CHAPTER 1
INTRODUCTION
Man in his eternal quest for knowledge, truth and power to conquer physical nature has heavily relied upon one tool namely *Thinking*. Professor Irwin Slesnick says: "The world we live in is a marvel of man's mastery over his environment. Through the explosive development of the natural sciences we now predict, control and understand phenomena to an extent never fully envisioned, throughout the millions of years of human development prior to the current century. The scientific revolution has maximized opportunities for human happiness and through its technical arms is providing material wealth and long and healthy lives. New knowledge and the process by which it is obtained, promise a spiritual fulfilment unavailable from the dry bones of fatalism and mysticism." Thinking about *thinking* has been the domain of philosophers traditionally and psychologists have entered the field recently. Now-a-days, a general consensus has reached among the investigators and philosophers that thinking is a much more complicated business than common-sense acquaintance with the term. According to the encyclopedia Britannica:

"...The term thinking itself has many definitions, no one of which is satisfactory to everyone. A useful one for those who attempt to study it scientifically defines thinking as that aspect of human activity that primarily involves processing of information... The operations or processes involved in thinking are many and varied in kind and complexity.... These processes are themselves the results of learning and hence vary from one thinker to another."
Thus, thinking is a multi-dimensional-activity with respect to both processes and products. Thinking is an essentially human activity occurring in two basic forms. We may think in order to attain knowledge of what is, what must or what may be the case i.e. it includes the understanding aspect of our cognition. We may also think with a view to make up our minds about what we will or what we will not do. This relates to decision making aspect of our cognition. Following Aristotle, these two forms of thought may be called contemplation and deliberation respectively. Both forms may be carried on well or badly, successfully or unsuccessfully, intelligently or unintelligently. It may be observed that successful contemplation terminates in a conclusion, whereas successful deliberation terminates in a decision or resolution. The form of reasoning involved in contemplation may be called theoretical, and the form involved in deliberation may be called practical (Aune, 1967).

A survey of the full range of view on thinking that have been influential in the history of philosophy, could reveal that most important theories of thinking have been variants of one or more of the following basic views: Platonism, Aristotelianism, Conceptualism, Imagism, Psychological nominalism, Behaviourism, Ryle’s Approach and Analogy Theory.

Fundamental to the conquest of nature by the scientist has been his method of approach to the unknown. Facts and
understandings bring the scientist to the frontier, but it is scientific methodology that extends the frontier of knowledge. For the student of science—for the citizen who must live in harmony with the times and participate constructively in a scientifically impacted society—information alone does not create literacy. The individual must learn through personalized experience the manner in which new knowledge is won from its natural ore. This very manner or act of knowing which undergoes changes throughout the human life span is implied by the term Cognitive Development.

Cognition is the act of knowing and the analysis of the act and its components has become the core of psychologists' and educators' attempts to understand the mind. Cognition is a troublesome term in psychology, because it has no clear referent. It has been defined so narrowly as to refer only to "awareness" (Guilford, 1967) and so broadly by others as to include all higher mental processes (perception, thinking, attention, language, reasoning, problem solving, creativity, memory and intelligence etc.).

Psychologically speaking, thinking is defined operationally as the establishing of order(s) in the apprehended world. This ordering relates to objects as well as to representations of the world of objects, and the ordering of relations between the representations of the objects. The figurative or pictorial representation (imagery) of what has been perceived makes it possible to order according to equality, similarity or difference. The objects with the same visual, acoustic, haptic or kinesthetic qualities are treated as
belonging together, inequalities lead to separation from the grouping of similar objects. The action of ordering with figurative and pictorial images is called intuitive thinking. Thought is said to be autistic if the ordering of the experienced world takes place according to states conditioned by feeling or motivation. Thought arbitrarily links persons, things or objects coinciding fortuitously with these inner states. If wish-fulfilment tendencies determine the results of thinking, the thought processes are defined as 'primary'. On the other hand, when rational ordering techniques determine the results of thinking, the thought processes are defined as 'secondary'. Magical thinking orders the relations of image, sign or symbol to the object as if objects as well as representations of them were capable of acting like human beings. This way of thinking is frequently found in younger children, uninformed adults and in exceptional existential states.

