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A study on Relationship between Right Brain Hemisphericity and Left Brain Hemisphericity.

S.Bhuvaneswari[1*] and Dr. T. Sarala[2]

[1]Research Scholar, Department of Education, Mother Teresa Women's University, Kodaikanal, Tamil Nadu, India
[2]Principal i/c, Women's University College of Education,Mother Teresa Women's University, Kodaikanal, Tamil Nadu, India
*Corresponding Author

Keywords

educational practice, cerebral hemisphere, Hemisphericity.

Abstract

The implications of the findings for educational practice are considered in this chapter along with suggestions for further research. Hemisphericity is the tendency for an individual to rely more on one than the other cerebral hemisphere for information processing, creativity, artistic and musical skills and photographic memories are part of the Right cerebral cortex of the Brain. Mathematic skill and easy work with numbers and words come from the Left hemisphere. Therefore for each individual there would be a Brain Dominance condition in which the two hemispheres are working together but with one clearly taking the lead. So it is necessary for the teachers to identify the Hemispheric Dominance of the students in order to give them an apt training to improve their thinking style.

Introduction

"The world of today demands more mathematical knowledge on the part of more people than the world of yesterday. Our society learns more and more heavily on science and technology. The number of our citizens skilled in Mathematics must be greatly increased; an understanding of the role of Mathematics in our society is now a pre-requisite for intelligent citizenship" Wagner (1960)

"Perhaps most importantly in today's information age, thinking skills are viewed as crucial for educated persons to cope with a rapidly changing world. Many educators believe that specific knowledge will not be as important to tomorrow's workers and citizens as the ability to learn and make sense of new information". D.Gough 1991, P.327

Education plays an important role in building the society. In a world based on science and technology, it is Education that determines the level of prosperity, welfare and security of the people. On the quality and number of persons coming out of schools and colleges will depend, our success in the great enterprise of national reconstruction where the principle objective is to raise the standard of living of our People (Indian Education Commission, 64-66)

National Policy on Education (1986) has emphasized the importance of Mathematics Education. "Mathematics should be visualized as the vehicle to train a child to think, reason, analyze and articulate locally". Mathematics in the real sense is a science of space and quantity that helps us in solving the problems of life which needs numeration and calculation. It provides opportunities for the intellectual gymnastic of the man's inherent powers. Everyone has some preferred style in learning and thinking**.** "Styles depend upon cerebral Dominance of an individual in retaining and processing different modes of information in his own. Style indicates the Hemisphericity function of the Brain and students learning strategy and information processing are based on the preferences of the Brain area" (Venkataraman, 1990).

Researchers indicate that it is possible to modify a person's preferred style of learning and thinking to best fit their demands of the cognitive tasks. Throughout history, philosophers, Politicians, educators and many others have been concerned with the art and science of astute thinking. A spirit of enquiry and dialogue characterized. But at the point of view of some others, it is the Age of Enlightenment, with its emphasis on rationality and progress (presseisen 1986, P.6). In the twentieth century, the ability to engage in careful,

reflective thought has been viewed in 'various ways' as a fundamental characteristic of an educated person, as a requirement for responsible citizenship in a democratic society and more recently, as an employability skill for an increasingly wide range of jobs. Deborah Gough's words quoted at the beginning, typify the current view point in education about the importance of teaching today's students to think critically and creatively.

Robinson (1987) state that, teaching children's to become effective thinkers is increasingly recognized as in immediate goal of education. If students are to function successfully in a highly, technical society, then they must be equipped with life long learning and thinking skills necessary to acquire and process information in an ever-changing world (P.16). Beyth-Marom, et.al (1987) underscores this point, characterizing thinking skills as means to making good choices. Thinking skills are necessary tools in a society characterized by rapid change, many alternatives of actions and numerous individual and collective choices and decisions (p.216).The societal factors that create a need for well developed thinking skills are only part of the story, however. The most basic premise in the current thinking skills movement is the notion that students can learn to think better if schools concentrate on teaching then how to do so(Presseien,P.17)

Mathematics curriculum provides avenues for the holistic personality development. The instructional programs and instructional materials have been designed appropriately to develop the genuine attitude to solve the problems. The scientific attitude upon which the basic material structure is fabricated will strengthen the Problem Solving Ability. Thus, Mathematics on a real sense is a Science of space and quality that help us in solving the problems of life leading to numeration and calculation. It provides opportunities for the intellectual gymnastic of the man's inherent powers.

BRAIN HEMISPHERICITY

The human brain is a complex structure. It is not very easy to decide which part of the brain is responsible for a particular behaviour. People in the past have made several attempts to unreavel the question of localization of brain function. Some people tried to locate the neutral centers of the brain that control specific functions such as speaking, recognizing, recognition of spoken words and printed words etc. They also tried to construct a map of the brain. It has now been proved beyond doubt that some function such as speech, recognition of spoken words and production of motor responses are localized in certain specific brain areas. All areas of brain are not equally potential. There are specified areas of the brain which are responsible for higher mental process such as Reasoning, Problem Solving etc.

The most recent development at least in evolutionary terms, in the organization and operation of our Brain probably occurred in the last million years: a specialization of the functions controlled by the two sides of the brain, which has symmetrical Left and Right halves.

Specifically, the brain can be divided in to two roughly similar mirror image halves-just as we have two arms, two legs, and two lungs. Because of the way nerves are connected from the brain to the rest of the body, these two symmetrical Left and Right halves, called "hemispheres", control the side of the body opposite to their location. The Left hemisphere of the brain then generally controls the Right side of the body and the Right hemisphere controls the Left side of the body. Thus damage to the Right side of the brain is typically indicated by functional difficulties in the Left side of the body.

Despite the appearance of similarity between the two hemispheres of the brain, they are involved in somewhat different functions. It appears that certain activities are more likely to occur in one hemisphere than in the other. In addition information is processed somewhat differently in the two hemispheres. On the other hand it is important to keep in mind that the differences in specialization vary from one person to another. Researchers have also unearthed evidence that there may be subtle difference in brain lateralization patters between males and females. In fact, some scientists have suggested that there are slight difference in the structure of the brain according to Gender and culture.

DEFINITIONS OF BRAIN HEMISPHERICITY

Brain Hemisphericity refers to the idea that people relay on a preferred mode of cognitive processing that is linked to predominant activity of either Left or Right Hemisphere of the brain.

"Hemisphericity is the cerebral Dominance of an individual in retaining and processing modes of information in his own style of learning and thinking". (Venkataranman, 1989)

Gray (2003) defined Hemisphericity as "The bias in thinking orientation, behavioural styles, and Personality resulting from the inherent laterality of the individual's sole executive system with in the bilateral brain. The brain side within which an individual's executive is localized determines whether they will be biased by the local Left brain environment towards the top down, self- survival, important details view or biased by the local Right brain environment towards the bottom up; grow up survival, global orientation".

Scientific evidences confirm that the Left and Right Hemisphere of the brain play distinct roles in thinking, perception, feeling and memory. In the mid-twentieth century, it was understood that the Left Hemisphere was directly related to functions of language, while the Right Hemisphere played a more important role in spatial tasks and making sensory discriminations such as the recognition of the faces or the detection of unfavorable tactile patterns (Gardner, 1982)

Researchers conducted during the last two decades have shown that the human Left cerebral Hemisphere is to be specialized for verbal, analytical, abstract, temporal and digital operations, while the Right Hemisphere is to be specialized for primarily non-verbal, holistic, concrete, creative, analogic and

aesthetic functions**,** (Bogen 1969, Gazzaniga 1970, Ornstein 1972).

According E.P. Torrance (1971) people relay on a preferred mode of cognitive processing that is linked to predominant activity of either Left of Right Hemisphere of the Brain. But Gorden (1961) observes "Cerebral Dominance is the tendency for an individual to rely on one than the other cerebral hemisphere for information processing.

