CHAPTER 2

REVIEW OF THE RELATED LITERATURE
An important and crucial aspect of a research project is the review of related literature that means to locate the real and evaluate the past as well as current literature of research concerned with the planned investigations. The time spent in such a survey invariably is a wise investment. The survey of related literature provides the investigator necessary knowledge and insight on what to start, where to start and how to start. Regarding the time spent in the search for reference material, Best (1970) observes, "It was a time consuming but fruitful phase of investigation."

The review of the literature is a must for scientific approach and is reported to, by and large, by all investigators in all areas of scientific research. Through review of research work, the investigator can have an understanding of the previous work, related to one's problem of study that has been done. One cannot develop an insight into the problem to be investigated into, unless and until one has learnt - what others have done and what remains to be done in a particular area of one's own interest. Thus, the related literature forms the foundations upon at which all work can be built and survey of related literature, besides forming one of the early chapters in a research report for orienting the readers, serves some other purposes.

According to Good, Barr and Scates, survey of related literature serves the following purposes:
1. To know whether the evidence already available solves the problems adequately without further investigations and thus, to avoid the risk of duplication.

2. To provide ideas, theories, explanations or hypotheses valuable in formulating the problem.

3. To contribute to the general scholarship of the investigator.

4. To suggest methods of research appropriate to the problem.

5. To locate comparative data useful in the interpretations of results.

For the purpose of systematic analysis and scrutiny of the problem at hand the studies conducted in the field have been grouped in five parts:

1. Studies regarding the relationship between divergent thinking and hypothetical reasoning.

2. Studies regarding the relationship between intelligence and hypothetical reasoning.

3. Studies regarding the relationship between school climate and hypothetical reasoning.

4. Studies regarding the relationship between sex difference and hypothetical reasoning.

5. Studies regarding the relationship between locale and hypothetical reasoning.

All the above stated categories are discussed under the following sub-headings:
a) Studies Conducted Abroad.

b) Studies Conducted in India.

What follows is the description of these studies indicating the problem investigated, the main objectives taken and the major findings.

1. **Studies Regarding the Relationship Between Divergent Thinking and Hypothetical Reasoning.**

   Jain (1982) and Kusum Dubey (1997) in India attempted to study the relationship between divergent thinking and hypothetical reasoning.

   Jain (1982) studied problem solving behaviour among adolescent pupils in relation to intelligence, creativity and reasoning patterns based on problems in physics as outside variables. Using factor analytic technique, three factors namely General Schematic learning, creativity and academic achievement in science were obtained.

   Kusum Dubey (1997) in her study of problem solving ability with creativity and achievement in science reported the following results: (i) Significant difference of means of scores with respect to scores of the variables of creativity especially originality. (ii) Significant difference of means with respect to creative performance between good and poor problem solvers. (iii) Problem solving ability is found to be highly correlated with creative ability (Product moment = .54). (iv) Creative performance insignificantly but positively correlated with
achievement in science subjects (r = .18). (v) Problem solving insignificantly correlated with achievement in science subjects r = .06) though positive.

Ashok Kumar Pandey (1992) in his study "Divergent thinking in Relation to Scholastic Achievement, Cognitive Style, Self Concept and Interest Pattern" reported significant correlation between cognitive style and different dimensions of creativity. It shows that learners with more complex and analytic cognitive structure shows greater ability of divergent thinking.

2. Studies regarding the relationship between Intelligence and hypothetical reasoning.


(A) Studies Conducted Abroad

Case, R.D. and Collinson, J.M. (1962) in a study of the development of formal thinking in verbal comprehension reported that children of matching CA and MA had different scores on formal thought. Hence, some other factors such as
cultural background, range of experience and verbal repertoire may be contributing to the development of formal thought.

Clayton, V. and Overton, W.F. (1976) in the study of concrete and formal thought processes in young adulthood and old age reported that except for the young sample, the operational tasks were found to be unrelated to fluid intelligence.

Cloutier, R. and Goldschmid, M.L. (1976) reported in their study of individual differences in the development of formal reasoning significant correlation between scores on the proportion list and non-verbal intellectual capacity as measured by Raven's SPM.

