CHAPTER I

INTRODUCTION

We are beginning to see a renaissance of interest in thinking, signaled by an unprecedented increase in the use of electronic games, books and puzzles that stimulate thinking faculty, and experimental classes in thinking offered in schools, colleges and university extensions in many countries. This may become a large revolution - a virtual epidemic of interest in using the mind in all its dimensions. Many teachers, especially freshers, who bring innovative ideas and imaginative techniques to their jobs, find themselves pressed into the mold of ritual and conformity by the structure of educational system itself. Many of them, exasperated by the lack of freedom, crowded classes and narrow-minded policies, find themselves at midcareer with a "what the hell" attitude. Very few teachers or administrators manage to retain a real enthusiasm for their careers and for the learning experiences of the students in the "factory" setting that characterizes so much of the educational system. It does not mean that children don't learn at all in this setting, nor that the setting is particularly harmful to them. But the emphasis is on the fact that overall educational system has always operated according to unspoken but clearly communicated values about how the growing children should be handled. The development of creative, logical or critical thought is not considered as the principal value governing the teaching process.
The effectiveness of any educational process largely depends on the extent to which it rests upon human nature and the nature of experience. In education, "the goals we seek, the things we do, the judgements we make, are determined by our belief about the nature of man and his capacities (Combs, 1962). Humans, therefore, will have to be understood in their actualities, in their possibilities and in their idealities - in short in their totalities. The report on Learning to be" (UNESCO, 1972) emphasized that such fields as neuro-psychology, genetic epistemology, semiology and cybernetics play an important role in the formulation of general system theory of education. The brain is constantly growing and changing. Therefore, the teachers need to be appraised of the changes that may affect the ability of the pupil to respond to different kinds of learning. The view of the changing plastic brain requires not only extra vigilance and care (on the part of educators) but also brings with it greater opportunities. Neurological hypothesis and theories will need to be tested and applied in class-room. One recent significant development in neuropsychology which clearly is important for education, is that of hemisphericity and knowledge about complementary hemispheric specialization. Innovative research from the late sixties onwards has made considerable advances in understanding and explaining the functional asymmetry of the human brain. It has supported Hippocrates' contention, "the human brain as in the case of all other animals is double" (Bogen, 1969). The duality was apparent to Plato as well, who according to an account by Cicero (Rather, 1965)
divided the mind into separate entities: "One partaking of reason and the other devoid of it". Probably the most detailed left right symbolism is found in the Tantric writings of northern India (Russell, 1979). These are fascinating in that although they were written many hundreds of years ago, they foreshadow much of what we are now discovering about the left and right hemispheres of the brain. Tantric writings associate the left nostril with the moon and with the feminine qualities, and the right nostril with the sun and masculinity. They maintain that the breath rarely flows through both nostrils equally; for a while it flows predominantly through the left and then for a while through the right, the changeover taking place once every twenty minutes or so in a healthy person. When the sun breath is flowing - that is, when the right nostril is dominant - one is advised to undertake the actions involving speech and instruction, as well as combat and physical exertion. These correspond to the linguistic functions associated with the left hemisphere, and the "active" competitive mode. When, on the other hand, the moon breath is dominant, one is advised to engage in painting, composing, listening to music and other creative and artistic activities - that is, with functions associated more with the right hemisphere. The Tantrists also claim that when a person gains enlightenment, that is to say, when he is fully aware both inwardly and outwardly, the breath is found flowing equally in both nostrils. This presumably reflects the fact that such a person would be using both hemispheres of the brain in balance, rather than temporarily suppressing one in order to make full use of the other.
But evidence has been reported indicating that modification in the tendency to rely on one or the other hemisphere during problem-solving is possible through modification of reinforcement contingencies (Gazzaniga, 1971) and through direct extensive training (Bever and Chiarello, 1974). Many of the objectives of education and modern society can be and have been attained through the kind of operations performed by right hemisphere, and almost all could be attained more effectively using both kinds of functioning (McCarthy, 1980; Torrance, 1981). In performing every task, information must be processed by both hemispheres and could be used in thinking and problem solving. In creative thinking, it is especially important to understand the specialized functions of both hemispheres, since by definition both kinds of processing are required to be creative.

1.5 Creative Thinking and Problem Solving Skills

There are two distinct modes of thinking or problem-solving activity, one referred to as convergent thinking and the other divergent thinking. Convergent thinking is stimulus bound and divergent thinking is stimulus free. Through former, one reaches at the right answer logically while through latter, to tackle the problems the mind could have to go into uncharted areas. The person would adapt new frames of reference, draw heavily on imagination and intuition, and seeks previously unsuspected relationships. According to Guilford (1968), the unique feature of creative or divergent thinking is that a variety of responses is produced. One thinks in different directions, sometimes searching and sometimes seeking variety while convergent thinking involves single and specific response. While divergent
thinking is undoubtedly the distinguishing characteristic of creative thinking, there is a place for convergent thinking too. In grasping what an unclear problem is, a good deal of logical, convergent thinking is needed. When the divergent thinker makes some critical choices or establishes an original line of enquiry or line of thinking, a good deal of convergent thinking must come into play. Quite often creative thinking consists of alternating phases of imaginative (divergent), rational (convergent) thinking (Torrance, 1979).

Creative thinking or divergent thinking is not one ability, but a cluster of abilities (Guilford and Merrifield, 1960).

The first is called FLUENCY or the ability to come up with a large number of ideas or solutions or concepts to a given problem.

The second is FLEXIBILITY, the ability to provide a large variety of solutions, to respond to a problem from a variety of viewpoints and to use a variety of approaches in problem solving.

