# CHAPTER VIII

# SUMMARY

## 8.1 Introduction

We are living in an exciting period in the history of human kind where new ideas appear faster than old ones become irrelevant. The advances made in the scientific and technological field have put greater demands on our educational system. This continually growing fund of scientific information developed daily, to be disseminated to the students in our science classrooms, in order to provide them with scientific and technological competence, requires that a teacher should make use of a variety of methods so that knowledge imparted becomes simple enough to be digested by the learner quickly. For this, the educators should become generally familiar with the findings of learning psychology, researchers and psychologists should be more aware of the problems and prospects of educational applications and the two groups should recognize the various ways by which they might exchange information so that both psychological theory and educational practice will be advanced. Considerable effort should be expended

to relate learning principles and theories to educational practice.

The learning theories, now known, may broadly be classified into two families, namely, S-R (Stimulus-Response) conditioning theories of behaviouristic family and cognitive theories of the Gestalt field family. An intentional teacher will always have to base his/her outlook on learning, which is very important in instruction, with the following choices :

(1) They may in both theory and practice adhere to one systematic position

or

(2) They may eclectically, that is, selectively, borrow sensible ideas from various theories and form new position to suit the environment in which learning takes place.

Since many of today's educators adhere to some sort of eclectic position with regard to learning process, a teacher being a potential instructional designer, should have some idea of the forms that eclecticism may take. One such in this section is eclectic behaviourism by Robert M. Gagne and his conditions of learning. Gagne's psychology centres on behaviourism, loosely defined, but contains marginal overtones gained from cognitive field theories (Bigge,1982).

In his efforts to bring out, develop a theory of instruction based on the conditions of learning, thus applying the findings from learning theories to education, Gagne's contribution is unique and needs special attention. Gagne has hypothesized that sequences of instruction should be developed utilizing the learning hierarchies that he proposed and the learning types he enunciated. Gagne has also addressed himself to the issues of student motivation, methods of presenting instruction and learning outcomes. However, the main focus of his work has been clearly to propose a hierarchy of learning types and to demonstrate its implications for instruction.

For Gagne, the purpose of psychology is to observe conditions under which learning occurs and to describe them in objective terms. Thus, his conditions of learning consists of various sets of observable circumstances that obtain when learning occurs. According to him the process by which all human beings learn is hierarchical and begins with storing bits of <u>information</u>. Passively or actively these bits are processed or <u>discriminated</u> into distinct groups which we call <u>concepts.</u> These concepts are linked into complex arrays which we may call <u>principles</u> or <u>rules</u>. We use our stocks of principles or rules again and again

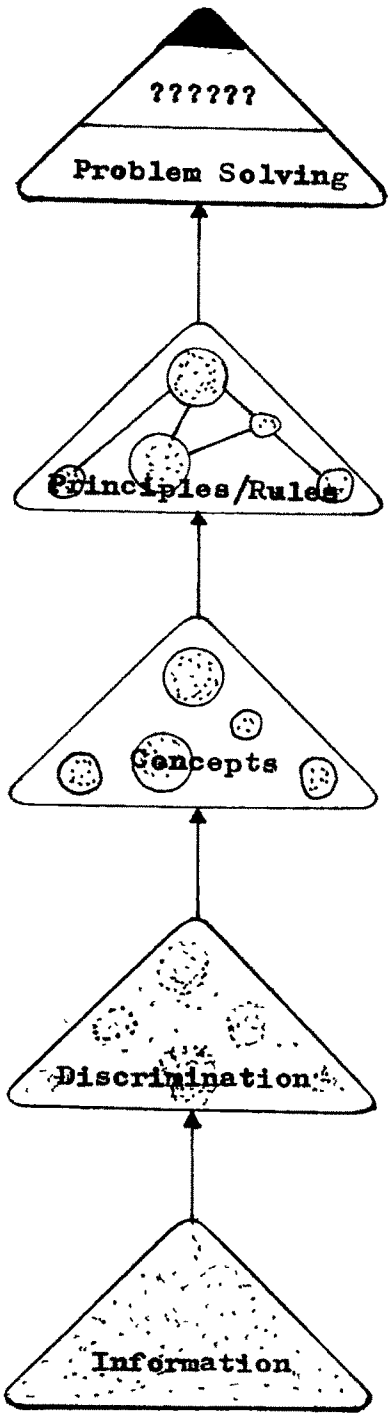


Fig.8.1: Learning Hierarchy

to solve problems, we are faced with. Higher order rule in problem solving form the top of Gagne's hierarchy, the most sophisticated stage in the learning process.

