Thinking cognitive skills) and thirdly, it requires inclination and willingness to engage in Critical Thinking to solve problems (Critical Thinking Dispositions).

1.4.1 Theoretical Foundations of Critical Thinking

The roots of Critical Thinking are as ancient as its etymology, tracing back to the times of Socrates who paved the way for the tradition of Critical Thinking. The literature on Critical Thinking reveals that it has roots in two different academic disciplines philosophy and psychology (Lewis and Smith, 1993). Sternberg (1986) has also noted a third Critical Thinking strand within the field of Education. These separate academic strands have developed different approaches in defining Critical Thinking that reflect their respective concerns (Lai, 2011).

Critical Thinking has been associated with philosophy since the time of Socrates. The philosophical approach assumes Critical Thinking as disciplined/ideal thinking and focuses and enumerates the qualities and characteristics of a hypothetical critical thinker rather than the behaviour or actions he can perform.
(Lewis and Smith, 1993). This approach has traditionally focused on the qualities and standards of thought and application of formal rules of logic. The main drawback of this approach is that it does not always correspond to the reality. Even though highlights the qualities of ideal critical thinker and what people have the capacity to do, this approach has less to contribute to discussions about how people actually think (Lai, 2011).

Psychologists have drawn their ideas about Critical Thinking largely based on Research in cognitive and developmental psychology and theories of intelligence (Bransford, 2000; Halpern, 1998; Sternberg, 1986). The cognitive psychologists contrasts with philosophical perspectives in two ways,

1. They tend to focus on how people actually think versus how they could or should think under ideal conditions.
2. Rather than defining Critical Thinking by depending to the characteristics of ideal critical thinkers, or enumerating the criteria or standards of ‘good’ thought, they tend to define Critical Thinking by the actions or behaviour critical thinkers can do.

This approach provides a list of skills or procedures performed by critical thinkers (Lai, 2011). Thus psychologists have researched and emphasized skills involved in Critical Thinking process, often ignoring the dispositions and standards.

The list of skills and dispositions drawn up by various philosophers and psychologists reflected considerable overlap and several recent attempts to synthesize contributions of psychology and philosophy appeared in the published Literature (Reed, 1990). Probably the best and broad based systematic inquiry into
the state of Critical Thinking was set in notice by the American Philosophical Association as an attempt to achieve consensus of opinion by a panel of 42 experts in Critical Thinking from various disciplines for the purpose of educational instruction and assessment (Facione, 1990). According to Delphi Report, Critical Thinking is defined as purposeful, self-regulatory judgment which results in interpretation, analysis, evaluation, and inference, as well as explanation of the evidential, conceptual, methodological, criteriological, or contextual considerations upon which the judgement is based.

1.4.2 The Dimensions of Critical Thinking

The dimensions of Critical Thinking comprise of both (a) cognitive skills and (b) affective dispositions. Facione and Facione (1996) state that having the requisite cognitive Critical Thinking Skills is essential for being a good critical thinker.

(a) The cognitive Critical Thinking Skills are defined as the mental abilities involved in Critical Thinking that includes:

- Interpretation: accurately interpreting problems as well as objective and subjective data from common information sources;
- Analysis: examining ideas/arguments in problems, objective and subjective data and possible courses of action;
- Inference: querying claims, assessing arguments (recognizes faulty reasoning) and reaching conclusions;
- Evaluation: evaluating information to ascertain its probable trustworthiness as well as its relevance;
• Explanation: clearly explaining and defending the reasoning in which an individual arrives at specific decisions;

• Self-Regulation: constantly monitoring one’s own thinking using universal criteria like clarity, precision, accuracy, consistency, logicalness, significance etc. and correcting oneself (Facione & Facione, 1996).

Facione (1998) divides the Critical Thinking process into three steps. Firstly, one evaluates information by means of interpretation, analysis, evaluation and inference. Secondly, one applies Critical Thinking and explains how to reach the conclusion by stating the results, justifying the procedures and presenting the arguments. Thirdly, one refines one’s process of thinking through self-examination and self-correction.

