CHAPTER – I

INTRODUCTION AND CONCEPTUAL FRAMEWORK

1.1. INTRODUCTION

Education is very important for each and every individual and society for the progress. Through education man develops skills like thinking, reasoning, problem solving, creativity, intelligence, aptitude, etc. A number of institutions help the child to become a full-fledged citizen of the country.

In the words of H.K. Kapur (1962) “Man as a social animal tries to understand the atmosphere from his birth. He acquires abilities to adjust himself in his society. There is a need to guide him, to rear him and to bring him to a better development and adjustment” (P. 16).

1.2. SECONDARY EDUCATION

In Tamil Nadu 10 + 2 + 3 System is followed. The schools having classes from VI to X are considered as High Schools. Education imparted in high school classes is the secondary education. As the primary education is intended to provide the minimum essential to children, secondary education helps children to become full members of a complex modern society. Secondary education coincides with adolescent period at the age of thirteen to fifteen. It is the most crucial period, which requires utmost care for the healthy development of the child.

1.2.1. Importance of Secondary Education

Secondary education is more valuable because of its terminal and transitional values. Participation of people in the educational process is highly limited and to a marginal extent encompassing only secondary education. A secondary school leaving certificate is a status of symbol for a school going child. That is the minimum qualification expected of an emerging youth power.

Secondary Education Commission says thus about the importance of secondary education, “The secondary school must make itself responsible for equipping students
adequately with civic as well as vocational efficiency and qualities of character that go with it so that they may be able to play their part worthily and competently in the improvement of national life”.

It is also important in overall development of the individual and also for the balanced development of a region. It is to be seen whether the present system of secondary education is performing these two functions. A number of types of regional disparities may exist in the performance of the system. If so, it is imperative to explore the ways and means by which the regional disparities in secondary education can be overcome and also to find out factors which facilitate or inhibit the performance of secondary school system.

1.2.2. Objectives of Secondary Education

The most essential reform in secondary education lies in the need for changing its form for relating it to the ambitions and need of the people, making it a powerful medium for the social, economic and cultural changes necessary for the achievement of national objectives. The major objectives of secondary education are stated below:

This is needed for praising and glorifying the social and cultural achievements of our country, removing the weaknesses of our country, arousing the desire to serve the country according to one’s abilities, sacrificing personal interests and preferences for the good of the nations.

By the end of education children should possess sound professional knowledge. Considering all possibilities for the development of personality of the child and acting there on is one of the vital needs of the hour. The Education Commission has placed training in leadership among the aims of education as a necessary condition for the success of democracy.

1.3. Curriculum at the Secondary Level

In India secondary education does not have a uniform nature throughout the country. The secondary education commission discovered the following form of secondary education. In some states, the middle schools are known as higher
elementary, vernacular middle schools etc. These schools provide education for classes six, seven and eighth, subsequent to primary education.

At the secondary level, education is generally split into two parts (1) Junior level (2) Higher level. In some states, the senior basic schools also come within the ambit of the secondary schools. These schools provide education for 3 to 4 years. In some regions, the working period for this stage is more than 3 years.

At the Middle Level

Languages, Social studies, General Science, Arithmetic, Art and music, Industry, Physical education are being taught at this level.

At the High School Level

In this course, children have to complete syllabus for either mother tongue and a regional language, or the mother tongue and a classical language.

In addition, they have to study one of the following languages:
1. Hindi (for those who do not use Hindi as mother tongue).
2. Elementary English (for those who did not study English at the middle level).
3. Higher English (for those who have already studied English).
4. Modern Indian Language (in addition to Hindi).
5. Modern foreign language (in addition to English).
6. A classical language
7. One of the following handicrafts
   i. Weaving
   ii. Woodwork
   iii. Metalworking
   iv. Gardening
   v. Typing
   vi. Workshop
   vii. Stitching and knitting
   viii. Modeling
1.4. HUMAN BRAIN

The human brain is the most complex mass of protoplasm. The brain has three basic parts. Each part of the brain developed during different times in the evolutionary history of human beings.

The brain’s functions are both mysterious and remarkable. All thoughts, beliefs, memories, behaviours, and moods arise within the brain. The brain is the site of thinking and the control center for the rest of the body. The brain coordinates the abilities to move, touch, smell, taste, hear, and see. It enables the people to form words, understand and manipulate numbers, compose and appreciate music, recognize and understand geometric shapes, communicate with others, plan ahead, and even fantasize.

The brain reviews all stimuli – from the internal organs, surface of the body, eyes, ears, nose, and mouth. It then reacts to these stimuli by correcting the position of the body, the movement of limbs, and the rate at which the internal organs function. The brain can also adjust mood and levels of consciousness and alertness.

No computer has yet come close to matching the capabilities of the human brain. However, this sophistication comes with a price. The brain needs constant nourishment. It demands an extremely large amount and continuous flow of blood and oxygen – about 20% of the blood flow from the heart. A loss of blood flow to the brain for more than about 10 seconds can cause loss of consciousness. Lack of oxygen or abnormally low sugar (glucose) levels in the blood can result in less energy for the brain and seriously injure the brain within minutes. However, the brain is defended by several mechanisms that can work to prevent these problems. For example, if blood flow to the brain decreases, the brain immediately signals the heart to beat faster and more forcefully and thus to pump more blood. If the sugar level in the blood becomes too low, the brain signals the adrenal glands to release epinephrine (adrenaline), which stimulates the liver to release stored sugar.

The brain is also protected by a thin barrier that prevents some toxic substances in the blood from reaching the brain. This barrier is called the blood-brain barrier. It exists because in the brain, unlike in most of the body, the cells that form the capillary walls are tightly sealed. The blood-brain barrier limits the types of substances that can
pass into the brain. For example, penicillin, many chemotherapy drugs, and most proteins cannot pass into the brain. On the other hand, substances such as alcohol, caffeine, and nicotine can pass into the brain. Certain drugs, such as antidepressants, are designed so that they can pass through the barrier. Some substances needed by the brain, such as sugar and amino acids, do not readily pass through the barrier. However, the blood-brain barrier has transport systems that move substances the brain needs across the barrier to brain tissue.

