CHAPTER I

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1.1 CONTEXT, NEED AND IMPORTANCE

1.1.1 The Concept and Purpose of Education

One of the basic principles of democratic living is the optimum - if not the maximum - development of all persons as fully functioning individuals in society. According to John Dewey:

Education is the process of living through a continuous reconstruction of experiences. It is the development of all those capacities in the individual which will enable him to control his environment and fulfill his possibilities. (B.119, p.6.)*

There is little disagreement on the purpose of education in a democracy as helping, guiding and facilitating such development as will enable each individual to become the most effective person he is potentially capable of becoming for his own success, wellbeing and happiness as well as the welfare and progress of society.

* References are indicated by giving within brackets the bibliography number concerned, followed by the page number(s).
Piaget's views on educational objectives in modern society are probably shared by most educators today:

The principal goal of education is to create men who are capable of doing new things, not simply of repeating what other generations have done—men who are creative, inventive, and discoverers. The second goal of education is to form minds which can be critical, can verify, and not accept everything they are offered. (B.114, p.5.)

By giving children opportunities for learning, both spontaneous and structured, in an active, loving, secure, encouraging and promotive climate, a good system of education should contribute to the physical, social, emotional, and moral development of the children apart from their cognitive development. In other words, the overall purpose of education— in its broadest sense—is the wholesome, harmonious and maximal development of the individual in all dimensions of his personality.

The school as the most significant and comprehensive formal agency of education is expected to provide the child with all kinds of experiences he needs in order to develop and sharpen capacities, master his developmental tasks adequately and derive satisfaction of his personality needs. While there is considerable possibility of fostering development of dimensions other than the cognitive through various other agencies of education, the main responsibility for fostering cognitive development in children rests with
the school, the most important formal agency of education, and that is why cognitive learning is predominant in the school system. Ada Schermann has clearly pointed out the importance of cognitive goals in school as follows:

Today society is looking to the educational system to attempt to raise the level of each child's cognitive ability. Individual needs must be taken into account; it is not sufficient to provide children with equal opportunities ... Routines are important, but so is departure from routine, for these moments of divergence are when we exercise cognitive skills. The role of the school is to provide the opportunity for the child to exercise the skills he brings with him to school, and to foster those which he lacks. (B.120(a), p. 275.)

The task of the primary school, then, should essentially be to capitalize on and consolidate the development that has already taken place during the pre-school period, make up for its deficiencies and defects, keep up - if not increase - the momentum of such development, and with all this, lay a foundation from which the child can take off to greater and greater heights.

At least some educationists who have critically examined the present school system have pointed out that the primary school programme, especially that of the first two years, with its over emphasis on the mechanical skills of the three R's - the way they are taught, if not the way they can and should be taught - tends to arrest, even curb the natural process of cognitive development in children.
At any rate, this could slow down the pace of such growth, whereas the purpose, the possibility and the promise are that it can and should be promoted through a carefully designed programme in the special environment of the school.

Educational surveys in different areas of India have consistently shown that the incidence of dropping out from school is highest in standard I and that on an average the daily attendance in this class is the lowest compared to that in the other classes.

The Kothari Education Commission (B.82, pp. 151-9) stressed the gravity of the problem of wastage - highest in Class-I, followed by the rest of the primary stage - and identified 'unsuitable curricula' in the existing educational system as one of the five - perhaps the most important - causes hindering progress. The inability of the teachers to use play-way techniques which can help in initiating the children pleasantly into school life was identified as another.

Mireille de Meuron has also commented:

Our present way of teaching largely verbally from first standard upward, does not allow a child who is still pre-operational, to learn through action on objects. The overwhelming use of symbols and deductive processes in teaching does not allow the young child, still thinking pre-logically, to explore mentally the
situation taught. According to his abilities and motivation, he will therefore either learn by rote or lose interest and misbehave. (B.94, p. 240)

If this is so, a thorough searching examination of the effectiveness of a programme providing in a purposefully selected and systematically organized way experiences suitable for fostering cognitive development and thereby revitalising the existing curriculum of Standard I (to begin with), improving its content and complexion, adding to its attractiveness and development potential, reducing wastage, and raising its overall quality is not only desirable but necessary.

1.1.2 Cognitive Development - the Concept and its importance

The term 'cognition' or 'cognitive development' is a highly generic term covering almost every aspect of behaviour. Dictionary of Psychological Terms by English (1934) gives the following definition. "Cognition - a generic term for any process whereby an organism becomes aware of or obtains knowledge of an object". Brunswick, E. (1957) suggests that cognition is the process of acquisition of knowledge. Bloom, (1956) in an attempt to classify educational goals states: "Cognitive domain ... includes those objectives which deal with the recall or recognition of knowledge and the development of intellectual abilities and skills".
As Bruner aptly points out,

Unquestionably, the most impressive figure in the field of cognitive development today is Jean Piaget. His principal mission is epistemological. He is deeply concerned with knowledge per se, knowledge as it exists at different points in the development of the child. (B.20, p. 7.)