**Figure 1.4: Critical Thinking Cognitive Skills**
The concept of Critical Thinking is also associated with a set of personal attitudes or dispositions that can be used to describe an individual who is inclined to use Critical Thinking.

(b) Critical Thinking Dispositions are defined as habitual inclination or tendency to think critically and explained as being:

- Open-minded: having an appreciation of alternate perspectives and willingness to respect the right of others to hold different opinions. Understanding other cultural traditions in order to gain perspectives on self and for others;
- Inquisitive: curious and enthusiastic in wanting to acquire knowledge, wanting to know how things work, even when the applications are not immediately apparent;
- Truth-Seeking: courageous about asking questions to obtain the best knowledge, even if such knowledge may fail to support one’s preconceptions, beliefs or interests;
- Analytical: Thinking analytically and using verifiable information. Demanding the application of reason and evidence and the inclination to anticipate consequences;
- Systematic: valuing organization and a focused and diligent approach to problems of all levels of complexity; and
- Self-Confident: trusting one’s own reasoning and inclination to utilize these skills, rather than other strategies, in order to respond to problems (Facione, 2000).
Facione and Facione (2000) state these dispositions or attributes/attitudes or habits of mind could be considered as the elements of a process of reasoning in an individual’s character that propels or stimulates an individual towards using Critical Thinking. Without these dispositions the engagement of Critical Thinking will not occur. This conceptualization of Critical Thinking was developed by a panel of experts of the Critical Thinking Delphi Project from the American Philosophical Association (1991).

1.4.3 Importance of Fostering Critical Thinking in Students

Critical Thinking means carefully considering a problem, claim, question, or situation in order to determine the best solution. When a person thinks
critically, he takes into consideration various sides of an issue, evaluates evidences, and imagines different consequences and the possible outcomes before he makes a decision. People proficient in Critical Thinking are often open-minded and mindful of alternatives, try to be well-informed, judge well the credibility of sources, identify conclusions, reason and assumptions, judge well the quality of an argument, including the acceptability of its reasons, assumptions, and evidences, can develop and defend a reasonable position, ask appropriate clarifying questions, formulate plausible hypotheses; plan experiments well, define terms in a way appropriate for the context, draw conclusions when warranted, but with caution and integrate all items in this list when deciding what to believe or do (Ennis, 2002). Hence development of Critical Thinking has become a promising strategy helping to increase efficiency of individuals. Critical Thinking is very essential for every one because

- It is a prerequisite for good citizenship, e.g. it has been suggested that there can be no liberty for a community that lacks the critical skills to distinguish lies from truth.
- People will be better equipped to compete effectively for educational opportunities, jobs, recognition, and rewards in our society if they can utilize their thinking abilities efficiently.
- The ability to think well contributes to a person’s psychological well-being; good thinkers are more likely to be well-adjusted individuals.
- Human civilization is currently facing several exceedingly complex and threatening problems and skillful Critical Thinking is essential for making constructive judgments on these prime issues and
Critical Thinking is increasingly needed to perform effectively in the workplace (Hager and Kaye, 1992).

But despite widespread expressions of concern about developing critical thinkers, studies have shown that most educational programmes are neither challenging students to think critically nor helping them develop the reasoning abilities needed to deal successfully with the complexities of modern life. Our educational system continues to graduate students who do not reason well (Paul, 1992). Even college education appears to have a limited effect on graduates’ Critical Thinking abilities, including making reasonable interpretations of texts and formulating unbiased and well-reasoned arguments (Halpern, 1998). It is evident that while concern about Critical Thinking is widespread, effective instruction for Critical Thinking is not occurring on a broad scale. i.e. Even though Critical Thinking ability is highly valued in students especially in contemporary world yet many students are confused about what it means and how to develop it.