Khun, D (1976) in the study of the relations of two Piaget's stage of concrete operations. However, the correlation is non-significant between mental age and progression towards Piaget's stage of formal-operations.

Stephen's, W.B. et al. (1969) in the study of the development of reasoning, moral judgement and moral conduct in Retardates and Normals reported significant correlation of intelligence with Piagetian tasks of reasoning and formal operations have been reported for subjects 16 to 18 years.

Valentine, E.R. (1975) conducted a study on performance on two reasoning tests in relation to Intelligence, divergence and interference proneness. The results show that convergent intelligence is a necessary but not a sufficient condition for success on the tasks.
(B) Studies Conducted in India

Vaidya, N. (1964) investigated problem solving in science among certain groups of adolescent pupils (15+) and found that a given problem is solved over a wide IQ range. Furthermore, there is a general tendency among adolescent pupils to set up hypotheses that they test against the given data.

Vaidya (1979) studied, The Growth of Logical: Thinking in Science During Adolescence, on a sample of 100 boys and 100 girls studying in grade VI to X matched on intelligence and socio-economic status and found that average performance increases with age and a given problem is solved successfully (or failed) over a wide I.Q range both within and across the grades. Moreover, adolescent pupils are able to set up hypotheses but they are not in a position, contrary to Piaget, to test them. This shows their minds have not become experimental yet.

Raizada (1979) in her study of relationship between problem solving ability and some relative personality, traits using Piagetian Tasks found significant correlation between the grades and scores on all tasks except those relating to classification and grouping of thought. Furthermore, intelligence correlated significantly with all types of Piagetian Tasks.

Sandhu (1980) in has doctoral study on the "Factorial Study of Adolescent Thought" investigated the thinking processes of adolescents in the rural areas of Punjab state. Ten Piaget type tasks related to different schemes of thought along
with 24 other variables such as achievement, adjustment, etc. were used for collection of data.

The results indicate (i) the performance of adolescents on Piaget type tasks increased with age and grades; (ii) intelligence and academic achievement were having significant positive relationship with adolescent thought; (iii) eight factors were extracted using factor analysis technique named as General Intelligence Factor, Academic Achievement Factor, Adjustment Factor, Temperamental Factor; Group Factor of Adolescent Thought, Behavioural Factor, Emotional Factors and Social Factors.

Padmini (1982) studied the growth of exclusion of variables during adolescence on 200 boys and girls in relation to other variables such as intelligence, personality, aptitude. Twelve Piaget type tasks (written in questionnaire form) were used to investigate stating and testing of hypotheses ability of adolescents. She found that (i) Many adolescents were still found to operate at the concrete level; (ii) adolescent pupils were in a position to state the hypotheses but not test them experimentally; (iii) age, aptitude, permutation and combination were significantly correlated with all measures of exclusion of variables; (iv) eight factors namely testing of hypotheses factor, stating of hypotheses factor, permutation and combination factor etc. were extracted using factor analysis technique.

Jain (1982) investigated problem solving behaviour in Physics among adolescent pupils. Four Piagetian task (metal
cylinder task and bending of rods tasks, pendulum task and equilibrium in the balance task) were administered to 180 students (B=G=90) of class XI in the age group of 14+ to 16+ years. Intelligence, Creativity and reasoning pattern based on problems in Physics were used as outside variables. He reported (i) Problem solving ability differed significantly among pupils operating at three levels of intellectual development; (ii) Performance 'hints' were provided; (iii) No sex difference was noticed in the problem solving abilities; (iv) Three factors namely General Schematic learning, Creativity and Academic achievement in science were obtained using factor analysis technique.

Mathur (1983) in a study of logical thinking among certain groups of Adolescents on a sample of 160 pupils studying in grades VI to X ranging in between 11+ to 15+ respectively. She found increase in the performance of Piaget type tasks and I.Q. with grade.