Piaget styles himself as a genetic epistemologist. According to his theory of cognitive development (largely descriptive in nature) evolved through his unique 'clinical method', there are clearly demarcated sequential stages in the cognitive development in an individual: sensory motor, pre-operational, concrete operational and formal operational stages, with clear qualitative changes or differences. Many competent studies have confirmed and validated this theory and indicated that the sequence is invariant - and irreversible - though the ages of onset and spread vary with circumstances.

Thus the structure of knowledge in an individual can be described in terms of its organized contents and operational capabilities at each stage of development. The implicit logical mode in which the child proceeds in dealing with cognitive tasks makes it possible to determine the way new information is processed. Information which comes in but is not represented adequately in the concepts and logic
already in use - in other words, the existing structure - forces whoever is receiving it to examine and perhaps modify his internal structures. This is the process of 'assimilation' and 'accommodation' through which 'adaptation' to new situations is made and continuous 'equilibration' is attained resulting in further cognitive development.

The three most important concepts that Piaget uses to explain cognitive development are cognitive structure, cognitive function and cognitive content. The total cognitive structure which is an integrated whole consists of several isolable structures that undergo both quantitative and qualitative changes during development. In fact, cognitive development is synonymous with changes in cognitive structure. The major cognitive functions are organization and adaptation, the former making for integration, and the latter comprising of two principles, assimilation and accommodation. Lastly, the cognitive contents refer to the internal representations of the environment and the behaviours of the individual.

The recognition of the invariant and sequential nature of cognitive development with contents and structure, and qualitative changes in processes as well as capabilities marks a clear difference between the traditional concept of intellectual functioning and cognitive development, though they are not mutually exclusive. Intelligence has a two fold
connotation. One of its usages refers to intellectual capacity as an innate power, and as a measure of individual differences; and the second to the acquisition and application of knowledge. It is the latter usage emphasising the qualitative and functional aspects of intelligence that is predominant in Piaget's theory as he does not accept intelligence as a pure 'measurement construct', that makes it quantitative. Jerome S. Bruner toes Piaget's line of thinking in his elucidation of intellectual growth as being characterised by

... increasing independence of response from the immediate nature of the stimulus, internalizing events into a storage system that corresponds to the environment and an increasing capacity to deal with several alternatives simultaneously, among other things. (B. 20, pp. 5-6.)

Thus cognitive development is the development of ways and capabilities of understanding one's world, representing it and dealing with it; it is therefore at the very core of one's functioning as a person.

1.2 PIAGET'S THEORY AND ITS IMPLICATIONS FOR EDUCATION

1.2.1 Piaget's Theory of Cognitive Development

Piaget's theory of cognitive development has evolved through decades of patient and purposeful research. Piaget
undertook the study of the development of knowledge in the individual through his life space as an important method for investigating the more extensive issue of the development of our epistemological system. He argues that the three processes - the adaptation of the organism to its environment during growth, the development of intelligence in the course of the construction of its own structures, and the establishment of cognitive relations - involve sets of cognitive structures constructed and continuously reconstructed in interaction between the subject and the external world. One of the central assumptions of the theory is that in order to know something one must act upon it and therefore transform it and related to this, that structures are the result of such construction. In his own words:

The living organism is not a mirror image of the properties of its environment. It evolves a structure which is constructed step by step, in the course of epigenesis ... (B. 104, p. 105.)

Piaget makes a clear distinction between two types of knowledge - operative and figurative. The operative knowledge refers to those activities that transform reality (knowledge-as-assimilation) whereas the figurative only attempts to represent reality as it appears (knowledge-as-copy). For Piaget's theoretical system the distinction between these two aspects of knowledge is crucial and both
these aspects are involved in cognition. Operative function serves in the structuring of the figurative aspects and to Piaget, knowledge is not a passive copy of external reality, but transcends and transforms it.

The distinction between figurative and operative aspects of knowledge is closely linked with that of empirical abstraction and reflexive abstraction, the emphasis on which is found threaded through recent volumes by Piaget that expand on the meaning of 'equilibration'. Whereas empirical abstraction is based on what is observed (information gathered from exogenous or external source), reflexive abstraction is based on what is related, coordinated or integrated in available information. Reflexive abstraction is actually another term for 'logico-mathematical knowing' which is, of necessity, constructive and endogenous (intrinsic) (B. 55, p. 8.) Piaget explains: "Reflexive abstraction does not 'replace' empirical abstraction, but frames it from the start and then goes infinitely beyond it". (B. 55, p. 8.)

