CHAPTER III

REVIEW OF RELATED LITERATURE
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3.1 INTRODUCTION

Acquisition of knowledge pertaining to the variables selected in the study is of prime importance in any research work. It not only provides insight into the problem but also helps to broaden the vistas of the study. It helps in studying the earlier works on the variables selected and thereby strengthens the study undertaken. In this chapter a sincere attempt is made to summarise the research studies related to the problem at hand namely,

"Hemisphericity, divergent thinking and problem solving ability in physical science of plus two students in Salem."

The researches done in the area of problem solving are thoroughly reviewed. Similarly the studies dealing with hemispheric dominance and the variables that are related to the problem solving ability are reviewed. A review of studies on divergent thinking and attitude towards science also has been attempted.
3.2.1 PROBLEM SOLVING

Buswell (1960) conducted a series of experiments in which problem solving was the main aspect. The results showed that problem solving and reading are very closely related.

Swenson (1965) emphasised the need for solving real problems drawn from actual experience of the children. The reading difficulty in problem solving may be reduced if the children could extract the information from reality rather than from a book.

Ajwani (1979) analysed problem-solving behaviour in relation to personality intelligence and age. The main findings of the study were:

1. Subjects with high intelligence and facilitatory personality traits proved to be better problem-solvers than those having inhibitory personality traits.
2. Problem solving ability of the subjects increased with an increase in age.
3. No significant sex difference were observed in the subjects' ability to solve problems.
4. The interaction between personality factors, intelligence, age and sex had no effect on problem solving ability of subjects.
Saxena (1980) studied children's problem solving and decision making strategies. The study revealed that:

1. While in a problem solving situation, the dead-ends were overcome by the creation of sub-goals related to the final goal states, the subjects in a decision-making situation abandoned the goal itself.

2. In a decision making situation, the interpersonal character of the situation where no strategy could be worked out without the cooperation of the partner did provide scope for the manifestation of total strategies or plans as made by the subjects.

Haught, Patricia (1985) examined the performance of twenty-five younger adults and twenty-five older adults on problem solving meanness including concept identification tasks, twenty question tasks, practical problem tasks, and three piagetian tasks. Younger adults were graduate students and older adults had at least high school education. The study concluded that when educational level is controlled, problem solving performance across adult groups are similar.

Behle (1985) stated that successful teachers of problem solving were frequent questioners and had problem sources other than the text book.
Conney (1985) found conflicts between a teacher's idealism and the reality of classroom practice as his students were not always receptive to his problem solving strategy.

Cervetti (1985) conducted a developmental mathematical program and it resulted in increase in arithmetic skills, retention, positive attitudes and success rates.

Farrar (1985) stated that no clear improvement was found favouring the divergent approach over the traditional approach.

Lacy (1985) in his investigation on 'Mathematical beliefs and problem solving' studied the beliefs and one's ability to do mathematics, beliefs about mathematics as a discipline, beliefs about where mathematical knowledge comes from, beliefs about mathematical problem solving and beliefs about how mathematics should be taught and learned. Each type of belief was found to influence problem solving behaviour.

Morales et. al (1985) concluded that fifth and sixth graders sorted work problems by schema whereas third graders sorted by surface structure. Sorting and accuracy did not depend on whether problems were in Spanish or in English.
Slife et al (1985) reported that learning disabled students were less skilled in knowledge of problem solving skills and ability to monitor their problem solving performance.

Borsky (1986) found no significant differences in arithmetic skills between groups given task specific strategies for mathematics problems or task approach strategies on visual motor activities.

Fickel (1986) studied the effects of learning Logo programming on the development of cognitive ability, problem solving ability and locus of control and he found that no significant differences in the development of cognitive ability resulted from the study of Logo. Also no significant differences in the development of cognitive ability problem solving ability or the learning of Logo were found with respect to gender. But in the high ability group significant differences were found for the cognitive ability, problem solving ability and Logo learning.

Levine (1986) studied the problem solving strategies of 10 and 13 year olds to comprehend mystery stories.
A prior knowledge interview was conducted initially as a screening device. A strategic knowledge interview was engaged to conduct the strategies used in solution of the mystery. It was found that the inductive mystery stories necessitating reasoned clue search followed by a logical solution could give cause effect relationship.

Mehrotra (1987) studied the problem solving behaviour among preschoolers in India and reported that fantasy did not act as a bridge between convergent and divergent thinking. The home environment was found to be a crucial factor in the prediction of original thinking.

Findell (1988) made an investigation of problem solving achievement as related to mode of problem presentation to determine whether the form of problem presentation affects college students abilities to solve linear cost problems. It was found that the mode of problem presentation had no effect on the problem solving ability.
Nichols (1988) on studying the "effects of problem solving strategies on different ability levels" concluded that the length of training is an important consideration in providing thinking skills instruction; that thinking skills instruction should be an integral part of the curriculum rather than a supplementary, isolated program; and that thinking skills instruction is appropriate for all ability level students.