The activity of the brain results from electrical impulses generated by nerve cells (neurons), which process and store information. The impulses pass along the nerve fibers within the brain. How much and what type of brain activity occurs and where in the brain it is initiated depend on a person's level of consciousness and on the specific activity that the person is doing. The brain has three main parts: the cerebrum, the brain stem, and the cerebellum. Each has a number of smaller areas, each with specific functions.

Cerebrum

The cerebrum, the largest part of the brain, consists of dense, convoluted masses of tissue. The outer layer is the cerebral cortex (gray matter). In adults, the cerebral cortex contains most of the nerve cells in the nervous system. Underneath the cortex is the white matter, which consists mainly of nerve fibers that connect the nerve cells in the cortex with other parts of the nervous system.

The cerebrum is divided into two halves – the left and right cerebral hemispheres. The hemispheres are connected by nerve fibers that form a bridge (called the corpus callosum) through the middle of the brain. Each hemisphere is further divided into a frontal, parietal, occipital, and temporal lobe. Each lobe has specific functions, but for most activities, several areas of different lobes in both hemispheres must work together.

Brain Stem

The brain stem connects the cerebrum with the spinal cord. It contains a system of nerve cells and fibers (called the reticular activating system) located deep within the upper part of the brain stem. This system controls levels of consciousness and alertness.
The brain stem also automatically regulates critical body functions, such as breathing, swallowing, blood pressure, and heartbeat, and it helps adjust posture. If the entire brain stem becomes severely damaged, consciousness is lost, and these automatic body functions cease. Death soon follows.

**Cerebellum**

The cerebellum, which lies below the cerebrum just above the brain stem, coordinates the body's movements. With information it receives from the cerebral cortex and the basal ganglia about the position of the limbs, the cerebellum helps the limbs move smoothly and accurately. It does so by constantly adjusting muscle tone and posture. The cerebellum interacts with areas in the brain stem called vestibule nuclei, which are connected with the organs of balance (semicircular canals) in the inner ear. Together, these structures provide a sense of balance. The cerebellum also stores memories of practiced movements, enabling highly coordinated movements, such as a ballet dancer's pirouette, to be done with speed and balance.

**1.5. HEMISPHERICITY**

Hemisphericity refers to the idea that people rely on a preferred mode of cognitive processing that is linked to predominant activity of either their left or right cerebral hemisphere. Individual hemisphericity was thought to be located somewhere on a gradient between right and left-brain dominance with most people being intermediate.

A reconstituted and quantifiable definition of hemisphericity, called hemisphericity made possible by this work: Hemisphericity is the basis in thinking orientation, behavioural style, and personality resulting from the inherent laterality of one’s sole executive system within the asymmetric bilateral brain. Thus, depending upon which brain side “the one and only you” inherently is located, one is either a left or a right brain oriented person. An L-bop’s cognitive and behavioral orientation is top-down, self-survival, important details view: a splitter. In contrast, an R-bop is biased toward a bottom-up, group survival, global orientation: a lumpers.  

“Right brain-oriented person” = R-bop = Rp = a Lumper  
“Right brain-oriented female” = R-bof = Rf  
“Right brain-oriented male” = R-bom = Rm
“Left brain-oriented person” = L-bop = Lp = a Splitter
“Left brain-oriented female” = L-bof = Lf
“Left brain-oriented male” = L-bom = Lm

Research has demonstrated the importance of understanding brain behaviour as it relates to learning styles and personality traits. In particular, studies revealed that brain hemisphericity greatly influences the individual’s learning style and all kinds of intellectual and personality characteristics (Boyle and Dunn, 1998; McCarthy, 1996; Shiflett, 1989; Torrance, 1982).

Functions of Right Hemisphere

The language area of the right hemisphere is capable of processing language if the discriminations are uncomplicated (e.g. a positive from a negative statement). It is non-verbal in nature with limited language processing ability, and it is creative in language. The right hemisphere deals with the tonal memory, tonal qualities and tonal patterns. For singing songs with pitch, rhythm, intonation and lyrics the right hemisphere should function effectively. The interpretation and retention of complex visual patterns, such as geometric designs and graphs, model building and recognition of faces are the important functions activated by right hemisphere. The right hemisphere functioning for left side of the body is also in charge of spatial movement, finding way in space, front and backspace awareness and perception of fine and gross motor activities. The functions of the right hemisphere have generally been described as creative, divergently productive, intuitive, holistic, gestation, concrete and analogical. It also deals with the body image and it controls emotional aspects such as laughing, crying and tonal expression.

Functions of Left Hemisphere

Expression of language through speech, verbal memory, word parts, syllable recognition, analyses of speech sounds, use of verbs and verbal aspect of writing are functions predominantly done by left hemisphere. Right visual field and right eye movements are controlled by left hemisphere and it deals with the functions such as naming of faces and labelling of parts. The motor activity of the right side of the brain, motor activities of speech, action words describing, movement of hands in speech, verbal
expression of movement through memory are the functions activated by left hemisphere. The left hemisphere is considered to be a rational linear mind specialising in sequential processing, logical, analytical thinking, inductive and convergent in production of ideas.

Mathematical reasoning, particularly calculations and algebraic abstract maths, digital operations and computations are activated by left hemisphere. Left hemisphere functions in daydreams, drugging, meditation, fantasy, hypnosis, diversion and play. It also functions for activating aggressive behaviour of a man and maintaining his masculine nature.

**Style Differences between Right and Left Brain Learners**

<table>
<thead>
<tr>
<th>Left Hemisphere</th>
<th>Right Hemisphere</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Utilizes motor skills more effectively</td>
<td>• Usually wants simple answers to complex problems</td>
</tr>
<tr>
<td>• Uses a more analytical approach to problem solving</td>
<td>• Prefers to think more holistically</td>
</tr>
<tr>
<td>• Does not like change</td>
<td>• Less organized than right brain learners</td>
</tr>
<tr>
<td>• Not creative in planning and organization</td>
<td>• More spatially oriented and creative in solving problems</td>
</tr>
<tr>
<td>• Typically have problems seeing the big picture</td>
<td>• Tend not to follow through with details</td>
</tr>
<tr>
<td>• Usually unemotional in their approach to human relations</td>
<td>• Does not follow procedures-likes to do their way</td>
</tr>
</tbody>
</table>

In general, people typically prefer the thinking style of one side of their brain or the other, although some people may use each side equally. Therefore, it is important for instructors to have knowledge of their own brain hemisphericity in order to identify advantages and disadvantages in their teaching techniques. In addition, knowledge of their own brain hemisphericity can assist them in becoming more flexible and effective in teaching in the classroom.