RIGHT BRAIN HEMISPHERE

The right side of the brain is the initial receiver of incoming information. The Right Hemisphere is the centre for visual, rhythm, "Artistic" or "Creative" abilities. The Right Hemisphere of the celebrum controls the left side of the body. It cannot verbalize what it knows and hence it is called the minor, subordinate or mute side, Geschwind (1970) found it to be anatomically smaller than the dominant Left Hemisphere. Though, most neurophysiologists felt that the Right Hemisphere is a more unconscious automation and that we live mainly in the Left Hemisphere. However Rubenzer (1978) contents that the Right Hemisphere is not totally silent. In fact language function is some what more equally shared between the Hemispheres before the age of five (Rubenzer 1978). The primary expressive mode of Right Hemisphere is speculated to be metaphorical in nature (Eccles 1973, Ornstein 1972, Samples 1975).

According to Hilgard and Bower (1977), the Right Hemisphere has crude capability for passive visual (verbal) recognition and comprehension; its comprehension in fact, appears best with concrete nouns, poorer with verbs and poorest with abstract nouns derived from verbs. The role of Right Hemisphere in Mathematical Problem Solving, Creative Thinking and analogies has been reasonably well documented by Krueyer (1976), Bogen (1969), Wallach (1975),Torrance and Reynolds(1978).

The results of the studies undertaken by Spercy (1968), Harnarel (1973), Ornstein (1978), Kingsbourne (1973), Galin (1974), Torrance (1978) and Wittrock (1978) conclude that Right Hemisphere may be more intuitive, imaginative, insightful, has a rudimentary verbal conceptual scheme, aesthetic experiences, produces usual imagery, sees things in a broader perspective, uses information from the Left Hemisphere to elaborate, to form new combinations, to attribute new meanings to it.

LEFT BRAIN HEMISPHERE

The two Hemispheres of the brain do not function the same way at all times. Each cerebral Hemisphere is capable of independent functioning of the two Hemispheres, the left one is considered dominant, in which speech is localized. It was believed that the Left Hemisphere was mainly responsible for the processing of language and planning, the two functions that clearly distinguished man from animals (Morgan, 1981). It is found to be anatomically larger than the Right Hemisphere (Geschwind, 1972). In most adults, it is found to be more active than the Right Hemisphere. The Left Hemisphere is concerned with logical and analytic skills. In processing the stimuli this side of the brain does a rational, sequential type of processing.

Each cerebral hemisphere is capable of functioning in a manner different from the other. For many years, attention was focused on the Left hemisphere in which speech was localized, the so called 'Dominant', leading or "Major" hemisphere. It is found to be anatomically larger than the Right hemisphere (Geschwind, 1972).It is considered to be more active than the Right hemisphere in most adults.

Psychological and Split- Brain researchers show that the two hemispheres have specialized, complementary functions. The Left hemisphere apparently specializes in sequential, logical, verbal, symbolic, convergent production and logical functioning (Ornstein, 1973; Wittrock, 1978; Languis, 1977). The Left hemisphere is relatively specialized in verbal functioning and is denoted largely to somatic abilities and functions.

Studies also indicated that, short term memory is primarily the function of Left hemisphere. There is conclusive evidence to believe that with respect to the expressions of language through speech is exclusively processed in the Left Hemisphere (Burkkand and Smith, 1974; Eccles, 1973; sperry, 1974; Nobes, 1974).

"The talents of the Left brain include putting things in sequential, logical order, forming thoughts in to words; speaking, reading and computing. The skills are quantitative, logical and analytical. The Left Brain talents and skills keep our life sensible, organized and on schedule" (patel, 1996).

" The Left brain controls the voluntary movements of the right side of the body and is found dominant in right handled people"(Halstead,1947). Investigations of Sperry(1975) and Hunter(1976) revealed that the Left hemisphere is involved in learning the 3 R's and reading is considered to be as a Left hemisphere function. The style difference of Left and Right brain hemispheres are given in Table 1.1

Table 1. Style Difference of Left and Right Brain Hemispheres

Left Hemisphere	Right Hemisphere
Utilizes motor skills more effective.	Usually wants simple answers to complex problems.
Uses a more analytical approach to Problem Solving	Prefers to think more holistically.
Not Creative in planning and organization	Less organized than left Brain
Typically have problems seeing the big picture	More spatially oriented and Creative in Solving problems
Usually unemotional in their approach to human relations.	Does not follow procedures likes to do their way.

'In general, people typically prefer the thinking style of one side of their brain or other, although some people may use each side equally. Therefore, Knowledge of their own brain hemisphericity is important for activating the functions of the less dominant hemisphere. Functions of the Right and Left Brain Hemisphere shown in Figure 1.1