If the representations, thoughts and their relations being ordered can no longer be expressed in imagery or figuratively, then thinking is non-intuitive, abstract or conceptual. In such thinking activity the task determines the direction that thinking will take. In the further course of socio-historical development it becomes possible to abstract from real actions, to replace them with mental actions, or those described with words (different signs are also used for this purpose). On this foundation the highest abstract and generalised form of thinking arises. Simultaneously, a separation of cognition takes place and
It becomes a special theoretical activity, which nevertheless remains linked to practice as the source and criterion of accuracy, and the place where the results of thinking will be used.

It is only recently that psychologists have tried to find out what happens when we think and what conditions influence our performance by applying the methods of science to this human capacity. Though, they are not fully successful in this venture, yet, they have shown that thinking is a much more complicated affair than common sense acquaintance with it. Psychologically speaking, thinking may be considered as an active purposeful process of cognition—a search for solutions to practical and subsequently to theoretical problems.

In the psychological theory and research, the term *thinking* has acquired a restricted meaning and has become identified with problem solving. Thinking starts when we become confronted with some perplexity or problem. As long as things are going smoothly there is no necessity for thought. Dewey (1916) cites the homely example of a man progressing without difficulty along a road until he comes to a fork in it. The emphasis on thinking as problem solving is very much in agreement with the psychological interpretations of it, and also the theoretical traditions are equally committed to viewing thinking as problem solving. For instance, the psychology of thinking based upon learning theory assumes that the same basic concepts of stimulus, response, discrimination and
generalisation are applicable to problem-solving and that thinking is to be conceived as part of the process by which an organism adapts to its new environment. The greatest merit in this definition is that it relates the process of thinking to the behaviour of men coping with their environment which is what we call experimentation or learning. Thinking, in psychological literature, may be reviewed from the viewpoints of the five major schools of thought: Behaviourism, Gestalt, Functionalism, Psychoanalysis and the Geneva School.

The theories of Jean Piaget (1896-1980) and his Genevan Colleagues are the most mature of the organismic theories of cognitive development, both from the specificity and completeness of the theoretical mechanisms and from the perspective of the richness of the empirical findings the theories have generated. Piaget proposed that knowledge is a process, a repertoire of actions that a person performs.

Piaget was one of the first psychologists to recognize explicitly that humans are born as active, exploratory, information-processing organisms. These ideas have been basic to his theory. He looks upon people's adaptive activities as more fundamental and important than the external stimuli and reinforcements connected with them (Piaget, 1970). For him, cognitive development proceeds from physical actions; activity provides feed back, not just reinforcement. In Piaget's opinion, to know something means to act on that thing, with the action being either physical or mental or both. As children grow up,
they are gradually freed from having to carry out direct physical behaviour in order to know something.

The task of a child's cognitive development needs continuous reorganizations (adaptation) of his cognitive structure so as to maintain harmonious relationship between his self and his environment (equilibration) by bringing changes in the existing cognitive structure either through banking upon his past experiences (assimilation) or learning new way of behaving (accommodation) (Jean Piaget). The techniques of adaptation in Piaget's system are called schemes. A scheme as a technique of adjustment, can be biological or mental or both. The grasping movement of the infant's hand is a scheme, a physical organization of actions that the child can generalize to grasp a bottle, a rattle, or the edge of the crib. On the intellectual level, an adolescent child's concept of a series is also a scheme, a mental organization of actions. He or she can apply it in constructing a series of numbers, or in arranging a series of colours by their shades. Such schemes, both physical and mental are always accompanied by feelings which Piaget called affective schemes (Piaget and Inhelder 1969).