Thus cognitive development is a dynamic process, influenced by both environment and maturation. Though the process of development explained in terms of several concepts, principles and mechanisms that Piaget identified (more important to some like Rheta Devries, 1978), it is described
in terms of an invariant sequence of qualitatively different stages with each stage necessary for launching oneself into the next.

(i) **Sensory-motor stage (0 to 2 years)**

This occupies approximately a period from birth to the appearance of language and is marked by sensory-motor structuring of the child's immediate spatial surroundings originating from reflexive mechanisms, leading to a system of movements and of displacements, and reflecting sensory-motor schemes of gradually increasing complexity.

(ii) **Pre-operational stage (from 2 to 7 years)**

(a) **Pre-conceptual period (2 to 4 years):**

The advance of symbolic function - the ability to represent something such as an object, event or conceptual schema by what Piaget refers to as a 'signifier' (can be language, a mental image or a symbolic gesture) - is evident during this period. The child reasons out transductively - from particular to particular - without any apparent logical connection. Transductive reasoning prevents the child from forming true logical concepts because he cannot cope with general classes. 'Pre-concepts', to quote Piaget - "are schemas which remain between the generality of the concept
and the individuality of elements composing them without arriving either at one or the other". (B. 92, p. 10)

(b) **The Intuitive stage (4 to 7 years)**

The extension of thought processes from the pre-conceptual period can be noticed as the rigid, static and irreversible structures of pre-operational thought organization begin to 'thaw out' and become more flexible, mobile, and above all, 'decentred' and reversible in their operation. The child of this transitional phase, having first 'centred' on a single, distorting facet of a display, gradually becomes able to decentre and take account of other correcting aspects. But the decentring process is only semireversible at first; later, through gradual regulation of his schemas the development of conservation will be attained - showing signs of attaining the stage of concrete operations. The concept of conservation is central to Piaget's theory, it is the ability of an individual to be aware of the invariant aspects or properties of objects in the face of transformation. Three sub-stages identified in this stage by Piaget are non-conservation, transitionary conservation and complete conservation, and these are applicable to a number of concepts - number, quantity, length, area, distance, etc. Logical operations such as the ability to arrange items along a continuity of increasing values (seriation), organize
objects into a hierarchy of classes (classification), return to the original point in thought (reversibility) are gradually acquired in this stage through assimilation - accommodation processes, modifying the previously formed structures. Intuitive thinking too emerges. Consequently the child develops an increasing ability to deal with concepts such as space, time, quantity and number. In effect, mental operations would be integrated into a cognitive system.

(iii) **Concrete-operational stage** (*7/8 to 11/12 years*)

The clearest indication that a child has reached the concrete level of reasoning is the presence of conservation. At the base of conservation is what Piaget calls the logical structure of 'groupings'. The five conditions of grouping which form a logico-mathematical scheme are identity, reversibility (as negation and as reciprocity), closure, associativity and iteration.

It takes sometime before these elementary logico-mathematical thought structures are brought to bear on all possible concrete contents. The principle of conservation is applied to the quantity of matter earlier than to weight, and to volume still later (horizontal decalage, as Piaget calls it). In every case, as earlier schemata are integrated into later ones, they are altered in the process. Inductive
reasoning is the dominant logical mode. The operational structure developed in this stage, in turn, forms the basis for further development of the formal operational level.

(iv) **Formal-operational stage (11/12 years onwards)**

The formal thought structure as compared to the concrete is marked by a higher degree of generalization, abstraction and reversibility. The adolescent's thought is not bound to the concrete here and now. He is capable of forming hypotheses and of deducing possible consequences from them. This hypothetico-deductive level of thought expresses itself in linguistic formulations containing propositions and other logical constructions. Inhelder (1965) maintains that the new operational abilities formed during this stage open up unlimited possibilities for constructive participation in the development of scientific knowledge.

1.2.2 **Implications of Piaget's Theory to Education**

Piaget's theory is relevant and suggestive to education in at least three ways:

(i) The theory provides a developmental perspective to teachers and curriculum builders since it focuses on the domain most relevant to education. Piaget has documented in
great detail the stages of development from infancy to adolescence and it serves as a framework to select and develop appropriate materials, situations and tasks and to order them. The focus should be on systematization of experiences according to the cognitive level of the child—maintenance of order and coherence in providing developmental stimulation being one of the most cogent principles of instruction. The maximum effectiveness of exposure to perceptual attributes and arrangement, incorporation of symbolic manipulation and emphasis on inductive generalization and abstractive construction all depend upon appropriate sequencing. In short, stimulation sequences must be suitably timed and paced.