Figure1.Hemispheric Functions of the Brain

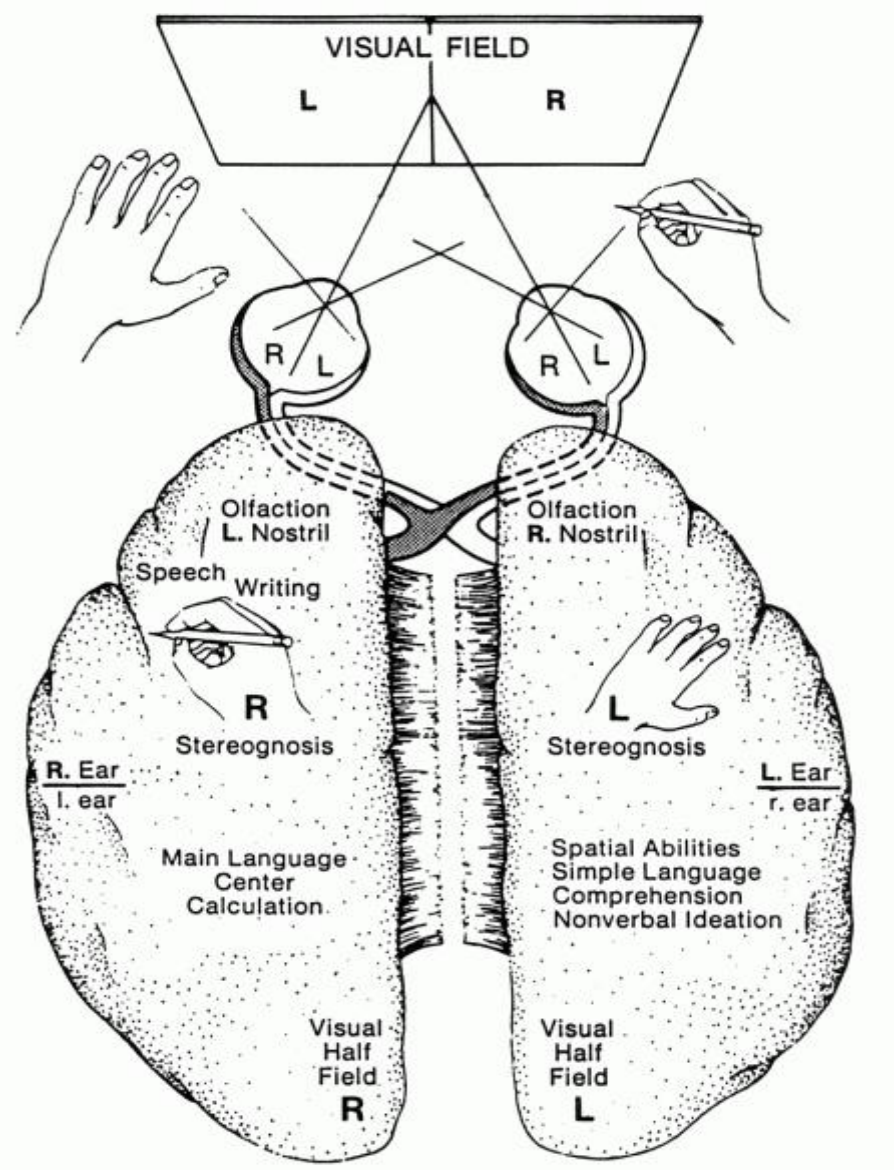


Table 2 Hemispheric Functions of the Brain

Code	Right Hemisphere	Left Hemisphere
Speech	Left ear	Right ear
Auditory	Left space awareness (stronger)	Right space awareness (stronger)
Language	Spatial Orientation Spatial localization Non-Verbal Symbolic aspects Tonal qualities Tonal patterns Tonal memory Singing (Pitch, rhythm, intonation and lyrics) Musical hearing Holistic / gestaltes Simultaneity Emotional aspects Spatial words Nouns Creative language	Verbal Grammatic logic syntax Analyses speech sounds Syllable recognition Analyses phonemes Verbal memory Phonics Word parts Spoken words Gesturing of hands Motor aspects Naming of objects Use of verbs Nonsense words Nonsense sounds Printed words and Letters Middle class
Visual	Left Visual field Left eye movers Spatial Orientation Finding way Location of points in two dimensional space Depth perception Holistic / gestalten Simultaneity Geometric from recognition Drawing Model building (from plan or picture) Recognition of faces creative	Right visual field Right eye movers Labels space Parts of space Notes detail Naming faces Sees printed words and letters labels seen objects
Motor	Left side of body Spatial movement finding way in space front and back space awareness Left tactual Braille Skills tactual Simultaneity of movement Motor learning Drawing Model building Movement memory Creative moment	Right side of body Right tactual Differentiated movements Verbal expression of movement through memory Action words(verbs) describing movement Movement of hands in speech Spoken words Motor activities of speech

Thinking	Deductive Divergent Holistic / gestalten Diffuse Intuitive Creative Simultaneity Visual – Spatial Directionality Localization Concrete Emotional thought Urban poor (Spatial / Holistic) Geometric organization Simple math computation Relational Concepts Geometric	Inductive Convergent Parts / Segmented Focal Logical Analytic Verbal Middle class (Verbal / analytic) Mathematical reasoning Abstract math computation Sequencing of concepts Algebraic
Affective	Emotional Body image Awareness of Personal disabilities Intuitive Recognition of faces Tonal expression Simultaneity Laughing Crying Passive	Intellectual Body concept Logical Remembering names Aggressive
Sexual	Feminine Passive Mysterious Artistic aspects Intuitive aspects More specialized in males	Masculine Aggressive Active More specialized in females

FUNCTIONS OF HEMISPHERE

The Hemisphere both Right and Left perform is different functions through different modes.

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 buildings and recognition of faces are the important functions activated by Right hemisphere.
The Right Hemisphere functions for Left side of the body is also in charge of spatial movement, finding way in space, front and back space awareness and perception of the fine and gross motor activities.

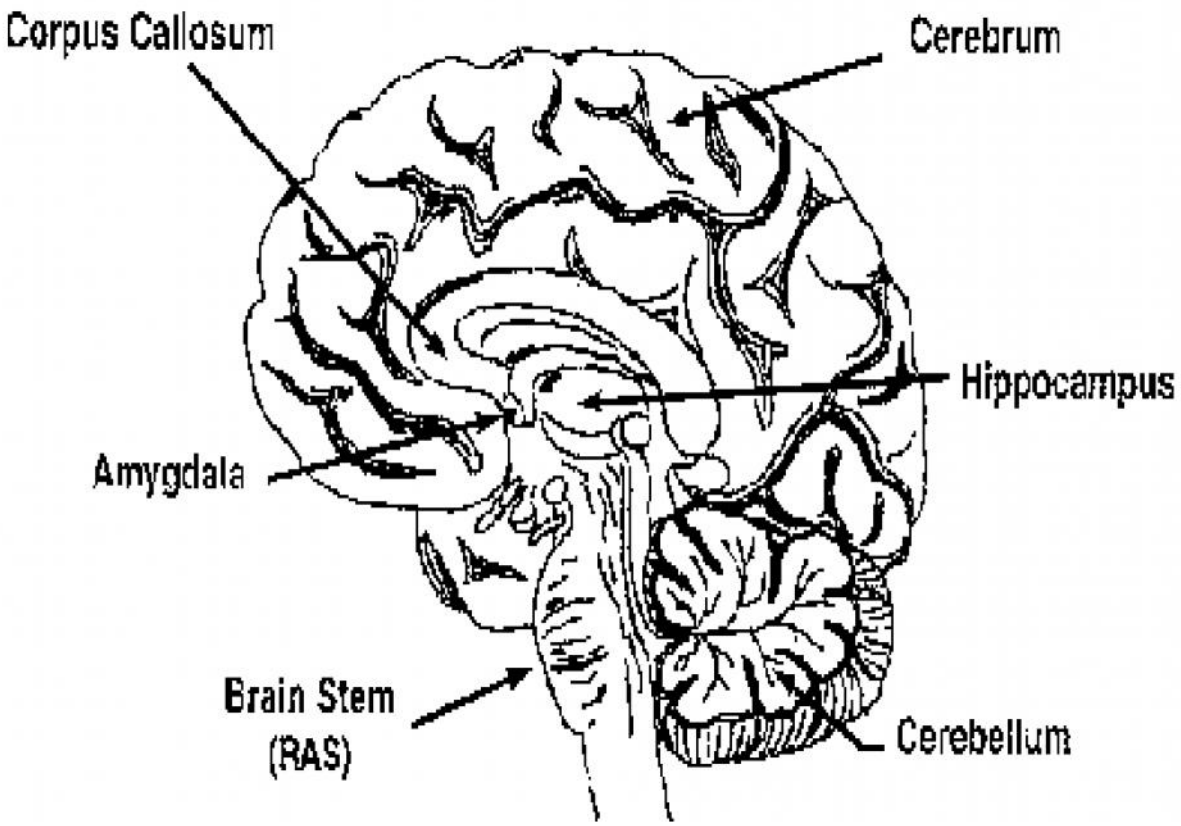
The functions of the Right Hemisphere have generally been described as creative, divergently, productive, deductive, intuitive, holistic, gestalten, concrete and analogic.

The Right Hemisphere functions in such a way that it is capable of dealing with the most difficult logical and systematic problems and finding solutions.

It deals with the functions of iconic presentation of information such a graphic displays, diagrams, flow charts and greatly facilities both the comprehension and the retention of information. The Right hemisphere helps to design thought experiments which Left Hemisphere simply could not.

The Right Hemisphere deals with the body image and it controls emotional aspects such as laughing, crying and tonal expression.
This part of the Brain is passive and its mysterious nature of functioning is well activated for aesthetic functions. The figure 1.2 shows Right hemisphere functions of the Brain.

Figure 2 Right Brain Hemisphere



FUNCTIONS OF LEFT HEMISPHERE

Expression of language through speech, verbal memory, word parts, syllable recognition, analyses of speech sounds, and use of verbs and verbal aspects of writing are functions predominantly done by Left Hemisphere.

Right visual field and Right eye movement are controlled by Left Hemisphere and it deals with the functions such as naming of faces and labeling of parts.

The motor activity of the Right side of the Brain, motor activities of speech, action words (verbs) 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 specializing in sequential processing, logical, analytical thinking, inductive and convergent in production of ideas.

