BLOCK II:
PROGRAMMED INSTRUCTION

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UNIT- 1
PROGRAMMED INSTRUCTION

Unit Structure:

1.0 Introduction:

Programmed instruction or programmed learning stand for one of the efficient improvement in teaching learning process. As a highly individualized and organized instructional approach, classroom instruction as well as self-learning or auto-instruction has been found quite useful. In a country like India, an attempt has been made for the use of programmed instructions particularly in providing material to the students of distance courses. Suitable self-instructional programmed materials for different subjects and grades have been prepared and it is being used for instructional or self-instructional purposes. Besides its use for instructional purpose, programmed instruction has full potentiality for being used as mechanism of feedback device for the modification of teacher behaviour and improving teaching efficiency.

1.1 Objectives:

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After going through this unit you will be able to–

- *know* the meaning and definition of programmed instruction,
- *understand* the nature of programmed instruction,
- *understand* the importance of programmed instruction.

1.2 Meaning and Definitions of Programmed Instruction:

In general, the instructions given by a teaching machine or programmed text book is referred to a programmed instruction or programmed learning. Let us take into consideration the definitions put forward by the various academicians in understanding the meaning of the term programmed learning or programmed instruction.

According to **Smith and Moore (1962),** "Programmed instruction is the process of arranging the material to be learned into a series of sequential steps, usually it moves the students from a familiar background into a complex and new set of concepts, principles and understanding."

According to **Jacobs and others (Jacobs, et. al, 1966),** "Self instructional programmes are educational materials from which the students learn. These programmes can be used with many types of students and subject matter, either by themselves, hence, the name "self-instruction" or in combination with other instructional techniques."

According to **Espich and Williams (1967),** "Programmed instruction is a planned sequence of experiences, leading to proficiency, in terms of stimulus responses relationship that have proven to be effective."

According to **Leith (1966),** "Programme is a sequence of small steps of instructional material (called frames), most of which requires a response to be made by completing a blank space in a sentence. To ensure that expected responses are given, a system of cueing is applied, and each response is verified by the provision of immediate knowledge of results. Such a sequence is intended to be worked at the learners' own pace as individualized self instruction."

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Susam Markle, (1969) opines that "It is a method of designing a reproducible sequence of instructional events to produce a measurable and consistent effect on the behaviours of each and every acceptable students."

Gulati and Gulati, (1976) is of the view that "Programmed learning as popularly understood is a method of giving individualized instruction, in which the student is active and proceeds at his own place and is provided with immediate knowledge of results. The teacher is not physically present. The programmer, while developing programmed material has to follow the laws of behaviour and validate his strategy in terms of students learning."

According to **N.S. Mavi, (1984),** "Programmed instruction is a technique of converting the live instructional process into self learning or auto-instructional readable material in the form of micro-sequences (the segments of subject matter) which the learners are required to read, make some right or wrong response, correct wrong responses or confirm the right response and attain the complete mastery of the concepts explained in the micro sequences."

STOP TO CONSIDER

Programmed instruction is a technique of self-instruction in which all of the instructional load is carried by teaching machines or programmed texts.

To conclude the above definitions may reveal the things given ahead regarding the meaning, nature and characteristics or programmed learning.

1.3 History of Programmed Instruction:

Some educators are of the view that the 'Gita' is the first example of programmed learning. They also maintained that the text of the 'Gita' has several ingredients of programming: initial behaviour, small steps, active participation, terminal behaviour, immediate feedback and self-evaluation by the learner.

Several academicians viewed that Socrates as one of the earliest programmers, saying he developed a programme in geometry. This was recorded by Plato in the dialogue MENU. Socrates used to direct his followers to knowledge by conducting them informally along a pathway from fact to fact and insight to insight.

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Programmed Learning as 'Technological Revolution' in Education:

Programmed instruction owes its source to the psychology of learning. First psychologist whose findings bear direct significance to programming is E.L. Thorndike (1874-1949). Thorndike gave some laws of learning. According to one of his laws, the law of effect, a learner likes to replicate his performance or takes more values in further learning if the present learning gives him pleasure or satisfaction. In other words, reward, pleasure or contentment contributes in strengthening the behaviour i.e. providing instant reinforcement. In this way, the law of effect has a close link with the concept of reinforcement, which is regarded as the backbone of programmed instruction.

The name of Sydney L. Pressey (1926), inventor of a teaching machine like devices, is also linked with the source of programmed instruction. His tool contained the format of multiple-choice items having provision for instant feedback. In such a tool out of the several choice provided for answering a question only one is correct and if a student select his correct answer the tool present the next item, if not, he is required to keep on with his selection process till he selects the correct one. Although suffering from some weakness the tool or machine developed by Pressey certainly had the components of programming.

Another leading move in the way of the development of programmed instruction came in middle fifties through the idea of operant conditioning put forward by B.F. Skinner of Hardware University. In operant conditioning, response of the individual is voluntary and natural and the chance of the occurrence of these responses is increased if there is a provision of instant reinforcement. While doing experiments on pigeons, Skinner tried to develop the fundamental principle of human learning and through these principles

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developed a teaching learning model which is popularly known as ***Skinnarian or Linear model of programmed instruction.***

Inspired with the work of Pressey and Skinner, Norman A, Crowder in 1955, tried to build up another model of programmed instruction widely known as branching.

The sixties witness a great deal of development in the field of programmed instruction. The mentionable are the following:-

1. Near the beginning of sixties, Robert Mager and others developed a method of programmed instruction, theoretically, known as ***"Learner Controlled Instruction".*** In this method, learner and not the programmer or instructor plays the main role. The instructor remains silent while the learner motivates him to respond or help.
2. In 1962, T.F. Gilbert developed a new method of programmed instruction known as Mathetics.
3. In 1965, E.Z. Rothkopt used a new expression '***Mathemagenics'*** for clearing up the progress of learning and put forward suggestion for useful mathemagenic programming.
4. Again in 1965, Lawrence Stolurow tried to reform the field of programmed instruction by bringing the idea of ***Computer Assisted Instruction (CAI).*** CAI tries to use the computer as an all knowing teaching brain in such a way that students can interrelate directly with it without the help of a teacher.

Thus, the idea of individualized self instruction prompted by programmed instruction approach has reached its height by the introduction of computer assisted instruction.

In this manner, the method of programmed instruction is becoming more and more scientific and practical by using the methodical and objective principles of Mathematics, Applied Sciences and Engineering. Originating from the psychology of learning and instruction it has now been developed as one of the important aspects of instructional technology.

STOP TO CONSIDER

Edward L Thorndike (1912) described the fundamental idea of programmed self-instructional materials in these words," If, by some miracle of mechanical ingenuity, a book can be so arranged that only to him who had done what was directed in page one would page two become visible and so on, much that now requires personal instruction could be managed by print." This 'miracle' later on becomes a reality.