Owens (1989) formulated a counsel model on factors affecting problem solving achievement and reported that significant direct effects exist relating to prior knowledge, meta-cognition, students strategy use and problem solving.

Shepardson (1990) studied the relationship between problem solving phase, standard interactions and thinking skills among middle school students. Direct classroom observations were made on 42 students during five different problem solving activities within the "Search Solve Create Share Problem Solving" instructional model. The results indicate that SSSS problem solving instructional model engage the students in the use of thinking skills during problem solving. It was also found that the problem solving phase had a greater controlling function on the use of thinking skills than student interactions.
Tilgner (1990) concluded that the problem solving method employed by the subjects consisted largely of recalled facts and personal experiences. The subjects were unable to deal successfully with interactions between two or more variables.

Godine (1991) stated that middle school students who were taught by teachers who employed the generative teaching approach to problem solving did academically better than those who were taught by the isolated or neutral approaches. Students who were taught by teachers who used the neutral approach to teaching problem solving did perform better in mathematics than those who were taught by generative or isolated teaching approaches.

Higgins (1991) in his study 'An investigation of the effects of students attitude, beliefs and abilities in problem-solving and mathematics after one year of problem-solving instruction using the approach advocated by Ovegon's Lane Country Mathematics Project' found that the group which was given one year of problem-solving instruction had high degree of liking of problems, ability to use the skills, perception towards mathematics, length of time they work on a problem and the
belief that the real 'math' problems could be solved by commonsense rather than the math rules learned in school.

Enrlich (1992) in his study (The Development of knowledge acquisition as evidenced by children's problem solving strategies) analysed development of knowledge acquisition in seventy seven 6 to 8 years old children and found that children did not show any developmental differences in process as measured through problem solving strategies.

Fauz (1992) studied the interaction of critical thinking creative thinking and intelligence with problem solving. Creative thinking was measured using the average of the three component scores from the Torrance Test of Creating Thinking Verbal Form A. Problem solving ability was measured using the raw score on the Whimbey Analytical Skills Inventory Pre-Test. The study revealed the following points:

1. There was significant correlation of both intelligence and critical thinking with problem solving.
2. Intelligence and critical thinking influence problem solving ability.
Higgins (1992) investigated into the effects of students' attitudes, beliefs, and abilities in problem solving and mathematics after one year of problem solving instruction. The study revealed the following facts. When problem solving instruction was given, it was found that the instruction increased,

1. The degree of liking of problems that made them 'think'
2. Ability to use the skills of making systematic lists and eliminating possibilities.
4. The length of time they would work on a problem and
5. The belief that real 'math' problems could be solved by commonsense etc.

McMullen (1992) studied the development of adaptive symbolic problem solving in children between the ages of two and a half and three years and reported that younger children relied on trial and error problem solving while older children derived symbolic solutions to the performance task problems.

Scheitinger (1993) in his study "Error Analysis on a Cognitive Processing Model of Verbal Problem Solving by Learning Disabled Students" found that problems
presented in pictorial forms using indefinite quantifiers forced a semantic meta-cognitive solution strategy, reducing errors by learning disabled subjects.

3.2.2 PROBLEM SOLVING IN SCIENCE

Efros (1985) conducted a study to determine whether students who received training in synectics, training in dealing with conflict or no training would significantly differ after treatment on six dependent measures. It was found that there was significant positive correlation among the three scales of problem solving perception.

Gage (1986) investigated and compared the problem solving behaviour of college chemistry faculty and undergraduate chemistry students in solving three quantitative homogeneous gas phase equilibrium problems. He found that major errors were committed by students independent of their previous chemistry grades. Students recognised problem types and applied learned algorithms rather than analysing problem systems.

Martin (1986) compared the problem solving ability of physics and engineering students in a two year
college and found that there is a significant differences in the ability of engineering students and physics students to solve statics problems. Engineering students scored higher in problem solving ability on physics problems.

Veldhuis G. Henry (1986) on investigating the differences in the categorisation of physics problems by novices and experts found that experts categorise according to deep structures and novices surface features. The categorisation by novices is less consistent than that by experts.

Crosby (1987) studied the effects of introductory college chemistry instruction on student qualitative problem solving ability. The study revealed that though the problem solving instruction was found to be accurate, text book and lecture method were inconsistent and incomplete in identifying and applying the concepts needed to solve qualitative problems.

Lythcott (1987) studied as to how problem solving can improve both conceptual knowledge and problem solving performance in chemistry. He developed a scheme for solving problems and called the learning strategy. The experimental group was taught chemistry using the learning strategy and the control group by the regular method.
He found that the experimental group performed very well. They could solve problems more accurately, since they had better knowledge of particles, chemical change, the balanced equation, formula and moles. Even the unfamiliar reactions were able to be inferred by the learning strategy group.

