CHAPTER II
THEORETICAL BACKGROUND OF PROGRAMMED LEARNING

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INTRODUCTION

It is obvious that science and technology have touched almost all the aspects of human life. Since people become conscious of importance of education and the populations of the world are exploding day by day, there is a need to find out a certain way to impart a large quantum of knowledge to a large population within a limited time. As a result, programmed learning has emerged as an application of behavioural science and technology in the field of education. It has shown a new path towards automation and individualization of instruction.

Though the term 'programmed learning' is not a very old name in the field of education, the concept is as old as Socrates. Programmed learning is regarded as a recent development because its practical application to the field of education has become apparent only in the past few years. But it is not so. One of the earliest programmers was Socrates. Socrates had developed a programme for Geometry. He taught his students by conducting them conversationally along a path from fact to fact. The same strategy is followed in programming.
The traces of programmed learning may be found in the law of effect proposed by E.L. Thorndike (1874-1949). In 1926 Sidney L. Pressey, a psychologist, invented the first recognised teaching machine. It was conceived as a testing machine that presented a series of questions to a student which were followed by correct answers informing him whether his answers to the questions were right or wrong.

In 1950, conditions in the world had changed. Greater knowledge in the science of learning behaviour created greater opportunities in the field of instruction. In this new era of 'science of learning and art of teaching', B.F. Skinner, Professor of Psychology of Harvard University and James G. Holland developed the programmed learning technique on the basis of his theory of learning which is called 'operant conditioning'. That style of programme is a linear one. Later on in about 1955, Norman A. Crowder of the University of Chicago introduced another style of programming known as branching programmes.

2.2. Concept of Programmed Learning

Programmed learning which is also known as programmed instruction is different from more commonly used term 'a programme of instruction'. Programmed learning has
principles and characteristics of learning and it promises to improve instruction. Edgar Dale (1969) writes in "Programmed Instruction" that the programmed learning is the product of the earliest efforts towards instructional improvement. These instances were relevant to the scientific approach, ability analysis and specification of behavioural objectives; criterion tests of terminal behaviour; feedback on the results of learning efforts and instructional design; individualized instruction and self-managed instructional materials and environments, and educational engineering.

Programmed learning is a way of anticipating student's responses during the teaching-learning process and of designing the entire gamut of learning experiences to a predetermined set of specific goals or objectives.

Programmed learning is a self learning technique according to which the clear concepts of the subject matter are clearly presented one by one in written form to the learner in a logically arranged small steps. In other words, it can be said that programmed learning is a planned process whereby the learner has to pass through certain planned steps of information with which he interacts in order to achieve the objectives of the course.
2.2.1 Programmed Learning Material

Programmed learning material (PLM) refers to self-instructional devices through which the content to be taught is analysed and developed into programmes, which is designed taking into consideration a theory of learning and the nature of the student for whom it is designed. It includes capabilities of particular device to be used. It helps a student to learn of his own without the help of a teacher.

By nature, programmed learning technique is a very powerful tool for learning. Its logical steps accelerate the learning rate. It is an effective technique because it constantly interacts between student and his learning material, programmed learning affects the stimulus by acquainting the student with only one item at a time and by presenting the total number of stimuli in sequence that lead to greater understanding. It governs the response through instant checks of answers and through consistent immediate reinforcement of learning.

2.2.2 Definition of Programmed Learning

The term 'programmed learning' has been defined by different educationists in a number of ways. Some of the
definitions are given below:

Callender (1969) defines programmed learning as, "an attempt of systematic education and training, using some of the methods of modern industry. It is also an attempt to make the teacher a more efficient mediator between learning and the learner". (p. 7).

According to L. William (1965) as cited by Peal (1982) programmed instruction is the process of arranging the material to be learnt in a series of small steps which are designed to lead a student through self-instruction from what they know to the unknown of new and more complex knowledge and principles (p. 49).

Marrile (1969) has defined programmed instruction as "a reproducible sequence of instructional events designed to produce a measurable and consistent effect on the behaviour of each and every acceptable student". (p. 104)

J. Leedham and D. Unwin (1965) state that "Programming does supply a modicum of individual attention, especially in so far as students are enabled to proceed busily without waiting or distraction". (p. 11).

Taber, Glaser and Schoer (1965), define it as, "a process of constructing sequence of instructional material
in a way that maximizes the rate and depth of learning, factors understanding and the ability to transfer knowledge to new situations, facilitates retention, and enhances the motivation of the student. It is an explicit process; it is what an effective teacher does intuitively". (p. 2).

McCall (1964), states that, "Programmed learning material is the arrangement of material to be learnt into ordinary series of learning experiences, in each of which material is presented and feedback given". (p. 130).