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1.4 Features or Characteristics of Programmed Instruction:

1. Programmed instruction is a system or technique of giving or receiving individualized instruction from a variety of sources like programmed text-book, teaching machine, computers etc. with or without the assistance of a teacher.
2. In this system the instructional material is rationally sequenced and broken into appropriate small steps or segments of the subject matter called frames.
3. For sequencing a particular unit of the instructional material, the programmer has to pay consideration for the first or entry behaviour of the learner with which it begins and the terminal or end behaviour or the capability which student is required to attain.
4. In factual operation the starting is made by presenting a frame (a small but meaningful segment of subject matter). The learner is required to read or listen and then respond actively.
5. Programmed instruction system has an adequate provision for immediate feedback which is based on the theory of reinforcement. For example while responding to the first frame of the programmed material the learner is informed about the correctness of his response. In case he is correct,

Space for Learners

his response is reinforced and if he is wrong, he may correct himself by receiving the correct answer.

6. It is the communication between the learner and learning material or programme which is stressed in the programmed instruction. Here the student is actively encouraged to learn and take action.
7. Programmed instruction provides self pacing and thus learning may occur at individual rate rather than general, depending upon character of the learner, learning material and learning situations.
8. It calls for the overt responses of the learner which can readily be observed, measured and effectively controlled.
9. It has the provision for continuous evaluation which may help in improving the student's act and the quality of programmed material.

On the basis of above features we may define programmed instruction in the following ways:

Programmed instruction is a systematically planned, empirically established and effectively controlled self-instructional technique for providing individualised instruction to the learner through logically sequenced small segments of the subject matter by using the principles of operant conditioning and schedules of reinforcement.

STOP TO CONSIDER

The terms Progarmmed Learning and Programmed Instruction have been used terchangeably in educational literature. The English educators prefer the use of programmed learning (PL). On the other hand, the American writers use the term programmed instruction (PI)

1.5 Difference between Programmed Instruction and Traditional Method:

Sl No.	PROGRAMMED INSTRUCTION	Sl. No	TRADITIONAL METHOD
1.	It is an individualised method of instruction	1.	It is group method
2.	It is based on teaching principles that have been known for years.	2.	It becomes difficult to apply teaching principles in crowded classrooms.
3.	It presents the instructional matter step by step in logical order	3.	It presents the instructional matter as a whole.
4.	The size of the unit of information presented to the pupil is small.	4.	The unit is a lengthy one. There is no provision for response from the pupil in the type of answers to questions.
5.	Instant feedback is given to the pupil.	5.	The pupil does not get instant feedback.
6.	Objectives are defined very clearly in effective terms.	6.	Objectives are not well-defined and are usually unclear.
7.	The programmer prepares his programme with care and precision.	7.	Little preparation is made.
8.	The programme is prepared in such a way that the student automatically participates actively by making reactions continuously.	8.	The pupil usually remains a passive listener and the teacher himself does the summarizing and reviewing.
9.	A programme is developed practically through a series of tryouts and is refined gradually. Efficient sequences of frames are retained and ineffective one discarded.	9.	It is usually found to be very difficult to modify traditional instruction on the basis of pupil's reaction.

1.6 Need for Programmed Instruction:

The technology of automation is the only solution to the challenge posed by "knowledge explosion' and 'population explosion'. The present era, therefore, is experiencing a silent revolution in the field of education. Programmed instruction is an innovative step in this direction towards automation and individualization of instruction.

Programmed Instruction, as discussed previously, was designed to enable students to work independently at their own pace with minimal repetition of errors while advancing through material only as they prove competency. Upon first introducing programmed instruction, proponents stated its benefits to be:

1. Instruction that was less labour intensive, and therefore, less expensive. The technology of programmed instructive allowed more students to engage in the material without the need for hiring additional human instructors.

Space for Learners

2. Programmed instruction enabled students to learn more extensively in a limited amount of time.

3. Programmed instruction utilized 'branching' which tailored instruction and feedback according to the needs and responses of each individual learner.

4. Programmed instruction adhered to Thorndike and Pressey's laws of recency, effect, and exercise by reinforcing the positive/correct responses of students and limiting the repetition of mistakes. In this manner, immediate feedback was given to address and correct student responses in order to support optimal, true learning. (Molenda, 2008)

Other benefits of benefits of programmed instruction included the idea that Pl materials could meet fixative, manipulative, and distributive measures (Uhumuavbi, 2009). For example:

5. Programmed instruction materials could be recorded and used at a later date according to the flexibility needs of each student's schedule (fixative).

6. The focus of instruction and materials could be edited and arranged so that events/subject matter that might have been missed in live instruction could be made more observable and noticeable (manipulative).

7. Programmed instruction materials can be reproduced and displayed to a large group or to multiple individual as often and in as many various locations as are needed (distribution).

8. The technology of programmed instruction does not treat students any differently based on assumptions of gender or race. According the Uhumuavbi's article on student achievement and programmed instruction "research findings have shown that male and female students have different classroom experiences with regard to science, technology, and math courses because human teachers tend to treat them differently. Expectations for females in some subjects are usually lower as they are declared to be for certain sex, racial ethnic groups (Uhumuavbi, 2009)".

The benefits of programmed instruction additionally include:

9. Because programmed instruction steps outside of the traditional classroom, it tends to appeal to students and leads to an improved attitude toward studying.

10. Additionally programmed instruction increases student independence and student achievement.

11. When class size increases in a traditional classroom achievement tends to decrease, but with programmed instruction this is not an issue. Student achievement is not affected by an increase in class size. (Boden, 2000)

Based on the multitude of positive effects shared above, one cannot deny that programmed instruction can indeed be very benefial to education for both students and teachers. Although it may not be the end-all answer to educational issues, it can be used as an effective tool for learning in several circumstances.

CHECK YOUR PROGRESS -1

Q.1. Who is the inventor of Teaching Machines?

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Q.2. Programmed Instruction owes its origin to the psychology of _____. (Fill in the blanks)

Q.3. Name the first psychologist whose findings bear direct relevance to programming.

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Q.4. Programmed Learning/Instruction is an audio-visual device. (Write True or False)

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Q.5. Which law of learning is regarded as the backbone of Programmed Instruction?

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Q.6. Define programmed instruction.

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Q.7. Write three characteristics of programmed instruction?