In the past quarter of a century considerable attention has been given to what is called brain hemisphericity. According to neurosurgeon Joseph Bogan (1975) brain hemisphericity is the reliance on one mode of processing than another by an individual. Roger Sperry (1975), a Nobel laureate in physiology for his work on hemisphericity, explained the nature of hemisphericity this way: “Each hemisphere has its own
sensations, perceptions, thought, and ideas all of which are cut off from the corresponding experience in the opposite hemisphere. Each left and right hemisphere has its own private chain of memories and learning experiences that are accessible to recall by the other hemisphere. In many respects each disconnected hemisphere appears to have a separate “mind of its own.”

These early brain researchers found that (1) The two halves of the brain, right and left hemispheres, process information differently; (2) In the split-brain patient, there seem to be two different people up there, each with his/her favorite ways of processing information, each with a different mode of thinking; and (3) Both hemispheres are equally important. These neurosurgeons’ findings had direct and obvious implications for teaching, but especially for the growing field of learning styles. Bernice McCarthy, who has applied the results of brain research to the 4 MAT model of learning sees the two hemispheres processing information and experiencing differently. Here are some differences that make a difference in helping to accommodate students with different learning styles. The concepts of brain hemisphere dominance play a vital role in the development of cognitive and affective characteristics of the individual.

**Left and Right Hemisphere Information Processing**

<table>
<thead>
<tr>
<th>Right Brain</th>
<th>Left Brain</th>
</tr>
</thead>
<tbody>
<tr>
<td>Visual, focusing on images, patterns</td>
<td>Verbal focusing on words, symbols, numbers</td>
</tr>
<tr>
<td>Intuitive, led by feelings</td>
<td>Analytical, led by logic.</td>
</tr>
<tr>
<td>Process ideas simultaneously</td>
<td>Process ideas sequentially, step by step,</td>
</tr>
<tr>
<td>‘Mind photos’ used to remember things, writing things down</td>
<td>Words used to remember things, remember names rather than</td>
</tr>
<tr>
<td>or illustrating those helps you remember</td>
<td>faces.</td>
</tr>
<tr>
<td>Make lateral connections from information</td>
<td>Make logical deduction from information</td>
</tr>
<tr>
<td>See the whole first, than the details</td>
<td>Work up to the whole step by step focusing on details,</td>
</tr>
<tr>
<td></td>
<td>information organized.</td>
</tr>
<tr>
<td>Organization ends to be lacking</td>
<td>Highly organized</td>
</tr>
<tr>
<td>Free association</td>
<td>Like making lists and planning</td>
</tr>
<tr>
<td>Like to know why you’re doing something or why rules exist</td>
<td>Likely to follow rules without questioning them.</td>
</tr>
<tr>
<td>Right Brain</td>
<td>Left Brain</td>
</tr>
<tr>
<td>---------------------------------------------------------------------------</td>
<td>---------------------------------------------------------------------------</td>
</tr>
<tr>
<td>No sense of time</td>
<td>Good at keeping track of time</td>
</tr>
<tr>
<td>May have trouble with spelling and finding word to express your self.</td>
<td>Spelling and mathematical formula easily memorized.</td>
</tr>
<tr>
<td>Enjoy touching and feeling actual objects. (sensory input)</td>
<td>Enjoy observing</td>
</tr>
<tr>
<td>Trouble prioritizing, so often late, impulsive.</td>
<td>Plan ahead</td>
</tr>
<tr>
<td>Unlikely to read instruction manual before trying.</td>
<td>Likely read an instruction manual before trying</td>
</tr>
<tr>
<td>Listen to how something is being said</td>
<td>Listen to what is being said</td>
</tr>
<tr>
<td>Talk with your hands</td>
<td>Rarely use gestures when talking</td>
</tr>
<tr>
<td>Likely to think you’re naturally creative, but need to apply your self to develop your potential</td>
<td>Likely to believe you’re not creative need to be willing to try and take risks to develop your potential</td>
</tr>
</tbody>
</table>

One of the arguments that brain researchers make is that school learning emphasizes and favors “left” brain learning over “right” brain learning. If listening to lectures and relying on the science textbook are left brain activities, then there is evidence to support this argument. For example, teachers who want to increase the number of right brain activities in their lesson plans, thereby giving right brain learners more of an opportunity for success would include such approaches as: mind-mapping, visualization experiences, imagery, analogies, use of paradox, role-playing, creative writing (yes, in science), demonstrations, experiments, intuitive activities, connecting ideas, and creative problem solving.

Some researches showed that there is a tendency, as with any theory, to draw simplified interpretations, and so it is with brain functioning and student learning style. One of the major oversimplifications is that rationality is exclusively a left-brain function, and creativity a right brain function. Evidence supports the idea that both hemispheres play a part in rationality and creativity. There are, however, some results that have powerful implications for a teacher.

Ann Howe and Poul Thompsen report that hemisphericity can play an important role in motivation and science teaching. According to work being done in artificial
intelligence, when a person is exposed to some new phenomenon, the first thing that occurs is that in the deep part of your brain you give a preliminary value to it: ‘is it interesting or not?’ If it isn’t, the person doesn’t give it any more attention. It is interesting then after 10 seconds or so it enters the right hemisphere, which attempts to make holistic sense of the phenomenon: ‘what’s this all about?’ If this succeeds, then the information is processed to the left hemisphere where the brain tries to deal with analytically. This notion supports the contention that we must pay close attention to the types of tasks that we present to students. Interest is an important aspect of science teaching, and the gatekeeper seems to be the deep recesses of the brain.