We know that thinking is a natural process but, left to itself its development is often distorted and partial. The quality of our life and what we produce depends precisely on the quality of our thoughts and hence excellence in thought must be systematically cultivated. All students, regardless of presumed limitations in ambition or ability, have some degree of potential to think critically. Their capabilities to think critically are likely to be increased if they practice appropriate strategies and skills systematically and extensively in all subjects of the curriculum, and in a manner that is consistent with their cognitive development and prior learning experiences. This potential can be developed to the fullest by embedding Critical Thinking in the core curriculum at all levels of education.
There are many teaching strategies used to help promote Critical Thinking. Costa (2001) mentions that generally there are four distinct categories of teaching strategies: Directive, meditative, generative and collaborative strategies.

The directive strategy includes direct instruction and mastery of thinking skills. This is teacher centered – the teacher provides with most of the knowledge through different activities like drills.

The meditative strategy is where the teacher acts as the facilitator and guides the students to become aware of their meta cognitive processes. Activities include making decisions through ethical disparities, guided by the teacher.

In generative strategies there is minimal input from the teacher, and the students have to discover the knowledge/skills involved. Activities include research projects and the like.

Collaborative strategies are the ones that encourage group work, be it promoting leadership or as a team player.

1.5 THINKING STYLES

Thinking Styles are defined as the preferred ways of using the abilities that one has. To manage the activities, individuals choose styles with which they feel comfortable and the styles are distinct from abilities, and involve preferences, not necessarily conscious, in the use of whatever abilities one has. Styles are not connected solely with ability, but rather, preferred ways of expressing or using one or more abilities (Sternberg, 1997). Individuals have a style profile, meaning that they show varying amounts of each style, but they are not locked into any one profile. People can vary their styles to suit different tasks and situations. Styles further vary over the course of a lifetime, and change as a result of the role models
they emulate at different points in their lives. People do vary in their flexibility to
shift styles, and in the strengths of their preferences. Thus, when we speak of
individual differences in Thinking Styles, we are speaking only of differences, not
of better and worse.

1.5.1 The General Principles of Thinking Styles

The general principles of Thinking Styles (Sternberg, 1997) are

- Styles are preferences, not abilities. There is a difference between how creative
  a student is (ability) and how much the student likes to be creative (style).
- Styles can vary across tasks and situations. People vary their styles, at least
  somewhat, to fit what they are doing. They do not have one fixed style.
- A match between styles and abilities creates a synergy that is more than its
  parts.
- People have profile of styles, not just a single style.
- People differ in strengths of stylistic preferences. Some people strongly prefer
  certain styles; others have only weak preferences.
- People differ in stylistic flexibility. Some people easily can switch among
  styles; others cannot.
- Styles are socialized. Styles are learned through interactions with the
  environment.
- Styles can vary across the life span—they are not fixed. People may change
  their styles over the years.
- Styles are measurable. We measure styles using various techniques.
- Styles are modifiable. People are not “stuck” with certain styles unless they
  want to be.
• Styles are teachable.

• A style which is valued in one time and place may not be valued in another.
  The very style that leads to success in one school or one job may lead to failure in another.

• Styles are not “good” or “bad”, but rather matters of fit between learner and teacher or learner and material. What one teacher considers a good style, another may consider bad, and vice versa.

1.5.2 The Theory of Mental Self-Government

The Present study is based on Sternberg’s Theory of Mental Self-Government. Apart from Sternberg’s Theory, Gregoroc (1979), Jones (1980), Harrison and Bramson (1982), Torrence (1988), Andrews (2003) and Albercht (2006) have also put forward their views on Thinking Styles. In addition to being general, the theory of Mental self-Government also possesses three differentiating characteristics in comparison with the previous models of styles.

First, the style it specifies fall along five dimensions. Second, the theory yields a profile of styles for each individual rather than merely the identification of a single style. Third, the theory corresponds to cognitive centered, Personality centered and activity centered traditions of styles. Moreover, compared to other models, this theory appears to be most suitable to academic situations than a professional environment (Gafoor & Lavanya, 2008). Considering these factors, the present study is based on Sternberg’s Theory of Mental self-government.

The theory of Mental Self-government (Sternberg, 1997), holds that styles can be understood in terms of constructs from human notions of government. The basic assumption of the theory of Mental self-government is that people, like
societies, govern themselves and their mental processes and establish systems and organizations for this governance. These different ways of managing our activities are our Thinking Styles. Thus Thinking Styles are our preferred ways of governing or managing our activities. The Theory of Mental Self-Government views people as self-organizing systems that actively shape their environment as well as themselves. People influence and respond in varied ways to the environment, depending to a large extend upon their styles of responding.