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Q.8.Programmed learning is based on operant conditioning. (Write True/False)

1.7 Summing Up:

- Programmed instruction is a systematically planned, empirically established and effectively controlled self-instructional technique for providing individualized instruction to the learner through logically sequenced small segments of the subject matter by using the principles of operant conditioning and schedules of reinforcement.
- Some educators are of the view that the 'Gita' is the first example of programmed learning. They also maintained that the text of the 'Gita' has several ingredients of programming: initial behaviour, small steps, active participation, terminal behaviour, immediate feedback and self-evaluation by the learner.
- Several academicians viewed that Socrates as one of the earliest programmers, saying he developed a programme in geometry. This was recorded by Plato in the dialogue MENU.
- The name of Sydney L. Pressey (1926), inventor of a teaching machine like devices, is also linked with the source of programmed instruction. His tool contained the format of multiple-choice items having provision for instant feedback.
- While doing experiments on pigeons, Skinner tried to develop the fundamental principle of human learning and through these principles developed a teaching learning model which is popularly known as ***Skinnarian or Linear model of programmed instruction.***

1.8 Answers to Check Your Progress:

1: Sydney L. Pressey (1926)

2: Learning.

3: E.L.Thorndike (1874-1949)

4: False (Strategy)

5: The Law of Effect

6: Smith and Moore (1962). "Programmed instruction is the process of arranging the material to be learned into a series of sequential steps, usually it moves the students from a familiar background into a complex and new set of concepts, principles and understanding."

7: i. Programmed instruction is a method or technique of giving or receiving individualised instruction from a variety of sources like programmed text book, teaching machine, computers etc. with or without the help of a teacher.

ii. In this technique the instructional material is logically sequenced and broken into suitable small steps or segments of the subject matter called frames.

iii. For sequencing a particular unit of the instructional material, the programmer has to pay consideration for the initial or entry behaviour of the learner with which it begins and the terminal behaviour or the competence which student is required to achieve.

8: True

1.9 Questions and Exercises:

Q.1. Define programmed instruction. Discuss its nature.

Q.2. Give five salient features of programmed learning.

Q.3. Write the difference between programmed instruction and traditional method.

Q.4. "The Socratic method reappears and makes its presence felt in the concept of programmed instruction." Explain the psychological basis of programmed learning.

1.10 References and Suggested Readings:

- Sampath.K and others *"Introduction to Educational Technology"*
- Chauhan, S.S. "*Advanced educational Psychology"*
- Mangal, S.K. *"Foundations of Educational Technology"*

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UNIT- 2

FUNDAMENTAL PRINCIPLES OF PROGRAMMED INSTRUCTION

Unit Structure:

2.0 Introduction:

A program is a subject which pupils learn. As far as programmed instruction is concerned, it is a new strategy of teaching. It is a device or strategy to control student's behaviour and help them learn without the supervision of a teacher. It is highly individualised instructional strategy for modification of behaviour.

The programmed instruction is the arrangement of materials which are to be learnt by the pupils in graded steps of difficulty; it is in such a manner and sequence that it will result in the most efficient rate of understanding and retention. It is a method of giving individualised instructions in which the student is active and proceeds at his/her own pace. Physical presence of teacher is not essential in this strategy.

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According to Smith and Moore (1962), "Programmed instruction is a process of arranging the material to be learned into a series of sequential steps, usually it moves from a familiar background into complex and set of concepts, principles and understanding."

Thus, it can be concluded that the programmed instruction is an auto instructional technique. The information is provided in small steps and each learner progresses at his/her own pace.

2.1 Objectives:

After going through this unit you will be able to–

- *know* the fundamental Principles of Programming,
- *identify* the rules concern with Art of Programming,
- *analyse* the effects of Programmed Learning on the Teaching Process,
- *identify* the various steps of Programmed Instruction,
- *discuss* the outcomes of Programmed Learning on the teaching,
- *identify* the merits of Programmed Learning,
- *identify* the demirits of Programmed Materials.

2.2 Principles of Programmed Instruction:

A good programmed instruction is based upon the principles of learning. These principles are based on psychological theories. There are five fundamental principles of programmed instruction. These are the following:

1. ***Principle of small steps:*** Experiments have shown that even the dullest students can learn as effectively as the brightest students if the subject matter is presented to them in suitably small doses, in the form of steps. When we divide the task to be learnt into very small steps, and ask the students to learn only one step at a time, then probably all the students will be able to learn one small step at a time and sequentially learn all the steps. It is a difficult task to climb a mountain, but once steps are cut into it, even a child can climb it easily. This is known as the "Principle of small steps"

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2. ***Principle of activity responding:*** The second psychological principle is that the students learn better and faster when they are actively participating in the teaching-learning process. In our classroom teaching, the teachers do ask a few questions and the students respond. But it is not possible for the teachers to ask all the students to respond at each small step. A teaching machine text or a programmed text contains a large number of questions - one question at each small step and the students respond actively. This is the principle active responding as used for the programmes. The teaching machines and programmes have proved to be superior because they provide opportunity to every learner to respond to every small step.

3. ***Principle of reinforcement***: Every response, even if approximately correct, must be reinforced immediately. Delayed reinforcement fails to work. This is possible only when teacher has to teach only one student at a time. The ideal situation is where the teacher can cater to the needs of all his students individually. But in classroom teaching, this is hardly possible. No teacher, however efficient and sincere he may be, can reinforce each correct response of each of his students as soon as it is made in a classroom situation where he has to teach about 40/50 students. The teaching machines and the programmers do the job far more efficiently.

4. ***Principle of self-pacing***: The programmed instruction is based on the basic assumption that learning takes place effectively if the learner is allowed to learn at his own pace. Therefore, a good programme of the material always takes care of the principle of self-pacing A learner moves from one frame to another according to his own speed of learning

5. ***Principle of student-evaluation or student testing:*** Continuous evaluation of the student and the learning process leads to better teaching-learning. In the programmed instruction, the learner has to leave the record of his responses because he is required to write a response for each frame on the response sheet. This detailed record helps in revising the programme.

STOP TO CONSIDER

The five fundamental principles of programmed instruction are - Principle of small steps, Principle of activity responding, Principle of reinforcement, Principle of self-pacing, Principle of student-evaluation or student testing.

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Another classification of principles of programmed instruction:

Prof Edward Fox has classified the principles of programmed instruction in two broad categories: Mandatory Principles and Optional Principles

- **Mandatory Principles:**

1. Principle of objective specification.

2. Principle of empirical testing

It includes: (a) Individual try-out, (b) Small group try-out, (c) Field try-out.

3. Self-pacing.

- **Optional Principles**

4. Overt responding

5. Immediate feedback.

6. Small step size.

2.3 Rules concerning the Art of Programming:

Klaus summed up 12 rules of the art of programming and building instructional frames:

1. **Active responding**: A learner learns from making a response and not from hearing or seeing it.
2. **Proper cueing:** The provision of proper cueing is the main difference between a test question and an auto-instructional frame.