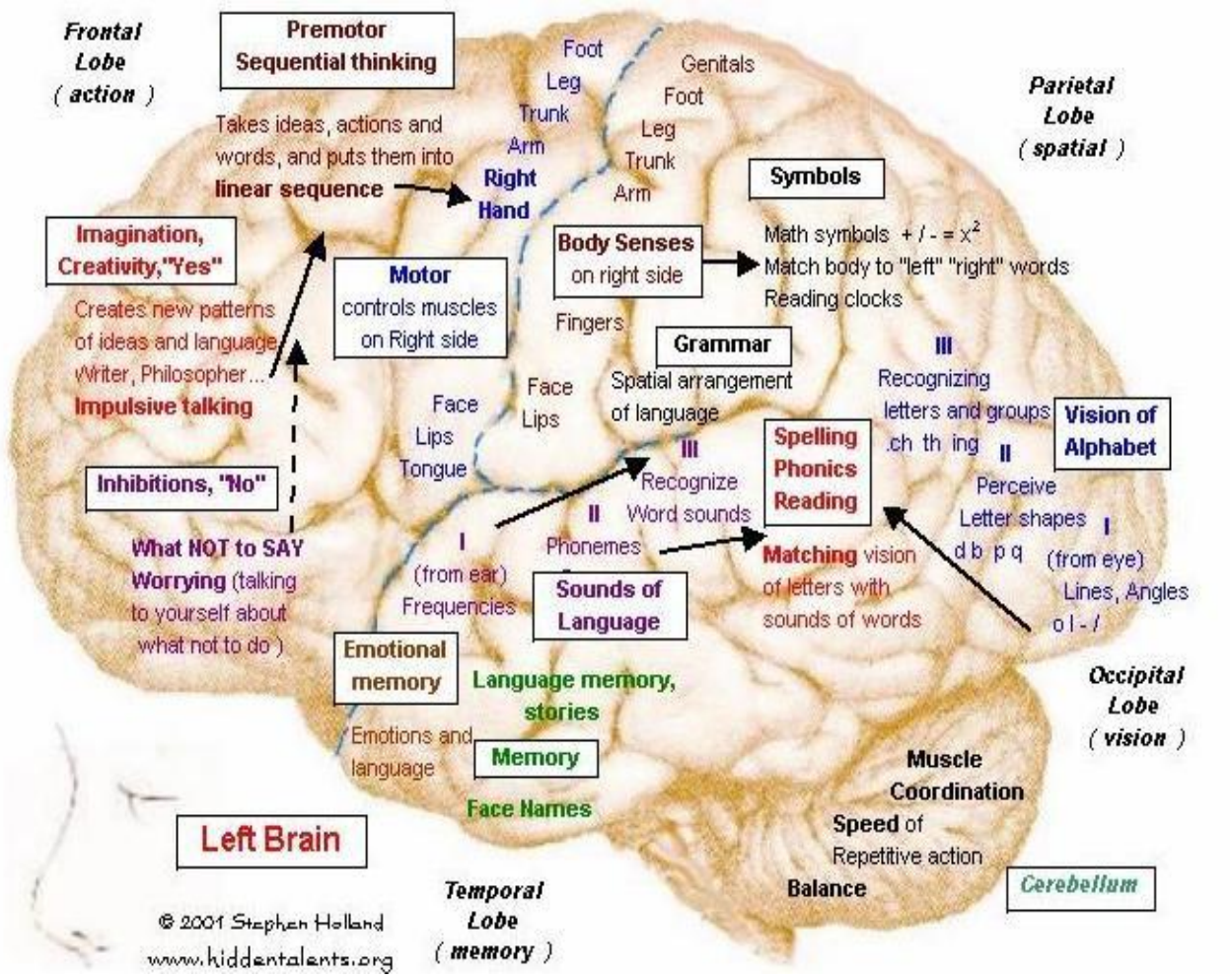
Mathematical reasoning, particularly calculations and algebraic, abstract Mathematics, digital operations and computations are activated by Left Hemisphere.

Education of relations, ability to analyses the common aspects of task and relationship among tasks linguistic task, retention of language and comprehension, learning the 3R's and acquisition of new habit patterns are the functions of Left Hemisphere.

In emotional aspects Left Hemisphere functions are day dreams, 'drugging' meditation, fantasy hypnosis, diversion, and play.

The Left Hemisphere functions for activating aggressive behavior of a man and maintains his masculine nature. Figure 1.3 shows the Left Hemisphere functions of the Brain.

Figure 3 Left Brain Hemisphere



ACTIVATION OF HEMISPHERIC FUNCTIONS

Different teaching techniques and methodologies can be adopted to activate and influence the Hemispheric functions of the Brain.

The teaching techniques in the schools can be undertaken in consonance with the student's style of learning and thinking. This approach will remove unnecessary restrictions on teaching and learning of the students and facilitates the actualization of the concept "no limits to learning".

This becomes possible by eliminating the barriers to learning by working with in the Hemispheric preference of the learners as well as providing opportunities for actuating the functioning of non-dominant hemisphere. This might help students to become more integrated learners with better processing skills in both hemispheres. The teaching and learning procedures must be organized in such a way that they tone up and activate the hemisphere functions of the Brain in students.

ACTIVATION OF RIGHT HEMISHPERIC FUNCTION

Films, Charts, Maps, Diagrams, Graphs and Cartoons etc, may be used in teaching. Based on the pictures shown students can be asked to construct stories. Incomplete stories can be given to be completed as exercises.

Learning by the doing may be encouraged at all levels in schools and colleges. Students may be given opportunity to work on simple projects and be assisted in carrying them out to completion. Use of metaphores and analogies in subjects can be made and this will enhance analytical thinking.

Role playing should from a technique in the teaching of history, language and also in Mathematics and science subjects. In the classroom divergent questions may be asked, so that students can think and answer in different ways. Problems of specific issues can be given to the students and they can be asked to solve the problems in different ways. Students can be encouraged to record their ideas and write stories, essays, dialogues and state talk.

Abilities in sports, music and art should be recognized and cultivated in the schools, children may be encouraged to play with words and interest can be created in preparing models and construction of buildings using of cubes and blocks.

Training can be given in drawings visual patterns and geometric designs with the help of pictures, training can be given the students in identifying the known figures of famous Personalities, locations, buildings and streets.

Excursion and field trips can be arranged to encourage pupils' curiosity and sense of observation.

ACTIVATION OF LEFT HEMISPHERIC FUNCTIONS

In the classroom new concepts can be introduced in an analytical; manner with verbal emphasis and importance can be given to the expression of the language.

Students may be asked to abstract speeches in the radios, televisions, public meetings and symposium.

They may be given training in analyzing and identifying different speech sounds and encouraged to give logical reasoning and example for unknown activities or functions without experimenting in general.

Discussions may be arranged on general problems, world affairs from the reading of daily newspaper and magazines. They can be encouraged in writing non-fiction essays and scientific explanations in plain language.

Games based on verbal materials, numerical, events and names and meditation can be encouraged after class hours.

Every individual prefers his own ways for organizing all that he sees, remembers and thinks about consistent individual differences in the ways of organizing and processing information and experience are termed as cognitive style. It is a process through which the individual receives information from the environments transforms and uses that information to responds to the environment in his own characteristic way. 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.

Research Design

Method of Study	Variables	Tools	Sample	Type of Analysis
Qualitative and Quantitative	Brain Hemisphericity	Style Of Learning And Thinking – Venkataraman (1994)	Total -635, Boys-318, girls-317	Descriptive Analysis, Inferential Analysis and Differential Analysis
	Creative Thinking	Scientific Creativity with Words- Dr.V.P.Sharma and J.P.Shukla (1985)		
	Achievement in Mathematics	Quarterly Examination Marks in Mathematics collected by School Mark Register.		
	Personal Variables	Personal Data Sheet		

DESIGN OF THE STUDY

Research design is a catalogue of the various phases relating to the formulation of a research effort. It is an arrangement of the essential conditions for collection and analysis of the data and forms the aims to combine relevance to research purpose with economy of procedure. The present study entitled "Brain Hemisphericity and Creative Thinking as related to Achievement in Mathematics among XI Standard Students" has been designed as a descriptive study**.** Best (1983) stated "Descriptive research deals with the relationship between variables, testing of hypotheses and development of generalization, principles or theories that have universal validity. (P.106) Hence the present study "Brain Hemisphericity and Creative Thinking as related to Achievement in Mathematics among XI Standard Students" has been designed as a descriptive study.

DESCRIPTION OF TOOLS

For the present investigation two standardized psychological tests were used to collect data.

(i) "Style Of Learning And Thinking" prepared and standardised by Venkataraman (1994)
(ii) The standardized test "Scientific Creativity with Words" by Dr.V.P.Sharma and J.P.Shukla (1985) was used to measure scientific creativity.