Gagne considers that instructional procedures should be systematically designed according to the basic principles that are established through research. As the manager of instruction, it is the teacher's job to plan, design, select and supervise the arrangement of external events, in the form of environment stimulation with the aim of activating the necessary learning processes. Instructing means arranging proper conditions of learning that are external to the learner. These conditions include the teacher communicating verbally with the student to inform him of what he is to

achieve, reminding him of what he already knows, directing his attentiom and actions and guiding his thinking along certain lines. It is a matter for the teacher to make sure that each student has the requisite capabilities for the learning task before him and stimulating the use of capabilities that the learner already has at his disposal. In any learning situation, the appropriate learning hierarchy consisting of pertinent pre-requisite intellectual skills, involves the application of conditions of learning. Any design of instruction should take into consideration the condition under which learning occurs. Gagne's contribution in this respect is both valuable and commendable.

The implication of any theory, be it the most venerable one, to instruction and thus to learning must always be examined and re-examined in the changing conditions, and in different cultural environment to re-establish its validity and usefulness. Though quite a bit of work has been done based on Gagne's learning model in western countries, not much has been done in our country. Even today, after almost two decades since Gagne initiatly proposed his conditions of learning, the literature getting published in the international journals reveals the prominent position that his views on learning

continued to occupy. The success of any theory depends on how it can help the practitioners in producing optimum learning conditions. For a practioner the adoption of the findings from learning theories not only provide organization and systematization in instruction but also help in the actual operation with a definite pattern which is psychologically sound and which can be monitored, analysed, criticized and evaluated at all stages. In fact, there is a great need to integrate the relevant and promising learning theories to actual classroom practices. We are convinced that despite the troubles in besetting education, there presently exists a really delightful and vigorous array of approaches to instruction that can be used to transform the world of schools, if only we will employ them. The present study is an attempt in this direction, which was titled :

"AN EXPERIMENTAL STUDY OF GAGNE'S CONDITIONS OF LEARNING FOR INSTRUCTION IN PHYSICS AT SECONDARY LEVEL".

## 8.2 Objectives of the Study

The main objective in this study was to develop an instructional strategy to teach physics, based on Gagne's conditions of learning and to conduct an investigation into its efficacy.

More specifically, the following objectives were formulated for the study :

(1) to design an instructional strategy based on Gagne's conditions of learning.

(2) to experimentally validate the instructional strategy developed.

(3) to examine whether the acquisition of higher order capabilities necessarily include lower order capabilities also.

(4) to determine whether the instructional strategy adopted brings any change in cognitive preferences of learner.

## 8.3 Hypotheses

Physics, because of the nature of the subject itself, consists mostly of intellectual skills - concepts, rules and problem solving. Therefore the investigators interest was limited to the hierarchies in learning at concept, rule and problem solving level only. No internal hierarchy relationship, if any, within the concepts or rules were intended to be brought out in the study.

The following hypotheses were formulated to be tested :

(1) The instructional strategy designed based on Gagne's conditions of learning can successfully be used in the normal classroom setting.

(2) The performance of the experimental group using the new instructional strategy will be better as compared to that of control group following traditional method.

(3) The existence of higher order capability problem solving ensures the presence of lower order capabilities rules and concepts and the acquisition of rule capability depends on the presence of concept capability.

(4) The hierarchy in learning does not depend upon the nature of instructional inputs and their sequencing.

(5) The learning hierarchy based on the instructional strategy with problem solving at its apex will bring changes in the cognitive preferences of learners from facts to problems.

## 8.4 Plan and Procedure

Plan and procedure of the whole of study was designed in accordance with the objectives mentioned and to test the hypotheses formulated within the limits mentioned therein.

### 8.4.1 The Sample

The experiment was conducted with students of Standard IX, numbering about 75, studying in one of the higher secondary schools of Baroda. The school is affiliated to the Central Board of Secondary Education, New Delhi.