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3. **Appropriate context:** This is the kind of stimuli that will be capable of evoking the desired response at some time in future.
4. **Small steps:** It is very desirable that the subject matter should be divided into as many small steps as possible.
5. **Sequence of topics:** The topics of the subject matter should be carefully sequenced so as to provide adequate motivation.
6. **Frequent repetition:** Cues associated should be changed and frequent repetition provided in frames.
7. **Knowledge of subject matter and technical accuracy**: A sound knowledge of these is essential for preparing a suitable and effective programme.
8. **Lecturing to be avoided:** The learner should be helped to learn. This is only possible if we provide facts to the learner.
9. **Evoking a relative response:** Right kind of illustration should be used for evoking a response.
10. **Providing cues in adequate number:** Excess of cues will prevent the learner from making his own generalizations and discovering principles.
11. **Not assuming too much knowledge:** The programmer should not assume too much knowledge on the part of the learner.
12. **Presenting of facts in frames:** Only one fact should be presented in one frame.

2.4 Effects of Programmed Learning on the Teaching Process:

(i) Tutorial experiences are provided for individual learners on a large scale, wherein the learner may proceed at his own rate.

(ii) Programmed instruction can exercise control on homework and individual study.

(iii) Programmed instruction can enable the learner to catch up if he has fallen behind in his learning schedule due to absence from school.

(iv) Programmed instruction provides a technological solution to the problem of individual differences. The lack of programmed instructional materials would compel the teacher to design his presentation to cater to what he senses is the student of average ability. But such a presentation is bound to be too slow for the bright students and too fast for the slow ones.

(v) The availability of instructional material of a programme and its powerful tools allow the teacher to be much more professional in his approach to teaching than he now is.

(vi) By interpreting the feedback obtained through oral questions and discussions in the class, the teacher can intelligently adjust the flow of information or further instruction.

(vii) A basic feature of teaching machines is immediate knowledge of results followed by immediate correction of errors and instant rewards for correct answers. It has been established by research that more frequent the rewards, the better the learner assimilates the material.

(viii) It eliminates cheating because the learner has nothing to gain by it.

(ix) The students prefer the use of machines over studying from a textbook.

(x) It eliminates the influence of teacher variables, as shown by research.

(xi) Immediate scoring promotes the learning process.

(xii) The technique is valuable in giving tests which can be automatically scored.

Professor John Blyth and **John Jacobson** described the following uses of programming

i. No class time is wasted on drill.

ii. Examination of students' work on the programme can enable all concerned to prepare for a class period with prior knowledge of the points that are needed for further clarification.

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iii. No time is wasted in locating and correcting misconceptions the students may be entertaining, on account of unchecked practices.

iv. Classroom efficiency may increase by about 30 per cent, since more material can be covered in less time.

v. Individual differences may be reduced to a considerable extent.

vi. Difficulties of the students can be easily diagnosed.

vii. Individual and class differences can be easily located.

viii. There can be a marked increase in the level of interest and overall morale.

2.5 Steps of Programmed Instruction:

The program process is highly vibrant, demanding and time-consuming exercise. The programmer must be expert person to write the programs. It has three major steps.

Namely:

I. Preparation: This step involves the following sub-heads.

(a) Selection of theme or units, to be programmed

(b) Preparing a content outline.

(c) Defining objectives in behavioural terms

(d) Constructing a test of entering behaviour.

(e) Constructing a test of terminal behaviour.

II. Writing the programme: This step involves the following sub-headings:

(a) Presenting the material in frames.

(b) Provide for dynamic student response.

(c) Provide for verification or correctness of student response or reinforcement.

(d) Use prompts to direct student response.

(e) Provide careful sequencing of frames.

III. Tryout and revision: After editing the draft, the program must be read by subject matter for expert to check in accuracy's in the content. Then it is tested validity by administering the program to group of pupils. Based on its evaluation, the revision of program density is calculated as given below.

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(A) Error rate: This is calculated on the basis of response given by the learners for each frame in the program. The formula to calculate the error rate is –

$$\text{Error Rate} = \frac{\text{Total Number of errors}}{\text{Total Number of frames X Numbers taking the programme}} \times 100$$

(B) Programme density: It is measured in terms of type taken ratio (TTR), which is calculated using the formulae –

$$\text{TTR} = \frac{\text{Number of different responses required in a section of the programme}}{\text{Total Number of responses required in asection of the programme}}$$

2.6 Outcomes of programmed learning on the teaching process:

(i) Tutorial experiences are provided for individual learners on a large scale, wherein the learner may proceed at his own rate.

(ii) Programmed instruction can exercise control on assignments and individual study.

(iii) Programmed instruction can facilitate the learner to catch up if he fallen behind in his learning programme due to absence from school.

(iv) Programmed instruction provides a technological explanation to the problem of individual differences. The lack of programmed instructional materials would force the teacher to design his presentation to provide to what he senses is the student of average capability, but such a presentation is bound to be too slow for the bright students and too fast for the slow ones.

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(v) The ease of use of instructional material of a programme and its influential tools allow the teacher to be much more professional in his approach to teaching than he now is.

(vi) By interpreting the feedback obtained through verbal questions and discussions in the class, the teacher can intelligently change the flow of information or further instruction.

(vii) A essential quality of teaching machines is 'immediate knowledge of results' followed by immediate correction of errors and instant rewards for correct answers. It has been established by investigate that more frequent the rewards, the better the learner understand the material.

(viii) It eradicates deception because the learner has nothing to gain by it.

(ix) The learners prefer the use of machines over studying from a textbook.

(x) It eradicates the influence of teacher variables, as shown by research.

2.7 Merits of Programmed Learning:

Programmed learning is well thought-out to be more well-organized method of teaching-learning. Its advantage is well-established over the conventional methods of teaching-learning. It is increasingly being used in highly developed countries. It is realised that programmed instruction has the possibility to transform the theory and practice of teaching.

Following are the principal merits of programmed learning:

(i) A well-programmed learning is a great force in the way of individualized instruction, as it is modified to the needs of the individual learner in the class.

(ii) It allows an individual learner to improvement at his own speed. An intelligent learner no longer needs to be bored or allowed to lose interest on account of slow development of other learners of the class. He can make progress at his own pace, even if it is faster than the rest of the class.

(iii) Since a programme requires constant response from the learner, it overcomes inactivity and passivity on the part of the learner.

(iv) The teacher can give description in the classroom if the error is common, or he may arrange individual conferences on definite points.

(v) Well-programmed instruction is a chief thrust in the way of individualized instruction as it is tailored to cater to the needs of individual students.

(vi) Learning material by way of programmed instruction is presented in such a way that learning look like an interesting game, motivating the learner to meet the challenges as per his own capacities.

(vii) It is the experts who developed the Program. They are experimentally tested and modified till they are standardized. Some learners can use a single good programme and thus save on textbooks.

(viii) In programmed instruction, the learner is instantly reinforced to spot on his response. This reinforcement sustains the motivation of the learner.

(ix) The self-instructional method presents material whose difficulty is simplified through the analysis of the subject matter, into small and more easily assimilated parts of information.

(x) The introduction of programmed instruction is of a great importance for developing countries which need to instruct millions of learners and are short of teachers.

