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2.1 Introduction:

The Education Commission (1964-66) has taken the note of advancement of educational technology developed and practiced rapidly. The modern technology of Education has extensively used the findings of the researches undertaken in Behavioural Social Sciences as well as Natural sciences. The modern technology of Education has concentrated on the idea of auto-learning, individual differences, social background, continuing education and use of mass media material. The commission was of the opinion that these all should be introduced to the teachers in training and in-service training. It recommends, for the last three decades,

The advancement in natural sciences and technology have expanded the frontiers of knowledge by lips and bounds in almost every aspect of human life. Hence
the members of the human societies in the world cannot afford to keep themselves ignorant to this. Hence auto-learning and continuing education are the two main aspects to be kept before in conduction of any learning process-programme.

The rich societies have their vast resources to meet with increasing expenditure for the expansion of learning process, but the poor societies cannot afford much expenditure for learning expansion. So societies cannot do without expansion of learning on one hand and at the same time it cannot afford to incur heavy expenditure for that on the other hand. Hence new technology has to find out new learning technology which could be economically cheaper in the long run and could be proved effective in providing intensive learning steps. In this regard B.F. Skinner and Crowder gave programme learning to meet with the newer challenges mentioned earlier.

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. However it is not so. One of the earliest Programmers was Socrates, who developed a programme for
Geometry which was recorded by Plato in the dialogue, Meno, So it is clear that the origins of idea of programmed learning is not new but the caption of it as a certainly new.

2.2 The Meaning of Programmed Learning:

Programmed learning as an instructional system is still not vigorously tried out and empirically tested in the classroom. The experiments and researches have been started and yet many more researches are needed. It is the directed application of the findings of the careful study of learning process. This type of design, which guarantees success is the innovation in the process of instruction. 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 writes; "The programmed learning is the product of the earlier efforts towards instructional
improvement. These instances were relevant to the scientific approach activity analysis and specification of behavioural objectives; criterion tests of terminal behaviour; Feed back on the results of learning efforts and instructional design; individualised instruction and self-managed instructional materials and environments and Educational engineering.

Psychologists, after careful study of the learning process have found that if the findings of the study are applied to Educational strategy, the learning would be more effective.

Dr. S.S. Kulkarni has summarised the research findings as follows:

1. Behaviour which are rewarded (re-inforced) are more likely to reappear.
2. Sheer-repetition without indications of improvement is a poor way to attempt to learn.

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3. Reward (reinforcement) to the most effective in learning must follow almost immediately after the desired behaviour and should be clearly connected with that behaviour in the mind of the learner.

4. The types of reward (reinforcement) which has the greatest transfer value to other life situations is the kind which gives one self the sense of satisfaction in achieving purposes.

5. Opportunity for fresh, novel stimulating experience is a kind of reward which is quite effective in conditioning and learning.

The above stated findings are the bases on which programmed learning is developed. Thus, programmed learning can claim to be a good instructor. The definitions of programmed learning are given below.

2.3 **Definitions of Programmed Learning**:

A Laymen's definition of Programmed learning material is, that it is a printed discussion between an instructor and an individual student, in which both the student and the teacher, take an active part.
Learning steps when the student become inactive and again resumes, when his attention returns. It is highly personalised and it can assist the student to teach himself at his own speed. Hence it is called 'go at your own pace course'. George L. Geis' professor of Psychology at the University of Michigan, has chosen the phrase validated instruction because the programmed learning is the student oriented design to produce terminal behaviour which is consistent with the objectives of the PLM.

G.O.M. Lieth from University of Birmingham has described programmed learning as 'a process of analysis and synthesis'. The subject matter to be taught is carefully defined, and synthesized and ordered according to a logical sequence. An examination of some of the definitions would prove useful.

"Programming is a process of determining empirically a sequence of action or operating that follow a present order to assure a dependable performance at an established standard."


"Programmed Learning is the application of behavioural technology to education." 4

"Programmed instruction means the kind of learning experience in which a 'program' takes the place of a tutor for the student, and leads him through a set of specified behaviours designed and sequence to make it more probable that he will behave in a given desired way in the future." 5

"Instructional programme is a reproducible sequence of instructional events to produce a measurable and consistent effect on the behaviour of each and every acceptable student." 6

"Programmed instruction is an auto-instructional approach to teaching which is changing the role of the classroom teaching." 7

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"Programmed Learning is an attempt of systematic Education and Training, using some of the methods of modern industry. It also is an attempt to make the teacher a more efficient mediator between learning and the learner."\(^8\)

"Programmed Learning material is the arrangement of material to be learnt into orderly series of learning experience, in each of which material is presented and feed back given."\(^9\)

"Science and technology have touched almost all the aspects of human life and Programmed learning is an application of behavioural sciences and technology to the field of Education."\(^10\)

From the above stated definitions given by some eminent educationists, it can be concluded that the

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essential characteristics of programmed learning are as follows:

- The subject matter is analysed into a 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, whether he is right or wrong.
- 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 programme.