### 8.4.2 The Design

Standard IX mentioned above had two Sections- A and B. It was decided not to disturb the classroom situation as it may bring administrative problems in the school. Besides, it was considered that an experiment conducted in the actual classroom situation will have more applicability than the one conducted in a specially created situation. Therefore, Standard IX-A was selected as experimental group and IX-B the control group, selection being done randomly. The help of a colleague,

teaching the same subject at the same level, was obtained and instruction was carried on a rotational basis. (i.e., teacher changing the class after half the programme was over). The data needed for the study were obtained through criterion tests at the end of each unit, a comprehensive test at the end, and the annual examination.

### 8.4.3 Development of Instructional Material

The first major work was related to the development of instructional materials. The material developed had three components namely :

(i) Classroom Learning Material (CLM)

(ii) Home Assignment Material (HAM)

(a) Self Learning Material (SLM)

(b) Self Evaluation Material (SEM)

(iii) Assessment Material (AM)

The classroom learning material development consisted of the following steps :

(1) Identification of topics

(2) Deciding the sequences of the topics

(3) Task analysis

(4) Formulating the topic objectives

(5) Deriving the learning hierarchies

(6) Checking the reasonableness of the postulated hierarchy with experienced teachers and subject experts.

(7) Preparation of the learning material based on learning hierarchies with evaluation questions at each level.

Having selected the topic, a task analysis map was prepared, and the learning hierarchy was constructed by asking Gagne's question, "What must the learner to able to do in order to learn this new element, given only instruction?" (Gagne 1962, p.358). In developing material at each stage due consideration was given to different attributes concerning the elements so that a concept or rule is dealt with extensively. Each concept is developed around the following general points :

(1) Definition

(2) Examples

(3) Type of quantity

(4) Written representation

(5) Specification (magnitude and direction)

(6) Special notes, if any

(7) Limitations, if any

(8) Illustrations

(9) Simple calculations

(10) Evaluation to test the concept capability

The rules were developed around the following points :

(1) Statement of the rule

(2) A representation of it in an equation form

(3) A derivation to establish the relationship between concepts

(4) Experimental evidence, if any

(5) Illustration to explain the rule

(6) Applications of the rule and its consequences

(7) Evaluation to test the acquisition of rule capability

Development of materials to induce problem capability involved the following steps :

(1) Problem statement

(2) Equations or rules involved in the solution of the problem

(3) Substitution of relevant values

(4) Calculation of result

Apart from the guided problem solving exercises evaluation items were also included at the end of each unit.

The home assignment material (HAM) was developed in

two parts. The first part, viz., self learning material (SLM) consisted of the following :

(1) Introduction to the students

(2) Programmed learning material

(3) Guided problem solving exercises

The second part consisted of self evaluation material (SEM) which consisted of different types of questions to test the capabilities at concept, rule and problem solving level. All the items included in HAM were provided with answers at the end so that students could evaluate themselves.

The assessment material (AM) was prepared in three parts; A for concepts, B for rules and C for problem solving. This was done to test the capabilities acquired at these three levels. The item types included multiple choice, completion types, definitions, statement of rules, short answer types, derivations, and problem solving exercises.

8.4.4 Treatment

Having prepared the instructional material the next important step involved was the instructional management which consisted of the selection and organization of instructional events. The initial orientation to the students focussed on :

(1) what the instruction was about

(2) familiarization with the learning materials.

(3) evaluation at the end of every element.

(4) assessment at the end of the topic and at the final completion stage.

The instructional events consisted of :

(1) informing the learner of the objectives

(2) stimulating the recall of pre-requisite learnings

(3) presenting the stimulus material by way of instruction

(4) providing the learning guidance by way of hints etc.

(5) eliciting performance through individual practice

(6) providing feedback about the performance correctness

(7) enhancing retention through self learning

(8) feedback about individualized self learning exercises

(9) assessing performance

(10) providing feedback based on the assessment.

Instruction in the control group was traditional lectures based on the textual material. Textbook formed their resource material. They were not provided with any self learning material.

8.4.5 Data Collection and Analysis

The necessary data for the experimental analysis was obtained through a criterion test held at the end of each topic, a comprehensive test held at the end of the experiment, the annual examination scores at the end of Class VIII and Class IX, and the cognitive preference test administered before and after the experiment. Provision was made in the criterion test to obtain separately the scores in respect of concepts, rules and problem solving.