Brain hemisphericity is the tendency of an individual to process information through the left hemisphere or the right hemisphere or in combination (Bradshaw & Nettleton, 1981; McCarthy, 1996; Springer & Deutsch, 1993). Research has demonstrated that the left hemisphere operates in a linear, sequential manner with logical, analytical, prepositional thought. On the other hand, the right hemisphere operates in a nonlinear, simultaneous fashion and deals with non-verbal information as well as dreams and fantasy (Iaccino, 1993; McCarthy, 1996; Oxford, 1996; Oxford, Ehrman & Lavine, 1991; Springer & Deutsch, 1993; Torrance, 1988). The left hemisphere appears to be specialized for language, whereas the right hemisphere is specialized for visuo-spatial and appositional thought. Kinsella (1995), Oxford (1996), and Oxford, Ehrman, and Lavine (1991) maintained that left hemispheric dominants are highly analytic, verbal, linear and logical learners, whereas right-hemispheric dominants are highly global, visual, relational, and intuitive learners. Whole-brain dominants are those who process information through both hemispheres equally and exhibit characteristics of both hemispheres. Those individuals have flexible use of both hemispheres (McCarthy, 1996).

Even though most of the literature appears to list characteristics associated with each of the brain hemispheres as dichotomies, the idea of hemispheric dominance suggests that brain hemisphericity operates on a continuum and is not dichotomous (Saleh & Iran-Nejad, 1995). It is important to keep in mind that individuals have different degrees of dominance, which affect to what degree they exhibit these characteristics.
Research has demonstrated that students are capable of mastering new skills if they are taught through instructional methods that complement their hemispheric preference (Boyle & Dunn, 1998; Dunn, Sklar, Beaudry, & Bruno, 1990). Several studies have found that students taught through methods that matched their hemispheric styles achieved statistically significant higher test scores than when they were taught through other teaching methods (Brennan, 1984; Dunn, Sklar, Beaudry, & Bruno, 1990; Jarsonbeck, 1984).

Studies have suggested that brain hemisphericity is associated with different occupations and academic majors (Kolb, 1979; McCarthy, 1996). Kolb believed people choose majors/fields based on congruence between their learning styles and the norms of those majors/fields (1979). People choose their academic majors based on the compatibility between the norms of these disciplinary fields and the individual's hemispheric dominance (Kolb, 1979; Gordon & Coscarelli, 1986; Rowe, Waters, Thompson, & Hanson, 1992). Academic subjects such as arts, the humanities, and architecture are believed by several researchers to require a more global, synthetic, and spatial orientation which make them more suitable for right-brain dominant students, whereas other subjects such as science, engineering, and language emphasize logic and verbal analysis, which make them a better fit for left-brain dominant students (Coulson & Strickland, 1986; Herrman, 1982; Katz, 1983). Lavach (1991) examined the brain hemisphericity of students with different majors. He reported that humanities students showed preference for the right-hemispheric dominance. Natural science students demonstrated a left-hemispheric mode, while social science majors showed preference for left-hemispheric dominance.

Another finding that has implications for teaching has to do with the role of emotion or feelings. The right hemisphere seems to play a special role in emotion. If students are emotionally involved in an activity, then both sides of the brain will participate in the activity, regardless of the subject matter or content. The two hemispheres are involved in thinking, logic, and reasoning, and in the creation and appreciation of art and music. This disputes earlier implications that the left-brain was the logical side, and the right brain the artistic side. This is how the question of the roles of hemisphere does not provide a definite answer but extends the scope of researchers in this area infinitely.
1.6. WHAT IS CREATIVITY?

Creativity has been defined in different ways by different people. It has been agreed that creativity is a process of an individual producing something unique for himself. Prof. Paul Torrance has defined creativity as follows “I have chosen to define creative thinking as a process of sensing gaps or discovering missing elements, forming ideas or hypotheses and communicating the results, possibly retesting the hypotheses” (Sood, J.K, 1989, P. 313).

It may be useful to generalize that creative thinking involves the highest mental function and the focus is on the creation of useful invention. One can define creativity as the mental phenomena, skills and/or tools capable of originating (and subsequently developing) innovation, inspiration or insight. Pop psychology generally may associate it with right or forehead brain activity or even specifically with lateral thinking (www.en.wikipedia.org).

Creativity is the process of bringing something new into being...creativity requires passion and commitment. Out of the creative act is born symbols and myths. It brings to our awareness what was previously hidden and points to new life. The experience is one of heightened consciousness—ecstasy (Rollo May, 2002).

Creativity has two parts: thinking, then producing. Innovation is embedded in the creative process. It is the implementation of creative inspiration (Linda Naiman, 2004).

A product is creative when it is (a) novel and (b) appropriate. A novel product is original not predictable. The bigger the concept, and the more the product stimulates further work and ideas, the more the product is creative (Sternberg and Lubart, 2002).

Creativity is defined as the tendency to generate or recognize ideas, alternatives, or possibilities that may be useful in solving problems, communicating with others, and entertaining ourselves and others. Three reasons why people are motivated to be creative:

- need for novel, varied, and complex stimulation
- need to communicate ideas and values
In order to be creative, one may need to be able to view things in new ways or from a different perspective. Among other things, he needs to be able to generate new possibilities or new alternatives. Tests of creativity measure not only the number of alternatives that people can generate, but the uniqueness of those alternatives. The ability to generate alternatives or to see things uniquely does not occur by chance; it is linked to other, more fundamental qualities of thinking, such as flexibility, tolerance of ambiguity or unpredictability, and the enjoyment of things so far unknown (Robert E. Franken, 2002, P. 394).

‘Creativity’ is commonly used in the following ways:

- Persons who express unusual thoughts, who are interesting and stimulating - in short, people who appear to the unusually bright.
- People who experience the world in novel and original ways. These are (personally creative) individuals whose perceptions are fresh, whose judgements are insightful, who may make important discoveries that only they know about.
- Individuals who have changed our culture in some important way. Because their achievements are deviant from public expectation, it is easier to write about them (e.g., Leonardo, Edison, Picasso, Einstein, etc.) (Mihaly Csikszentmihalyi, 2001, Pp. 25-26).

Creativity is bringing into something which did not exist before, either as a product, a process or a thought.