Abell (1988) studied "the effects of a problem solving inservice program on the classroom behaviour and attitudes of middle school science teachers" and reported that the extended inservice education program makes the teachers decrease the percentage of time spent on observing and listening to students.

Martens (1988) while studying 'the implementation of a problem solving curriculum for elementary science' found that the presence or absence of environmental factors such as administrative support and flexibility, available science materials, a school philosophy that encourage the full development of student potential, outside of school student experiences that encourage independence, parental support and teacher status strongly affected teacher's efforts. Background in science, ability to see interdisciplinary teaching possibilities need to maintain control over student activities and thinking, understanding of the relationship between science content and problem solving and general openness
to change facilitate problem solving.

O' Donnell, (1988) studied the use of mental imagery as an heuristic technique in solving physics problems. It was obvious that if problem solvers construct and utilize functional images during a problem solving activity, then the link between perception and mental imagery may effect the performance. The study offered the following conclusions.

Instructions which stress large distances have no differential effect on either the scale of the students' diagram or their performance on the problem solving activity and instruction using written materials that contain complexities have no significant effect on either the complexity of the diagrams drawn or the performance on the problem solving activity.

Barlow (1990) investigated the extent to which the type of laboratory activity bears upon problem solving abilities of college biology students. The sample for the study was grouped in three groups (randomly constituted) group I comprised of students participating in conventional laboratory activities. Group II participated in laboratory activities based on computer
assisted instruction and Group III participated in laboratory activities presented through video based macro contexts. The study revealed no significant difference among the three groups with regard to problem solving skills. Students participating in computer assisted instruction in the laboratory obtained significantly higher scores in attitude than students participating in video based macro contextual activities. The higher scores indicate a positive attitude toward the laboratory experience.

Barrow (1990) from his study on "The effects of micro computer based laboratory exercises on achievement and attitude towards physical science of pre-service middle school teachers" drew the following conclusions:

1. MBL has a significant positive influence on students' achievement and a significant positive influence on students' attitude toward the use of computers in learning science.

2. MBL affects students' confidence in interpreting physical relationships in science.

3. Students have confidence in MBL as a problem solving tool.
Edgar (1990) made an exploratory study to identify the relationship between curriculum components and problem solving performance of two year college students. It was found that the general studies curriculum enhanced the problem solving ability of students. Number of courses completed and grades earned in three broad curriculum areas were also significantly and positively related to problem solving scores. Regression Analysis identified number of courses in physical science and cumulative grade point average in English as effective predictors of problem solving scores.

Katkanant (1990) investigated the effects of using interactive Video Disc laboratory simulation on problem solving and learning performance of high school chemistry students. Results revealed that the IV group spent more time in devising the plan and less time in carrying out the plan than the LAB group. It was also found that the IV group had significantly higher scores on problem solving strategy and spent less time in completing the experiment. There was no significant differences between IV and LAB groups on problem solving ability achievement and retention scores.

Sumrall (1990) studied the effects of content and repetition on the problem solving abilities of physical
science students. Velocity type problems were presented to subjects through a pretest and computer programs were developed for the study. The computer programmes enabled to provide the repetitions needed to master sets of velocity type and acceleration problems. The results showed that subjects who score high in ability to solve velocity type familiar, unfamiliar and science problems scored high in velocity problems. The subjects' ability to solve simpler problem in velocity type did not significantly predict the subjects' ability to solve more complex acceleration problems. The study also showed that the fewer the repetitions needed to master either the velocity type or acceleration problems, the higher the achievement in solving velocity and acceleration problems.

Hafner (1991) examined the high school students' model revising problem solving in genetics. Six students were selected and asked to solve problems requiring model revision. Genetics computer construction kit was provided. It was found that all the six students had success in model revising problem solving to produce models of increasing complexity and realism.
Halpin (1991) studied the strategies students use to solve chemistry problems. This study was undertaken to know (1) how students solve chemistry problems (2) to identify indicators or a group of indicators that might be used as predictors of the strategy a student may use and (3) to determine if some strategies are more successful and/or efficient than others in solving chemistry problems. The problem solving strategies employed by the students were compared to independent variables like gender, SAT scores, intelligence scores, etc. It was found that no one strategy could be identified as the best strategy to solve problems in chemistry. The successfulness of the problem solving was independent of the strategy used.

Maurer (1991) studied the effectiveness of a mastery learning strategy in enhancing student cognitive achievement, problem solving skills and retention of these concepts in an introductory chemistry program. It was found that the students who received the mastery learning strategy had a significantly better cognitive.
achievement than those students who do not receive the treatment. The mastery learning strategy did not significantly improve the cognitive retention of the treatment group.

