C H A P T E R I

INTRODUCTION

INSTRUCTIONAL SYSTEM

It is a fact that we are living in an era of rapid change - an era in which the nature of our society and the place of the individual in it are rapidly changing. There is an increasing replacement of old by the new. When such is the situation, any country, be it developed or developing, has continuously to look into her various societal systems, namely, the social, economic, political and educational and reconstruct them suitably to meet the demands of change and progress. Such a reconstruction can be effected by bringing about a change in the systems independently, as also through a change in one of the systems, which is closely related to the others.Probably, the system of education can be visualized as closely related and even to some extent determinant to changes in the other systems. More explicitly, reconstruction in the various societal systems can be facilitated by effecting changes in the educational system. Such a process of effecting a change in other systems through the system of education, though complex by nature, basically aims at reshaping men and through men,the society.

Harnessing education for reshaping men would mean

2 developing in individuals certain intellectual skills, attitudes and values which would enable them to adjust to the changing needs of the society. It is presumed that such well adjusted individuals through their effective functioning would contribute to the growth and development of the society. This, then, necessitates education a subsystem in the total societal system to operate in close conjunction with other subsystems of the society and have sufficient influence on individual and societal development.

Acceptance of the broad social objectives of education, and the impressive recognition of its potentials as a means of achieving efficient society, have led to concentration of efforts to improve all aspects of education in general and the process of instruction in particular. Instructional process is the core process that centres all activities in the educational system. It is the core process for the reason that it is through the process of instruction individuals are initiated into societal norms and thinking at a point of time. A little reflection on the other aspects of education, viz., curriculum construction, evaluation, educational administration, organization, management, etc., would reveal that they are supportive to the process of instruction.

The process of instruction refers to a series of events (instructional experiences) which can be controlled and manipulated to bring about desired behavioural changes in

3 the learners. Defining the process technically, it is a process through which the environment of an individual (learner), who becomes a part of the environment, is deliberately manipulated to enable him to emit or engage in specified behaviours under specified conditions or as responses to specified situations (Corey, 1967). Such a connotation, when subjected to scientific examination, will imply the following. One, the specifiability of the behaviour to be learned as well as the learning conditions or experiences appropriate for learning that behaviour; and two, the degree of manipulation of the learning conditions to the end that the behaviours to be learned will be brought under the control of learning conditions. The above analysis essentially implies that the behaviours, desired by those planning the instruction, will be emitted by the individual instructed as a response to the relevant situations - technically speaking to the learning conditions which represent varied stimuli. Through his responses to these varied situations (environment), the individual learner would modify his behaviour, which constitutes learning.

The 'manipulation of the environment' which forms central to the process of instruction, may, of course, be extremely varied. The plan may have the learner required to go through books, look at pictures and charts, do simple activities in groups and individually, or even being talked to by the instructor, etc. All these activities would be a

4 consequence, in instruction, of planned or deliberate manipulations of the learner's environment. The entire environment which includes the learner, the instructional planner or designer (teacher) and the instructional medium, i.e., the environment in which instruction takes place, would together constitute a complete system, which may be called as 'Instructional System'. The working of all the above components are geared towards one end, viz., enhancement of learning on the part of the learner.

As any system could be envisaged in terms of its inputs, outputs and process, the instructional system also could be envisaged in a similar way. The main input into the instructional system upon which it is designated to operate, consists of the entering behaviour of the learners. This entering behaviour comprises of the initial repertoire, aptitudes and prior educational background of the learners. The other inputs are the content matter, human as well as material resources, different methods and media, information, and even the interaction of these interrelated components. The planning, organization and sequencing of the instructional inputs to bring about the desired behavioural changes in learners constitute the process of instruction. The behavioural changes on the part of the learners form the output. Since the instructional system, as a whole, is aimed at modifying the behaviours of the learners, the first step in planning and organizing learning conditions necessary for bringing

about the behavioural changes would be specifying the desired behavioural changes on the part of the learner. The other steps would be assessing the stage at which the learner is (entry behaviour), assessing the gap between entry behaviour and specified terminal behaviour, making decisions regarding the appropriate learning conditions, and organizing them for taking the learner from 'where he is' to the desired terminal behaviour. This step calls for identifying the different learning conditions (inputs) seeing their potentialities in the achievement of the outputs (terminal behaviours) - establishing the relationship between input variables and the outputs. And lastly, assessing the outputs, that is, assessing the extent to which the output specifications have been achieved through the organization of the inputs.