In this theory, Sternberg proposes thirteen Thinking Styles grouped within five dimensions of Mental self-Government- Functions, Form, Level, Scope and Leaning. Function refers to how mind copes with the world. Like a government, the mind legislates, plans, implements, executes, judges or evaluates. Hence he identified three distinct Thinking Styles in the functioning of mind, the executive, legislative and judicial.

Form refers to the preferred ways of approaching and dealing with a problem. The theory specifies four forms- the Monarchic, Hierarchic, Oligarchic and Anarchic. The levels of Mental self-government are global and local. Sternberg classified the Scope into internal and external on the assumption that government needs to deal with internal or domestic affairs. Leaning encompasses liberal and conservative Thinking Styles.

Thirteen Thinking Styles in Sternbeg’s Theory of Mental Self-Government and their Key characteristics are presented in the Table 1.1.
Table 1.1: Characterization of Thinking Styles

<table>
<thead>
<tr>
<th>STYLES OF MENTAL SELF-GOVERNMENT</th>
<th>Thinking Style</th>
<th>Characterisation</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Functions</strong></td>
<td>(1) Legislative</td>
<td>Likes to create, invent, design, do things his or her own way, have little assigned structure</td>
<td>Like doing science projects, writing poetry, stories, or music, and creating original artworks</td>
</tr>
<tr>
<td></td>
<td>(2) Executive</td>
<td>Like to follow directions, do what he or she is told, be given structure</td>
<td>Like to solve problems, write papers on assigned topics, do artwork, form models, build from designs, learn assigned information</td>
</tr>
<tr>
<td></td>
<td>(3) Judicial</td>
<td>Like to judge and evaluate people and things</td>
<td>Like to critique work of others, write critical essays, give feedback and advice</td>
</tr>
<tr>
<td><strong>Forms</strong></td>
<td>(4) Monarchic</td>
<td>Like to do one thing at a time, devoting to it almost all energy and resources</td>
<td>Like to immerse self in a single project, whether art, science, history, business</td>
</tr>
<tr>
<td></td>
<td>(5) Hierarchic</td>
<td>Likes to do many things at once, setting priorities for which to do when and how much time and energy to devote to each</td>
<td>Like to budget time for doing homework so that more time and energy is devoted to important assignments</td>
</tr>
<tr>
<td></td>
<td>(6) Oligarchic</td>
<td>Like to do many things at once, but has trouble setting priorities</td>
<td>Like to devote sufficient time to reading comprehension items, so may not finish standardized verbal-ability test</td>
</tr>
<tr>
<td></td>
<td>(7) Anarchic</td>
<td>Likes to take a random approach to problems; dislike systems, guidelines, and practically all constraints</td>
<td>Writes an essay in stream-of-consciousness form; in conversations, jumps from one point to another; starts things but doesn’t finish them</td>
</tr>
<tr>
<td><strong>Levels</strong></td>
<td>(8) Global</td>
<td>Likes to deal with big picture, generalities, abstractions</td>
<td>Writes an essay on the global message and meaning of a work of art</td>
</tr>
<tr>
<td></td>
<td>(9) Local</td>
<td>Likes to deal with details, specifics, concrete examples</td>
<td>Writes an essay describing the details of a work of art and how they interact</td>
</tr>
<tr>
<td><strong>Scope</strong></td>
<td>(10) Internal</td>
<td>Likes to work along, focus inward, be self-sufficient</td>
<td>Prefers to do science or social studies project on his or her own</td>
</tr>
<tr>
<td></td>
<td>(11) External</td>
<td>Likes to work with others, focus outward, be interdependent</td>
<td>Prefers to do science or social studies project with other members of a group</td>
</tr>
<tr>
<td><strong>Leaning</strong></td>
<td>(12) Liberal</td>
<td>Likes to do things in new ways, defy conventions</td>
<td>Prefers to figure out how to operate new equipment even if it is not the recommended way, prefers open-classroom setting</td>
</tr>
<tr>
<td></td>
<td>(13) Conservative</td>
<td>Likes to do things in tried and true ways, follow conventions</td>
<td>Prefers to operate new equipment in traditional way, prefers traditional classroom setting</td>
</tr>
</tbody>
</table>
In the present investigation, only the Thinking Styles under the dimension functions of Mental Self-Government are studied. The Functions of Mental self-government includes the Executive, Legislative and Judicial Thinking Styles.