Jain (1984) investigated Piagetian logical thought among adolescent pupils using a group test. The sample of her study consisted of 980 students (490 boys and 490 girls) studying in grade VI to XI and were in the age range of 11+ and 16+. A battery of sixteen Piaget type tasks in questionnaire form related to eight schemes of thought was used as principal test instrument. Intelligence, Personality and language usage formed outside variables. She found (i) Majority of adolescents were not in a positions to reason formally; (ii) Adolescent pupils
were not in a position to test hypotheses, conserve volume, solve proportionality and probability problems; (iii) The performance on tasks showed an increasing trend with age; (iv) Intelligence and linguistic abilities correlated significantly with adolescent thought; (v) Six factors namely combinatorial reasoning, Grasping the essence of a problem, Classificatory reasoning and using a constant difference etc. were extracted through factor analysis.

Sadhna (1984) in a study of adolescent thought, observed the increase in the performance on Piaget type tasks with age in adolescent pupils and found significant intercorrelations between all seven schemes of thought of adolescent. Two significant factors were extracted, namely: stating of hypotheses and I.Q. in her study.

Mishra, R.M. (1986) conducted a study entitled, “A Study of the Role of Hypotheses in Problem-solving in Relation to Personality Traits, Intelligence and Socio-economic Status of 11+ School going Children”. The major objectives of the investigation were: (i) to study the role of hypotheses formation in solving problems involving a continuous chain of reasoning, (ii) to study the problem-solving process in relation to intelligence, personality, socio-economic status, and (iii) to determine the relationship between scores on hypotheses formation and variables: sex and types of school.

The present normative survey study was conducted in the Lucknow region and was confined to public and non-public
schools situated in urban and rural areas. The sample, consisting of 756 school-going students of both the sexes, was randomly selected from the 11+ age group. The tool used for collecting data were: an adaptation of Cattell’s H.S.P.Q., Standard Progressive Matrices (Raven), SES Scales (Kulshrestha), and Quality Scale (Quinn). Besides, a Hypothesis Test Questionnaire covering eight problems such as combinational grouping, numeral, missing number, framing questions grasping the essence of a problem, stating of hypotheses, testing of hypotheses and visualizing was developed on the pattern of Piaget’s work. The split-half reliability of the questionnaire was 0.63. The data collected were treated using mean, SD, correlation, t-test and factor analysis.

The major findings of the study were: (a) all boys had sure creative signs of insight, irrespective of place and school, and (b) intelligence and socio-economic status helped in reducing errors among pupils.

Dutt, Sunil. (1989) conducted a study entitled, “The Effect of Problem Solving Strategies on the Problem Solving Ability In Science of High School Students in Relation to Anxiety Level and Intelligence”. The main findings were: (1) Intelligence is found to be highly correlated to problem solving, (2) Anxiety has no contribution.
3. Studies Regarding the Relationship Between School Climate and Hypothetical Reasoning.

There is a dearth of studies focusing on the effect of school climate on the development of reasoning patterns in the students of senior-secondary schools. Although it has been observed that schools markedly vary in their psycho-social characteristics, the knowledge of relevance between the two variables is of vital importance from sociological, psychological and educational point of view.

The investigator could trace only the study of Somerville, S.C. (1974); abroad and Misra, R.M. (1986); Agarwal, V.P. (1987) in India who attempted to study the effects of various types of schools attended. The findings of their study are given below:


Mishra, R.M. (1986) conducted a study entitled, “A Study of the Role of Hypotheses in Problem-solving in Relation to Personality Traits, Intelligence and Socio-economic Status of 11+ School going Children” reported that (a) there were no significant differences in the performances of the pupils on the combinatorial grouping problem, irrespective of school.

reported that different types of schools do differ in their impact.

4. Studies Regarding the Relationship Between Sex Difference and Hypothetical Reasoning


Somerville, S.C. (1974) in his study "The Pendulum Problem: Pattern of Performance, Defining Developmental Stages" found that over all level of performance on the pendulum problem is not related to sex.

Sandhu (1980) in his doctoral study on the "Factorial Study of Adolescent Thought" investigated the thinking processes of adolescents in the rural areas of Punjab state. Ten Piaget type tasks related to different schemes of thought along with 24 others variables such as achievement, adjustment etc. were used for collection of data. The results indicated that the performance of boys on some tasks were better than girls.

Jain (1982) investigated problem solving behaviour in physics among adolescent pupils. Four Piagetian tasks (metal cylinder task and bending of rods tasks, pendulum task and equilibrium in the balance task) were administered to 180 students (B = G = 90) of class XI in the age group of 14+ to 16+ years. Intelligence, Creativity and reasoning pattern based on
problems in Physics were used as outside variables. No sex difference was noticed in the problem solving abilities.