Space for Learners

2.8 Demerits of Programmed Materials:

Programmed materials have been severely criticised as threatening to replace the teacher.

It is argued that there is too much importance in learning facts and very little importance on the mastery of principles and concepts.

Some critics of programmed instruction maintain that the user of a programme does not know where he is moving.

Again they opined that the learners are not aware of the organisation and programmed instruction is unrelated to other features of instruction.

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Another demerit of programmed instruction material is that it is very costly and only rich nations can afford it.

It is also stated that the progress and use of programmed instructional material requires expert knowledge and training. An average teacher finds it very hard to make use of this machine.

CHECK YOUR PROGRESS – 1

Q.1. Write three advantages of programmed learning.

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Q.2. Write three limitation of programmed instruction.

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Q.3. What are the Objectives of Programmed Learning/Instruction?

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Q.4. What are the principles of programmed learning?

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2.9 Summing Up:

- Principles of Programme Instruction are: i) Principles of small steps, ii) Principles of active responding, iii) Principle of reinforcement, IV) Principle of self-pacing, v) Principle of student-evaluation or student testing.
- Steps of Programming- (i) Preparation, (ii) Writing the Programme, (iii) Tryout and Revision.

2.10 Answers to Check Your Progress:

Answer to Q.No.1: Three advantages of programmed learning are:

(i) A well-programmed learning is a great thrust in the direction of individualised instruction, as it is tailored to the needs of the individual learner in the class.

(ii) It permits an individual learner to progress at his own speed. An intelligent learner no longer needs to be bored or allowed to lose interest on account of slow progress of other learners of the class. He can make progress at his own pace, even if it is faster than the rest of the class.

(iii) Since a programme requires continuous response from the learner, it overcomes inertia and passivity on the part of the learner.

Answer to Q.No.2 Three limitations of programmed instruction are:

(i) It is also argued that there is too much emphasis in learning facts and very little emphasis on the mastery of principles and concepts.

(ii) Some critics of programmed instruction maintain that the user of a programme does not know where he is headed.

(iii) They also point out that the learners are not aware of the organisation and programmed instruction is unrelated to other aspects of instruction.

Answer to Q.No.3: Objectives of Programmed Learning:

(i) Help students to learn by doing.

(ii) Provide the situation where learning is at learner's own pace.

(iii) Help students to learn without the presence of a teacher.

(iv) Present the content in a controlled manner and in logically related steps.

Answer to Q.No.4:

Principles of Programme Instruction are: i) Principles of small steps ii) Principles of active responding iii) Principle of reinforcement iv) Principle of self-pacing v) Principle of student-evaluation or student testing

2.11 Questions and Exercises:

1. Discuss about the basic principles of programmed instruction.
2. What are the rules concerned with the art of programming?
3. Effects of programmed learning on the teaching process.
4. Write about the steps of programmed instruction.
5. Write the merits and demerits of programmed learning.

2.12 References and Suggested Readings:

- Sampath.K and others *"Introduction to Educational Technology"*
- Chauhan, S.S. "*Advanced educational Psychology"*
- Mangal, S.K. *"Foundations of Educational Technology"*

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UNIT- 3
STYLES OF PROGRAMMING

Unit Structure:

3.0 Introduction:

The person most responsible for applying behavioural principles to education is B. F. Skinner (1954) whose theory of operant conditioning provides the basis of developing programmed instruction strategy.

The theory of *Operant Conditioning* represents the process by which human behaviour becomes shaped into certain patterns by external forces. The theory assumes that any process or activity has observable manifestations and can be behaviourally defined, that is defined in terms of observable behaviours. Either or both of the theory's two major operations, reinforcement and stimulation-control, are emphasised in the educational applications of operant conditioning theory.

Conditioning refers to the process of increasing the probability of occurrence of existing or new behaviour in an individual by means of reinforcement. In operant conditioning the response or behaviour operates

upon the environment to generate consequences. The consequences are contingent upon the emission of a response, and they are reinforcing.

B.F. Skinner and *E.L. Thorndike* are alike in being connectionist theorists who emphasize reinforcement as a basic factor in learning, who take a keen interest in problems of education and who do emphasize theory. Skinner has made it quite explicit in his system.

B.F. Skinner's Theory is called as an operant conditioning. The term operant conditioning is applied by Skinner in (1938) to a procedure of exciting control over the behaviour of an organism in a relatively free environment by means of the appropriate use of reinforcement. In some of its application, operant conditioning represents a maximum of flexibility in contrast to the less flexible behaviour involved in classical conditioning and instrumental conditioning.

Kind of Learning:

B.F. Skinner recognizes two different kinds of learning. They are different because each involves a separate kind of behaviours:

(1) Respondent behaviour, and

(2) Operant behaviour.

(1) Respondent Behaviour: This type of behaviours is emitted by presenting the specific stimuli. It is formed of such specific stimulus-response connections-called reflexes. We are born number of reflexes. Skinner emphasizes the reinforcing role of the unconditioned stimulus.

(2) Operant Behaviour: This type of behaviour is of a different kind. Skinner refers to as operant behaviour of this kinds which most occurs. The characteristic of operant is that it occurs in the environment.

There is no specific stimulus which will emit an operant behaviour. Skinner has termed it as operant behaviour as being evoked by the organism rather than elicited by stimuli. Most of the human behaviours are of this kind e.g. walking, talking, working and playing are all made up operant responses.

Skinner does not mean to say that operant behaviour is no influenced by stimuli. Much of his analysis of behaviour is concerned with ways in

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which operant behaviour is brought under the control of stimuli. The learning of operant behaviour known as conditioning but it is different from the conditioning reflexes.

Theory of Operant Conditioning:

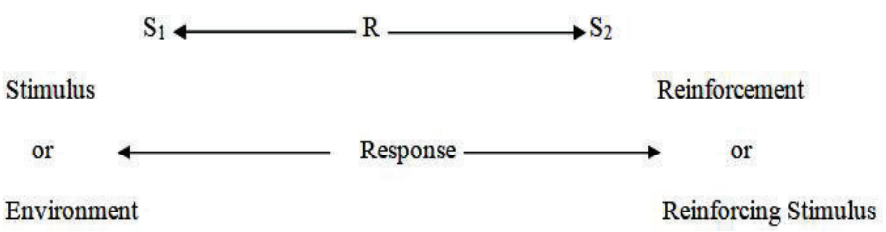
The theory of Operant Conditioning is formulated by ***B.F Skinner*** Professor of Psychology in Harvard University USA. He conducted experiments on rats and pigeons in developing this theory.

'Operant Conditioning is the learning process whereby a response is made. An operant is strengthened or reinforced.'

The ***S-R theories*** give emphasis on stimulus which helps in respondent behaviour. But Skinner has reversed the sequence and emphasizes the (R-S) theory learning. Because operant behaviour is not emitted through a stimulus. The desirable behaviour is evoked by generating an environment.