From the above definitions given by some eminent educationists, the following conclusions can be arrived at:

- The subject matter is analysed into well ordered sequence of stimulus items.
- The student responds to each stimulus item, in the same specified way.
- The student's response is reinforced immediately by supplying feedback.
- The student proceeds in small steps.
- The student commits a few errors.
- The student reaches the terminal objective by successive approximation from what he was knowing to what he has to know, by going through the program.
2.2.3 Characteristics of Programmed Learning

Programmed learning is a carefully ordered and organised sequence of material to assure the best possible learning conditions for a student. It utilizes the principles of reinforcement to make certain that learning actually does occur. The programmed learning embraces both the factual matter of the subject and the skills involved in learning patterns, using every aspect of reinforcement theory to lead a student to a full understanding of its material.

As stated by Fips (1966) programmed learning owes its potency to four characteristics and to a point of view that is often—and deplorably—absent from other forms of instruction. The four characteristics are as follows:

1. **Small steps**: The subject matter is presented in meaningfully organised small steps which are called "frames".

2. **Active participation**: Programmed learning makes the student respond actively while he is going through the programme.

3. **Immediate knowledge of result**: After the learner has made a response, he is provided with the knowledge.
of results to confirm his response which works as a feedback to the learner.

(4) **Self-paced** : In learning through the programme, the learner proceeds at his own pace. By providing self-paced programming becomes more suited to individual difference in learning.

2.3 **Styles of Programming**

There are three styles of programming. They are:

i. **Skinner's Style**

ii. **Crowder's Style**

iii. **Gilbert's Style**

2.3.1 **Skinner's Style**

Skinner's style is also known as linear type or extrinsic type. This type of programme was originated by Skinner on the basis of his analysis of learning processes. The desired change in behaviour can take place in the best way if the response is included and then the desired behaviour rewarded. The linear programmes present a sequential development of the material. The material is presented in a very small step. Each step is called a frame. Each frame has a blank or blanks or short question along with the adequate cues or prompt to which a learner...
has to respond. The correct response is presented to be marked and then to be tallied with learner's own response. If the response is found to be correct he feels rewarded and thus the material is strengthened. Errors on frames are considered irrelevant and undesirable and their occurrence is restricted to a negligible number. This implies that the number of frames should be increased, all related concepts should be included, repetition should be encouraged and adequate cues should be provided. The characteristic of linear programmes is a single path sequence and in which all students read and respond to the same material as shown in the diagram below.

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1 → 2 → 3 →
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The student responds to the first item and then-after receiving word of the accuracy and adequacy of his response, proceeds to the second item. He goes on to the third and subsequent items in linear form irrespective of any errors he might make on intervening items.

In short linear style postulates three principles round which programming is based. They are:

- Active Response
- Minimal Error
- Feedback
2.3.2 Crowder's Style

Crowder's style is also known as branching or intrinsic style of programming. In this style the material is presented in a large size of frame followed by a multiple choice question, which has two or more alternatives along with the page numbers written against them. After having selected the alternative, the learner is required to turn the page number given against the alternative where he was told whether he was correct. A diagram of simple step in branching programme is shown as an example below:

In the first item, the student is given a small unit of information. He is then given a brief test question on the material and a choice of three responses. If he selects the correct answer, he will be directed to the fourth item and goes on to the next instructional unit. But if his response to the first test question is incorrect or inadequate, he is sent to either eighth or twelfth item where he gets additional information, and is then returned to the first item to take the test again. Having got to
the fourth item directly or after intermediate stops, he
reads another unit and answers another test question which
will direct him to the ninth, seventeenth, or thirteenth
item depending upon the accuracy and completeness of his
response. Learning through branching programme, therefore,
the students are directed to different stream according to
their individual requirements. A bright student with
adequate pre-requisites may finish the programme much
earlier by going through the main stream whereas a slow
learner may be branched to different remedial materials
wherever he fails to respond correctly.

By its very nature, the Crowder's style of pro-
gramming works well with the slow and retarded learners.
Such learners require a thorough understanding of the bits
of knowledge before the coherent idea takes shape in their
mind. The incorrect responses of the learners are thus
corrected by the programming style.

The rationale of intrinsic programming postulates
that the basic learning takes place during the students'
exposure to the new material on each page. The multiple
choice question is asked to find out whether the student
has learned; it is not necessarily conceived as playing
an active part in the primary learning process involved.
Here no attempt is made to eliminate errors by the students. It is impractical to eliminate errors because of inevitable individual differences, both in ability and information, that will occur among students.

2.3.3 Gilbert's Style

Gilbert's style of programming is also called mathematics style of programming. Mathematics programme begins with a detailed analysis of what is to be taught. Gilbert emphasizes that analysis should cover subject matter together with the learner's activity. In this type of programming a special strategy is provided which is called process of chaining. Chaining is the arrangement of the operator so that the student is presented the last step of performance first, next to the last step second, till all operators have been taught to the students.

Beside the three main schools of programming, viz., linear branching and mathematics, there are some others to be mentioned. They are as follows:

2.3.4 Adjunct Programmes

S.L. Pressey is the contributor of adjunct programmes. It has emerged from his opinion that the structure of
textbooks is very complex. Therefore he designed adjunct programmes to make them understandable and thereby learnable.