The second function of stimulus pacing is feedback; it furnishes teachers with a constant psychocognitive assessment of a child’s developmental learning process. (B, 49, p. 518). By using as indices a child’s task mastery and motivation, a teacher has a built-in method of deciding when to proceed to the next phase, when to review certain components. Moreover, this assessment enables teachers to search for, observe, and become aware of ‘learning paralysis’ at a given level. (B, 49, p. 518).

(ii) Piaget has offered a mass of substantive data describing the forms of knowledge and knowledge getting
processes compatible with most educational objectives. This facilitates the essential analysis of subjects in different areas into components of instruction for it is useful to analyze a concept into its constituents with a thorough knowledge of the concept and its development in the first place. Thus, introduction and gradation of concepts with suitable operations, in different subject areas in general and concepts in Science and Mathematics in particular may be guided by Piaget's meaningful findings.

(iii) The theory makes for significant extrapolation of principles and rationale in formulating strategies for teaching. Though Piaget claims to be a genetic epistemologist and is not particularly concerned with education, he is quite clear regarding teaching strategies in his recent books. To quote his words—"Experience is always necessary for intellectual development ... the subject must be active, must transform things and find the structure of his own actions on the objects". (B. 114, p. 4). Related to this is the importance of the social setting in which the child reacts. He feels that the social interactions in a school situation should be an integral element in the process of cognitive growth. Thus development of mental structures from transactional experiences in a social setting rather than the perceptual, and concept acquisition through equilibration
process (inducing cognitive conflict) rather than learning specific responses through reinforcement techniques should pave the way for constructive and critical thinking irrespective of the subject area studied.

Although considerable work has been done on sieving out the theory's educational implications, educators feel that there is a missing link between successful laboratory teaching strategies and their application in the classroom. The latter situation is more complex, less controlled and more variable than laboratory research. More classroom research is needed in between.

Recently Piagetian models have been developed and tried out as bases for pre-school education. The efforts have not yielded uniform contents or teaching strategies but rather have produced varied approaches from the highly structured environments and directive teaching (Hooper) to spontaneous development approach (Kamii). The results also indicate varied degrees of success. Thus the application of Piaget's theory to education raises many problems, no doubt a function of the complexity and comprehensiveness of the theory and the differential acquaintance educators have with it. Hopefully sensitized to the complexity, the teacher can tune in to teaching strategies which help to assess levels of cognitive functioning from children's
behaviours and then enter with appropriate cognitive conflicts to energize the children toward problem solving and acquisition of new cognitive structures.

1.3 TRENDS IN RESEARCH ON COGNITIVE DEVELOPMENT

During the first decades of the twentieth century the development of 'measurement approach' to intelligence paved the way for standardized intelligence tests, mostly on normative approach, initiated by Binet and Simon and later in the United States by Terman, Merrill, Genell and others. However, these standardized intelligence tests failed to contribute much to the understanding of how intelligence develops or functions. Consequently, attention was shifted to theories of cognitive development with a view to understanding the mechanisms of knowledge development and processing. Thus, the resurgence of interest in cognitive processes and cognitive development during the last twenty five years is reflected in the output of theoretical and empirical writings on various facets of this complex process. There is little doubt that the most significant and voluminous contribution has come from the work of Piaget and his associates at the International Centre of Genetic Epistemology, Geneva. No other investigator has produced within a developmental framework as comprehensive and
thorough an exposition of the acquisition of cognitive structures as Piaget. In a prolific output of books and articles, he has concerned himself with the developmental stages in an individual with the primary focus on ontogenetic system. Although some efforts to define stages of intellectual development have been made by Goldstein (1939, 1942), Goldstein and Scheerer (1941), Werner (1948, 1957), Vygotsky (1962) and Werner and Kaplan (1963), Piaget has presented the most detailed step-by-step description of stages of the course of cognitive development. So much research has been geared to Piaget's ideas since 1955, that he can fairly be said to bestride the field of contemporary cognitive studies like a Colossus.

During the early 1960's, scores of studies were undertaken to replicate Piaget's studies as reported by him and his colleagues in a number of volumes. The replication research has generally tended to support the sequence of stages with their characteristics as specified by Piaget.

A second stream of research during the late 1960's reflects a shift towards modification of cognitive growth through training of the subjects, with different experiential variables. Conducting training programmes, particularly in relation to conservation of different concepts became the order of the day. The two main reasons for
selecting conservation as the focal problem seem to be its amenability to experimental investigation and its importance as the central concept of concrete-operational stage of Piaget's theory. The modifiability of cognitive structures, durability of the changes induced and the generalizability of the concepts learned in training were intensively investigated, through various techniques such as the influence of direct reinforcement, cognitive conflict or self-discovery, didactic lessons with demonstrations, perceptual re-orientation, verbal and non-verbal procedures, and different combination of these. Interestingly, the intention of these training studies was not to assess the various teaching strategies mentioned above, but to evaluate Piaget's theory in respect of modifiability of cognitive growth.