Skinner's refusal to ask why a stimulus has reinforcing properties is part of the general resistance to the formulation of theoretical properties. He takes the position that when we known enough exercise control over behaviour. Skinner theorizing about the behaviour, thus remains consistently informed, inductive and implicit rather than formal deductive and explicit. He prefers to develop broad empirical generalization rather than specific constructions. Skinner's theory has no intervening variables, thus it is an empty organism theory of learning. The operant conditioning is represented by the following paradigm of Learning.

The operant conditioning is represented by the following paradigm of learning:–



The stimulus and reinforcement are independent variables upon which the response is dependent as Skinner phrases it "....the stimulus acting prior to the emission of the response, sets the occasion upon which the response is likely to be reinforced." A stimulus is "any condition, event or change in the environment of an individual which produces a change in behaviour." It may be verbal (oral and written) of physical. A response may be defined as unit of behaviour. It is the basic unit upon which complete performance or response repertories are built. Response may be defined as a unit of behaviour. Response repertories consist of many kinds of responses which are functionally related. The response is an every changing. Somewhat artificial unit of behaviour. In a classroom the condition upon which reinforcement will occur depends upon the standard set by the teacher, with skill development, for instance, a poor writing performance is acceptable for the beginner. However, with increasing practice the teacher expects greater accuracy.

The initial response must exist in some strength in the individual repertoire; the task of the instructor is to build more complex patterns of responses from this initial response by changing the contingencies. Since behaviour is continuous activity, its breakdown into identifiable units to facilitate analysis is necessarily somewhat artificial, but is useful, especially when simple responses must be built into more complex ones.

According to Skinner, reinforcement must immediately follow response if it is to be effective. Delayed reinforcement is much less effective in modifying behaviour. This contrasts sharply.

Skinner does not ask why a stimulus is reinforcing, he seeks to determine that a stimulus has reinforcing properties can be shown by a simple test. The rate of emission is called the operant level. In Skinner term, reinforcing may be either positive or negative. A positive reinforcing stimulus increases the rate of operant responding when it is applied immediately after each response. Punishment is defined as the removal of a positive reinforcer or application of negative reinforcing stimulus.

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3.1 Objectives:

After going through this unit you will be able to–

- *analyse* various styles of Programming,
- *understand* the application of Programmed Instruction in India,
- *describe* the use of Primes, Prompts and Cues in Programming.

3.2 Styles of Programming:

In programmed instruction the presentation of the learning material or subject matter to the learner in a suitable form is termed as programming. Various types of programming have emerged because of researches and experimental studies in the field of programmed instruction. Some of the mentionable are listed below:

(1) Linear or extrinsic Programming.
(2) Branching or intrinsic Programming.
(3) Mathetics Programming.
(4) Rule system of programming
(5) Computer Assisted Instruction (CAI)
(6) Learner Controlled Instruction (LCI)

The first three types – linear Branching and Mathetics – represent the actual basic formats. The rule system represents inductive and deductive approach. The CAI and LCI are actually the ways and means of providing instructions.

STOP TO CONSIDER

Various types of programming are-

(1) Linear or extrinsic Programming.
(2) Branching or intrinsic Programming.
(3) Mathetics Programming.
(4) Rule system of programming
(5) Computer Assisted Instruction (CAI)
(6) Learner Controlled Instruction (LCI)

3.2.1 Linear or Extrinsic Programming:

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B.F. Skinner of Harvard University developed linear programming model. Psychologists have defined it as *"A programmed material sequence in which each student proceeds in a straight line through a fixed set of items."* This type of programme is also called Skinnerian type of programming because for the first time he used this type of sequence to form the behaviour of animals and prepared ground for human learning.

The instructional material in Linear programming is sequenced into a number of significant small steps called frames. These frames arranged in sequence are presented one at a time to the learner. The learner is required to act in response actively at each step. Immediately learner gets the feedback regarding the exactness of the response. This reinforces the learner and inspires the learner to process to the next frame at his own pace of learning. By passing through all the frames of the program, the learner acquires the desired learning experiences and changes his behaviour.

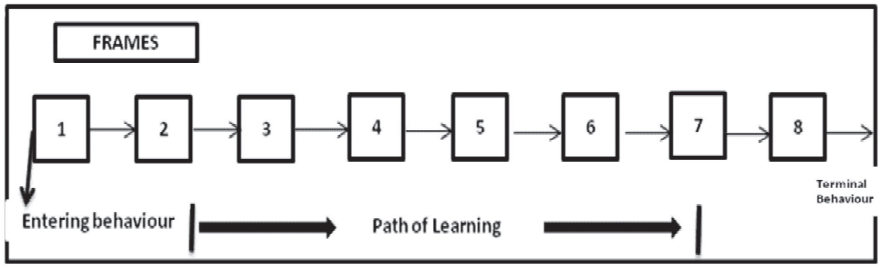

Fig: 3.1: Linear Programming

(A) Characteristics of Linear Programming:

1. Linear means scheduled in a straight line. Generally, in linear programme, information is broken down into small steps of 40 to 50 words in length which is called a frame. The learner must respond to each frame in series by filling in word or phrase in a blank.
2. *Linear arrangement:* In such type of programme, the learner proceed in a single series of short steps which are designed to make sure a high rate of correct responding to the questions (frames). Each learner follows same path. The learner starts from his first behaviour to the terminal

Space for Learners

behaviour following straight-line sequence. All learners pass through the same path.

3. *Responses are controlled:* In linear programme, the programmer controls responses. The responses and their order are fixed. The learner has no option to respond in his own way.
4. *Response is emphasised:* In linear programme, the importance is laid on response. The learner must respond to each frame in order the learning to occur.
5. *Feed-back is quick:* As soon as the learner responds the frame he can immediately compare his response with the response of the programme.
6. *Provision for prompt:* In the beginning, prompts or cues are supplied to helps learning to occur.
7. *Cheating* is dejected by not revealing the answer to the learner.
8. S.D. *is important* and is emphasised in linear model.
9. It may be used from first position.
10. Learner can leave out certain frames.
11. Reaction is self-constructed.

(B) Demerits of Linear Programming:

1. Need of motivation: It is assumed that learning becomes boring and learners experience dullness and tediousness. It takes to a large amount time to teach very few points.
2. No place for freedom of choice: The learner has no alternative of his own to respond, thus, it is alleged that inventive imagination of learner is inhibited.
3. Expensive: The researcher found that the preparation of programmed material consumes too much paper and time.
4. Rothkopf that opines that in many programmes, the learners find out the hint as to what is to be filled in blanks and important terms are guessed.

5. It can be used in limited areas where the behaviour is calculable and noticeable such as maths and science.

6. S.L. Pressey and his associates have enquired the value of linear programming format on the following grounds:

   (a) Serial Order: The frames are presented in sequential order.