(iii)Quarterly Examination Marks in Mathematics collected by School Mark Register.
(iv)Personal Data Sheet prepared by the investigator to collect information on the selected Personal Variable.

TOOL- I - Style Of Learning And Thinking (SOLAT)

"Style Of Learning And Thinking" prepared by Venkataraman (1994) was used for finding the Brain Dominance of an individual. This tool has been designed to assess the preferred Brain Dominance of students.

The difference in preference of the two hemisphere for information processing have been referred to a Style of Learning and Thinking, Venkatraman (1994) and Torrance (1977) have developed the SOLAT tool based on the Hemisphericity functions of the Brain. It identifies hemisphere Dominance by way of studying the hemisphere functions. It indicates a student's learning strategy and Brain hemisphere performance.

The tool consists of fifty items designed to access the Brain Dominance of an Individual. For each item, there are two statements and four ways to respond. There is no time limit. But normally it takes thirty minutes for giving responses. Sample item is given below. (A copy of the tool in Appendix 'A').

Sample Items.

1. I understand clearly the information passed through by actions a□
2. I understand clearly the information passed through by words b□

Structure

The numbers of items in each dimension of learning the thinking styles are given in Table 3.2

Table 3.2Dimensions of Learning and Thinking Styles

S.No	Dimensions	No of items and serial no of items
Learning Style		
1	Verbal	5 (1 to 5 items)
2	Content preference	5 (6 to 10 items)
3	Class preference	5 (11 to 15 items)
4	Learning preference	5 (16 to 20 items)
5	Interest	5 (21 to 25 items)
Thinking Style		
6	Logical/Factorial	5 (26 to 30 items)
7	Divergent/Convergent	5 (31 to 35 items)
8	Creative	5 (36 to 40 items)
9	Problem Solving	5 (41 to 45 items)
10	Imagination	5 (46 to 50 items)
Total No. of items		50

Reliability

The author of the tool measured the reliability of the tool by test-retest method. One month after the first test, retest was conducted to 635 students consists of 318 Boys and 317 Girls. The reliability co-efficient of correlation for the Right hemisphere function was found to 0.89. For the Left hemisphere functions, the co-efficient of correlation was found to be 0.65. The coefficient of correlation for integrated score was 0.71. These co-efficient suggests that SOLAT posses reliability to a significant level. The reliability coefficient as given in the manual as described above was accepted as the reliability of the tool.

Validity

The SOLAT tool was constructed and validated with the help of standardised SOLAT tool constructed by Paul Torrance. To find out the validity of the tool both the SOLAT tools (i.e., Tool prepared by Paul Torrance and tool prepared by Venkatraman) were administered to 635 subjects. The correlation between the two tests scores was 0.842 for the Right hemisphere part; 0.621 for the Left hemisphere part and 0.678 for integrated part. The correlation coefficient reveal that SOLAT tool possess high level of concurrent validity.

Scoring Procedure

Scoring was done as per the procedure and key given in the manual. There are 50 items in the tool. For each items, there are two statements and 4 ways to respond. Students are required to record their responses in the blank space on the test sheet. In the tool, against series number 1 to 50, checking of the first item indicates Right Hemispheric

Dominance and checking of both the items indicates integrated hemisphere or whole Brain. The Hemisphericity Dominance was determined on the basis of the highest score in three categories.

TOOL – II – Verbal Test of Scientific Creativity

The standardized test "Scientific Creativity with Words" by Dr. V.P. Sharma and J.P. Shukla (1985) was used to measure scientific creativity. The verbal test of scientific creativity includes four subtests, namely consequences test, unusual uses test, New relationship test and just think why test? These four subtests are groups under four "Activities". The four activities have three items each. Each activity measures fluency, flexibility and originality of students. (A copy of the Personal data sheet is given in Appendix 'B').

Sample Items

Task I: Consequences Test
1. What would happen if there is no land on the earth?
2. What would happen if there is no bone in human body?

Task II: Unusual Uses Test
1. Finger Nails-Utility
2. Water-Utility

Task III: New Relationship Test
1. Sugar and salt
2. Dog and Cat

Task IV: Just Think Why Test

1. Under what conditions population of heart shoots up?
2. Under what conditions a man cannot express himself?

Reliability

The author of the tool measured the reliability of the tool by test-retest method. Here the test battery was administered to 100 students in school twice with a gap of 10 days. The coefficient of correlation between the two sets of scores was found to be 0.82 indicating the high reliability of the test battery.

Validity

The square tool of the reliabilities coefficient is a measure of the validity of the tool (Garrett 1969). Therefore the validity of the test was found by computing the square root of the co-efficient of reliability and it was found to be 0.90 indicating the high validity of the test battery.

Administration and Scoring Procedure

After explaining the purpose of the test, clear instructions as to how the test item should be responded were given to the students. The total time required for the administering the test is 50 minutes in addition to the time necessary for giving instruction, passing out test booklets to students and getting them back. The students were allowed to write their response in Regional language and in English.

As there is no Right or wrong responses for the test, much care was exercised at the time of scoring while scoring the test on Creative Thinking, each item scored for fluency, flexibility and originality as per the directions given in the scoring guide. The procedure given in the scoring sheet, to summaries scores for fluency, flexibility and originality obtained by testing in different activities was followed. The composite creative scores could be computed after converting raw score into standard scores by the statistical procedure given in the scoring guide. To obtain the total score for Creative Thinking for each students, the sum of standard scores for originality, fluency and flexibility were taken. The score range from 101 to 265.

TOOL – III - Personal Data Sheet

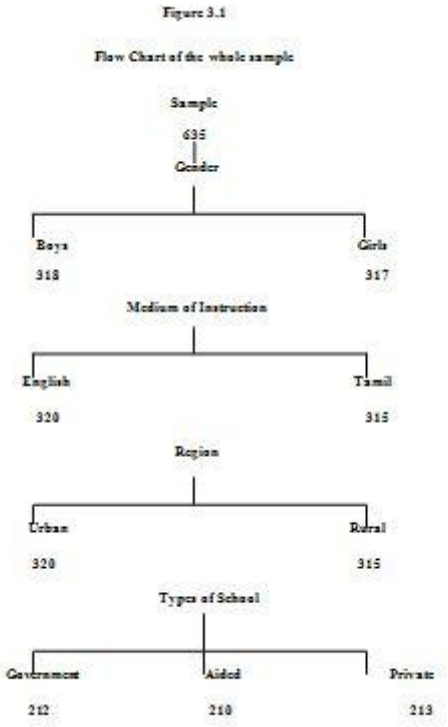
To collect the information on selected Personal variables, Personal data sheet was prepared by the investigator and was distributed among the XI standard students. Ten minutes time was given to fill the Personal data sheet (A copy of the Personal data sheet is given in Appendix 'C').

No separate tool was prepared by the investigator to measure the Achievement in Mathematics. The marks scored in Mathematics by the subjects in their quarterly examination conducted by the school as recorded in the school register was taken as the achievement scores in Mathematics.

SELECTION OF SAMPLE

The sample for the study was selected randomly. Representative sample of 635 students from XI standard were selected in Government school, Aided school and Private school in Rural and Urban areas.

A total number of samples 635 were selected of width 320from Urban and 315 from Rural. There are 212 Government Institutions, 210 Aided Institutions and 213 Private Institutions included in the Sample.



The sample constituted of 635 XI Standard students drawn from ten schools from Rural and Urban areas. The institute wise distribution of sample is given in Table 3.3.