Siripunkaw (1991) invested the variables involved in physics problem solving by tenth grades in Thailand. Seventy tenth grade students were taken for the study. Data were obtained by means of testing, the think aloud interview, clinical interview and classroom observation. The major findings were as follows:

1. Problem solving achievement had a fairly high correlation with mechanics, conceptual understanding, mathematical skills, problem representation and organisation. Problem representation influenced the achievement in solving physics problem.

2. Significant difference was found in the problem solving variables like cognitive development, conceptual understanding, mathematical skills, problems presentation, organisations,
use of heuristics etc., between the successful problem solvers and unsuccessful problem solvers.

3) There was no significant difference between boys and girls with regard to all the problem solving variable: except conceptual understanding and use of heuristics.

4) The difficulties that the Thai students encountered in solving physics problems were associated with inability to demonstrate logical thinking, misconceptions, mathematical errors and the poor problem representation.

Ketterling (1992) in his study on "A delayed assessment of a problem solving inservice program on the classroom behaviours and attitudes of middle school science teachers after three years" analysed teacher behaviours and attitudes after participation in a problem solving inservice program. Conclusion of this study was in favour of the experimental group, where different behaviour were utilised. This group was more committed to innovation.
3.3 HEMISPHERICITY

Schwartz et. al (1975) found that spatial and emotional responses were associated with the right cerebral hemisphere whereas verbal and non-emotional responses were associated with the left cerebral hemisphere.

Sudjanen (1976) contrasted the left cerebral hemisphere as linear, time oriented, rational, analytic and cerebral with the right cerebral hemisphere as non-linear, lateral-thinking, intuitive, artistic and creative.

Samples (1976) saw the intuitive holistic function reside in the right cerebral hemisphere.

Allinder (1983) designed a study to enhance the use of right hemisphere of the brain in worship and learning experience. The study revealed that not only did the enriched worship services and learning experiences reach the right hemisphere but uncovered a left hemispheric hunger for such enriched experiences as well.

Stiles (1983) studied the development of four right hemisphere damaged children to determine whether and how
early brain injury affects the development of spatial and class realations. He reported that the right hemisphere
damaged children appear to be developing normally in their
construction of class relations, but they are limited in
their ability to express that understanding through spatial
means.

Franco et.al (1977) showed through their experiments
that many of the properties of intuition were associated
with the right cerebral hemisphere.

Dietzon (1987) investigated the relationship
between verbal sequential and non-verbal simultaneous
hemispheric processing styles of 3 to 5 years old low
income students. It was found that simultaneous processing
style for non-verbal information correlated significantly
with their hemispheric specialisation for non-verbal
material. Also the sequential processing style for verbal
information correlated with hemispheric specialisation for
verbal material.

Fin (1987) studied the relationship of brain domi-
nance spatial visualisation ability, attitude toward
mathematics gender and geometry proficiency test score
among high school students and the following were the
findings.

1. Gender difference was found on hemisphericity and
   level of achievement.

2. Spatial visualisation ability difference was found
   on hemisphericity and level of achievement.

3. Hemispheric difference was found on the genetic
   proficiency test and level of achievement.

4. No significant difference toward mathematics was
   detected on hemisphericity.

5. Math. subjects showed greater preferences for right
   brain dominance, better spatial visualisation
   ability and better geometry proficiency test scores.

Gwany (1985) investigated the relationship between
brain hemispheric functioning and academic achievement
and found that there was significant difference between
students' right brain performance. It was also found that
there was no correlation between students' cognitive later
ability performance and their achievements in geography, arts, social sciences.

Jones (1985) investigated the relationship between student behaviours and hemisphericity. A group of 25 non-disruptive students, a group of 25 disruptive students and a group of 26 alternative centre students were randomly selected. Form CC your style of learning and thinking survey to get a preference score, Myers Briggs Type Indicator to get indicator scores were used for data collection. It was found that there was a significant difference between the brain preference scores among the three groups of students. Also, there was significant difference between the disruptive group and the other two groups. The disruptive group was predominantly right brained. Extroversion introversion showed a negative correlation in the non-disruptive group and sensing Intuition a positive one. The alternative centre group showed a negative correlation on extroversion-introversion and a positive correlation in both sensing-Intuition and thinking feeling.

Ventre (1985) explored the strategies used to manipulate brain hemisphericity activity while reading. This
study revealed left-right brain theory has little or no application for teaching reading at this time.

Groff (1986) in his study of 'hemispheric preference as it relates to reading and recalling, nonsense words from a card reader' found that readers older than six need a trend toward the left or right hemispheric method in order to make adequate progress in reading. Multiple testings showed considerable variation in some subjects.