Research on learning in relation to cognitive development gained momentum during the late 60's and early 70's. The absence of any explicit analysis of learning in Piaget's theory has been counted in the past as one of the weaknesses of the theory. Piaget had loftly dismissed inquiries about learning and acceleration on the ground that they were strictly 'American questions'. More recently, however, Piaget has himself admitted that learning has an effect on cognitive contents associated with his stages. Recent
publications by Piaget and his associates have attempted to spell out the basic principles of the Genevan approach to learning (Inhelder, B. and Sinclair, H. 1969; Inhelder, Sinclair and Bovet, 1974; Piaget 1967 b, 1970 d; Sinclair 1973). Virtually, most of the subsequent research outside Geneva has focused on the learning of conservation of concepts concentrating on teaching strategies, especially self-discovery procedures. The number of experiments has now grown quite large and as a result, several scholarly reviews of them have been written in recent years (Beilin 1971; Brainerd 1973 1977, 1978; Brainerd and Allen 1971 a, Glaser and Resnek 1972, Straum 1972).

Attempts to relate or apply certain aspects of Piaget's theory to education are noteworthy. These include general interpretations (Aebli 1951; Peel 1960; Skemp 1962; Flavell 1963, Wallace 1965, Bruner 1966, Beilin 1966) and special treatments of Mathematics instruction (Dienes 1960, 1963, 1965; Lovell 1961, 1966). A number of curriculum development conferences focusing on the value of Piaget's contributions have also been held and these are reported in Bruner (1960), Monisett (1966), Ripple and Rockcastle (1964) and Sigel (1966 a). A great deal of valuable research directed towards classroom applications of Piaget's theory is in progress in the U.K. (Nuffield Mathematics Project,
Attempts to standardize Piaget's tasks (Vinhbang 1957; Laurendeau and Pinard 1962, Tuddenham 1968, 1969; Lunzer 1970) seem to offer viable alternative to traditional intelligence tests. Adding to these, very recently, a few programmes aimed at fostering/accelerating cognitive development, have actually been worked out and put into operation on an experimental basis at the pre-school level.

In India, there has been a sad neglect of this area of research and the few studies conducted have been mostly on development of language in children. Probably, the first of the development studies was conducted by Shamala (1961). Other recent research studies (Joshi 1963; Rao, S.N. 1975; Rao, S.N. and Reddy, D.J. 1974; and Chatterjee, R.G. 1973) throw some light on development of logical thought in children. Thus the need for experimental and other studies on cognitive development of children, pertaining to primary school period in particular, cannot be overemphasised.

While developmental studies relating cognitive capabilities of children to environmental variables as well as particular age-periods help in selecting and designing suitable class-room experiences to foster cognitive development, experimental studies assessing the worth of the teaching learning activities, strategies and programmes
with an appropriate orientation should have more significant implications for education in general, and curriculum and classroom processes in particular.

1.4 THEORETICAL BASES AND ASSUMPTIONS

(a) Basic position on cognitive development

In a way the whole of Piaget's theory of cognitive development as briefly outlined in sections 1.1.2 and 1.2 supra formed the theoretical foundation for this study; with the enrichment from the contributions of a few others and some compromise on its assessment. However the essence of the basic position on the nature of cognitive development and on fostering such development is stated below.

Cognitive development occurs as an orderly process in a bio-social context, the four factors which account for the sequence of development being 'maturation' (biological), 'experience' of the physical environment, the 'action' of the social environment and 'equilibration' by the organism.

Cognitive development is a long term, continuous and dynamic interaction between the organism and the environment expressed in identifiable stages or periods which follow an invariant sequence. Inhelder et. al say -
Cognitive development results essentially from an interaction between the subject and the environment. In terms of successful procedures for fostering cognitive development, this means that the more active the subject is, the more successful his learning is likely to be. However, being cognitively active does not mean that the child merely manipulates a given type of material; he can be mentally active without physical manipulation. Just as he can be mentally passive while actually manipulating objects. Intellectual activity is stimulated if the opportunities for acting on objects or observing other people's actions or for discussions correspond to the subject's level of development. (B. 72, p. 25).

The emphasis on both individual and environmental conditions in the development of cognitive behaviour and capabilities reflects a major shift in the way development process is conceived - no longer the passive outside stimulus triggering a response, but the active construction of the world in a framework of existing schemata, which themselves alter as a result of what is done. Nor is it seen as primarily as a process of maturation. In the words of Gruber -

Behaviour is not seen as an inevitable unfolding of potential, but a process influenced by both the nature of the infant and the condition under which he lives. The model is of a goal seeking, purposive and self-regulating control system; an open system which becomes progressively patterned, differentiated and articulated. (B. 121, p. 212).