Adjunct programmes are the programmes of instruction which organise the textbooks and other teaching material to make them more meaningful to the student. The student is guided to study the text by asking him to study the index, table of contents, heading and sub-headings of the topic under study; the student also studies indices graphs and figures; after this he uses the adjunct programme for review and to differentiate the major points that he has learnt in the textbooks.

The programme consists of number of graded questions in which the responses are reinforced. If he is not found correct, the remedial work is provided by telling him why his answer was wrong.

2.3.5 Mixed or Hybrid Programmes of Brainer Style

This style is the combination of two styles, viz., Branching and Linear styles. It can be started with a branching style and if the student makes a correct choice, let him go to the next frame in the main stream. But if he is incorrect, let him go through the linear form of the same concept. At the end of this linear series, let the
student respond to another critical question. If he responds it correctly, let him go to the main stream; if he is still incorrect, let him take the first frame of the linear series again.

2.3.6 Skip Programme

It is known as Skip programme if the principle of branching is applied in the linear programme of small steps.

At the beginning of each concept, one or two frames are presented which are followed by a terminal frame. The student will be able to answer this frame in the light of the material presented in the earlier frames. If the student is correct in this frame, he will go to the next concept, skipping over the further explanation of that point. If he is wrong, he has to go through all the frames related to that concept and then he has to take the terminal frame. Then only he can go to the next concept.

2.4 Psychological Principles Involved in Programmed Learning

B.F. Skinner formulated certain laws of behaviour on the basis of his extensive experimental studies. He prepared grounds for the application of those laws in human
behaviour. He was fully convinced that principles of operant conditioning promise equal success in school learning. Programmed learning is the application of operant conditioning.

It is also emphasized by Power and Brown (1972) in the preface of 'Work Book in Physics' that the following three psychological principles underlying all efficient and effective instruction are involved.

1. We learn best those responses we actually make and others only in proportion to their resemblance.

2. The ideas or concepts to be associated in learning and the association of these ideas or concepts must be identifiable i.e. recognizable to the learner.

3. Becoming conscious of unanswered questions bring a state of dissatisfaction which is removed by finding answers to the questions. The satisfaction strengthens the association that are formed.

According to the first principle a learner selects one response to a given stimulus and thereby learns by doing. According to the second principle the material is presented to the learner in small steps; leading him from known to the unknown. As it is given in it that the idea
or concepts to be associated are rendered identifiable to the learner. According to the third principle - the last one, the associations that are formed are strengthened (reinforced) by immediate knowledge of the results. Whenever an unanswered (difficult) question is likely to bring about a state of dissatisfaction, clues are provided to enable the learner to find the correct answer.

From the analysis of learning process in programmed learning it would be seen that this new technique in its operation utilizes maximally the three main principles from psychology of learning and psychology of individual differences such as:

1. Selecting a response or making a response to a stimulus and thereby establishing connection or in other words "learning by doing".

2. Principle of reinforcement or strengthening the connection.

3. Recognition of individual needs and individual differences.

In the linear programming, it is started from "ongoing behaviour", that is, existing repertoire of responses in verbal field and ending in "terminal behaviour", that is
responses to be learnt, passing gradually through a graded sequence of small steps with prompts and cues and being reinforced at each step relate fully to the learning principles. In fact, linear programming is a psychological discovery. Inclusion of correct response in the frame immediately following the stimulus question in the programmed instruction is direct application of the psychological principle of reinforcement postulated by Skinner, Pavlov, Hull and other behaviouristic psychologists.

The multiple choice type of response in branching programming helps to refine the diagnosis and to make for a sensitive assessment of individual differences. However, the linear programming also takes account of individual differences since it permits each student to go through the material at his own speed.

2.5 Sociology of Programmed Learning

In fact, the programmed learning is much individualized in character. Therefore, the important values of a class room atmosphere are not contributed to programmed learning. Extreme individualization in learning is ineffective in the total growth of a learner, as some of the desirable implications of group learning are lost. But the careful preparation of the programmed learning material
if wisely used in the classroom, a synthesis between individualization and group instruction can be achieved.

Skinner (1962) has tried to show the competition and co-operation arising between the two pigeons that were trained to play the game of ping pong. Each pigeon is separately prepared for its part in the total performance, and the social relation is arbitrarily constructed. This explains that the task of social relation can be constructed by carefully designing the programme of proper scheduling and the contingencies of reinforcement, so that the strength of the behaviour is maintained.

2.6 Conclusion

Programmed learning and programmed instruction have both been used interchangeably. Skinner, Crowder and Gilbert are the founder of different schools of programmed learning. Students have to interact with skinnerian or linear, Crowderian or branching and Gilbert-type or mathematics programmes. Interaction with the programme results into definite learning, because programmed learning is based on the definite theories of psychology and sociology. The programmed learning materials are quite different from other tools of learning. The students' learning through programmed learning continuously participate in the learning process,
equip themselves with the knowledge in the field. Then the mastery level of the subject is assured by the results of criterion test.

Review of the work done in programmed learning is given in the chapter to follow.

2.7 References