What is to be recognized in planning and organization of the instructional process is that instructional system is a complex and dynamic system with the interplay of various factors. The complexity and dynamism involved in the instructional system is due to the reasons that it is typically a behavioural system with individuals varying in their motivation, values, previous experience, aptitude and personal behavioural patterns, and the influence of the social setting in which it occurs. Because of the complexity and dynamism involved in the system, establishing a one-to-one causal relationship between inputs and outputs, as it could be done in any physical or mechanical system, would be difficult. To

6 make it more explicit, in a physical or mechanical system, it is possible for a perfect matching of the output specifications and the potentialities of the inputs to be utilized for realizing the outputs. This is due to definite causal relationships that can be established between the input variables and the output specifications, the degree of control that can be exercised over the inputs and the precision in the measurement of the accomplishment of the outputs. On the other hand, in a behavioural system, a perfect matching of input variables and output specifications may be difficult due to comparatively lower degree of specificity in terms of defining appropriate input variables and lack of one-to-one relationship between definite inputs and defined outputs. In other words, it is not an additive model, wherein specific sets of inputs can be causally related to definite outputs. As a matter of fact, for definite outputs, it may be possible to select various combinations of inputs from the gamut of inputs. It is owing to this, the possible relationships between inputs and outputs will have to be hypothesised, and the inputs hypothesised to lead to the desired outputs will have to be selected. Through carrying out empirical studies, the hypothesised relationships between inputs and outputs could be seen and the resulting data could be utilized for further concretising the relationships. It may have to be considered that in a given instructional situation, comprising of a defined set of learners, for a specific content matter and for a given organizational set up, the

inputs which would be amenable for certain manipulation, would be modes of treatment of the content and the presentation of the content that is the media. It is through the media, varied learning conditions would be provided to learners to emit the desired responses. Explaining the term 'media', it is used to connote the various components of the learning environment that generate stimulation to the learner. In other words, communicate with him. Such a connotation takes into its fold not only objects and materials, but also the human medium (teacher). The individual learner, through his responses to the various learning conditions presented through different media, modifies his behaviour which constitutes learning.

As a matter of fact, educational researches, in the area of instructional process, have been mainly carried out with a view to analysing and understanding the complexity involved in the instructional process, identifying the different instructional inputs for realizing specified outputs and in sharpening these relationships, i.e., in terms of making the relationships between inputs and outputs more specific. The empirical studies, about which a mention was made in the previous paragraph, are actually meant to substantiate these relationships. It needs to be mentioned that in this process of understanding, controlling and predicting the events in the instructional process, emphasis has always been to enhancing learning on the part of the learner.

8

In the attempts at understanding the process of instruction and improving it in its effectiveness and efficiency in causing learning on the part of the learner, the contributions of psychologists need to be appreciated, since more scientific efforts to understand, predict and control instruction began with the consideration of learning as a psychological phenomenon. Many schools of psychology such as Structuralism and Functionalism or Behaviourism and Gestalt Psychology, with their diverse perspectives and methodologies have tried to understand and explain the complex phenomenon of learning. Today, through the experiments conducted in psychological laboratories on learning with infra-human and human subjects, it has been realized that learning is largely dependent on events in the environment with which the individual interacts. These interactions make it possible to view learning as an occurrence that can be examined more closely and profoundly. Learning is not simply an event that occurs naturally, but it is also an event that may be observed under certain conditions. Further, it has also been realized that these conditions can be altered and controlled, and it is possible to detect relationships between these conditions and the changes in the human behaviour that occur as learning, which would enable one to make inferences about what has been learned. By taking into consideration the behaviours to be learned and the conditions needed for generating those behaviours, appropriate stimuli or learning conditions could be presented, so that the behaviour could

9 be presented, so that the behaviour could be brought under the control of these stimuli.