Logical analysis of qualitative changes in cognitive structures due to continuous cognitive function inferred through cognitive contents (vide section 1.1.2 supra) shows
that cognitive development proceeds in a certain direction - through irreversible, invariant and sequential stages. In line with cognitive development theories as described independently by Piaget and Bruner (vide section 1.1.2 supra) among others, it can be expected that change or modification would occur because of the interaction between the individual and his world - physical or social. Interaction demands the assimilation of input into the existing schema and the accommodation of schema to discrepant input. Then it follows that the greater the interaction the more differentiated and articulated the schema should be, leading to acquisition of more cognitive contents than what was present before. The opportunities the child has in his social world, the kinds of play in which the child engages, the kinds of materials available to him and the mode of utilization he makes of these materials play a significant role in helping the child acquire conceptual and representational schemas.

It is obvious, then, that the nature of impetus to change - i.e. the characteristics of the interaction, both physical and social, which induce cognitive conflict and stimulate equilibration - warrants serious consideration in fostering cognitive development. The caution on experiences provided to foster cognitive development, which may of prove useless in case/the role played by the experimenter
is given by Piaget himself.

... it appears that many educators, believing themselves to be applying my psychological principles, limit themselves to showing the objects without having the children manipulate them, or, still worse, simply present audio-visual representation of objects in the erroneous belief that the mere act of perceiving the objects and their transformations will be equivalent to direct action of the learner in the experience. The latter is a grave error since action is only instructive when it involves the concrete and spontaneous participation of the child himself.... (B. 72, p. ix).

(b) *Principles/guidelines for a programme for fostering cognitive development*

In the light of the above logic coupled with recognition of the influence of environmental stimulation on the quality of the thought patterns, the basic assumption is that cognitive development can be nourished and fostered through a carefully designed programme - with both spontaneous and structured experiences and exercises - in a special environment like that of the school.

Thus, the question of providing appropriate experiences to foster cognitive development in schools can be considered on four basic principles:

(i) appropriate environmental stimulation with adequate breadth and depth,
(ii) learning as an active process,

(iii) priority of intellectual activities based on actual experiences rather than on language, and

(iv) the importance of social interactions among children.

These basic principles can be elaborated in the following guidelines.

(i) Activities should be cognitive capability oriented rather than information oriented.

(ii) Activities should focus on concepts and operations in forms appropriate to the age-group.

(iii) Activities should be based on previous capabilities as estimated - and initial capabilities are to be confirmed/strengthened.

(iv) Activities should have wide range, variety and scope in terms of concepts, operations, tasks and materials.

(v) Activities should be suitably sequenced and structured, focusing on a concept or two primarily and touching related ones.
secondarily - as planned and/or incidentally.

(vi) Activity sessions/sequences should contain a wide range and variety of perceptions, operations, manipulations and responses.

(vii) Preliminary activities of observation, reporting description, interpretation etc., at the initial capability level or just beyond it, should be provided at the beginning of each sequence/session and also interspersed as and when necessary to produce/stimulate relevant learning sets, including disposition,

(viii) Activities should be designed as group activities - with individual and collective responses - that can be applicable to large classes (though with less effect).

(ix) The content, sequence and form of activities and interactions should be considered flexible, fluid and modifiable (as warranted).

(x) Activities should provide optimum opportunity for learner autonomy, self-direction, spontaneity, initiation (both questions and statements), etc.
(xi) **Adequate scope should be provided for cumulative building up and strengthening of the same concept in different situations and sessions through repetition, recapitulation and integration.**

(xii) **The spirit of play-way should pervade and an informal - cordial atmosphere should prevail throughout the activity sessions, marked by rapport, pleasantness, co-operation, enthusiasm and vigour.**

(c) **Assumptions for assessing cognitive development status**

The operative theory of cognitive development, as formulated by Piaget, unlike theories on the structure of intelligence, can be applied to illuminate changes of mental structure or modes of thought in relation to the child's age. The sequence of mental structures and cognitive capabilities, one succeeding another in a certain order following a definite evolutionary principle, can make for an instrument capable of searching out the child's cognitive capabilities in the progression as identified by Piaget and his collaborators, and would furnish an excellent index of cognitive development status. Such a judgment would be given in terms of clearly designated substages, with
qualitatively different distinguishing features or capabilities, rather than numerical scores or ratings (or even categories) on a normative frame as given by conventional intelligence tests. The latter claims to yield a reasonably precise measure of one's total intellectual capacity on the basis of performance in one kind or more of tasks (depending on the theory of intelligence accepted and followed) — each usually arranged in the ascending order of complexity and difficulty — and taken in relation to the general performance of the age group. In other words it is based on a sampling of a variety of appropriate tasks adequately representing the major factors or components of intelligence and the level attained therein by persons of the age concerned.