Assimilation occurs when a person encounters a new experience in the environment and interprets this experience as being identical or very similar to a scheme already in his or her repertoire of physical or mental acts. A child meets an animal and concludes that it fits a label he or she already knows, dog. A
student faces a problem in mathematics and concludes that its form is familiar, that of quadratic equation.

Sometimes, however, people do not perceive a good match between an experience with the environment and any of their existing schemes. In such instances, one of two things occurs. Either the person fails to comprehend the experience at all, or else he or she must alter existing schemes to produce some new variant that fits the new experience. This latter process of adding to, refining and elaborating schemes to create new versions is called accommodation.

The appropriate model of equilibration is not the beam balance, but the analytical balance in chemistry. It is a balance of a self-regulated set of simultaneous interactions between the elements of the system in which, so to speak, the swings of balance continually increase in amplitude and power and do not dampen to a prior equilibrium. Piaget often uses the word "equilibrium" to describe both the process and outcome of balanced assimilation and accommodation. However, the term too often has the connotation that the system has returned to a resting state or has eliminated tension. The word "equilibration" stresses the idea that the system is always in some sort of controlled tension. When the balance is disturbed (disequilibration) there is a possibility of advancement to a new level of balanced tension, not necessarily a return to a state of imbalance or a state of rest. One of Piaget's central theses is that
only through the tensions and conflict of imbalance assimilation and accommodation does intellectual growth occurs.

There are two interrelated aspects of equilibration. The first refers to a tendency towards balance in the interaction between the individual and his environment. The second refers to a wholeness or balance within the individual's cognitive structure. The most obvious challenge to an existing balance occurs whenever we are presented with something new and unexpected sensation. Assimilation may not help us to understand and cope; accommodative changes may not have developed. At the moment, our existing cognitive structure is inadequate. The resulting state of heightened disequilibration (manifested in conflict and confusion) could lead to compensatory activity. In such a case, feedback of new information could result in transition to a new stage.

Piaget distinguishes four major stages in cognitive development, as well as numerous sub-stages within the major ones. The four stages are considered qualitatively distinct from one another, even though the transitions between them are admittedly slow and uneven. The breaks in the process of growing up suggested to him that the child had at each such time completed one phase of growth and was not engaged in further phase. So the Piagetian model of cognitive development can be called a stage theory.

There are four main periods or levels of development in Piaget's theory;
Level 1: the sensory-motor period (birth to age 2 roughly);
Level 2: the preoperational thought period (about age 2 to 7);
Level 3: the concrete operational period (about age 7 to 11); and
Level 4: the formal-operational period (about age 11 to 15).

The first stage or level is composed of six sub-stages which mark the infant's progress from only performing reflex actions in complete idealism (no dissociation of the self from the objects and from others especially the mother). The effects of such a dissociation are: perceptions of the effects of the infant's own actions upon objects, anticipations of the actions of people and objects and, at the very end of this period, the beginning of a mental representation of things and thoughts, which existed only in actions so far and thereby cognitively combining and manipulating them.

The second level or period has been divided into two levels. The first, from about 2 to 4 years of age, is characterized by both egocentric speech and primary dependence on perception in problem solving. Egocentric speech is the running oral commentary young children carry on to accompany what they are currently doing, and it is not intended as a vehicle of communication with others. The child's heavy dependence on perception means that in problem-solving he or she draws conclusion from what can be directly seen or heard rather than from what he or she might recall about the permanent characteristics of objects and events.
The level of intuitive thought is reached between ages 5 and 7. It is a transition phase between the child's depending solely on perception and depending on logical thought in problem solving. While in earlier years children's thinking suffered from centering (focusing exclusively on one dimension of a situation), during the intuitive period they begin to recognize that more than one factor at a time influences an event in a coordinated manner. A short wide glass holds as much liquid as a tall thin glass, because the short glass' greater width compensates for its lack of height. This increasing coordination leads to the next level, that of concrete operations.