Mathur (1983) in a study of logical thinking among certain groups of Adolescents on a sample of 160 pupils studying in grades VI to X ranging in between $11^+$ to $15^+$ respectively. No significant sex difference was observed except in X grade on thinking process.

Sahu (1985) investigated factorial structure of formal reasoning among adolescent pupils and extracted five factors using factor analysis technique. These factors were: proportional reasoning, using prediction, classification reasoning, probability reasoning and using a constant difference. He also found that formal reasoning favoured boys than girls.

Mishra, R.M. (1986) conducted a study entitled, “A Study of the Role of Hypotheses in Problem-solving in Relation to Personality Traits, Intelligence and Socio-economic Status of $11^+$ School going Children” reported that there were no significant differences in the performances of the pupils on the combinatorial grouping problem, irrespective of sex.


Kusum (1997) in her study of problem solving ability in relation to creativity and achievement in science reported that girls have superior problems solving ability than boys.
5. Studies Regarding the Relationship Between Locale Hypothetical Reasoning.


Wozny, C.D. (1974) studied the effects of culture and educations on the acquisition of formal operational thinking. It has been found that a sub-urban culture background promoters the development of formal operations.

Waite, J.B. (1975) conducted a study comparing college science students performance on Piagetions type tasks, including cross-cultural compassions. No significant differences were found between cultural background and overall performance on Piaget type tasks among college science students.

Mishra, R.M. (1986) conducted a study entitled, “A Study of the Role of Hypotheses in Problem-solving in Relation to Personality Traits, Intelligence and Socio-economic Status of 11+ School going Children” reported that there were no significant differences in the performances of the pupils on the combinatorial grouping problem, irrespective of place.

Suri, I.S. (1989) in his study, “An Investigations into the Structure of Reasoning Ability of 15 Years Old Students Belonging to Rural and Urban Areas”, studied the reasoning ability of rural and urban students.
Factor analysis of data yielded cognition of semantic classes, cognition of semantic relations and convergent production of semantic implications as three major factors accounting for the reasoning ability of rural children. For the urban group, on the other hand, convergent production of semantic classes emerged as the only factor to account for students' reasoning ability.

Summary of the Findings of Studies Related to Formal Thought

From the above cited literature having diverse aims and objectives and diversity of tests, tools and techniques used, the following key statements emerge:

1. Majority of adolescent students lack the formal operational stage.
3. Performance on Piaget type tasks points corresponds to chronological age and grade.
4. A high inter-correlation between written Piaget type tasks and Piagetian Tasks exists.
5. The adolescent pupils are found to be in a position to state hypotheses but they are not able to test them experimentally.
6. Formal operational stage correlates significantly with intelligence, age and grade.
7 Formal operational stage does not show any correlation with sex.

8 Beyond 16+ years, a fifth stage called problem finding stage is quite possible.

9 The main components of formal reasoning (thought) are: combinational reasoning, Proportional reasoning, correlation and probability reasoning and controlling of variables.

10 Significant correlation exists between creativity and formal thought.

Most of the research conducted on Piaget's theory outside Geneva deals with cognitive contents belonging to the concrete operational stage. Journals that publish research on the psychological development of children receive more papers on the concrete operational stage than on any other subject (Brainer, 1978). There is a dearth of research studies on the formal operational thought. In comparison to the number of excellent works published on effective, social and emotional domains of adolescents, little work has appeared in the psychological literature on the formal thought (Inhelder and Piaget, 1958). Very few research studies have tried to find out the relationship of the development of formal thought to the other cognitive, cultural, social and personality traits of the adolescents. Getzels and Jacksons and others (1962) had suggested the elaboration of creative thinking as an important aspect of creative problem solving behaviours. Piaget and
Bruner have insightfully initiated the research in this area. The elaboration of these researches in the area of school-subjects has hardly been done so far. For the qualitative improvement in education the investigators need to pay attention to this aspect of education also.

The present problem is an attempt in this direction. It aims at establishing interrelationship among the variables of problem solving ability, creativity, intelligence and school climate.