The third creative ability is ORIGINALITY. It is perhaps the most vital element of creativity, at least in the popular mind. It is an elusive quality, and very rare. Originality has to do with the production of unusual ideas or solutions that are not only clever, surprising and novel, but also useful, relevant, elegant or appropriate.

The fourth is ELABORATION which involves the working out of the implications of a bright idea by a combination of analytical, evaluative and associative thinking i.e. unfolding ideas, assessed in terms of aesthetic or moral or technical or economic criteria.
The fifth creative ability is SENSITIVITY to the unusual feelings, anomalies or problems.

Another ability is to go to the roots of a phenomenon by unravelling its causes, and equally, to visualise its consequences. It is a vital ingredient of scientific creativity.

These abilities are not generally found in equal measure in the same individual. It would be inappropriate to categorise a person as creative or uncreative without specifying which he has more limited ability. It is quite striking about creative individuals that their head may be in the stratosphere but their feet are planted on the ground. Many of them are fascinating combinations of a flaming imagination and a very few earthy practicality. Ordinary people seem to choose between a life of imagination and a life of practicality. Creative individuals tend to prefer both. But ordinary people can be trained to be more creative under favourable conditions of high motivation, appropriate training and an encouraging environment (Parnes and Noller, 1973). Rose and Lin (1984) found that creativity training generally raises various divergent abilities at least moderately. Originality and fluency are particularly strengthened through training.

1.6 Creative Problem Solving Skills in Mathematics

NCTM'S Agenda for Action 1980 recommended that problem solving should be the focus of school mathematics in the 1980's at all levels. Divergent thinking is the most modern way of guiding the learner to solve problem situations in an original way. The creative individual does not stick to previous solutions, but he will use the skills which he has learned. He uses these skills
in a more or less automatic way, putting them in his background so that his creative impulses are free to take over.

Creativity in mathematics has been of vital importance. But most of the students encounter difficulties in solving mathematical problems. In solving such problems creatively, human mind seems to take least from the outside world. Problem solving in mathematics requires intuition, imagination, experimentation, judicious guessing, insight, immense patience, continuous involvement in thinking, sudden illumination and sense of achievement. Education can help a lot in encouraging problem solving skills and the development of creative potential.

Bruner (1965) suggests that a theory of teaching which helps in developing the cerebral symmetry will perhaps strike a balance between the expository mode and the hypothetical mode of teaching. Teaching style, should mostly let the student develop a subtle enough way of doing things so that the student retains the sceptical, the tentative, the wondering art of constructing conceptual schemes. The strategies should also give credit to the expression of highly subjective intuitive ideas. Teachers have to recognize the legitimacy of intuition, creativity and divergent thinking as an intellectual operation. Some subjective, imaginative and impulsive thoughts may not produce the right answer, but they extend the conceptual possibilities for the child, when expressed. Conditions in the classroom should be created that permit and support autonomous search, information processing, and theory building.
The teacher should show great respect for ideas of individual children and there should be a heightened sensitivity to individual differences, as knowledge is received according to the manner of the receiver.

1.7 Intelligence, Personality and Cognitive Style as Related to Creative Problem Solving Skills and Cerebral Dominance

In solving a problem, the solver struggles not only with the problem but also with him/herself (Stepnov and Semenov, 1982). The development of successful problem solving strategies must take into consideration both intellectual and personality aspects. Recent texts address the following topics which are responsible for variation in performance skills, intelligence, special abilities, creativity, cognitive styles, personal constructs, values, attitudes and interests (Tyler, 1974; Messick, 1976; Tyler, 1978).

Shuell (1981) divides individual differences into two main categories:

i. Mental abilities

ii. Personality

Intelligence is a mental ability, whereas cognitive style is a personality trait. Through cognitive styles are often classified as personality traits, they also reflect consistent differences in cognitive functioning and thus reflect both differences in abilities and personality (Cronbach and Snow, 1977).

Cognitive styles are what many educators are discussing when they use the term "learning styles". Under cognitive style, Messick (1976) includes dimensions such as the following: field-independence vs. field-dependence (responding to the environment in analytical as opposed to
global terms), cognitive complexity vs simplicity (the tendency to construct the world in a multidimensional or abstract way as opposed to a single dimensional or concrete way); reflection vs impulsivity (differences in the speed and adequacy with which alternative hypothesis are formulated and information is processed); risk taking vs cautiousness (individual differences in a person's willingness to take chances to a desired goal); and sensory modality preferences (individual differences in relative reliance upon the kinesthetic, visual or auditory sensory modalities). Research suggests that cognitive styles may be importantly related to learning.

Recently many educators have argued that learning can be improved by adapting teaching to student's learning style (Cognitive style) or by putting students with teachers who have similar learning styles (Dunn and Dunn, 1978; Fischer and Fischer, 1979; Rechinger, 1979).

Instruction can be improved when it is based upon personality type, intelligence level and process oriented cognitive styles that related to knowledge about the encoding strategies of the brain. Zelniker and Jeffrey (1976) found that reflective children use a left hemispheric analysis cognitive style and impulsive children used a right hemisphere global cognitive style. Findings of Zelniker and Jeffrey imply that we can expect learning to be difficult when a mismatch exists between a child's global cognitive strategy and the analytic organization of many instructional tasks.

No single strategy or model of teaching aims at enhancing creative problem solving skills or developing brain potential. A combination of
models, which share many features is perhaps, a useful approach to work out a system of teaching in this context. Inquiry model (Suchman, 1966) or Inductive Teaching model (Taba, 1966) or most importantly, the synectics model (Gordon, 1961) will have to be considered seriously to arrive at a meaningful model for the teaching of right brain. Torrance (1965) conducted a good deal of research on class-room nurturance of creativity and suggested that creative-skills of students can be enhanced.

A number of research studies have been conducted in the past in this area. A review of the related literature is presented in the next Chapter.