One would be demonstrating creativity if he:

- Invents something which has never existed before
- Invents something which exists elsewhere but he is not aware of
- Invents a new process for doing something
- Reapplies an existing process or product into a new or different market
- Develops a new way of looking at something (bringing a new idea into existence)
- Changes the way someone else looks at something
- In fact, all are creative every day because they are constantly changing the ideas, which they hold about the world and about them. Creativity does not have to be about developing something new to the world, it is more to do with developing something new to themselves. When they change themselves, the world changes with
them, both in the way that the world is affected by their changed actions and in the changed way that they experience the world.

Creativity can be used to make products, processes and services better and it can be used to create them in the first place. It is expected that increase in creativity will help their organization and their customers become happier through improvements in their quality and quantity of output (http://www.brainstorming.co.uk).

1.7. DIMENSIONS OF CREATIVITY

Creativity, while highly desirable, is popularly regarded as an elusive, subjective characteristic. Within education, it is reflected largely in compositions. However, creativity can be measured objectively and its involvement of education is not limited to learning. Accumulating findings indicate that learning enhances intellectual creativity in general.

An investigation published in this regard indirectly speaks to the issue of what sort of and how much practical-related education is needed to enhance creativity. Apparently it must be more than twice weekly for three months. Thus, Vaughn and Myers (1971) gave 4th and 5th graders a special program using this schedule, which involved showing students the many parallels between various processes and major factors in general creative thinking, such as fluency, flexibility and originality (Pp. 337–341).

Teresa Amabile (1996) also reports that creative individuals rely on a repertoire of knowledge and skills to wonder, imagine possibilities, and mentally play with high-level ideas. Like Segal, Amabile finds creative individuals are intrinsically motivated to tackle – and finish – complicated tasks. Perseverance (or ‘task commitment’) is a necessary quality, Amabile says, noting that creative individuals concentrate for long periods and persist even when their work becomes frustrating and ends up in failure.

Teachers in creative classrooms understand that kids need to have their own repertoire of knowledge and skills to pursue high-level inquiries and problem-solving. They foster thinking skills such as:
Fluency – produce many responses to an open-ended question or problem
Flexibility – generate unconventional ideas and view situations from different perspectives
Originality – produce unique, unusual, or novel responses
Elaboration – add rich detail to ideas
Visualization – imagine and mentally manipulate images and ideas
Transformation – change one thing or idea into another to see new meanings, applications, and implications
Synthesis – combine parts into a coherent whole.

Creativity is based in fluency, flexibility, and originality of thought. Students whose teachers encourage them to experiment with ideas and to be ‘mentally playful’ – including taking risks in their thoughts and actions – stand a good chance of being creative and productive (American School Board, 2003).

Several approaches to directly measuring creativity have been developed over the years, and these have been applied successfully in many settings. For example, Guilford (1967) developed an “Unusual Uses” test in which a person is asked to devise as many uses for a common object as possible; e.g., what are unusual uses for a brick? Also, his “Unusual Situations” test, which asks, for example, what would happen if no one had to sleep anymore? The Torrance Test of Creative Abilities (1966) is also widely used; e.g., a child might be asked to sketch as many objects as possible given a set of blank circles.

This is not to say that all workers agree on which measures are best. Amabile (1996) has argued for and applied assessments of creativity based on the collective judgments of e.g., a work of art, by individuals who are widely regarded as experts within the field in question. But even with overall judgments, definite factors are evaluated. These include novel use of materials, novel ideas and spontaneity as well as other factors that might be less closely related to the ‘core’ concept of creativity. This ‘core’ one takes to be a new way of thinking or doing which is not merely different or bizarre but is coherent and perhaps illuminating.
1.8. CHARACTERISTIC FEATURES OF CREATIVITY

Most of the studies have revealed that creative persons, in a variety of fields, exhibited the same pattern of values and interpersonal relations, including high theoretical and aesthetic values, high self-sufficiency, introversion, greater concern with ideas than with people, and uninterested in social activities. Some of the specific characteristics of creative persons are as follows:

- Challenge assumptions
- See in new ways
- Recognize new patterns
- Make new connections
- Construct new networks
- Take risks
- Take advantage of chance

Some other attributes of creative persons are as follows:

- Think originally, flexibly, divergently and imaginatively
- These persons are able to elaborate
- These persons are able to improvise, innovate and invent
- They also exhibit a common pattern of perception and cognition, including preference for complexity, independent judgement, resistance to group pressures and willingness to take risks.
- Children who were judged creative were humorous in their free associations and aspired to unconventional rather than conventional careers.

Characteristics of the Creative Personality

- Creative individuals have a great deal of energy, but they are also often quiet and at rest.
- Creative individuals tend to be smart, yet also naive at the same time.
- Creative individuals have a combination of playfulness and discipline, or responsibility and irresponsibility.
- Creative individuals alternate between imagination and fantasy at one end, and rooted sense of reality at the other.
Creative people seem to harbor opposite tendencies on the continuum between extroversion and introversion.
Creative individuals are also remarkable humble and proud at the same time.
Creative individuals to a certain extent escape rigid gender role stereotyping and have a tendency toward androgyny.
Generally, creative people are thought to be rebellious and independent.
Most creative persons are very passionate about their work, yet they can be extremely objective about it as well.
The openness and sensitivity of creative individuals often exposes them to suffering pain yet also a great deal of enjoyment (Robert E. Franken, 2002, Pp. 58-73).

1.9. CREATIVE THINKING

Creative thinking is the process, which one uses when he comes up with a new idea. It is the merging of ideas, which have not been merged before. Brainstorming is one form of creative thinking: it works by merging someone else’s ideas with their own to create a new one. They are using the ideas of others as a stimulus for their own.

This creative thinking process can be accidental or deliberate. Without using special techniques creative thinking does still occur, but usually in the accidental way; like a chance happening making to think about something in a different way and then discovering a beneficial change. Other changes happen slowly through pure use of intelligence and logical progression. Using this accidental or logical progression process, it often takes a long time for products to develop and improve. In an accelerating and competitive world this is obviously disadvantageous (www.brainstorming.co.uk).

Using special techniques, deliberate creative thinking can be used to develop new ideas. These techniques force the mergence of a wide range of ideas to spark off new thoughts and processes. Brainstorming is one of these special techniques, but traditionally it starts with unoriginal ideas.