The Executive Thinking Styles shows preference to follow rules and plans, prefer problems that are pre fabricated or structured, like to fill the gaps within the existing structures, follow directions and orders and evaluate themselves in the same way the system is likely to evaluate them. The legislative Thinking Styles prefers to formulate rules and plans, decide for themselves, imagine possibilities, come up with their own ways of doing things, create ideas and products and not pre structured and pre fabricated. Individuals with Judicial Thinking Styles prefer to compare, analyse things and make evaluations about quality, worth and effectiveness of existing things and ideas.

1.5.3 Importance of Thinking Styles in Education

Thinking Styles can affect learning hence styles of thought are important in education from several points of view. The theory of mental self-government provides different modes of rendering teaching more effective through style differentiated instruction for those who teach and assess students at any level. The key principle is that for students to benefit the most from instruction, at least some part of the instruction should match their styles of thinking even though it is not possible to provide a perfect match all the time. If we want students to show what they truly can do, a match of instruction and assessment to styles is essential. Studies reveal that certain Thinking Styles have sufficient influence on the achievement of students and it is possible to develop these Thinking Styles in students and teachers can do much with the knowledge of students Thinking
Styles. As per the theory, the styles can be tuned towards Thinking Styles that contribute to achievement (Gafoor & Lavanya, 2008). Hence teachers must take care to give remedial measures or other instructional strategies to bring up these Thinking Styles in the learners.

Students need to learn, and the world does not always provide people with a perfect match to their preferred ways of doing things. Hence flexibility in Thinking Styles is as important for students as it is for teachers. But if we want students to show what they truly can do, a match of instruction and assessment to styles is very important. If a teacher wants to reach and truly interact with a student, he or she needs the flexibility to teach to different styles of thinking, which means varying teaching styles to suit different styles of thought on the part of students.

According to Sternberg (1997) there are various methods of instruction that are most suited for the different Thinking Styles. The following is a list of the various methods of instruction and the styles that are most compatible with these methods

- Lecture with executive
- Thought-based questioning with judicial/legislative
- Problem solving of given problems with executive
- Projects with legislative
- Small-group recitation with executive
- Small-group discussion with judicial
- Reading for details with executive
- Reading for main ideas with executive
• Reading for analysis with judicial

• Memorization with executive

Teachers can reach more students by varying their activity prompts in teaching and assessment. Hence it is necessary that teachers must accommodate an array of thinking and learning styles, systematically varying teaching and assessment methods to reach every student by using the full range of styles that are available.

Thus it can be concluded that Styles matter. They are often confused with abilities, so that students are thought to be incompetent, not because they are lacking in abilities, but because their styles of thinking do not match the styles of the people creating the assessments. Hence especially in teaching, teachers need to take into account students’ styles of thinking if they desire to reach them. This means differentiating instruction in a way that helps students, at least some of the time, capitalize on their stylistic preferences. So Teachers need to carefully consider how their practices in educational settings may deprive able people of opportunities, while giving opportunities to those who are less able For attaining this aim, teaching should be differentiated to help each child capitalize on strengths and compensate for or correct weaknesses

1.6 RATIONALE FOR THE STUDY

Learning is not a passive pursuit. It is not merely the process of absorbing information from external sources; on the contrary it is the act of processing of information in the ways that are meaningful to the learners. Students do not learn just by sitting passively in the classroom listening to teachers, taking notes, memorizing the answers or recalling facts. They must be
actively involved in the process of learning by talking about what they are learning, writing about it, by relating it to past experiences and applying it to their everyday lives (Davis, 1993; Bonwell & Eison, 1991; Chickering & Gamson, 1987). Students learn best when they are actively embedded in the learning process. Active learning shifts the focus from teaching to learning, from students acquiring knowledge to students actively, independently, critically and creatively generating meaning and constructing knowledge by themselves.