Table 3.School wise Distribution of Sample

S.No	Name of the School	Types of school	Sample		Total
			Boys	Girls	
1	Government Higher Secondary School, M.G.R Nagar.	Government	50	51	101
2	Government Higher Secondary School, Kundrathur.	Government	-	55	55
3	Government Higher Secondary School, Thirumalisai	Government	37	19	56
4	M.G.R Higher Secondary School, Kodambakkam.	Aided	50	21	71
5	Dr.K.K.Nirmala Girls Higher Secondary School, K.K.Nagar.	Aided	-	38	38
6	Sr Ramasamy Mudaliar Higher Secondary School, Ambattur,	Aided	53	48	101
7	St.Antony Matriculation Higher Secondary School, Kottivakkam.	Private	39	24	63
8	Amutha Matriculation higher Secondary School, Thirunindravur.	Private	29	18	47
9	Vidyaniketan Matriculation Higher Secondary School, Ashok Nagar.	Private	18	12	30
10	Velankanni Matriculation Higher Secondary School, Ashok Nagar.	Private	42	31	73
Total			318	317	635

Sample for the study has been selected following random sampling technique. The sample consisted of 317 Boys and 318 Girls. The distribution of the sample based on selected Personal variable is shown in Figure 3.1.

DISTRIBUTION OF SAMPLE ACCORDING TO THE SELECTED PERSONAL VARIABLES

The sample was classified on the basis of selected Personal variable and their sub divisions. The Table 3.4 represents the distribution of the sample according to the selected Personal variables.

Table.4Distribution of Sample according to Selected Personal Variables

Variables	Sub-Categories	Size N	Percentage
Gender	Male	318	50.1
	Female	317	49.9
Region	Rural	315	49.6
	Urban	320	50.4
School/Management Type	Private	213	33.5
	Aided	210	33.1
	Government	212	33.4
Medium of Instruction	Tamil	315	49.6
	English	320	50.4
Socio-Economic Status	Low	167	26.3
	Average	315	49.6
	High	153	24.1

The sample was classified on the basis of selected Personal variable and their sub divisions. The Figure 3.2 represents the distribution of the sample according to the selected Personal Variables.

COLLECTION OF DATA

To collect data for the present study, the investigator visited 10 higher Secondary School. After obtaining the permission from the heads of the Institution and ensuring the cooperation of the teaching faculty the investigator administered the tools to the students.

The "Thinking Creatively with Words" was administered first. After highlighting the purpose of the test, clear instructions and directions as to how the items in the test should be responded were given. After completion, the response sheets were collected back.

The "Style Of Learning And Thinking" was administered immediately after the administrations of "Thinking Creatively with Words" clear instructions were given to the XI standard students as to how the response sheet of SOLAT. After completion, the response sheets were collected back and the Quarterly marks collected from class teacher Mark Register.

To collect the information on selected Personal variables namely Gender, Medium of Instruction, School Management Type, Socio-Economic Status, the Personal data sheets were distributed among the students. Ten minutes time was given to fill the Personal data sheet.

CRITERIA FOR CLASSIFICATION OF DATA

Criteria for classifying the sample as per their levels of Mathematical Achievement, Creative Thinking and Socio-Economic Status of the Parents were fixed. The criteria were arrived at by computing quartile deviation and it is presented in the Table 3.5.

Table 3.5Criteria for Classification of Data according to varying levels of Mathematical Achievement, Creative Thinking and Socio Economic Status

Variable	Levels	Criteria	Range
Mathematical Achievement	High	>Q3	>63
	Average	Between Q1 & Q3	Between 48 - 63
	Low	< Q1	<48
Creative Thinking	High	>Q1	>195
	Average	Between Q1 & Q3	Between 169 - 195
	Low	>Q1	<169
Socio Economic Status	High	>Q3	>18
	Average	Between Q1 & Q3	Between 11 -18
	Low	<Q1	<11

STATISTICAL TREATMENT OF DATA

The major functional variables for analysis and interpretation of data include Mathematical Achievement, Creative Thinking & Brain Hemisphericity and Personal Variables include Gender, Region, School type, Medium of instruction, Socio Economic Status.

The following statistical techniques were used for analysis and interpretation of data.

(i) Descriptive Analysis
In the initial analysis of the data, the XI standard students were classified into various groups and subgroups on the basis of different selected variables. Mean and standard deviations were calculated for the whole sample as well as for the sub sample.

(ii) Critical Ratio
(iii) One-way Analysis
(iv) Chi-Square Analysis
(v) Correlation Analysis
(vi) Regression Analysis
(vii) Discriminate Analysis
Discriminate Function Analysis was selected for discriminating between high and low Creative Thinking of students.

ANALYSIS AND INTERPRETATION

There is no significant association between Mathematical Achievement and Brain Hemisphericity.

Table 4.3.10 Chi-Square Table showing the Association between Mathematical Achievement and Brain Hemisphericity

Brain Hemisphericity	Level of Mathematical Achievement			Total	Chi-Square Value	LOS
	Low	Average	High			
Left	102	156	73	331	6.199	0.05
	(30.8)	(47.1)	(22.1)			
	[8.3]	[52.5]	[44.8]			
Right	73	141	90	304		
	(24.0)	(46.4)	(29.6)			
	[41.7]	[47.5]	[55.2]			
Total	175	297	163	635		

Note: 1. The value within ( ) refer to Row Percentage**.**
Note: 2. The value within [ ] refer to Column Percentage**.**

Since the calculated value of Chi-Square (6.199) is greater than the tabulated value of Chi-Square (5.991), for degrees of freedom 2, the null hypothesis is not accepted. Thus there is significant association between Mathematical Achievement and Brain Hemisphericity.

H4: There is no significant association between Creative Thinking and all selected Personal variables namely Gender, Region, Medium of Instructions, School Management Type, Socio-Economic Status and Brain Hemisphericity.

4.3.16. There is no significant association between Creative Thinking and Brain Hemisphericity.

Table 4.3.16 Chi-Square Table showing the Association between Creative Thinking and Brain Hemisphericity

Brain Hemisphericity	Level of Creative Thinking			Total	Chi-Square Value	LOS
	Low	Average	High			
Left	72	171	88	331	4.180	0.05
	(21.8)	(51.7)	(26.6)			
	[45.3]	[55.2]	[53.0]			
Right	87	139	78	304		
	(28.6)	(45.7)	(25.7)			
	[54.7]	[44.8]	[26.1]			
Total	159	310	166	635		

Note: 1. The value within ( ) refer to Row Percentage**.**
Note: 2. The value within [ ] refer to Column Percentage**.**

Since the calculated value of Chi-Square (4.180) is less than the tabulated value of Chi-Square (5.991), for degrees of freedom 2, the null hypothesis is accepted. Hence, there is no significant association between Creative Thinking and Brain Hemisphericity.

H5: There is no significant association between Brain Hemisphericity and all selected Personal variables namely Gender, Region, Medium of Instruction, Types of School and Socio-Economic Status.

There is no significant association between Brain Hemisphericity and Gender.

Table 4.3.17 Chi-Square Table showing the Association between Brain Hemisphericity and Gender

Sex	Brain Dominance		Total	Chi-Square Value	LOS
	Left	Right			
Boys	181	137	318	5.862	0.01
	(56.9)	(43.1)			
	[54.7]	[45.1]			
Girls	150	167	317		
	(47.3)	(52.7)			
	[45.3]	[54.9]			
Total	331	304	635		

Note: 1. The value within ( ) refer to Row Percentage**.**
Note: 2. The value within [ ] refer to Column Percentage**.**

Since the calculated value of Chi-Square (5.862) is less than the tabulated value of Chi-Square (6.635) at 0.01 level of significance for degrees of freedom 1, the null hypothesis is accepted. Thus there is no significant association between Brain Hemisphericity and Gender.

There is no significant association between Brain Hemisphericity and Region.

Table 4.3.18 Chi-Square Table showing the Association between Brain Hemisphericity and Region

Region	Brain Dominance		Total	Chi-Square Value	LOS
	Left	Right			
Urban	122	198	320	50.673	0.01
	(38.1)	(61.9)			
	[36.9]	[65.1]			
Rural	209	106	315		
	(66.3)	(33.7)			
	[63.1]	[34.9]			
Total	331	304	635		

Note: 1. The value within ( ) refer to Row Percentage**.**
Note: 2. The value within [ ] refer to Column Percentage**.**

Since the calculated value of Chi-Square (50.673) is greater than the tabulated value of Chi-Square (6.635) at 0.01 level of significance for degrees of freedom 1, the null hypothesis is not accepted. Thus there is significant association between Brain Hemisphericity and Region.