Johns (1986) investigated the interaction of progressive part versus whole methods of practice with hemispheric preference for processing information and the impact of these on speed and accuracy of type writing in the beginning. This study indicated the effect of left right hemispheric preference on speed. The moderate left hemisphere dominant group was consistently the fastest group and the extreme the right dominant group was consistently the slowest, but they were most accurate. Progressive part practice method was not superior to the whole method in terms of speed and accuracy.
Reitz (1986) studied the thinking styles of school administrators and their relationship to leader effectiveness and indicated that there was no relationship existed between the thinking styles and leadership effectiveness of school administrators. The human Information processing survey was used, to study the thinking styles and career leader program was used to measure the leader effectiveness.

Falletta (1986) studied the relationship between sinistrality and right cerebral hemisphere cognitive functions in a select sample of college students and it was found that there is no relationship between the variables of sinistrality and divergent thinking.

This study was an effort to discover whether or not there is a relationship between sinistrality, or left handedness and right cerebral hemisphere cognitive functions, specifically divergent thinking. It was found that no relationship existed between the independent variable handedness, and the dependent variable divergent thinking.
Susan Janet (1986) while studying the role of the right hemisphere in the production of linguistic prosody reported a preserved ability by right hemisphere damaged patients to produce linguistic prosody at the word level.

Melesky (1986) - "A study on the correlation of right or left hemispheric participation with success in Foreign Language learning" - conducted a study to determine to what extent greater participation of the left cerebral hemisphere or greater participation of the right cerebral hemisphere might be related to success in the early stages of learning foreign language. The study revealed that both cerebral hemispheres are contributive to early second language learning. The right hemisphere appeared to be of importance due to the right cerebral hemisphere's superior visual-spatial abilities.

Bledsoe (1987) reported that when students with right brain hemisphere dominance were motivated, could perform very well in creativity, fantasy oriented activities and visualisation.

In a study to examine the relationship between processing styles of the right and left hemispheres of
the brain and the development of communication proficiency in the beginning stages of formal foreign language exposure among adults. Mauthner (1987) stated that there is a positive relationship between performance on language task and LH strategies and a negative relationship for the RH.

Grun (1987) analysed the learning styles and academic achievement based on experimental learning theory, conceptual level theory and right left brain hemisphere theory. Results showed that learning styles were significantly related to academic performance. But learning styles were unrelated to grade point average. The study showed considerable variability in learning styles among subjects which reveals that individuals have distinct, dominant learning styles. Overall, the results provided evidence that learning styles influence different facets of learning and need to be considered in appraising students and their needs.

Jaffe Meryl (1987) studied the cognitive skills and hemispheric specialization of good versus poor readers. It was found that good readers had significa-
tly better verbal and figural analogies scores and signi-
ficantly greater left hand scores on the dichaptic non-
sense shape test.

Wray (1987) found that the psycholinguistic and
clinical assessments induce a language focusing strategy
and thus deactivates the right hemisphere.

Iovino (1987) undertook a study to determine the
effect of dominant hemispheric processing modes and note-
taking strategy on the comprehension and retention of
academically under prepared college readers and found
that there were no significant differences between the
mean scores of students with different dominant hemisphero-
ric preference modes or both immediate recall and reten-
tion tests.

Leslie (1987) attempted to assess the thinking
preferences (Brain dominance characteristics) of student
nurses and nursing faculty. The results of the study
revealed that there were no significant differences
between overall left or right, cerebral or limbic thinking
preference scores for students or faculty. It was found
that there were no significant differences between student groups for the use of left or right oriented learning strategies.

Wesson (1986) studied the relationship between hemisphericity and reading comprehension and found that there is no significant correlation between reading comprehension and hemisphericity for the total population as well as for the male and female students.

Barrett (1988) studied the hemispheric asymmetry for sequential memory mediated by manual responses. He selected 96 normal right handed college undergraduates for the study. They were asked to remember the sequence of taps and to reproduce the sequence by pressing micro-switches located underneath each finger. It was found that initial response time was shorter for the left hand as compared to the right. But for the total response time the right hand was significantly quicker than the left. That means the left hemisphere is specialised for the memory of complex sequential motor movements.

to hemispheric laterality" - attempted to determine the
the occurrence of descriptors occurred in sampled content
of each text book. In each case descriptors associated
with the left hemisphere outnumbered right. The
greatest differences in percentage of occurrence for
both the left and right hemisphere associated descrip-
tors were within the area of language arts.

Bowlin (1988) investigated into the relationship
between cognitive styles and sex, I.G. academic achieve-
ment and hemispheric preference in high school seniors.
This study revealed that hemispheric preference did not
affect the performance.

Murdock (1988) studied hemispheric learning
style and student sense of inclusion in LDS seminary
classes. The herman Participant Survey Form, the
Brain Dominances Test and the Student Rating Scales were
used to collect data from XI and XII grade seminary
students and teachers with strong hemispheric thinking
style. The study reported the following conclusions.
1) Hemispheric thinking bias of teachers did not influence whether students attended seminary or not.

2) Teachers with left brained thinking Styles are more homogeneous than other teachers.

3) Differences in brain dominance between teachers and students did not influence inclusion as much as other dynamics.