Because of the quantum of research conducted on the phenomenon of learning, one may expect that these learning psychologists have provided the educational practitioner with useful practical models for improving instruction. However, when one looks into the works on learning till nineteen-fifties, one would notice that most of the work has been on the theoretical understanding of the phenomenon of learning and arriving at certain principles of learning through experimentation on either animals or human beings in controlled laboratory conditions, which did not offer a finished practical model to the educational practitioner in systematising the process of instruction. This is not, however, to undermine the importance of contributions made by the psychologists of the early part of this century in the field of learning to educational practice. For the very reason, the efforts of Thorndike to understand the process of learning is yet unparalleled. The first psychologist to offer a practical model for systematising instruction based on the psychological principles, was B.F. Skinner. As a matter of fact, if one considers Skinner's views on the modification of behaviours, one would notice that even Skinner owes several of his principles of learning to the laws of learning put-forth by Thorndike. The contribution of Skinner towards systematisation of instructional process and how his work

10 has been considered as a pioneering work in the process, have been discussed under the next heading.

PROGRAMMED INSTRUCTION AND SYSTEMATISATION OF INSTRUCTION

Skinner (1968) viewed instruction as a process of arranging contingencies of reinforcement under which students learn. He contended that students can learn in the natural environment without any special assistance, but it could best be assured and expedited if teachers make appropriate provisions so that gradual changes in behaviour in desired directions are systematically reinforced. Based on his operant conditioning theory of learning, he developed a technique of auto-instruction which he called programmed learning or programmed instruction. Emphasising that the primary concern of instruction is the behaviour of the learner, Skinner focussed attention on the specification of entry and terminal behaviours of the learners. He conceived programmed instruction as a systematic attempt to bridging the gap between stated entry behaviour and terminal behaviour, on the model of operant conditioning learning. The underlying principle in programmed instruction is 'shaping', i.e., selectively reinforcing the variety of responses initially emitted by the learner, thereby shifting the pattern of responses by successive approximations towards the desired performances. Programmed instruction represents a valid model of instructional system development.

11 It has to be taken in the sense that output and input specifications are made in clear and measurable terms, and a relationship is established between inputs and outputs in the form of organizing specific learning conditions, trying out for evaluating the effectiveness of the established relationships and utilizing the results of the tryout for further refinement of the relationships between the inputs and outputs. Therefore, the concept of programmed instruction could be considered as a significant landmark in the process of systematisation of instruction. By systematisation of instruction is meant a systematic way of designing, carrying out and evaluating the process of instruction and bringing about effective instruction through the optimal use of the findings of research in human learning and communication and of men and material resources. This contribution of programmed instruction to the process of systematisation of instruction, has been emphatically stated by Lumsdaine and Glaser (1960) in their "concluding remarks", the crux of the programmed instruction concept is that ".....instruction and learning are amenable to systematic description and improvement through empirical inquiry" and that ".....the process of teaching and learning can be made an explicit subject matter for scientific study, on the basis of which a technology of instruction can be developed".