Current researches and anecdotal evidences on instructional practices worldwide indicate that the active learning approaches can increase student understanding of science concepts because they facilitate student learning processes resulting in improved student attitudes and retention of knowledge and promote a learning environment more amenable to the metacognitive development necessary for students to become independent and critical thinkers and self-managed learners (Bransford et al., 2000; Michael, 2006; Prince, 2004; Preszler et al., 2007; Felder & Brent, 1997; Yoder & Hochevar, 2005; Sivan et al., 2000; Morable, 2000).

By considering all the listed benefit of Active learning, and more, many International agencies like UNESCO and the United Nations have made several attempts to sensitize and popularize the need for promoting the Active learning pedagogies worldwide. Following these worldwide efforts to respect the Rights of child and the call for participatory pedagogic practices, the educational system in India also witnessed several drastic revolutions in field of pedagogic principles and practices. NCF (2005) has proposed a shift in rote learning approaches in
teaching and learning and outlined the need to institute Active learning pedagogies in the classroom. These transitions in the pedagogic practices were also reflected in the Kerala Curriculum Framework (KCF, 2007). Hence it is imperative to employ participatory pedagogic practices in the classrooms that will promote the active learning in the learners and the number of active learning tasks is limitless. However it is often observed that passive learning environment of teacher centered lectures remains the predominant environment encountered by students in classrooms and effective teaching method based on how people learn are often rarely applied in regular classroom.

Critical Thinking is ability or set of skills that is highly valued in students especially in contemporary world and development of Critical Thinking has become a promising strategy helping to increase learning effectiveness while teaching any subject matter. Improving Critical Thinking Skills is accepted as a crucial goal of education and schools are considered one of the best places where Critical Thinking Skills can be developed efficiently. However as a result of the current classroom practices, it is often noticed that learners are not encouraged to improve themselves as thinkers and overemphasis is placed on information transmission, memory, practice, rote learning etc., paying little focus on higher order thinking. Consequently, majority of school leavers are not able to think effectively and deal efficiently with many of the practical situations. Hence teachers need to realise that it is their prime duty to develop Critical Thinking Skills in the students by modifying the curriculum to integrate active, authentic and evidence based practices that will develop our students’ Critical Thinking Skills to the optimum level.
Thinking Styles are the preferred ways of using the abilities that one has. According to Sternberg’s Principles of Thinking Styles, Individuals have a style profile and it is possible to vary their styles to suit different tasks and situations. Styles further vary over the course of a lifetime, and change as a result of the role models they emulate at different points in their lives. Styles are modifiable are teachable. Thinking Styles of the students can affect their learning considerably, hence different modes of teaching must be employed by the teachers for style differentiated instruction so that students can benefit the most from instruction. For this, at least some part of the instruction should match the styles of thinking of the students, even though it is not possible to provide a perfect match all the time.

So therefore there is an urgent need for an overall revisiting of the pedagogic practices being followed presently in the class rooms and deliberate efforts should be taken to adopt Active Learning Strategies appropriate to develop the thinking faculties of the students at an earlier stage itself so that they can make the fullest possible use of their thinking abilities and styles to realize the best ways to invest their true potentials. On looking into the researches conducted in the past, it was found that Active Learning Strategies had proved to be one of the best methods appropriate to develop the thinking abilities and attitudes in the learners and in many studies it was found that Critical Thinking is related to certain Thinking Styles. Majority of the studies reviewed on these lines were conducted abroad and very rarely were the studies on the analysis of the effectiveness of Active Learning Strategies on the thinking abilities were found to be held in India and particularly in Kerala. So, in the present study, the investigator intended to study the influence of certain Active Learning Strategies on Critical Thinking,
Thinking Styles and Achievement in Physics of secondary school students of Kerala. This study was designed to investigate the influence of Active Learning Strategies like Group Investigation, Think-Pair-Share, K-W-L, Concept Mapping and One Minute Papers on Critical Thinking Skills, Critical Thinking Dispositions, Executive, Legislative and Judicial Thinking Styles and Achievement in Physics among the Secondary School Students. Even though there were other categories of Thinking Styles, the investigation is confined only to the Thinking Styles based on the functions of mental self-government – the executive, Legislative and Judicial Thinking Styles. The secondary school students are in the beginning of their early phase of Piaget’s formal operational stage and their ability to think hypothetically and logically is nascent. A proper training and guidance given to the exercise of thinking at this stage will help the students to develop their thinking skills and styles to the optimum. So the present investigation is intended to study the influence of Active Learning Strategies on Critical Thinking, Thinking Styles and Achievement in Physics among secondary school students.