The term "operation" in Piaget's system means manipulating objects in relation to each other. In order to qualify as operations, actions must be internalizable, reversible and coordinated into systems that have laws that apply to the entire system and not just to the single action itself. "Interiorization" means the eventual dissociation between the general form of a coordination and the particular content of an external action. Interiorization leads from "practical" (sensory motor) to operational intelligence and is the precondition for objective knowledge as well as for symbolic representation, by opposition to "internalization" which is the eventual diminution of external movements that become covert and sketchy, illustrated in imitation and language. "Reversibility" is the possibility of performing a given action in a reversed direction. It's two chief forms are negation (not male = female) and reciprocity (not better = worse) (Piaget, 1972 p.8).
In the third concrete-operational period, children become capable of performing true operations, ones directly related to objects. Concrete does not mean the child must see or touch the actual objects as he or she works through a problem, but rather that the problem involves identifiable objects that are either directly perceived or imagined.

It is during these years that children's understanding of conservation matures. The term conservation refers to those aspects or events that remain constant when other changes are produced in objects or situations when a ball of clay is rolled into a sausage shape, the form has been altered but the substance, weight, and mass have been conserved. Distinguishing between what has been changed and what has been conserved during transformations marks a major advance in children's reasoning skills during this stage. This system of regulations (conservation) is made out of three main groupings: classification, seriation, and number.

By the end of the period of concrete operations, children have markedly increased their abilities to account for the course of physical events so that they are now ready to solve not only problems that involve real objects but also ones concerning hypotheses and proportions about relationship. The adolescent can now imagine the conditions of a problem-past, present or future and devise hypotheses about what might logically occur under different combinations of factors. For example, if a child younger than age 12 or so is asked to imagine a problem in
which water runs uphill, he or she will typically claim that the problem cannot be solved because water does not run uphill. But by the close of the formal operational period the adolescent can accept the hypothetical condition of upward flow and can apply it in solving problems that are posed.

This readiness to think in hypothetico-deductive terms is the hallmark of the stage of formal operations. It is typically manifested in propositional thinking and a combinatory system that considers the real as one among other hypothetical possibilities. Formal operations are characteristics of the final stage of operational intelligence which reflects on concrete operations through the elaboration of formal group structures. By the end of this final stage of mental development the youth is capable of all the forms of logic that the adult commands. Then further experience over the years of youth and adulthood fill in the outline with additional, more complex schemes so that the adult's thought is more mature and free of egocentrism than is the adolescent's.

In Piaget's system the process of cognitive development-of generating a growing complex of schemes is governed by four factors: heredity (internal maturation); physical experience with the world of objects (spontaneous or psychological development); social transmission (education or instruction) and equilibrium (Piaget 1973).

Heredity, in Piaget's view, furnishes the newborn with the initial equipment the infant needs for coping with problems met
in the world. Heredity also establishes a time schedule for new development potentials to arise at successive stages of individual's growing years. However, genetically determined internal maturation does not guarantee the materialization of the potential schemes or abilities. Their fruition depends also on the nature of the person's interaction with the environment.

Unlike many theorists, Piaget separated the child's involvement with the environment into two varieties: direct and generally unguided experience (physical experience or spontaneous development); the second factor, and the guided transmission of knowledge broadly known as education or instruction; the third factor. He, however, contended that the first of these varieties must precede the second.

The fourth factor determining development called equilibrium is a coordinating force, performing the regulation and compensation among the other three factors that are needed to make the entire system of development a coherent whole.

In the light of the above stated factors we can trace the significance of the environment of home and school contributing immensely to the flowering of the innate capacity of the child to make sense of the world on their own.

The need for exploring the environment and the curiosity of knowing the unknown are the psychological needs of children (Maslow, 1954). It is the capacity of human beings to think that comes to his aid; the motive for thinking being the reduction of tension or conflicts with which one is confronted
in order to attain the organism's natural state of equilibrium. It is in this interaction between the structured characteristics of the environment and the active imposition of order by the child, according to Piaget arises the organization of knowledge.