With the introduction of programmed instruction on to the instructional scene, more rigorous attempts have been

12 made in systematising instructional process. The works of Hommes (1970), Keller (1967), Gagne (1962), Glaser (1966), Briggs (1967), etc., are direct evidence to this. Application of the techniques of contingency management to school situations have been described by Homme, et al. (1969), Berkley and Walker (1970), and Madson and Madson (1970). However, many of these behavioural scientists, Gagne, Glaser, Briggs, Melton (1964) have taken a more eclectic view of learning theories than restricting themselves to only operant conditioning principles to instructional system development. The argument, as reflected in their works, for taking such a view is the recognition that there is not just only one kind of learning, and hence, a given principle of learning would not be applicable to all the different kinds of learning. Thus, they have proposed a careful analysis of the tasks involved in the final goal performance as well as many intermediary subgoals with their respective tasks. Once the tasks have been delineated, the specific principles of learning from different learning theories may be selected for accomplishing the tasks. A good many examples for drawing principles of learning from different learning theories and their utilization in designing instruction could be seen in the works of Gagné (1970) and Gagne and Briggs (1974). Ofcourse, the drawing of appropriate principles would depend upon the conditions which produce that type of learning to the next subtask or to the ultimate real life situation. Eventhough Gagne, Glaser, Melton, Briggs have been eclectic

13 in drawing principles of learning from different learning theories, the basic structure in their models is behavioural in orientation as is illustrated by their consistent reference to meditation of stimuli and responses, and gradual progression as evidenced in their hierarchy of learning tasks. If one goes through the works of these behavioural scientists, one can easily discern the psychological basis they envision for planning and organizing the instructional process. They recommend procedures such as specification of the instructional goals in terms of the learner's terminal performance, identification of the entering characteristics of the learners, planning the instructional procedures, selecting appropriate media for presenting the learning conditions, provisions for monitoring individual student's progress and for periodic evaluation for determining the effectiveness of the learning conditions provided, etc., all of which have been originally prescribed as essential features of the developmental procedure of any programmed learning material. In this context, it may have to be recognized that Skinner's contribution of PLM is just a plausible model of instruction. As already mentioned, much of his contribution lies in the fact that PLM has initiated the process of systematisation of instruction. 'Systematisation' here is in the sense as has been explained earlier.

What is discussed above should not be taken to imply that programmed instruction has been considered as an

14 unquestionably perfect instructional technique. It has been criticised with regard to its very structure. In what follows are focussed a few pertinent criticisms levelled on this ground.

Programmed instruction has been mainly criticised on the grounds that it is totally verbal in nature and is devoid of human interaction. It has been argued that PLM with its bias on verbal learning is not an adequate technique for teaching all the objectives - particularly those which involve complex behaviours such as formulating and restructuring of problems during problem solving process, retroductive reasoning, etc. In this respect, Kersh (1965) argues that the unique capability of a human instructor should be capitalized on to identify, elicit and reinforce complex behaviours in others. As an example, suppose the learner is engaged in a problem solving activity. In such a situation, the human instructor by interacting with the learner (interaction being in the form of focussing learner's attention to the relevant points of the problem through appropriate questions and suggestions, motivating them in arriving at a solution to the problem through offering encouragement, cues, prompts, etc., sometimes through refocussing the problem) can effectively 'shape' his heuristic behaviour without breaking the continuity of the learner's complex behaviour. Many studies have been conducted with this role of human instructor in enabling the learner to develop certain problem

15 solving or heuristic behaviours (Ausubel, 1961; Gagne and Brown, 1961; Kersh, 1964; Kersh and Wittrock, 1962; Arunkumar, 1978). On similar lines, Krutch (1970) argues that PLM is overly simplistic at best and grossly in error at worst. He criticises that it is all too easy to restrict one's objectives to those which are more easily presented in measurable form, such as those involving factual rote memorisation and psychomotor responses and to ignore complex but meaningful human learning. In a similar way, Silberman (1963) states that early attempts to adopt programmed construction to all educational goals resulted in considerable amount of wasted effort. However, an opposing view is offered by Resnick (1963). He argues that previous attempts to teach complex behaviours may have been ineffective because the behavioural components of such skills have never been clearly identified, and because techniques for shaping up discriminations and for establishing stimulus control are not yet perfected. A perusal of literature related to PLM would reveal that in a few studies such complex abilities such as appreciation, creativity and productive thinking, etc., have been achieved through PLM by bringing about certain modifications in its structure (Reid, Ciardi and Perine, 1963; Crutchfield, 1965; Williams, 1977). Crutchfield and Covington (1966) approached the linking of creativity and programmed learning as an apparent paradox to be resolved, since features of PLM appear to be antithetical to the requirements of fostering creativity. Basing on their experiments with PLM in fostering