Developments of products occur much more rapidly using these deliberate techniques than by accident. Many people known for being creative use these techniques, but are not aware they are doing so because they have not been formally trained in them.
If they use these deliberate techniques during advanced brainstorming sessions then they too will be more creative.

With practice, ongoing creative thinking (the continuous investigation, questioning and analysis that develops through education, training and self-awareness) occurs all the time. Ongoing creativity maximizes both accidental and deliberate creative thinking. Ongoing creativity takes time and deliberate practice to become skillful becomes an attitude, not a technique.

The first step to take is to learn the creative thinking techniques so that they can deliberately use them to come up with new ideas. They will then be at an immediate advantage over those who do not know how to use them. They should then practise the techniques to increase their skill at ongoing creative thinking.

1.10. BASIC PRINCIPLES OF CREATIVE THINKING

Creativity is something reserved for scientists or artists for many people. But this is to ignore the fact that one may face with countless problems in daily life, and it is precisely creative thinking that helps them to come up with solutions to these problems. One may need to make use of the creativity whether they are thinking about how to earn more money or how to make the life happier.

Many people also seem to think that creativity is a matter of waiting for inspirations. How inspiring ideas come about is however regarded as a rather mysterious process, and it is just a fact that some people are more creative than others. But it would be a mistake to think that creativity is a passive state of mind. While it is true that there is no special algorithm for creativity, there are thinking skills that can be taught and things one can do to enhance one’s creativity. But to begin with, one may need to understand these basic principles that underlie creativity.

1. New ideas are composed of old elements

Critical thinking is mainly about correct thinking. Creativity is mainly about alternative possibilities - how to come up with new and useful ideas. A new idea might be a new theory, a new product, a new solution to a problem, or a conception for a piece of art.
To come up with something new is to produce something that is distinctive and special. The practical implication here is that in order to be creative one must be ready to deviate from the ordinary and the traditional. Many people have the habit of following instructions and are afraid of challenging the status quo or exploring anything new. This implies a certain courageous exploratory attitude and curiosity in one’s character.

But where do new ideas come from? The simple answer is that new ideas are actually old ones rearranged in a new way. So there is a sense in which it is true that “there is nothing new under the sun”. This applies not just to the creation of concepts or theories but also the launching of new fashion or cultural trends.

How does one generate new ideas from old ones? Roughly speaking, ideas are usually composed of different elements, and look for new combination of ideas by joining different ideas together, deleting some elements, or replacing some elements by other ones. Consider the idea of a mobile phone. This idea is of course the combination of the idea of wireless information transmission and the idea of a telephone.

The ingredients for creativity depend on the store of ideas that are available for recombination. If one has a limited domain of knowledge, he will have fewer resources to draw from in forming new ideas. This is why intellectual curiosity and a wide knowledge base can significantly enhance one’s creativity - one has in one’s possession more concepts, theories and experience to choose from. This is also why it can be useful to try to solve a problem by consulting other people with different expertise.

2. Not all new ideas are on a par

Creativity is not simply a matter of coming up with new ideas. The kind of creativity that is valued is the ability to come up with new and useful ideas; ideas that serve an important need or creates a new trend that makes an impact.

Creativity might be divided into cognitive and artistic creativity. Artistic creativity consists in the creation of artwork and expressing one’s ideas and emotions through various forms of art. Critical thinking as such is not opposed to artistic creativity, but the enhancement of critical thinking skills obviously might not improve one’s artistic creativity. However, critical thinking is a necessary condition for cognitive
Creativity. Cognitive creativity is a matter of coming up with solutions to practical or theoretical problems. This includes for example creating a new scientific theory, or launching a new commercial product.

Cognitive creativity has two parts - the generation of new ideas, and the evaluation and modification of new ideas. When one may need new ideas to solve a problem, critical thinking is necessary to help determine the relevance and effectiveness of the idea. To build a rocket that flies to the moon, one should not violate logic or the laws of physics. The evaluation of any proposal to solve a problem must involve good critical thinking.

It is sometimes suggested that creativity often requires going against the usual conventions, and that new and important ideas might be lost if one is too critical. But good critical thinking does not mean that one must always be critical. If experience tells that it is useful to brainstorm, that sometimes it might be productive to suspend one’s critical judgment and list out new ideas before evaluating them, then it is of course rational to do so. This is certainly not inconsistent with the principles of critical thinking. It is thus a serious misconception to regard critical thinking and cognitive creativity as opposed to each other.

3. Creativity is enhanced by the ability to detect connections between ideas

The store of ideas provides the ingredients to generate new ones, but it is important to remember that useful ideas might come from unexpected sources. A successful marketing campaign might appeal to certain psychological studies and relate to particular trends in the society. This involves seeing a connection between the subject matter one is interested in (the marketing exercise) and other subjects (sociology and psychology), which might seem somewhat remote.

So if one wants to be creative, he must be ready to explore connections between different areas. This means that he should have a wide knowledge base. Creative people are usually people who read widely, who have a great sense of curiosity, and are often willing to explore topics which do not bring about immediate benefits. Next one should ensure that the learning processes should aim at a deep understanding of the connections between key concepts. Studying is not simply remembering bits and pieces of unrelated
information. One should make sure that he looks at the information he has from different angles, reformulate them systematically in a way to achieve better understanding.

**1.11. INTELLIGENCE AND ITS DEVELOPMENT IN DIFFERENT STAGES**

“Intelligence is like electricity: easy to measure, but almost impossible to define” – Crider, Solomon. V. (1989).

Since the dawn of civilization one could witness a perpetual renewal, replenishment and refinement of the standard of living conditions. The Stone Age man lived in caves amidst constant dangers and hence in a state of insecurity. Over the years he learnt to use tools to surmount obstacles and to survive. He was able to protect himself from wild beasts, sunshine and rain by creating shelter in caves. There was no language for communication. Even before the introduction of language human beings did possess thought – processes. Behind thinking lies the invisible faculty of intellect which enables an individual to reason and judge. Perhaps it was in its embryonic stage.