Bruno (1988) studied the effects of hemisphericity and instructional strategies upon college students mathematics achievement and attitudes and reported that no significant differences emerged between students attitude scores when instructional strategies were congruent/incongruent with their diagnosed hemisphericity. But a significant difference did emerge between students diagnosed hemisphericity and their learning style preferences.
Breien - Pierson (1988) explored the influence of brain hemisphericity on the composing process of twelfth graders. It was found that the right brained students approached the composing process in a different manner than the left brained students. It was also found that the right brained students preferred free writing and creative writing while the left brained students enjoyed doing research papers and book reports. Thus it was concluded that the brain hemisphericity influence the composing process.

Lamphere (1988) conducted a study to examine whether knowledge of hemispheric preference in processing information contributed to an increase in problem solving scores of middle school mathematics students. The treatment group received information regarding their individual hemispheric style preference in processing information while the control group did not. It was found that there is no significant difference between mean scores on the
five subtests calculated for the pretest and posttest among the hemispheric preference groups between treatment and control groups or in gain scores between the treatment and the control groups.

Holtzman (1988) examined the relationship between hemispheric dominance and learning styles. Two standardized testing instruments the MBTI and the HIPS were employed and found that there is a definite relationship between brain dominance and learning style.

Wessman (1988) investigated into the relationship of brain hemisphere dominance to the professional development of chief educational administrators. The brain research brain dominance, and management/leadership literature were surveyed to determine cognitive potential and organisational needs for executive development. The findings of the study were 1) chief administrators are characterised by a style predominantly left brained in orientation. 2) Top level administrators with responsibility for academic and financial affairs are characterized by a style congruent with the content of their work.
Mc Michen (1988) studied whether the priming of the hemispheres with stimuli known to increase the activity of the right or left hemisphere would affect subjects' performance on tasks which favour left right hemisphere processing. The following conclusions were drawn. The special teaching given to one or the other hemisphere did not affect the subjects performance in the particular hemisphere. Effectiveness in accomplishing tasks processed by a hemisphere is not enhanced by priming.

Wright Strawdesman (1988) studied the depression in students with learning disabilities and hemispheric differences. This study examined the prevalence of depression of a sample of pre-school children identified as LD by state standards. The study revealed that the relationship of hemispheric functioning and severity of depression was not significant.

Glenda (1989) examined the relationship between hemisphere preference and environmental characteristics of learning styles in college students. Human information processing survey and the productivity Environmental preference survey were administered. On analysis it was found that eight environmental variables related to
left hemispheric preference, five to right hemispheric preference and seven to integrated processing.

Smith (1988) explored the effect of localised hemispheric lesions on the performance of specific and integrated modality memory tasks by primary school children and reported that a variety of localized lesions have an adverse effect on development of memory processing with right hemisphere lesions. In young children an intact right hemisphere is essential for either establishment of cognitive structure basis to memory processing or development of problem solving strategies essential to performing memory tasks.

Kenn (1989) reported that Principals who perceived themselves as preferring mental processes that are predominantly left brain hemispheric perceived themselves to be initiating structure leadership style and those who perceived themselves to be right brain hemispheric saw themselves to have consideration for leadership style.

Kummerow (1989) studied the hemispheric dominance of high school students enrolled in selected education
programs. This study focused upon the measurement of the hemispheric dominance of a group of one hundred and ninety one high school seniors enrolled in general education and alternative education programs. It was found that there was no relationship between the hemisphere dominance and the variables like academic success, gender, handedness etc.

Vankleek (1989) studied hemispheric differences in visual parsing and reported that the right hemisphere is superior at parsing that proceeds in accordance with the Gestalt principles.

Brand (1990) studied the effect of hemispheric asymmetry and sex role on two modes of therapy: cognitive and affective. The study revealed strong correlations between right brain hemispheric dominance feminine Bem Sex Role inventory score Gestalt Therapy. Similarly strong correlations were found between left brain hemispheric dominance and reality therapy. Right brain hemispheric dominance and Integrated hemispheric dominance showed high correlation with feminine Bem Sex role inventory score. At the same time no correlation was
found between left hemispheric dominance and masculine 
Bem Sex Role inventory score.

Luh Shink Peir (1990) studied the learning styles 
personality type and brain-hemispheric preferences of 
teacher education majors. The following were the 
conclusion of the study. There was no predominant learning 
style, personality type, or brain hemispheric preference 
found among teacher education students. Gender 
difference was only minor influence in the above rela-
tionships. No differences existed among the three vari-
ables between the females and the males.

Borgert (1991) studied the effectiveness of right 
brain stimulation on creativity in writing and it was 
found that both the right and left hemispheric preference 
groups demonstrated an increase in creativity. But there 
was no significant difference between the creative 
expression of those children with a right hemispheric 
preference. The females showed a greater change in 
creative expression than the males. It was also found 
that children in the classroom of the teacher with right
hemispheric preference were more creative than those of
the teacher with the left hemispheric preference.