1.7 STATEMENT OF THE PROBLEM

The study attempts to develop instructional material integrating Active Learning Strategies to teach topics in Physics to students of standard IX and to study its influence on the Critical Thinking Skills, Critical Thinking Dispositions, Executive, Legislative and Judicial Thinking Styles and Achievement in Physics among Secondary School Students of Kerala. Hence the study is entitled as “A Study of Influence of Active Learning Strategies on Critical Thinking, Thinking Styles and Achievement in Physics Among Secondary School Students”.

44
1.8 OPERATIONAL DEFINITIONS

The terms used in the study are operationally defined as the following

1.8.1 Influence

The term Influence in the present study has been defined as the power to affect or to have an effect upon the factors considered. The present study analyses the influence of Active Learning Strategies on Critical Thinking, Thinking Styles and Achievement in Physics. By the term influence it means whether the Active Learning Strategies are producing any effect as indicated by the change of scores in the tools used to assess these dependent variables.

1.8.2 Active Learning Strategies

Active Learning Strategies are defined as pedagogical strategies that enable learners to take active role in the learning process rather than merely listening to lectures passively in the class room. The Active Learning Strategies utilized in the present study were Group investigation, Think-Pair-Share, K-W-L, Concept mapping and One Minute Papers.

1.8.3 Critical Thinking

Critical Thinking is defined as a set of skills and attitudes that result in reasonable, reflective thinking that is focused on deciding what to believe and do. In the present study, the term Critical Thinking is used to indicate Critical Thinking Skills and Critical Thinking Dispositions.

1.8.3.1 Critical Thinking Skills

Critical Thinking Skills are defined as the mental abilities involved in Critical Thinking that includes interpretation, analysis, evaluation, inference,
explanation, and self regulation which can be measured using the test on Critical Thinking Skills.

1.8.3.2 Critical Thinking Dispositions

Critical Thinking Dispositions are defined as the habitual inclination or tendency to think critically, which is explained as being inquisitive, open-minded, Truth seeking, Analytical, systematic and self confident and can be measured using Scale of Critical Thinking Dispositions.

1.8.4 Thinking Styles

Thinking Styles are defined as the preferred ways of using the abilities that one has. In the present study, the classification of Thinking Styles as proposed by Robert. J. Sternberg’s Theory of Mental Self Government is followed and the three Thinking Styles as indicated by the functions of Mental self-government – Executive, Legislative and Judicial Thinking Styles are studied. So in the present study, Thinking Styles denote the Executive, Legislative and Judicial Thinking Styles.

1.8.4.1 Executive Thinking Styles

The Executive Thinking Styles shows preference to follow rules and plans, prefer problems that are pre fabricated or structured, like to fill the gaps within the existing structures, follow directions and orders and evaluate themselves in the same way the system is likely to evaluate them.

1.8.4.2 Legislative Thinking Styles

The Legislative Thinking Styles prefers to formulate rules and plans, decide for themselves, imagine possibilities, come up with their own ways of doing things, create ideas and products and not pre structured and pre fabricated.
1.8.4.3 Judicial Thinking Styles

Judicial Thinking Styles are preferences to compare, analyse things and make evaluations about quality, worth and effectiveness of existing things and ideas.