Piaget disapproves of this approach which starts with intelligence as a pure 'measurement construct' in the context of obvious individual differences. At the same time, it has to be conceded that cognitive capabilities of the kinds that Piaget highlights and traces also reflect individual differences possibly attributable to certain biological factors and differences in life experiences. More over 'cognitive development status' can be seen not as just a point in the natural progression or a step on the ladder of cognitive development but as representing the overall cognitive capability of the individual, which in turn consists in a variety of specific capabilities that can be defined in
terms of different concepts and operations appropriate to the age level, as emphasized by Piaget himself.

Thus it should be possible to meaningfully reconcile the two approaches in developing instruments for assessing cognitive development or cognitive capabilities. This would combine the quantitative and qualitative aspects of intelligence or cognitive capability in a correct and comprehensive perspective. In other words, cognitive development status of individuals can be assessed by a reliable tool adopting operational concepts/contents of cognitive development as described by Piaget, together with the psychometric approach of standardized test items yielding individual scores that can be summated into a total cognitive development status (capabilities) score (Vinhbang 1957, Laurendeau and Pinard 1962, Tuddenham 1968, 1969, Lunzer 1970).

1.5 STATEMENT OF THE PROBLEM

1.5.1 Nature, Scope and Objectives of the study

This was designed as an experimental study seeking to develop a programme for fostering cognitive development in first standard pupils and try it out under adequately rigorous experimental conditions. The programme was conceived and developed on the foundation of the theoretical
bases and assumptions given in sections 1, 2 and 1.4 supra. The central objective of the study was to assess the effectiveness of such a specially designed activity programme in fostering cognitive development in primary school entrants. The study thus involved a school activity programme as the manipulated independent variable and cognitive development status as dependent variable.

The special activity programme based on selected concepts and operations appropriate to the age level of first standard pupils, was designed as a series of 40 sessions of 30 to 40 minutes each, and was offered to the EG, while the control group had the usual school activities. The gains in cognitive development status of the EG achieved through the programme had to be analysed in comparison with the corresponding gains of the control group to establish the worth and efficacy (or productivity) of the programme. This was done by measuring cognitive development status of both the experimental and control groups at the beginning and at the end of the programme through an appropriate tool - the Mysore Cognitive Capabilities Test (MCCT).

The additional objectives of the study aimed at relating -

(i) initial level of cognitive development status to the socio-economic status and preschool education of the subjects.
(ii) gains in cognitive development status to factors of age, sex, pre-school education, SES, institutional variations, and intelligence (as conventionally measured) of the EG subjects, and

(iii) final level of CDS to academic achievement of the subjects in respect of both EG and CG.

1.5.2 Hypotheses to be verified

The primary hypothesis for verification in the study was related to the main objective of the study (vide section 1.5.1 above) and was formulated as follows in the form of research hypothesis with the anticipated direction of change rather than as null hypothesis, in view of the fact that the programme the experimental treatment in the study, was planned and organized with the express purpose of fostering cognitive development.

H₁: Those who take the specially designed cognitive development oriented activity programme as against the usual activities in school would show significant gains in cognitive development status (as assessed by Mysore Cognitive Capabilities Test) as compared to those who have only the usual activities provided in school.
The additional hypotheses for verification in the study related to the set of additional objectives of the study (Vide section 1.5.1 supra). They were formulated as 'null hypotheses' in the absence of sound logic, widely accepted theoretical postulates and arguments or research evidence that clearly indicated the direction or degree of the relationships involved.

$H_2$: There is no significant relationship between (i) pre-school education of the subjects, and (ii) their socio-economic status on the one hand and their cognitive development status on the other.

$H_3$: There is no significant relationship between (i) pre-school education of the subjects, and (ii) their socio-economic status on the one hand and their gains in cognitive development status on the other (in respect of experimental group).

$H_4$: There is no significant relationship between the (i) age of the subjects and (ii) their initial levels of cognitive development on the one hand and their gains in cognitive development
status on the other (in respect of experimental group).

$H_5$: There is no significant relationship between
(i) the levels of intelligence of subjects and
(ii) the experimental treatment on the one hand and their gains in cognitive development status on the other.

$H_6$: There is no significant relationship between
(i) the institutions, and (ii) the experimental treatment on the one hand and their gains in cognitive development status on the other.

$H_7$: There is no significant relationship between
the sex of the students and their gains in cognitive development (in respect of experimental group).

$H_8$: There is no significant relationship between
the final status of cognitive development and academic achievement of the subjects.