Gabari Gambarte (1991) studied the two hemispheres
of the human brain. The cerebral asymmetry between
the two hemispheres of the human brain has raised an
interest in discovering possible correlates of such
variety at a neuro functional level as well as for
the ontogenetic development of the functional
lateralization. An experimental study with 28 subjects
suffering from congenital hemisplegia (14 with the
injury on the left as hemisphere and the other 14 on
the right) and another control group with 28 hemogenized
according to the variables age, sex and origin was
conducted. The following conclusions were made.

1) Clinical analogies can be established between the
injuries on the left hemisphere and the dysphasic
Syndrome "Anomical syntactical' and between the
injuries to the right hemisphere and attention
deficit disorder syndrome and those of the primary
vigilance deficiency disorders.

2) The RH injuries have a worse prognosis than the LH.
Nak Carol (1991) examined the correlate of EEG hemispheric integration. The study examined preferred, modes of information processing, meditation, history, gender, age, occupation orientation, educational level and handedness and their relationship to the magnitude of interhemispheric differences. The study revealed that hemispheric integration is strongly associated with being female and with having a low preference for right hemispheric information processing.

Chad J Marsolck and Stephen M Kosslyn (1992) studied form specific visual priming in the right cerebral hemisphere and reported that two separate systems encode the visual representations that produce priming. The system that is more effective in the RH is better at representing form specific information, whereas another system that is not effective in the RH does not distinguish among distinct instances of word forms.

3.4 DIVERGENT THINKING

Verma (1973) in his study on divergent thinking in relation to certain personality dimensions found out
that autonomy, non-conformity and openness of mind were functionally related to the abilities of divergent thinking.

Mohammad Miyan (1982) examined whether the methods of teaching had any effect on the development of convergent and divergent thinking components of mathematical creativity. He found out none of the methods was significantly different in developing divergent thinking and convergent thinking abilities.

Kane (1984) studied the effects of response narrowing and response widening training on intelligence and mental processes in preprimary children. The Wechsler preschool and primary scale of intelligence, Kanfiman assertion battery for children learning Abilities Test and thinking creativity with action and movement were the tools used. Training programme was given to the experimental groups to widen or narrow their responses, respective to find correct answers. It was found that the response widening training increased the divergent thinking, creativity and simultaneous processing, response narrowing training increased the convergent thinking and
sequential processing. Training for high level thinking was found to be highly effective with preschool children.

Strauss (1986) in his study on 'Imagery and divergent thinking' found that X-checking task interfered significantly with the letter tracking task. Students responded to the divergent thinking questions, under No interference. Fluency scores were significantly higher for concrete than abstract questions.

Cropley (1987) designed a study to evaluate the divergent thinking in young handicapped children and found that there were no significant difference in the scores on fluency and originality between the handicapped and non-handicapped students. Handicapped children scored below the age norms on the imagination task.

Loomis (1987) studied whether depressed individuals have divergent thinking deficits in impersonal and interpersonal problem solving tasks. It was found that the depressed individuals have greater difficulty with producing alternative kinds of ideas than non-depressed individuals.
Reiss (1987) investigated into the relationship between Piaget's stages and the development of divergent thinking abilities in pre and early adolescence and it was found that there is no correlation between divergent thinking measures and intelligence measures.

Coghlin (1988) studied the effects of creative thinking techniques seminar on divergent thinking. The verbal and Figure. Form A of the Torrence Test of creative thinking was used as the pretest for the divergent thinking. Verbal and Figural Form B were used as post test. Four hours training was given to the experimental group students. It was found that there was no treatment effect for training on scores of divergent thinking. The gain scores indicate that the training programme had some positive effect on verbal creativity scores.

The effects of divergent thinking and metacognition on objective test analogy items in gifted children was conducted by William (1988) and found that a high
number of potentially true answers were more closely associated with a lack of knowledge than a high degree of content sophistication.

Mack (1992) explored the divergent thinking of pre-schoolers. The purpose of this study was to explore the extent of divergent thinking traits of fluency, flexibility and originality among the pre school children. Data was collected through six methods - three figural and three verbal, that were developed as part of the study. The study revealed that the verbal fluency was significantly higher than figural fluency and suggests that there is a developmental influence for this trait.

3.5 Attitude towards science:

Bishop (1986) investigated into the relationship between criteria established for an effective science learning environment as perceived by students and their attitude towards science. The following conclusions were arrived at by him.

1) All criteria for classroom environment were significantly related to student attitudes at source grade or school level.
ii) Teacher enthusiasm, motivation interpersonal relationships, student attitude toward school, evaluation of students, student attitude toward science were significantly related to student attitudes at every grade level.