Recently, Programmed Learning is considered to be the first step towards Educational Technology. It considers teaching as an act of input and learning on the part of students as an output. The above-mentioned view develops Education as a science.

"Programmed Learning is a beginning of such a science. It can also be considered as a beginning of
Educational technology as it attempts to apply the laws of behavioural science to teaching-learning process.}\(^ {11}\)

2.4 **Characteristics of Programmed Learning**:

It has been mentioned earlier that a 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. Thus, the programme and the person who assigns it bear the major responsibility for the students success. If the student commits errors or fails to master the subject matter, the fault is that of the programme and not of the students.

Following are the common characteristics of the successful programmes as indicated by Lysought and Williams. 12

(i) **Assumptions Stated clearly in Writing**:

A programme builder has to make certain assumptions about the student to whom his programme is directed e.g. (a) He reads at a particular level of competence. (b) He has a command of vocabulary that is consistent with the language of the programme.

(ii) **Explicitly Stated Objectives**:

The programmer must determine the objectives or goals of the learning programme. These objectives should be defined in operational, observable and in measurable terms in order to make easy the construction of the programme and its subsequent evaluation.

(iii) **Logical Sequence of Small Steps**:

Subject matter, broken down into fragments of information, is arranged in an orderly sequence of growing difficulty so that the students may progress

steadily from one point in the programme to the next. It tends to reduce the number of student errors because the former steps have prepared the students to respond correctly to the new stimulus.

(iv) **Active Responding**

It is known that the programmed Learning requires interaction between the student and the programme. In the first few frames of any programme the stimuli usually are so arranged that the responses they seek are quite simple. So the students complies and receives reinforcement for doing so correctly, he establishes a pattern of stimulus response interaction.

(v) **Immediate Feedback of Information**

As soon as a student makes each response, the programme informs him of his correctness or incorrectness. The more rapidly this check or feed back follows his responses, the more effective becomes reinforcement or extinction, as the case may be.

(vi) **Individual Rate**

For a long time educators have recognised that students learns any single unit of material at different rates. The several techniques of programming allow a student to proceed rapidly or slowly according to his
own accomplishment. Programming can be said fairly to accept and take advantage of individual differences in the rate of learning.

(vii) **Constant Evaluation**:

From examining the student responses to the items or frames teacher can obtain an approximate of the programme's success and the student's progress.

2.5 **Types of Programmed Learning**:

There are three principal methods of programming, i.e. Linear, Branching and Adjunct. There are number of hybrid forms also in addition.

(I) **Linear Programmes**:

This method of programming was devised by Skinner. It is also known as Skinnerian type programme. This programme is a basis of his analysis of learning processes. The learner processes a repeater of responses, some of which are more likely to be made in a given situation than others and these are of different degrees of complexity. In teaching something new to the learner it is possible by reinforcing successive
approximations to the response to be acquired, to lead him from a response already possessed through a small progressive steps, to the new response. Only those approximations which lead to this goal are reinforced.

The Linear programme is also known as extrinsic programme. The Linear or Extrinsic programmes present a sequential development of the material through which each student, regardless of his response, proceeds in exactly the same order. A diagram of the process would look like this:

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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 items.

**Characteristics of Linear Programmes:**

1. The frames are small in the sense that each frame contains only one idea, example or rule.
2. The response asked for needs a critical observations and comprehension of the frame.

3. Most of the frames requires one response.

4. In the earlier frames prompts are provided to minimize the probability of error. The error rate on frames desired is usually less than 5%.

5. Immediate knowledge of results is given in the form of correct response.

6. All the students follow the same frames in the same order.

7. Each student is allowed to work at his own speed.

(II) Branching Programme:

There is another philosophic approach to programmed learning that has similar concerns, but different solutions to suggest. This other approach is that of branching or intrinsic programme.

Norman Crowder developed intrinsic programming from his experiences over several years in training armed forces personnel to understand and use complex electronic equipments. Crowder explained his basic approach in this way.\textsuperscript{13} The student is given the

\textsuperscript{13} Ibid., p.81
material to be learned in small logical units; immediately after he has read and digested one of these units, he is given a short test on it; the results of the test are used to determine what next unit of information shall be presented to the student. For instance the students response to a test item might indicate that he has understood the lesson unit thoroughly and is ready to go to next piece of information. On the other hand the information he has just studied, or it may show that he has understood the lesson material only partially. In either case, he would be directed through the medium of the programme to the next appropriate bit of information to restate the lesson or to clarify a point that he has misunderstood or to return to the previous units of material and work through it again.