In this interaction, one factor can never be evaluated without knowing the others. It is not possible to account for a particular cognitive organization without specifying particular environmental conditions. And it is not possible to assess the impact of any environmental event without knowing something about the child's intellectual organization. Intelligence, metaphorically, acts as a generator which transforms raw input into usable power.

For factor analysts like Guilford (1950), the aspect of intellect represented by the I.Q metric is only one of the numerous factors, and not necessarily even the most important one. He segregated the factors of intellect, distinguishing especially between convergent and divergent thinking. Convergent thinking is the generation of new information maximally dependent on known information as in most intelligence test problems where the only acceptable solution is a single already-known solution. Divergent thinking is the generation of new information minimally dependent on known information, and the acceptable response to a given problem may be a variety of emergent solutions characterized by fluency, flexibility, originality and elaboration which are said to be principal components of creativity. These components of the
"many splendoured thing" (Guilford, 1959) constitute the 'potential', which may unfold in a suitable climate providing which in case of students is the responsibility of the formal agency of education i.e. the school.

Veck (1986) and Focaoru (1985) pointed out that effective creative behaviour requires more than divergent thinking, motivation, self-confidence and similar personal and effective factors that are very important.

The direction to look for the answer to the other important factor is provided by Stein (1974) who divided the creative process in three stages only. These are: (i) stage of hypothesis formation, (ii) stage of hypothesis testing, (iii) Stage of communicating the results. However, he points out that preparation or education precedes these stages. Stein's conceptualization also highlights Piaget's concept of attainment of hypothetical reasoning as the main feature of the formal operational stage of cognitive development in adolescents.

Getzels and Jacksons et al. (1962) suggested the elaboration of creative thinking as an important aspect of creative problem solving behaviour.

....Presumably school is where creative talent should be recognized and nurtured. Yet in practice, educational institutions at all levels may so focus on academic performance to the exclusion of all else that they not only obscure potential creative talent but act as an incubus to its expression (Getzels, 1979).
Schools can play an important role in inculcating students a creative attitude, which is a kind of belief that human ingenuity can find a solution to all problems and these solutions can be more or less satisfactory.

But education or schooling is probably mistakenly concerned with the acquisition of information and skills (3Rs) and the educators hold a static and stereotyped view of intelligence (in terms of I.Q. Scores). The usual conception of intelligence is that which intelligence tests test (J.P Guilford, 1950). But we are reminded in the first few pages of the Newton Report that intellectual talent is not a fixed quantity with which we have to work but a variable that can be modified by social policy and educational approaches. The results of investigations increasingly indicate that the kind of intelligence which is measured by intelligence test is largely an acquired characteristic. This is however, not to deny the existence of a basic genetic endowment; but other factors can be identified. Particularly significant among them are the influences of social and physical environment; and since they are susceptible to modification, they may well prove educationally more important. (Newton Report, 1963, p.6).

Sociologists also have increasingly laid emphasis on the significant relationship between the social context in which education is experienced by pupils and their achievement in school, the length of their school life and their access to different kinds of education. The environment from
sociologists' point of view not only involves the physical environments of home, neighbourhood and school but also the attitudes and values of the adults and children who live in them.

On the basis of the sociological consideration, the social environment of education falls into 3 inter-related categories, namely (i) the social environment of the individual pupil (ii) the internal social environment of the school and (iii) the external social environment of the school.

Here, in this study, the focus is on the social relationship and the organization of the school, involving examination of the roles and the values of head teachers, teachers and pupils. The recognition of the link between school-structure and educational achievement is, of course, long standing. It is implicit in most appraisals, favourable or critical, of the school. What is new is the more precise analysis of the social relationships and the structure of schools and their consequences, now being initiated by sociologists. Such study may be fruitful for example, in explaining why two schools matched in all external factors produce strikingly different responses in pupils.