Pogge (1986) studied the attitude toward science and science teaching of the teachers and students at Baldwin school, and found that there were no significant correlations between teachers attitudes toward science and science teaching and student attitude toward science. Student perceptions of their teachers and science classes and their attitudes toward science were found to be correlated significantly.

Clyne (1988) examined the relationship of science achievement, attitude, and motivation toward science of third and 6th grade students. The following conclusions were drawn from this study.

1) Relationship of science achievement and attitude was stronger for male and female students.

2) Relationship of science achievement and motivation was low.
Gololin (1988) investigated the attitude towards science of nonscience students and science students and reported that classroom environment affects the formation of positive attitude towards science.

Abdul Razak (1991) compared science and Mathematics achievement, attitudes, curricular experiences, and career interest found that students who attended the KAMSE (Kalamazoo Area Mathematics and Science Centre) special program took more science courses and scored higher in mathematics and showed better career interest in science. The special program did not bring in any change in the attitude towards science scores.

Neathery (1991) conducted a study to find out the relationship between science achievement and attitude toward science and the relationship of attitude toward science and additional school subjects. It was found that there was no difference in science achievement based on gender and ethnicity. There was a difference in Science achievement based on ability grouping and grade levels. The high ability group performed better
than the low ability group. It was also found that males believed science to be more exciting than females. The attitude toward science is higher for higher ability group of students. It was also revealed that attitude toward science was similar to attitude toward Mathematics, Social studies and language arts.

Pedersen (1990) compared the effects of science, technology and societal issues with attitude toward science, anxiety toward science, problem solving perceptions and achievement in secondary science of 11th and 12th graders. The results indicated that science, technology and societal issues presented in a co-operative controversy framework improve students' attitude toward science, decrease anxieties toward science and improve students' perceptions of their problem solving abilities. No difference was observed between the treatment and control group on achievement.

Eichinger John (1990) conducted a study to identify variables endogenous to the secondary level science classroom that foster student interest and positive attitudes towards science and related fields. Secondary
Science was found to be held in highest regard by the college science students, followed by non-science students. Science major students preferred teachers who were knowledgeable, committed competent and friendly. Science and non-science major students reported same levels of science interests in grades 7 and 8. But the two groups differ. significantly in grades 9 through 12 as science major students' interest rose while non-science major's interest remained relatively static. Teacher knowledge, course content and instructional methods were all identified as important variables in developing student interest. Results indicated that teacher personality is the single most important factor affecting student attitudes.

Leach (1992) investigated the effects of the Full option science system on the attitude toward science and the achievement of fifth grade students. This study revealed that students in the FOSS treatment group compared with the text-book based control group scored higher in science achievement, in science process skills and demonstrated more positive attitude towards science.
Morrell (1992) examined the students' attitudes towards school and classroom science. Science attitude scales for middle school students (by Musiti, Shringley and Hanson and one constructed by author) were administered to 5th, 6th, 7th and 10th graders. The results indicated that statistically significant relationship existed between students' attitude toward school and toward classroom science. No gender difference was found with respect to attitude towards classroom science. Fifth graders had more positive attitudes toward science than seventh and tenth graders.

Smith (1991) compared the elementary students' achievement, process skills and attitude towards science, when receiving hands on versus traditional science instruction. The following conclusions were drawn from the study.

1. The achievement of students in grades two through five who received hands on science instruction was significantly higher than those students who received traditional science instruction.
2. The process skills of students in grades two through five who received hands-on science instruction were significantly higher than those students who received traditional science instruction and

3. The attitude towards science of students in grades two through five who received hands-on science instruction was significantly higher than the other group.

McCune (1989) investigated the effect of integrating Bloom's Taxonomy and the scientific method on critical thinking, achievement and attitude towards science. The following conclusions were drawn

1. Critical thinking skill was significant at .01 level which indicates that the critical thinking skills improved considerably with the instruction.

2. No significant changes occurred in attitudes and content achievement between the experimental and control groups.
3.6 CONCLUSION

Understanding and problem-solving has become the chief goal of education at school in the wake of revolution of science and technology, all over the world.

On studying the related literature, it is seen that individual differences exist in hemisphericity, divergent thinking, problem solving ability and attitude towards science and problem solving. Also it is thought that problem solving ability is influenced by hemisphericity and the divergent thinking. Some students exhibit hemispheric dominance whereas some do not have any preference.

It had long been thought that individual differences in cognitive ability existed only with respect to sex, locality and type of schools. Since it is found that brain dominance also is bound to change from individual to individual, this investigation attempts to find out the extent of individual difference in hemisphericity. Also how far this variable affects divergent thinking and problem solving ability of students is the focus of this study.
The divergent thinking is a factor which will accelerate problem solving process. The investigator is interested to find out how far hemisphericity and divergent thinking affect the problem solving ability and hence this study is undertaken.

In the next chapter the design of the study is spelt out.