Homosapiens have come a long way from their primitive predecessors. They have now conquered Nature, tamed and domesticated animals, exploited the natural resources to generate power. Living in the Space Age of the Twentieth century and marching into the next millennium “Homosapiens” are worried over the kind of software to be fed in to their super computers. They are busy installing robots to replace human labour. What an astounding accomplishment has human Intelligence, not to speak of Artificial Intelligence, performed over the past few centuries: – from the soul – stirring plays of Shakespeare, lilting lyrics of Wordsworth, incredible inventions of Edison and Marconi, admirable artistic creations of Leonardo-da-Vinci and magnificent sculpture of Michael Angelo – that has totally transformed the quality of life from that of cave – dwellers. People now live in multi – storied flats in metropolitan cities, circle around the world in supersonic jets; reach the bottom of the seas. Before studying the psychology of intelligence let us have a peep into the organic structure that lies behind intelligent behaviour. Psychology is rooted in physiology and behind human behaviour and excellence lays an internal mechanism.
1.12. CEREBRUM – THE SEAT OF INTELLIGENCE

The cerebrum is the most precious part of the human brain. It controls all voluntary activities and thinking processes. The cerebrum in man is much larger than found among lower species of animal life. The outer surface of the cerebrum is formed by a layer of grayish material called the Cerebral Cortex.

The brain’s structure and function are shown to be unrivalled by anything we know of in the Universe. Massively parallel, elaborately inter – connected, marvelously miniaturized and highly adaptive, it quickly forms new circuits – strengthens or weakens synaptic connections – based on experience with the environment. Commenting on the functioning of the human brain, Dr. K. Ganapathy, Neurosurgeon says: “Though the original prototype was launched almost seven million years ago, we still do not have the complete circuit – diagrams. How can one maintain service and repair the most intricate computer that has ever been produced. Yet, today brain functions are being mapped with an unbelievable precision.

Encountering an exceptionally intelligent person, one often remarks that person’s brain must be really active. This is far from the truth, says Dr. Ganapathy. “Higher the IQ lesser the activity in the brain. Intelligence is apparently a matter of efficiency – neural efficiency. Smart brains get away with less work, because they use far fewer neurons or circuits, or both. Conversely, when a less smart brain thinks, lots of extraneous or inefficient circuits crackle. Therefore, intelligence is a function not of effort, but efficiency. One should switch on a table lamp to illuminate the reading material, not switch on all the lights in the house, expending unwanted energy”.

1.13. INTELLIGENCE IS MENTAL ABILITY

Intelligence is perhaps the most controversial topic in modern psychology. It has created furious debates throughout the 21st century and continues to do so. The issue is that creates this controversy concerns whether intelligence is inherited or not.

If we are going to investigate intelligence, then we must to be able to measure it. The first test of intelligence was developed in France by Alfred Binet, who is “The Father of Intelligence Tests”. He started his scientific studies by examining the
relationship between head size and intelligence in Paris at the beginning of the twentieth century.

Intelligence is mental ability. It involves convergent thinking. Convergent thinking refers to the mental process that looks out for the correct response to a problem. In this type of thinking, mental operations consist of locating the correct information to give the appropriate response. This form of thinking is needed in a situation or a problem where there is only one acceptable answer. Convergent thinking narrows down the options. It is used to analyse, develop, refine and evaluate options.

### 1.14. FACTORS INFLUENCING INTELLIGENCE

1. Heredity and environment are necessary for the intellectual growth of an individual.
2. Distribution of intelligence is not uniform among the human beings.
3. Individual differences among individuals can also be a cause.
4. Intelligence in the same individual varies from age to age.
5. Difference in sex does not contribute towards difference in intelligence, and
6. Intelligence is not the birth right of a particular race or group. The ‘bright’ and ‘dull’ can be found in any race, caste or cultural group.

### 1.15. ACHIEVEMENT IS THE INDIVIDUAL’S OUTPUT

Achievement is the actual performance on a given test at a given time. Achievement tests are usually used to determine the degree of mastery of subject matter, content or skills. However, the score on an intelligence test, which attempts to measure mental ability, is a measure of past learning or by definition a measure of achievement. In other words, complete separation of a pupil’s capacity, ability and achievement is not possible in test situations. Achievement is the task – oriented behaviour that allows the individual’s performance to be evaluated according to some internally or externally imposed criterion that involves the individual in competing with others, or otherwise involves some standard of excellence.

The definite things, an achievement is not, however, are a failure, a debacle, a defeat, a flop, a washout, a blow off, a shortage, a losing of, or a quitting. Achievement is not, not doing something. There must be some kind of an action, mental or physical.
Achievement is not being in the progress of something, but having done something. The act of beginning to do something difficult or something you are unwilling to do, in it, is not an achievement. Instead, the making up of your mind to do that task is an achievement. Achievement is an accomplishment, an attainment, a success, an actualization, a completion, a conquest, a fulfillment, victory and even an effort or a realization. Achievement discriminates between neither big nor small feats, whether it be of importance or negligible to the general public (or even swallowing a tiny pill). In the place of the general public’s opinion, is your heart, the true judge? It alone holds the power to decide if you’ve made an achievement or not.

1.16. ACHIEVEMENT TEST

Achievement tests try to measure how much an individual has learned about a particular subject, rather than the general ability for learning. Schools use achievement tests more than any other kind of test. Throughout primary school, secondary school and college most teachers rely on such tests when rating a student’s progress. Special achievement tests are used to license people in such professions as law, medicine and accounting. Many teachers prepare achievement tests that closely follow their own method of instruction. They also use standardized achievement tests. Some schools ask students to take standardized achievement tests, as well as scholastic ability tests, for admission or placement.

Achievement, it is meant that the accomplishment attained by a student after undergoing a specified course of instruction or training. The test constructed to measure this attainment is known as achievement tests.

The main focus of educative process is to improve the performance or learning of the students. The learning outcomes of the students are measured with the help of their achievement. The achievement tests are controlling process for teaching-learning activities. It helps in evaluating the effectiveness of teaching instructions. It also provides the feedback to the students as well as to the teachers. Educational measurement is the task of a teacher. Teaching and testing are the main responsibilities of a teacher. In the achievement test main emphasis is given on content coverage or course. The achievement test that has the focus on the relation of objectives of teaching – learning is known as criterion test.
1.17. ACHIEVEMENT TESTS IN EDUCATION

Achievement tests are generally used in educational services, industry, civil service and also for guidance, counselling and clinical purposes.

i. Standardized achievement tests are more often used to assign course grades in special programmes in government, industry and turnings courses. It is more meaningful to assign grades on the basis of achievement test score.

ii. In educational institutions the students are promoted to higher class on the basis of achievement test scores.

iii. Achievement tests are often used to classify students in to special courses, high school or college.

iv. Achievement tests are very useful to the school psychologists and the clinical psychologists and

v. Achievement tests in combination with course grades are useful in helping the students to choose future programme of school work or vocational training.