There is no significant association between Brain Hemisphericity and Medium of Instructions.

Table 4.3.19 Chi-Square Table showing the Association between Brain Hemisphericity and Medium of Instructions

Medium of Instructions	Brain Dominance		Total	Chi-Square Value	LOS
	Left	Right			
English	178	142	320	3.165	0.05
	(55.6)	(44.4)			
	[53.8]	[46.7]			
Tamil	153	162	315		
	(48.6)	(51.4)			
	[46.2]	[53.3]			
Total	331	304	635		

Note: 1. The value within ( ) refer to Row Percentage**.**
Note: 2. The value within [ ] refer to Column Percentage**.**

Since the calculated value of Chi-Square (3.165) is less than the tabulated value of Chi-Square (3.841) at 0.05 level of significance for degrees of freedom 1, the null hypothesis is accepted. Thus there is no significant association between Brain Hemisphericity and Medium of Instructions.

There is no significant association between Brain Hemisphericity and Types of School.

Table 4.3.20 Chi-Square Table showing the Association between Brain Hemisphericity and Types of School

Types of School	Brain Dominance		Total	Chi-Square Value	LOS
	Left	Right			
Government	112	100	212	6.198	0.05
	(52.8)	(47.2)			
	[33.8]	[32.9]			
Aided	96	114	210		
	(45.7)	(54.3)			
	[29.0]	[37.5]			
Private	123	90	213		
	(57.7)	(42.3)			
	[37.2]	[29..6]			
Total	331	304	635		

Note: 1. The value within ( ) refer to Row Percentage**.**
Note: 2. The value within [ ] refer to Column Percentage**.**

Since, the calculated Chi-Square value (6.198) is greater than the value of Chi-Square value (5.991) at 0.05 level of significance for degrees of freedom 2, the null hypotheses is not accepted. Hence, there is significant association between Brain Hemisphericity and Types of School.

There is no significant association between Brain Hemisphericity and Socio-Economic Status.

Table 4.3.21 Chi-Square Table showing the Association between Brain Hemisphericity and Socio-Economic Status of the Parents

SES	Brain Dominance		Total	Chi-Square Value	LOS
	Left	Right			
Low	96	71	167	25.346	0.01
	(57.5)	(42.5)			
	[29.0]	[23.4]			
Average	134	181	315		
	(42.5)	(57.5)			
	[40.5]	[59.5]			
High	101	52	153		
	(66.0)	(34.0)			
	[30.5]	[17.1]			
Total	331	304	635		

Note: 1. The value within ( ) refer to Row Percentage**.**
Note: 2. The value within [ ] refer to Column Percentage**.**

Since, the calculated Chi-Square value (25.346) is greater than the value of Chi-Square value (5.991) at the 0.01 level of significance for degrees of freedom 4, the null hypotheses is not accepted. Hence, there is significant association between Brain Hemisphericity and Socio-Economic Status of the Parents.

DISCUSSION

In the present study it is found that there is no significant Gender difference in Mathematical Achievement of students. This finding is in conformity with the finding of D' Zurella et al (2001) and Nagalakshmi (1995) who reported that there was no significant difference between Boys and Girls in their Achievement in Mathematics. The study reveals that there is no significant difference in Mathematical Achievement for students of varying Socio-Economic Status, Rural and Urban area students and types of schools. The Chi-Square analysis also confirmed all the above findings as there is no significant association in Mathematical Achievement among students of varying Gender and Region.

The study reveals that there is significant difference between the Tamil medium and English medium students, favoring Tamil medium students better than Achievement in Mathematics in English medium students. The study also shows no significant difference in Mathematical Achievement among students of Left and Right Brain Dominance. There is significant association in Mathematical Achievement among students of varying Medium of Instructions, School Management Type, Socio-Economic Status and Brain Hemisphericity.

The present study reveals that there is no significant association Brain Hemisphericity of Urban and Rural area students and Socio-Economic Status. The study reveals that there is no significant association in Brain Hemisphericity among students of varying Boys and girl's students, Tamil medium and English medium students and School Management Type. The study also reveals there is no significant association between Creative Thinking and Achievement in Mathematics.

The results of regression analysis show that Creative Thinking, Brain Hemisphericity and the selected Personal variables significantly predicts the Achievement in Mathematics of the students. More than 10% of the variance in the student's Achievement in Mathematics is accounted for by the variance in the independent variables. Also Creative Thinking is the most important predictor variable of Achievement in Mathematics followed by Gender, Socio-Economic Status, Creative Thinking, Medium of Instructions, types of school , Region and Brain Hemisphericity and in that order.

Hemisphericity is the cerebral Dominance of an individual in retaining and processing modes of information his own style of learning and thinking (Venkataraman 1989). Individuals with different Brain Dominance patterns would send to approach a problem differently. It is believed that for the great majority of people the Left Brain hemisphere is far better and performing logical analytical, mathematical tasks particular those involving spatial, visual and simultaneous processing. In distinct contrast, the Right Brain hemisphere is much better at non-verbal ideation, intuition, holistic and synthesizing activities.

It is seen from the present study that there is no significant difference in Brain Hemisphericity owing to the selected Personal variables. Understanding student's Brain Hemispheric Dominance where Left or Right will help the teachers to succeed in class and outside their class. Knowing one's Hemispheric Dominance provide an important dimension of self discovery and Personal growth. By being aware of different student's Hemispheric Dominance, teachers can enhance the chances of student success by teaching to the strengths of multiple constituencies. Thus students must be given training to identify their own Hemispheric Dominance and some technique to make the class room more valuable for everyone, both with respect to the specific couriers and the wider goals of preparation for life.

This study on Mathematics Brain Hemisphericity and Creative Thinking must be brought to the student's curriculum as it has direct aid log lasting effect on the teacher, students and the society as a whole.

RECOMMENDATIONS FOR FURTHER RESEARCH

The following are some specific areas to which attention of further research may be undertaken:

(a) This study can be extending by consideration more independent variable like Intelligence and Problem Solving Ability in State Comparison.
(b) For the present study specified random sampling has done, it can be done utilizing other methods of sampling too.
(c) Research studies can be carried out to explore how for the problem solving skills developed in Mathematics classroom are helpful to solve life problems.
(d) Research can be carried out to explore the components of the Creative Thinking.
(e) This research can also be done with the help of other tools developed for Creative Thinking and Brain Hemisphericity can be developed by investigator itself.

CONCLUSION

This study on Mathematical Achievement, Creative Thinking and Brain Hemispheric of students indicated significant relationship among the variables. It is also seen that this study is of great relevant in these field of Mathematics Education.

REFERENCES

Bhaskar Reddy S.V.(2008), " Creative of Students teaches of college of education" Edutracts, ISSN 0972-9844, Vol 7 No.12, PP 40-41.

Borgert (1991), "Effectiveness of right brain stimulation on children and their creative in writing "DAT Vol. L11 No.3 September 1991, p. 844A

Bonk (1988), "The effects of convergent and divergent computer software on children are critical and creative thinking'. ED296715, Paper presented at the Annual Meeting of the American Educational Research Association, New Orleans, LA, April 5-9, 1988.

Carlsson and Ingegard (1992), "The creative personality", hemispheric variation and sex differences in defence mechanisms related to creativity, Dissertation Abstract International, Vol.XIII.No.4, 1992.

Chang, Chunyen and Taipei(2002), "Exploring interrelationship between problem solving ability and science process skills of Earth sciences students in Taiwan", International Journal of Science Education. No.XXIV, May 2002), pp. 441-451.

Devi (2002), "A study of creative thinking of secondary school students in relation to parental disciplinary practice, school climate and need achievement",

Maharishi Dyanand University, Sixth Survey of Educational Research (c.f Devi Ahilya University, http:/edusearch.danuniv.sc.in.)