16 creativity, they have offered suggestions for improving programmes on the following lines: (a) accommodate choices of materials and paths in PLM; (b) use flexible kinds of feedback; (c) generate uncommon ideas; (d) use large steps to create productive tension. It may be conceivable that complex abilities when clearly identified and discriminated by the learner might be effectively shaped by PLM because the learner could easily evaluate his own performance according to printed instructional material. But the question that remains open for discussion is just because PLM has proved effective in achieving certain complex abilities, as mentioned earlier, is it necessary to force-fit programmed learning to all educational goals? Perhaps, the answer would be 'no' due to the very reason that PLM itself has proven more effective when combined with other techniques of instruction in achieving certain instructional objectives, then it being used alone (Klaus, 1961; Goldbeck, et al., 1962; Tobin, Biran and Waller, 1969; Jaya Chandran, 1980). Further, it also appears reasonable to think that one learner may benefit from one medium (due to his preconceived cognitive structure, learning style and study habits) and another from yet another medium. Since very little is known about which medium under what conditions will suit a particular student best in his pursuit of certain objectives, it may be necessary to employ several media in an instructional situation until more definite guidance is offered by research about matching of different media with the characteristics of the learners.

17 Briggs (1964), while favouring combined methods of instruction, states that it may be necessary to adopt combined methods of instruction which incorporate programmes for the main reason that programmes are not yet perfect either in technique or in coverage, and they often require presentation of supplemental information and correction.

The instructional objectives being diverse in nature, when specified in behavioural terms, would lead to various categories of behaviours which have a formal identity irrespective of the content matter. The categories of behaviour can be described as performances and distinguished from each other. An excellent classification of such behavioural complexities and hierarchy involved can be seen in the works of Gilbert (1962) and Gagne (1965). When one considers the repertory of behaviour structures underlying the different instructional objectives, and the learning conditions needed for enabling the learners to learn the different categories of behaviours, it becomes evident that multiple techniques (media) may have to be utilized to present different learning conditions for approximating the desired behaviours. This can be explained with the help of an example. Suppose the instructional objectives are to train students in laboratory procedures or train students in participating in discussions besides providing basic information. It may be seen from the objectives that they require different learning conditions to be presented through different media, in the above case,

18 through the medium of laboratory exercises and discussion sessions respectively. In this regard, it may be argued that through the utilization of a single technique, it may not be possible to achieve all the instructional objectives. Considering PLM in particular, it becomes obvious that it cannot serve as the sole technique for providing all the learning conditions because of its structural limitations. Further, the structural limitations of PLM do not provide sufficient scope for the learner to interact with materials which provide a diversity of sensory experiences which act as effective learning conditions for certain objectives. It may be mentioned that recognizing the limitations of PLM, efforts have been made to deviate from traditional Skinnerian programming by incorporating pictures, diagrams, games, problems, discussion sessions, simple experiments, etc., into the PLM for achieving different objectives. (Yadav and Govinda, 1976; Kapadia, 1974; Menon, 1977; Arunkumar, 1978; Vardhini, 1980). The attempts have been made to sequencing these different media of proven potentials for approximation of the behaviours, specified on the part of the learners. Annet (1972) after considering different studies conducted in behavioural control (Rothkopf, 1963; Frase, 1968; Schaefers, 1963; Hill and Cavanagh, 1969) indicates that there is room for wider utilization of materials and devices in addition to programmed text for making instructional process effective. What is implied from above is that one has to think beyond the programmed text for other techniques,

19 social (discussions, seminars, group activities, etc.) as well as electro-mechanical (audiotape recorder, slide and overhead projectors, radio, T.V., computers) for directing the learners attention to the relevant aspects of the task and getting him respond in appropriate ways.