The criterion test scores were analysed using statistical techniques such as percentiles, mean and standard deviation to study the feasibility of the instructional strategy in the existing classroom environment. The analysis also was directed towards modification of the instructional components particularly the software, if needed. The combined criterion test scores, comprehensive test scores and annual examination scores were studied using analysis of covariance to examine the status of this instructional strategy developed against traditional method of instruction. Concepts, rules and problem solving scores were analysed separately using chi-square test to examine the hypotheses related to the existence of learning hierarchy. Finally, the pre-test and the post-test scores on Science Cognitive Preference

Inventory (SCPI) were computed to determine, the difference in mean and t-ratio and hence to find the shift, if any, in cognitive preference.

## 8.5 Major Findings

(1) The instructional strategy designed and developed based on Gagne's conditions of learning was found feasible to be adopted for normal classroom teaching.

(2) Instructional strategy based on Gagne's conditions of learning was found more effective than traditional method of instruction in terms of student performance.

(3) Successful problem solvers were those who had shown better performance at the concept and the rule levels.

(4) Problem solving forms the weakest area for many students, in the hierarchy of learning.

(5) Hierarchical relationship was found in the learning of intellectual skills with problem solving coming at the apex followed by rules and concepts taking the bottom place.

(6) The hierarchy in learning did not depend upon the type of instructional input and their sequencing.

(7) The existence of a higher order skill ensured the possession of lower order skills also.

(8) The instructional strategy based on Gagne's conditions of learning was found to change the cognitive preferences from facts and applications to principles and problem solving.

## 8.6 Educational Implications

The study and the findings therefrom are of direct significance for planning and designing of instruction, and for organization and management of classroom events. The strategy tells us that a variety of specific procedures are to be designed to make learning process effective. The instructional events are to be planned and delivered to the entire class with provisions for stimulating the recall of pre-requisites. Systematic attention to the recall of pre-requisites would have noticeable effects on learning.

Intellectual skills form the major part of school learning especially when it comes to science and mathematics. Designing materials for the acquisition of these

capabilities, concepts rules and problems based on proper hierarchies is of immense importance for systematisation of classroom instruction. Significantly the study has brought out the following main implications :

(1) There is a need for identification of various intellectual skills present and required in a subject-matter of study.

(2) Complex concepts have to be split into smaller elements making it easier for children.

(3) Learning hierarchies may be produced and validated in different subject areas which could easily be used by instructional practioners.

(4) Alternate instructional strategies should be developed to first master the lower order skills and the then proceed for acquisition of higher order skills.

(5) Changes in the cognitive preferences can be used as an indication to the effectiveness of an instructional strategy.

## 8.7 Conclusion

The central problem facing educators, today, is how to improve levels of learning and performance of the students in the classrooms. In order to improve learning, teachers will have to employ various instructional strategies; they must understand the principles enunciated through different learning and instructional theories and cast their lessons, presentations and evaluations according to these principles. Over the years, a great many educational models leading to the development of various instructional strategies have been suggested by people engaged in distinctly different kinds of activities. These strategies were based on practices, empirical works, theories, hunches, and the research done on several theories. It would be easy to provoke a heated debate over which one is 'best', as there is no single known answer to it.

The research evidence dealing with the question of which strategy is best for instruction so that children are at their best in learning, is remarkably ambiguous. Several hundred studies compare one general teaching method to another and most of these studies - whether curriculums are compared, specific methods for teaching specific subjects are contrasted, different approaches to

counselling are analysed or various strategies developed are compared - show little evidence, to date, to give any encouragement to those who would hope that we have identified a single reliable, multipurpose teaching strategy as the best approach (Joyce and Weil,1985). Possibly one particular strategy may not be the answer to all our problems. May be, as Gagne (1963) pointed out, teaching embraces attributes too numerous to be encompassed at the present time by a single strategy, theory or a family of theories. As the time, the environment, the population and the subject matter change, alterations may have to be brought about in any model to obtain the best result.

Many of the theories suggested and experimented are not complete in many respects. Most find it difficult to adjust to the classroom situation of today. With classrooms crowded with a vast variety of learners suitability of some of these theories and strategies have become doubtful and fail to attract the customers - practitioners. Unquestionably, every strategy designed and developed, should be practically feasible. It seems reasonable to suppose that as our technology for studying teaching and learning improves, people will discover regularities in the teaching learning process that have

not been apparent before. A few general methods or strategies may emerge as superior. It is more likely, however, that a few weak models will be exposed as such, but a variety of strong ones will remain.