From a survey of research on modernization, Werner (1979 p. 289) noted that "Education was found to be the most powerful factor in determining the degree of modernization in the attitudes, values and behaviour, of the groups studied".

While the culture of the school exerts some influence on both physical and social characteristics of the learners, it is in
the realm of psychological development that the school makes its greatest impact. There is little serious challenge to the contention that schooling strongly affects the learner's cognitive structures. Few traditional societies are consciously concerned with fostering cognitive abilities, that is, of consciously devising methods for forming people's thought-processes. In contrast to the task-oriented instruction imparted in traditional societies, the learning system in industrial societies stresses such constructs as classifications, rule-seeking, problem-solving, concept-formation. In other words, the school emphasizes the development of power of abstraction, that is, the ability to carry on mental processes in a relatively context free mode.

Questions about the impact of schooling on development are intertwined with the questions Berry and Daren (1974 pp 11-12) have identified as the major themes in research on culture and cognition.

..."Firstly, are there qualitative differences in cognitive processes among different cultural groups or are the processes identical (or almost so) throughout the species, with the apparent differences attributable to the different cultural materials entering into the processes?... Secondly, are there quantitative differences in cognitive processes among cultural groups?... Thirdly, are the characteristics of growth in cognitive operations (both qualitative and quantitative) similar in all cultural groups?"

In summary, the role of schools in affecting individual's development is complex. It is extraordinarily difficult to sort
out the interrelationships among such factors as economic conditions, ethnicity, degree of urbanization and schooling.

The unexpected observation by Getzels and Jackson (1962) that despite a 23-point difference in I.Q, their high-creativity and high I.Q groups performed equally well on standard measures of achievement gave rise to a number of studies with similar and discrepant results. Explanations for the diversity of results called attention to the possible effects of relative rigidity and permissiveness in learning conditions of the school, and of the systematic interactions between convergent and divergent teachers and convergent and divergent pupils.

Reports on inequalities of family-background and education by J.S. Coleman and by C.Jencks in the United States concluded that differences in quality or type of schooling made little difference in achievement. However, M.J. Rutter in England claimed that performance on objective achievement tests is too narrow a criterion of effective schooling. He found significant differences at grade 9 between 10 secondary schools on a variety of outcomes, including conventional written examinations, delinquency rates, and behaviour at school, even when holding constant the ability level of the students entering each school. Some of the influential school characteristics were size and age of school, academic emphasis in the instruction, differences between teachers and especially the overall climate of the school and student teacher relation-ship (Rutter et al 1979).
J.W. Getzels (1979) in his discussion of educational issues concerning creativity has posed the following question:

...Although such broad categories as convergent and divergent thinking do not exhaust the possibilities, they do suggest the possible existence of different styles of both learning and teaching, the one style focusing rather more on the acquisition of skills and established knowledge, the other on the cultivation of imagination and creativity. What is the effect of the interaction of those different styles among students and teachers?

The interaction effect of convergent thinking and divergent thinking among students can best be studied while keeping in consideration the type of school-climate available to the child. But the investigator could not trace any study attempting to test the interaction effect of intelligence, divergent thinking and school-climate on hypothetical reasoning; the development of which forms the basis of the formal thought attained during adolescence. Attainment of hypothetical reasoning is very important for the cognitive functioning of an individual throughout his life, and also it is most crucial from the educational point of view. So the present investigator visualized a need to conduct an empirical study to find out how the ability to hypothesize is developed in Indian situation under the influence of extrinsic variable of school-climate and intrinsic variables like one's capacity to think divergently and
convergently, both. Therefore, the investigator delineates the present problem more clearly as under:

**STATEMENT OF THE PROBLEM**

*A Study of the Development of Hypothetical Reasoning in Relation to Divergent Thinking, Intelligence and School-Climate.*