   (b) Penetrating of material is not allowed as in a textbook. Judgemental learning is not adapted.

   (c) Linear programming does not allow discrimination among responses.

7. Students do not contribute for innovation of answers except to follow a rigid line set by the programme.

8. Programmes are generally designed with a view that learner has no previous background of the subject matter. It is very difficult to find out exactly the background of each learner.

9. In case of book form presentation, learners are likely to be sincere but from all learners we cannot expect sincerity. They can see the right response without reading the frames.

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CHECK YOUR PROGRESS-1

Que.1: _____ developed the Linear Programming mode. (Fill in the blanks)

Que.2: According to linear programming Recall is more important than recognition in the learning process. (Write True/False)

.....

Que.3: What are the three major types of programmes for programmed learning?

.....

.....

.....

Que.4: What are the structures of the frames of linear programme?

.....

.....

.....

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Que.5: The Linear programme is based on the learning theory of _____. (Fill in the blanks).

Que.6: In linear programme every learner follows the _____ path. (Fill in the blanks)

3.2.2 Branching or Intrinsic Programming:

Norman A. Crowder originated the branching or intrinsic programming. He has given its definition as: "It is a programme which adapts to the needs of the students without the medium of extrinsic device as a computer." It is called intrinsic because the learner within himself makes the choice, to become accustomed with the instruction to his needs.

The underlying principle of intrinsic programming postulates that the basic learning takes place during the student's exposure to the new material on each page.

(A) Origin Branching Programming:

Origin Branching Programming got started by way of an ordinary practical training problem. In (1954) Norman & Crowder was a psychologist with United State Air. He was asked to investigate the training of aircraft maintenance men. These technicians were being taught to 'trouble shoot' or repair faults, in a bomber navigation system.

Crowder found that trouble-shooting was best learned through solving problems using the real equipment, under guidance from a qualified human tutor innately qualified tutors were few. He solved his problem with the aid of Spects a screen and a panel of buttons. He built a simulator which stood in the real bomber-navigation system and, at the same time, acted very much like a private tutor.

It makes no assumption about the nature of learning process and further a has no theoretical basic about how education should be conducted. It is a technique for preparing written materials that will accommodate quite a large range of educational purposes. In a branching programme item the student is given a don discussion of the material to be learned Followed by

a multiple choice question designed to test the point just discussed. Each answer alternative has a page number beside it. The student chooses what he believes is a correct answer to the question and turns to the page number given for that answer. If he has chosen correctly he is lead to next item and if he has chosen an incorrect answer, he is directed to a page where in the reason for incorrectness is dismissed.

The strategy of Norman, A Crowder formerly U. S. Industries Inc. was also essentially stimulus-centred. For Crowder, 'The essential problem is that of controlling communication process by the use of feedback. The student's response serves primarily as a means for determining whether the communication process has been effective and at the same time allows appropriate corrective or remedial action to be taken when the communication has been ineffective'. Crowder's approach is thus based essentially on a psychology of individual differences. Indeed, he is very little concerned or interested with the nature of the learning process itself.

Thus, the identifying feature of Crowderan programme is the way in which material is presented to the student on the basis of his performance. The branching programming in particularly suitable for dealing with material that involves complex problem solving strategy. The subject matter should have a logical basis or structure which can be systematically developed frame by frame.

(B) Basic theory of Branching Programming:

Originally Branching programming has no theoretical basis because Crowder develops the strategy on the basis of his training experience. The following theoretical basis may be attributed to this strategy:

(1) This style provides more information per frame. It also employs multiple choice response pattern, i.e. a student is required to discriminate the choose the one right answer which is presented along with a number of other plausible but incorrect answers. Learners, who make the wrong choice from among those presented, are asked to follow another trade or branch which corrects their error or further classifies the point in

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question. The branching sequence may continue for a number of frames, again depending on students' responses, before he finds himself on the main track.

(2) The assumption in branching programming, according to David Cram is that a wrong response does not necessarily hinder in learning of a correct response. The responses are useful mainly in guiding the student through the programme. Each response is used to test the success of the latest communication to the student and in that sense; it gets the programme known, where to take the student next. It follows the method of trial and error, learning.

(3) In a branching programme, the response takes the form of a choice of various answers. The student is much more likely to err in this programming. He is almost encouraged to do so. The wrong answers suggested by the programme are certainly chosen to correspond with popular misconception or frequent errors that are shown by experience to be likely to occur at that particular stage of instruction.

(4) Such a programme works like this: we arrange a logical sequence of information, and we put it do the student one point at a time. We give his just as much information as we thing he can handle; this will vary from one sentence to several paragraphs. But each new unit of information is followed by multiple-choice questions, i.e. we ask a questions and allow the student to check his own answer against a list of several alternative answers. Only one of these answers normally is correct: the other will represent plausible errors which the student could only have reached by following some particular false trial.

The above patterns of multiple-choice question are only necessary whenever we want to say something special to students who cannot get the right answer straight away. At other times, we may prefer to use one of the following forms:—

(1) Constructed-Response Questions.
(2) Constructed-Choice Questions
(3) Block Questions and
(4) Linear Sequence.

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(1) Constructed-Responses Questions- These are the questions to use when we want the student to decide on (construct) his answer without being shown any alternatives. We pose the questions in the normal way and we ask the students to write down his answer. We leave it to the students to decide on the rightness of his answer. We are not offering remedial help against his going wrong but he can return to look over the previous pages.

(2) Constructed-Choice Questions- The students is asked to write down his answer to a direct question and then turn a page to check his answer. When the reaches the next page, he is reminded of the question and is given a set of alternative answers from which he must chooses and the one that most resembles his now. If he chooses an incorrect answer, then we give him remedial help in the usual way.

(3) Block-Questions- These rather like the comprehension questions commonly used to test a passage of reading in an English examination. The student as presented with quite a chunk of information and is expected to answer several gestions about it. This format would be quite wrong for the initial teaching the dent is being asked to process a lot of information and make several quite involved responses Furthermore, he will be given neither immediate knowledge of result individual remedial help.

(4) Linear Sequences- Sometimes we may want to use a linear sequence in our basically branching programme-particularly when we have to get the student de some memorising; formulating symbols, related technical terms, arbitrary but fixed procedures.

This is the kind of learning that will need more practice-much more than will conceptual understanding.

(C) Fundamental principles of Branching Programme:

The branching programme is based on the three fundamental principles:

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(1) Principle of Exposition- The learner should perceive the whole phenomena which should be so exposed to him. It means a student learns better if the whole concept is presented to him. The complete information is provided on Home page. It serves two purposes teaching and diagnosis.

(2) Principle of Diagnosis- The principle refers to identify the weakness of learner. After exposition it is assessed whether he could learn the concept or not if he could not learn what the causes are for it. A multiple choice format is used to diagnose the weakness of the learners.