DEVELOPMENT OF INSTRUCTIONAL STRATEGY AND SYSTEMATISATION OF INSTRUCTIONAL PROCESS

What could be inferred from the discussions presented in the preceding section is that there is no one instructional technique (medium) that would prove to be effective in achieving all the instructional objectives. On the other hand, in an instructional situation, a number of media may have to be utilized in an integrated and interrelated manner for realizing different instructional objectives. The use of different media would be dictated, mainly, by the instructional objectives (terminal behaviours) and entry behaviours of the learners and attributes of different media, since the learning conditions would be designed and presented through different media to make it possible for the learner to achieve the terminal behaviour from 'where he is' at the start of the instructional process. Different instructional media of proven potentials such as lectures, discussions, programmed text, text-books, audio-visual materials, etc., which form different instructional inputs will find their due places in the instructional process. For example, one set of objectives may require students to carry out simple

activities, look into charts and models and instruction written on the blackboard. Yet another set of objectives may call for group discussions, films, project work, etc. What should be noted is that each of these activities differing in their presentation of learning conditions, sequenced and organized in such a way that all would contribute to approximating the desired behaviour.

As regards the attributes of the medium, it may be mentioned that they are the capabilities of that particular medium to present particular types of learning conditions - to show objects in colour, objects in motion, objects in three dimensions, to provide information in printed words, in spoken words, simultaneous visual and auditory stimuli,etc. Once the appropriate media attributes for a given task and learner characteristics are specified, the medium which incorporates these attributes is identified. However, it may be quite possible that sometimes more than one medium would be capable of providing the required attributes. For example, PLM or lecture or taped commentaries can be thought of for providing basic information. Similarly, diagrams related to a particular concept may be presented on paper, projected on a screen, or even may be drawn on a chalkboard. In such cases where more than one medium is capable of providing the required attributes, further choice may have to be made on the basis of the availability of media and certain other pragmatic determinants such as time, cost, etc. Having chosen

21 the media that are appropriate for presenting the learning conditions, the next step would be synthesizing or integrating them into a reasonable instructional sequence which, as a matter of fact, depends upon the sequencing as suggested by the terminal behaviours. The effectiveness of the different media and the sequence in which they have been utilized could be seen empirically in terms of the learner's attainment of the terminal behaviours. This would provide necessary feedback for further modification and revision of the inputs and their combination. Thus, the process of instruction could be conceived as identifying and selecting, designing and organizing different sets of activities or learning experiences for attaining prespecified objectives. The sets of instructional activities that are selected, designed and organized in an integrated manner for attaining the specified instructional objectives may be denoted as an instructional strategy. The outcomes of such a systematic way of looking at instruction would be knowledge about the different components of the instructional system and their operation, which would contribute for the systematisation of the instructional process.

While attempting to systematise instructional process, a point to be considered is the fact that instructional system at any level of education is characterized by different courses of study. Evidently, the content included under these courses and the objectives for each

present a wide variation. An examination of the instructional objectives set at these levels, the type of learning conditions to be provided for the attainment of these objectives and the characteristics of the learners would reveal that no single instructional strategy can be evolved which would uniformly apply to all the content matters and at all levels. This implies that in relation to objectives, structure of content matter, nature of the learner's characteristics, etc., various instructional strategies have to be evolved.

Further, even at a particular level of education, for a given course of study, a single instructional strategy may prove to be ineffective in catering to the differential needs of the learners and their levels of comprehension and ability, since learners pose variation in their learning characteristics. This calls for efforts to identify different instructional inputs of equal potentialities (in terms of achieving the same instructional objectives) which cater to the differential characteristics of the learners and organizing them into suitable alternative instructional strategies. Through the development of such alternative instructional strategies, more flexibility could be brought into the organization of instructional process in catering to the heterogeneous nature of the learner's characteristics.