1.8.5 Achievement in Physics

Achievement in Physics refers to the relative accomplishment or proficiency of performance of the learner in a given body of knowledge or skill related to Physics as a subject of study, which can be measured by Achievement Test in Physics.

1.9 VARIABLES OF THE STUDY

In the present study which explores the influence of Active Learning Strategies on Critical Thinking, Thinking Styles and Achievement in Physics, the dependent, independent and the intervening variables are as follows:

- Independent variable – Active Learning Strategies.
- Dependent variable – Critical Thinking
  Thinking Styles and
  Achievement in Physics
- Intervening Variable – Intelligence

1.10 OBJECTIVES OF THE STUDY

1. To study the influence of Active Learning Strategies on the Critical Thinking of secondary school students.

2. To study the influence of Active Learning Strategies on the Thinking Styles of secondary school students.

3. To study the influence of Active Learning Strategies on the secondary school students’ Achievement in Physics.
4. To study the main and interaction effects of intelligence and gender on secondary school students’ Critical Thinking, Thinking Styles and Achievement in Physics.

5. To study the relationship among Critical Thinking, Thinking Styles and Achievement in Physics of secondary school students.

6. To study the reactions of students towards Active Learning Strategies.

1.11 HYPOTHESES OF THE STUDY

1. The experimental group will be better in Critical Thinking when compared to the control group as a result of implementation of Active Learning Strategies.

2. There will be a difference in Thinking Styles of experimental group when compared to control group as a result of implementation of Active Learning Strategies.

3. The experimental group will be better in Achievement in Physics when compared to the control group as a result of implementation of Active Learning Strategies.

4. There will be differences in Critical Thinking, Thinking Styles and Achievement in Physics among high, average and low intelligence group of students of the experimental group as a result of implementation of Active Learning Strategies.

5. There will be no differences in Critical Thinking, Thinking Styles and Achievement in Physics with respect to gender among the students of experimental group as a result of implementation of Active Learning Strategies.
6. There will be differences in Critical Thinking, Thinking Styles and Achievement in Physics after the implementation of Active Learning Strategies as a result of interaction effect of intelligence and gender.

7. There will be a relation among Critical Thinking, Thinking Styles and Achievement in Physics of the students of the experimental group.

1.12 RESEARCH QUESTIONS OF THE STUDY

1. Is there any influence of Active Learning Strategies on Critical Thinking, Thinking Styles and Achievement in Physics of secondary school students?

2. Is there any effect of intelligence on Critical Thinking, Thinking Styles and Achievement in Physics of secondary school students?

3. Is there any effect of gender on the Critical Thinking, Thinking Styles and Achievement in Physics of secondary school students?

4. Is there an interaction effect of intelligence and gender on the Critical Thinking, Thinking Styles and Achievement in Physics of the secondary school students?

5. Is there any relation among Critical Thinking, Thinking Styles and Achievement in Physics of the secondary school students?

6. What are the reactions of the students towards Active Learning Strategies?

1.13 DELIMITATIONS OF THE STUDY

1. The influence of the select Active Learning Strategies were only studied in the present investigation

2. The combined effect of Active Learning Strategies was studied.

3. The study was confined only to secondary level students.

4. The study was restricted to teaching of Physics of class IX.

5. The study was confined only to SCERT syllabus.
6. The study considered only the three Thinking Styles as indicated by the functions of Mental self-government – Executive, Legislative and Judicial Thinking Styles.

7. The effect of Active Learning Strategies on the select variables like Critical Thinking, Thinking Styles and Achievement in Physics were studied.

1.14 CHAPTERISATION OF THE STUDY

Chapter–I highlights the importance of Active Learning Strategies and the need to promote the thinking faculties of the learners through innovative pedagogic practices, rationale of the study, objectives, hypotheses, research questions and delimitations of the study.

Chapter–II deals with the research studies carried out considering the variables taken in the study.

Chapter–III, the methodology of the study, discusses the details pertaining to methodology followed in the study.

Chapter–IV, deals with the presentation of the data analysis and its interpretation.

Chapter–V, summary of the study along with findings and discussion of the findings, and conclusions are presented.