1.5.3 **Delimitations, limitations and precautions**

(i) The study had to be limited to primary school entrants or students of standard I, covering a
limited age group, 5 to 7 years, in a single medium of instruction, namely Kannada, the language of the area.

(ii) The sample of 120 children studying in standard I was chosen from five primary schools located in the limited geographical area of Mysore City, in view of the need for repeated visits, heavy work involved and time consumption.

(iii) The sample could not be a pre-determined random sample or a strictly stratified random sample from the total population of first standard pupils in Mysore City, as the selection had to be limited to those schools where the authorities assured adequate co-operation (throughout one academic year to conduct this experimental study) after clarification and persuasion.

(iv) The number of schools had itself to be limited as children from different schools could not be called together to form viable groups and they had to be taken in school-wise groups.

However, every effort was made to
make the sample as representative as possible with reference to subjects' age, sex, pre-school education, and socio-economic status. The sample was also representative of schools of different types of management and composition. (v) Only performance IQ, prorated from four performance tests in WISC were considered for the study, though it would have been better if a Full Scale IQ comprising both Verbal and Performance Tests - could have been adopted. It was preferred and justified too, as the special activity programme as well as the tool MCCT used in this study to assess cognitive development status were based more on activities/performance than verbal explanation by the subjects, and there was no verbal or non-verbal test of intelligence appropriate to the population concerned, except RPM which has its own limitations.

1.6 **DEFINITION OF KEY TERMS**

(i) **Cognitive Development Status**

In tune with the explanation of the nature and process of cognitive development given in section 1.1.2 supra and the
assumptions for assessing Cognitive Development Status vide section 1.4 supra, Cognitive Development Status was operationally defined in terms of the overall cognitive capabilities of children as assessed by performance on a variety of tasks involving different concepts and operations included in the Mysore Cognitive Capabilities Test (MCCT) developed by Padmini and Nayar and represented by the total score obtained on MCCT.

(ii) **Concepts and Operations**

Conceptualization is an abstracting, categorizing and generalizing process based on sense perception. Thus 'Concept' as Klausmeier et al define:

... is an ordered information about the properties of one or more things - objects, events or processes that enables any particular thing or class of things to be differentiated from and also related to other things or class of things. (B. 80, p. 4.)

Concepts and their utilization in thinking are joint products of maturation and learning. Though early concepts (object concepts) representing concrete objects are simple, the level of conceptualization becomes more complex and abstract with development of the child. The more the prehensile ability develops the better would be the level of cognitive thinking of the child leading to the formation of 'Attribute Concepts' (concerning attributes of objects such as length, area,
volume, amount, etc.) and 'Relation Concepts' (concerning relation between objects, people, situations, etc., like spatial relations, temporal events, and causality).

Closely linked with the conceptualization process is the development of 'operations' as both are complementary to cognitive thinking. Operation is a process which takes a specific track of mental activities that are necessary in order to derive a product (Sigel and Cocking). In other words, operations specify what particular mental activity is involved. For Piaget, operations form the crux of thought. In his own words:

Psychologically, an operation is, above all, some kind of action whose origin is always perceptual, intuitive (representational) or motoric... The logico-mathematical operations derive from actions themselves because they are the product of an abstraction which proceeds from the coordination of actions and not from the objects themselves. (B. 115, p. 81).

Thus the various attribute and relational concepts and operations considered and selected for the present study (both for testing and for activity programme) were appropriate to the age-level concerned and the attainment of concrete-operational stage as described by Piaget, as the subjects of the study were in transitional stage from pre-operational to concrete-operational stage (5 to 7 years of age).
(iii) **Intelligence**

Intelligence has been defined by many psychologists and educationists in different ways. The Concise Oxford Dictionary says, the term intelligence means 'intellect' and 'understanding'. A comprehensive definition of intelligence given by Drever is worth quoting,

Intelligence is the ability to perform tests/tasks, involving the grasping of relationships or concepts, the degree of intelligence being proportional to the complexity and/or the abstractness of the relationships or concepts involved. (B. 41, p. 81).

According to Weshcler -

(i) Intelligence, however defined is not a simple entity but a complex function, (ii) it is of the nature of a resultant effect, and (iii) the resultant effect depends upon the interaction of a theoretically infinite but practically limited number of qualitatively different but additive component of factors.

Intelligence was represented in this study by the IQ score obtained on Performance Scale of Wechster's Intelligence Scale for Children (WISC) with four performance items (Picture Completion, Picture Arrangement, Block Design and Object Assembly).

(iv) **Pre-school Education**

Pre-school education was taken as any type of
pre-school education - Lower Kindergarten, Upper Kindergarten, Nursery or Balawadi - received by the subjects for a minimum period of one academic year.

(v) **Academic Achievement**

Operationally, it was taken as represented by the percentage of total marks obtained in the final examination of standard I.