In the attempts to develop instructional strategies

23 at a particular level of education for different courses of study, the issue of specialization and integration of knowledge needs to be tackled. It is a matter of known fact that 'knowledge' is one and it has been classified on the basis of certain commonalities observed in sets of facts, principles, etc., into different disciplines. Inspite of this distinctive placement of knowledge under different heads like Physics, Chemistry, Biology, Mathematics, etc., a little reflection would reveal that there is a commonality characterized by the interdependency of all bodies of knowledge within themselves when they are channelized or directed to contribute to the understanding of any phenomenon or to the development of its applications. In recent years, it has been recognized that learning is more effective when facts and principles from one field can be related to another, especially when applying this knowledge (Taba, 1962). The specific consideration to be kept in mind, while developing instructional strategies for different content matters, is how the interrelatedness of different disciplines could be brought home to students with the distinctiveness of the disciplines being retained. This necessitates developing instructional strategies incorporated with the principles of integration of knowledge.

Since the major aim of studies in the area of systematisation of instruction would be arriving at

effective instructional strategies and institutionalizing them, the question of their feasibility in terms of time, cost and schedule involved needs consideration. The data related to such practical determinants would throw light on the applicability and practicability of the strategies. The developed strategy should be realistic in terms of time, cost and schedule. This brings into focus continuous evaluation of the strategies throughout the development from these practical points of view.

A practical constraint inherent in the development of instructional strategies is that it consumes much time in its planning, designing, developing and its organization. Added to this, it also involves personnel who are subject matter specialists and experts in educational methodology. Hence, it sounds rather impractical to think of developing instructional strategies for the complete system of education in one shot. On the other hand, it may have to be done through several well planned and coordinated efforts. This necessitates making choices of appropriate levels of education and content matter for which instructional strategies may have to be developed more appropriately and effectively.

SYSTEMATIZATION OF INSTRUCTIONAL PROCESS AT SCHOOL LEVEL

It was discussed earlier as to how research efforts are to be directed towards developing effective

and efficient instructional strategies for different courses of study at different levels of education and thereby systematising the process of instruction. The needs for undertaking such efforts at school level are discussed below.

As in the case of many developing countries, in India also, a large majority of the student population tend to leave the educational stream after the school stage. This very reason rests the responsibility on schools for providing a basic education in its broad perspective. Education at school stage has to serve a dual purpose, It has to prepare the students for stepping out into various walks of life, and also enable them to adjust themselves into changing social conditions in a better way through the development of certain intellectual skills, personality qualities such as confidence, self-reliance, tolerance for other's ideas and co-operation, independent study habits, etc. Further, the school has also the task of preparing the small percentage of students who opt for higher education, so that they can meet the challenges of higher education. Obviously, the needs of these different groups of learners as well as the measures of meeting their needs would be different. Research and developmental activities focussed on these aspects would provide a rich source of data to plan out systematic educational efforts for specific student

population. From the above, the need to systematise instructional process at school level could be easily discerned.

Systematisation of instructional process at school level would be most ideal, if all the content matter of the school curriculum could be appropriately dealt with through an effective instructional strategy, so that students are fully exposed to it as to avail themselves of the fullest advantage of the instructional strategy. However, taking into consideration the amount of time, energy and finances involved in developing learning material to be presented through various components of the strategy, it is but practical to experiment on the effectiveness of the instructional strategy in a particular subject at a time. When data obtained through such individual studies analysed, certain similarities and differences operating in various instructional situations could be obtained. Thus, each individual study would have a place in scrutinizing the process of instruction through subjecting it to scientific inquiry, thereby throwing light on the instructional process as such.

At school level, science as a discipline of mind and a preparation for higher education deserves its due emphasis alongwith other subjects. A few factors which emphasise systematisation of science instruction at school level have been discussed below.