A diagram of a simple step in branching programme looks like this:

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1  5  14
 
9  10 17
13 18 12

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At 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 is referred to the fifth item and goes on to the next instructional unit, if his reply to the first test question is incorrect or inadequate, he is sent to either the ninth or the thirteenth item where he gets additional information and is then returned to the first item to take the test again. Having got to the fifth item directly or after intermediate steps, he reads another unit and answers another test question which will direct him to the tenth, fourteenth or eighteenth item depending on the accuracy and completeness of his response.

Characteristics of Branching Programmes:

1. Each frame is of relatively bigger size as compared to the linear type. This frame may contain two or three ideas of related sequence.

2. A single question, usually of multiple choice type will be most probably asked at the end of a frame.

3. In order to answer the question, the learner has
to arrive at an answer by seeing the relationship between one idea and the other and by filling up the gaps not fully expressed in the frame. Then only he can select the correct alternative from the multiple choice.

4. Branching programmes do not try to minimize errors. Errors are anticipated and made the best possible use by diagnosing them and by providing remedial instruction.

5. Branching programme contains multiple choice of items where the student selects the response.

6. According to the alternatives selected, the student will be directed to go to a particular page. If his response is incorrect, he goes to a remedial page where in his mistake is partially or fully explained.

From the above mentioned characteristics, it can be said that in branching programme, all students do not follow the same route. Rather the route depends on the responses made by the student. Thus, students branch according to their responses.
(III) Adjunct Programmes:

Adjunct programmes are contributed by S.L. Presey. According to his opinion the structure of textbooks is very complex. To make them understandable and thereby learnable Presey designed adjunct programmes.

Adjunct programmes are the programmes of instruction which organize 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 subheading of the topic under study; the student also studies graphs and figures; after this he use the adjunct programme for review and to differentiate the major points that he 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.

Thus, as existing textbooks do not provide all the information required, they supplement the text. They are easily prepared and in less time.
(IV) **Mixed or Hybrid Programmes of Branier Style**:

Branier style is the combination of two styles; Branching and Linear style.

The combined strategy of linear and branching styles can be made use of one can start with a branching style and if the student makes a correct choice, let him go to the next frame in the main stream. If he is wrong, 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 is able to respond here correctly, direct him to the main stream. If he is still wrong, let him take the first frame of that linear series again.

(V) **Skip Programme**:

When the principle of branching is applied in the linear programme of small steps, another hybrid programme is produced which is known as Skip programme.

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

2.6 Characteristics of the Present Programme:

The present programme has been prepared by the investigator on the following basis.

(i) The style of the programme is linear and branching.

(ii) The subject matter is sequenced in small steps, which consist of stimulus items. To each step, the student responds.

(iii) The way of responding is either 'fill in the blank' type i.e. recall type of questions, or to discriminate the correct responses from the other discriminators i.e. recognition type of questions.

(iv) The student's response is reinforced immediately by supplying whether he is right or wrong.
(v) The student reaches the terminal objectives when he completes the programme by successive approximation.

2.7 Psychological Principles of Learning

Underlying Programmed Learning:

From the analysis of the 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 association or in other words, learning by doing.

2) Principle of reinforcement or strengthening the connection.

3) Recognition of individual needs and individual differences.

Leith points out that programmed materials aim at implementing the following criteria of sound teaching method.
1) The learner makes active responses to the stimulus materials.

2) Teaching matter is carefully arranged and organised to evoke response.

3) The sequence and the contents of the programme area being progressively altered until children learn successfully and efficiently.

4) Few mistakes are made in learning.

5) Knowledge of results is given immediately.

6) Learning is self-paced.

The characteristics of linear programming starting from 'on-going behaviour' i.e. existing repertoire of responses in verbal field, and ending in terminal behaviour' i.e. 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 Pavlov, Hull, Skinner and other behaviouristic psychologists. Reinforcement is a stimulus
that increases the possibility of recurrence of a response.

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 by the rate of which a programme is completed as well as to some extent by time taken and errors occured.

2.8 Sociology of Programmed Learning:

The Programmed Learning is much individualized in nature. Therefore, the important values of a classroom atmosphere are not contributed by programmed learning. Extreme individualization in learning is in effective 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 easily used in the classroom, a synthesis between individualization and group instruction can be achieved.

Skinner 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's separately prepared for its part in the total performance, and the social relation is the arbitrarily constructed. 14

2.9 Conclusion:

Skinner, Crowder and Pressy are the founders of different schools of programmed learning. Students have to interact with Skinnerian or Linear, Crowderian or Branching and Pressy type or adjuncts programmes. Interaction with the programmes results into definite learning, because the 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 the programmed learning material, continuously participates in the learning process, equip themselves with the uptodate knowledge in the field. Finally, the results of the criterion test assure the mastery level in the subject.