Dutt (1989), "Effect of problem solving strategies for problem solving abilities in science and the relationship with certain cognitive style and intelligence", Perspective in Education, Vol.13,No.14, October 1989, p.207.

Gakhar and Dharmindra (2003), "Intellective and Non-Intellective factors associated with Mathematical Creativity at the elementary school stage", Journal of All Indian Association for Educational Research, Vol.15 (3-4), p.39-42, 2003.

Gray (2003), Recent Advances in Psychology, Dell Publishing Company Inc, New York. p.74.

Jho-Ju Tu and Johnson, (1990), "Can computer programming improve problem-solving ability?" University of Illinois at Champaign-Urbana, College of Education, ACM SIGCSE Bulletin, ISSN: 0097-8418, Vol.22, Issue 2, (June 1990), pp: 30-33.

Jayesh and Nark (1998), "A comparative study on creativity of rural & urban students of secondary schools in Surat district", The Proceed of Education, Vol.LXXII, No.8, (March 1998), p.176.

Johnson – Laird (1993), General Psychology, Indian Edition, Eurasia publishing Home, New Delhi. p.376.

Krishnan and Navaneetha (1990), "Problem solving strategies in mathematics among high students in Devakottai District", Third Survey of Research in Education 1988 – 93, p.543.

Kwatra (2000), "Understanding of science process in relation to scientific creativity, intelligence and problem solving ability of middle school students of Bhopal Division", Barkatullah University, Sixth Survey of Educational Research (c.f Devi Ahilya University, http:/edusearch,dauniv.ac.in.)

Lin (2003), "The relationship between student perception of constructivist learning environment, self directed learning readiness, problem solving skills and team work skills", Ph.D. IOWA State University 2003. Order No.DA3105087 cf. Dissertation Abstracts International, Vol.LXIV, (March 2004) p.3223A.

Manivannan and Nellaiyappan (2004), "The relationship between hemispheric dominance and problem solving ability in Mathematics", Indian Education abstracts, Vol. 2, No. 3,(July 2004) p.76.

Manoranjanhan and Patel (2002), "An investigation into creativity of the students of secondary of Mehsana district with respect to some variables". Journal of Education and psychology, Vol.LIX, No.4, (Jan-June 2002).

Mohansundaram (2000), "Relationship between hemispheric dominance and achievement in history", Andhra University, Sixth Survey of Educational research (c.f Devi Ahilya University, http:/edusearch.dauniv.ac.in)

Nagalakshmi (1995), "Construction of Problem Solving Ability Test in Mathematics for secondary students and study the problem solving abilities of students of X class in twin cities of Hyderabad", Osmania University, Sixth Survey of Educational Research (c.f Devi Ahilya University, http:/edusearch.dauniv.ac.in.)

Naik (2002), "A study of creativity among students in relation to their personality characteristics, motivational characteristics and school background", SNDT Women's University, Sixth Survey of Educational Research (c.f Devi Ahilya University, http:/edusearch.dauniv.ac.in)

Noymonee (1999), "A study of the school environmental factors influencing the creative thinking of secondary school students in Thailand", Sardar Patel University, Sixth Survey of Educational Research (c.f Devi Ahilya University, http:/edusearch.dauniv.ac.in)

Passolunghi, Maria, Pazzaglia and Francesca (2004), "Individual differences in memory updating in relation to arithmetic problem solving", learning & individual differences, ISSN-1041-6080, Vol.14, No.4, p 219-230, 2004.

Prakash (2000), "A study of mathematical creativity and achievement of elementary school students in relation to problem solving ability, anxiety and socio-demographic variables", Punjab University, Sixth Survey of Educational Research (c.f Devi Ahilya University, http:/edusearch.dauniv.ac.in)

Poonamsukul (2007), "Acritical study on creative thinking in relation to certain emotional characteristics". Meston Journal of Research in Education, April 2007, Vol.6. IssueNo.7, ISSN No.0973-6859. pp 27-34.

Patel (1996), c.f Rani (2005) "Brain Laterality and Education", University News, Vol.XXXIV, No.36

Rani (2005), "Brain hemisphericity as related to mathematics and science achievement among higher secondary students". Perspective in Education, ISSN 0970-1502, Vol.5 No.1, (July 2005)

Rangarajan (2000), "Creativity, autonomy in learning anciety, academic achievement of teacher trainees", Experiments in Education, Vol.27, No.2, pp. 173-176.

Risk (1965), Innovative Science Teaching for Physical Science Teachers, Third Edition, Prentice-Hall of India Pvt. Ltd, New Delhi, p.147.

Singhal and Liegise (1994), "Schools and creative thinking of students: some evidence from Nagaland." Perspective in Education, ISSN 0970-1575, Vol.10. No.3, (July 1994).

Sharma (2000), "Effectiveness of problem solving teaching technique on the evolvement of higher level learning outcomes." Psycho-Lingua, No.XXX, 2000, pp.99-105.

Steven Poris (1997), "Effects of computer based cooperative learning on the problem solving skills of grade six students" Nova Southeastern University, ISBN: 1-58112-101-6, Dissertation Abstracts International, October 1997.

Selvi (2006), "Brain hemisphericity as related to creative thinking among XI standard students", New frontiers in Education. Vol.21, No.3 ISSN 0972-1112, (Jan-Mar 2006).

Singh (2004), "A study of scientific creative thinking in relation to achievement motivation and family

relationship among the students of senior secondary schools," Maharishi Dyanand University, Sixth Survey of Educational Research (c.f Devi Ahilya University, http:/edusearch.dauniv.ac.in)

Terrypage and Thomas (1979), Dictionary of Education, McGraw Hill Book Company, New York. p.273.

Tung (2001), "Hemipspheric preferences in relation to creativity and intelligence". Dissertation Abstract International DAI – 61/04, October 2001, p.22.

Upadhyaya (2008), "Relationship of piagetian stage of cognitive Development to creative thinking potential". New frontiers in Education. Vol.41, No.1 ISSN 0972-1231, (Jan-Mar 2008)

Usha (2001), "Influence of intelligence and creativity on the achievement in Mathematics among X class students of Visakhapatanam District – A relational study", Andhra University, Sixth Survey of Educational Research (c.f Devi Ahilya University, http:/edusearch.dauniv.ac.in)

Vengopal and Mridula (2007), "Styles of Learning and Thinking", Journal of the Indian Academy of Applied Psychology, January 2007, Vol. 33, No.1, pp. 111-118.

Visser (2003), "The effect of problem based and lecture based instructional strategies on learner problem solving performance", Problem Solving Processes and Attitudes. Ph.D. The Florida State University, 2003. p. 194. Order no.DA3109316.

Venkataramanan S.D (1989), "A study on activation of right hemisphere for creativity development by shifting hemisphericity preference of style of learning and thinking, with the help of synthetics techniques", M.Ed. Thesis, unpublished data, Madras University.

Vinod and Kadlaskar (1999), "Exploration into brain preferences of girls and the association between their giftedness and behavioural intelligence." Indian Educational Abstracts, Vol.II, (January 1999) p.9.

Venkataraman (1989), "The no limits to learning concept, Research Article, The Hindu November 2000. p.15.

Verma and Sangeetha (1999), "Cerebral hemispheric preferences and learning styles of pre service teachers as related to their level of self - esteem", Indian Psychological Review, Vol.44, pp. 125-127.

Venkataraman (2008), "Impact of creativity traning on hemisphericity dominance of students", University News, ISSN 0566 – 2257, Vol.46, No.24, (June 16 – 22, 2008), pp 5-9.

Walker (2003), "Enhancing problem solving disposition, motivations and skills through cognitive apprenticeship". North Carolina, State University, Dissertation Abstracts International, No.LXV, (July 2004) p.127A.

Woodworth and Marquis (1948), General Psychology, Indian Edition, Eurasia Publishing Home, New Delhi. p.263.

Welsch (1980), Introduction to Psychology, Himalaya Publication, p.205.

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