1.18. TYPES OF ACHIEVEMENT TESTS

There are two types of achievement tests: norm – referenced and criterion – referenced. In Norm – referenced testing an individual’s performance is compared with the performance of a specific group of subjects. A norm provides an indication of average or typical performance of the specified group. Norms are needed because the raw score, in itself, is not very meaningful. The norm sample should be truly representative of the target population with regard to age, sex, grade level and socio-economic status. Binet’s tests are norm – referenced tests.

In criterion – referenced testing is used to identify an individual’s status with respect to an established standard of performance. Individuals are compared to some established criterion, rather than to other individuals. This approach measures tests can say whether a child is ready to proceed to the next level of instruction, whether there are certain sub skills that require more attention than others and what curriculum materials might help the child master the necessary skills.
1.19. FACTORS AFFECTING SCHOLASTIC ACHIEVEMENT

The five main factors affecting scholastic Achievement are,

1. Motivational factors
2. Environmental factors
3. Cultural factors
4. Physiological factors
5. Psychological factors

The other factors affecting scholastic achievement are social class value, parental attitude, peer group attitude, infrastructure facilities of the classroom, socio-economic status, sex, psychological factors such as anxiety, depression, self-acceptance, self esteem and safety needs.

1.20. INTELLIGENCE AND SCHOLASTIC ACHIEVEMENT

It is matter of common knowledge that a child with above average I.Q. does very well in class studies and it’s A.Q.

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\text{Achievement Quotient} = \left( \frac{\text{Achievement Age} \times 100}{\text{Chronological Age}} \right)
\]

will be equally high. But it is also possible that some pupils with high I.Q. are even below average in scholastic achievement. This is because scholastic achievement implies knowledge of school subject, which is different from intelligence. Further, for success in academic studies, along with intelligence, interest in studies, a high level of aspiration, continuous efforts as well as conducive home and school environment are needed. Bright children who lack these may be academic failures. The upper units of school achievement in the case of pupil with average or below average I.Q. can go only up to a certain level of achievement even if he puts forth maximum effort. So along with intelligence tests, scholastic achievement tests are necessary to predict a pupil’s success in later school career.
1.21. INTELLIGENCE TESTS AND ACHIEVEMENT TESTS

Intelligence test differs from Achievement test. In some respects they measure more or less the same ability. There are some differences too. Both attempt to measure one’s aptitude, learning capabilities and also what one has achieved informally though not intentionally. Both test samples of behaviour. It is difficult to test all that one has achieved in as much as it is equally impossible to measure one’s fullest potential. Yet, Intelligence tests are broader in coverage than achievement test. A Standardised Intelligence Test is certainly more fool – proof than teacher – made achievement tests. Intelligence Tests are more valid measures of learning potential than achievement tests. It has immense predictive value. It is also used to find out those who fail to show the expected level of average achievement. They are termed ‘Underachievers’. By administering an Intelligence Test and an achievement test to a group of students and using the technique of Regression Equation, one could identify those slow learners who are not functioning up to the expected level of performance. Achievement tests are retrospective in nature. It measures what one has acquired as a result of formal schooling with a prescribed syllabus. Often teachers provide remedial instruction to those who lag behind in class work with a view to enhance their performance. The brighter ones are allowed to fend for themselves. Intelligence tests stress the ability to apply information in new and different ways, while achievement tests stress mastery of factual information. Thus, Intelligence tests measure less formal achievement than do achievement tests.

The mental ability of Intelligence is mainly responsible for high scoring in achievement tests. There is positive high correlation between intelligence and achievement. Gifted students are those who have been endowed with high intelligence and naturally they score well in all academic achievements. Sometimes it may also happen that highly intelligent students are low achievers in academic subjects. The reasons for it may be the lack of motivation, lack of proper environment and facilities, presence of bodily ailments etc., not they lack the capacity to achievement.

1.22. NEED FOR THE STUDY

Students in secondary and higher secondary schools are very much pressurised to move higher and higher in their academic performance. The parents as well as the teachers turn out to be hard taskmasters in extracting more and more work from them.
There is no dearth of studies relating intelligence and academic performance, and also relating creative thinking and academic achievement. Of late in Tamilnadu, the influence of cognitive abilities on academic achievement has been given much importance in doctoral level researches. In fact, it is not without reason, because, it has been proved beyond doubt that academic performance is a cognitive act. However, on further going deep into this area, one may find the influence of left or right hemisphericity on academic achievement. Moreover, the entire manifestation of one’s behaviour is attributed to left and right part of the brain. Therefore, more and more research works have been designed to study the functioning of left and right hemisphericity in deciding certain typical characteristics. In the cognitive domain, there are certain behavioural aspects, which are distinct and different from other so called characteristics. For the creative ability of the students, though the role of the brain is the basis, it stands contrast to the intelligence of the individual. Similarly, though performance in different school subjects is mainly attributed to the intelligence, the role of creative thinking in this cannot be totally avoided. That is, the students’ achievement and acquisition of different skills may be attributed to factors like intelligence, creative thinking etc. which in turn are governed by left or right part of the brain. Hence, the need for investigating into the functioning of left and right part of the brain is of paramount importance to form a clear picture of the academic achievement of the students.

Therefore, the investigator has worked out a design to study the dominance of left hemisphericity or right hemisphericity of students in high school classes in order to find its influence on the diverse characteristics related to cognitive domain. The conceived research problem is stated as given below.

THE ROLE OF LEFT AND RIGHT HEMISPHERICITY IN INFLUENCING CREATIVE THINKING, INTELLIGENCE AND ACADEMIC ACHIEVEMENT OF HIGH SCHOOL STUDENTS
1.23. REFERENCES


33. www.brainstorming.co.uk

34. www.en.wikipedia.org