27

The advancements in science and technology has left its finger prints on almost every aspect of human life. It has changed man's intellectual outlook and values, and has made one aware that the world of today is no longer like that of yesterday. Further, the production of new knowledge in science, and its applications in technology is changing our entire pattern of vocations and career advancements. Today, there is an increasing percentage of jobs requiring scientific or technical training. But, it is a fact that it is no longer possible to prepare one for a lifelong career, since knowledge requirements change and many jobs become obsolete. When such being the advancements in science and technology, instruction in science should prepare young people to learn on their own. The emphasis on self-learning is due to the reason that as a learner gains experience through self-learning ways, he acquires more and more characteristics of a self-learner. The experience would enable him to use skills and strategies by which he manages his own learning, and continues to manage learning even after leaving the educational stream. Besides this, the experience in self-learning would enable him to undertake later career changes and be flexible enough to meet them successfully.

It is also a fact that advancements in science and technology have provided many comforts to man, at the same time they have posed him with many problems. If the aim of

education is to enable one to adjust oneself to the changing needs and thereby survive in the world, then the task in science instruction would be to provide students with the kind of education which would not only provide an understanding of today's problems, but also help him to recognize the future problems and act accordingly. Further, it should also help students in developing certain abilities like logical reasoning, accuracy and precision which are of utmost importance for an individual to meet the challenges of the time.

Since the generation of knowledge is a major endeavour in any society, it would not be sufficient, if science education just imparts conceptual framework in science. It should enable him to participate in the process of establishing new knowledge. In other words, instruction in science should enable students to think and act like a scientist. The emphasis, then, would be on the development of the skills of scientific inquiry and of scientific attitude.

Add to the above, subjects like physical sciences and natural sciences are distinguished by a continual flow of new knowledge accompanied by new theories and models. It is needless to mention that instruction in science must reflect these advancements. There needs to be a curriculum programme to prevent courses from becoming outdated. In other words, there should be a continuous reappraisal of the

29 content and methods of teaching. In India, already many attempts have been made to upgrade the content, which has brought the necessary impetus for modernization of instruction. Various media of instruction such as PLM, team teaching, simulations, discussions, tape-recorders, films, radio, T.V., etc., have gained popularity in the educational field due to their proven potentials of achieving various instructional objectives. An integrated utilization of such media in instructional situation may go a long way in achieving various instructional objectives.

In the light of what has been discussed so far and also keeping in mind certain limitations of the investigator regarding the mastery of the content matter and limitations of facilities available (organizational as well as financial) for carrying out such a piece of research, an attempt has been made in the present investigation to develop a multimedia instructional strategy for teaching the content Biology at the secondary school level, and study its effectiveness and operational feasibility in actual classroom situations. The strategy being conceived of various instructional inputs (components) of proven potentialities, planned, designed and organized into an instructional system for achieving the prespecified objectives of instruction. Thus, the problem, in the main, refers to identification and selection of different instructional inputs of proven potentialities and

30

organizing them into an instructional strategy, and validating the strategy for its effectiveness in terms of the attainment of instructional objectives. Efforts have also been made in the investigation for studying the feasibility of the developed strategy in terms of time and cost, and also certain relationships between learner characteristics and their achievement through the strategy.

The specific title and objectives of the study have been presented below:

Title: "DEVELOPMENT OF MULTIMEDIA INSTRUCTIONAL STRATEGY FOR TEACHING SCIENCE (biology) AT SECONDARY SCHOOL LEVEL".

OBJECTIVES OF THE INVESTIGATION

1. To develop a duly validated multimedia instructional strategy for teaching the course Biology at VIII std. level.

2. To study the relationship between students' achievement and their intelligence.

3. To study the feasibility of the strategy in terms of (a) time and (b) cost.

4. To develop alternative instructional components for teaching a few concepts and studying their relative effectiveness.