(3) Principle of Remediation- The diagnosis provides the basis for remediation. The remedial instructions are provided on Wrong page. If a learner chooses wrong alternative, he has to move to a Wrong Page Where remedial instruction is provided to him a direction to return to Home Page. He is asked to choose the right response. It is known as a principle of remediation.

(D) Characteristics of Branching Model:

1. Material in a frame is larger; lot information is presented at each step. A step may consist of two to three paragraphs and occasionally a full page.
2. The method of student response is different from the linear model; student has to make choice out of a number of choices. Multiple-choice questions are asked. Each response to the question is keyed to diverse pages. If the learner selects right response, his response is confirmed and in case he selects wrong response, then he is routed to materials which clarify as to why he is wrong.
3. Crowder holds that teaching is communication and so he focuses his attention upon the enhancement of communication.
4. Learner has freedom to decide his own path of action according to the background of subject matter. The learner controls the correct sequence that he will follow.
5. The programme has plenty of chance to utilize the literacy style.

6. Students are more aware and deliberate on the subject matter more carefully.

7. Revealing and correction of errors is essential. Crowder holds that making error is necessary to learning. He permits 20 per cent errors in his model. In such a model first the errors are revealed and then corrected. Learner can make out why he is wrong. Crowder says that it is unrealistic to remove errors in the process of learning.

8. The vital and categorizing attribute of branching model is the fact that the material presented to each student is constantly and directly controlled by the learner's performance in answering questions.

9. Intrinsic programmed material when presented in a book form, the book is called scrambled book because the pages do not follow in regular sequence.

10. It is very helpful to concept learning or where the material is given in larger steps.

11. The role of active response is not central in intrinsic theory. Intrinsic programmes offer less direction to learner as to what material in the frame is important.

(E) Assumption of Branching:

i. Learning takes place better if the subject matter is presented in its whole form.

ii. Learning takes place better if the subject matter is presented in the form of significant components or units.

iii. Wrong answers do not essentially hamper the learning of a correct answer.

iv. Multiple-choice items assist more in the learning process.

v. It is based on the possibility of revealing and correcting errors.

vi. Vital learning takes place during the learner's disclosure to the new material.

vii. Learning takes place better if the learner is allowed enough freedom to take choices for adopting the instruction to his needs.

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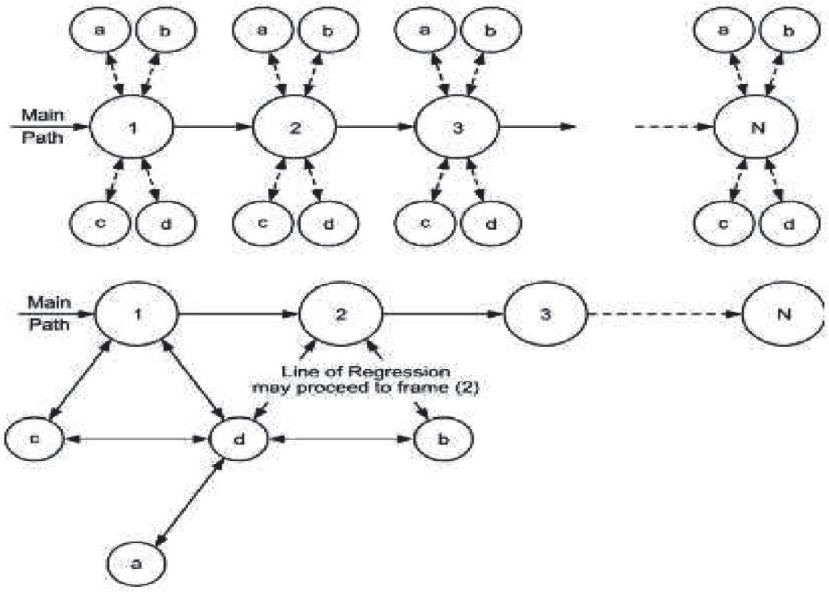

Fig. 3.2: Main path and branching in branching programme

(F) Merits of a Branching Programme:

i. Big size of a frame as well as the branching reduces unnecessary repetitions and responding, thus reducing the amount of learning time and fatigue.

ii. The drawback and consequences of incorrect logic are usually explained in the remedial frames so that the learner not only gets the correct response but also understands why some other response is not correct.

iii. Instead of simple response, it provides choices in the form of multiple choices.

iv. Through its broad frames, branching programme presents for more freedom to respond and scope of choosing one's own path of learning according to one's need. Thus, it helps in maintaining the interest and initiative of the learner.

v. Branching programme is helpful in the progress of the power of discrimination of the learner.

vi. Branching programme helps in the development of originality and problem-solving capability.

vii. Branching is most useful in the areas beyond facts, definitions and fundamental skills.

viii. The frames, being of larger size, contain a good deal of information and this may enable the programmer to enrich his method and develop his ideas.

(G) Demerits of Branching:

1. The learner may guess the right response devoid of understanding the subject matter of the frame.
2. Endless branching cannot be provided. It cannot make available to the needs of all individuals. It is very complicated to find out the total number of branches for every individual.
3. Preparation method is very expensive, audio-visual equipments is costly.
4. The programme needs review after every two years which is a very costly affair.
5. Programmes are the product of programmer's imagination and it is who decides analytical questions and level of content.
6. Branching model can be used after VI grade because small children do not understand its mechanism.
7. It is very hard to ask questions on the whole matter of frames because frames are too large and sometimes essential subject matter is left.

(H) Comparison between Linear and Branching Programming:

	Linear Programming		Branching Programming
1.	**Exponents** : B.F. Skinner (1954)		Norman A Crowder (1954)
2.	**Source of Origin:** Psychological laboratory experiments. Application of operant conditioning learning theory to teaching		Semi-industrial situation with emphasis on efficient instruction to improve job performance. Its origin is form human training technique
3.	**Learning Theories:** It is based on the operant conditioning learning theory its response-centred approach of learning.		It is based on cognitive theories of learning i.e., problem solving approach. It is stimulus-centred strategy of learning.

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4.	**Principles:** Have five fundamental principles: Small step, Active responding. Immediate confirmation, self pacing and student testing.		It employs three basic principles: principle of exposition, diagnosis and remediation
5.	**Assumptions:** (a) Students learners better if content is presented in the small units. (b) Student's response should be immediately reinforced for learning (c) Students error hinder is learning. (d) Student learns better if he gets the freedom to learn or own speed.		(a) Students learn better if the whole content is exposed. (b) Students errors help in diagnosis and does not necessarily hinder in learning (c) Students learn better if the remediation is provided side by side for weakness of the learner.
6.	**Frame Size:** Small step may be one sentence or two frames.		Large size may be para or page in a frame.
7.	**Frame Structure:** Three aspects: stimulus, response and reinforcement		Three aspects: Exposition or presentation, diagnosis and remediation
8.	**Types of Frames:** Linear has four types of frames: Introductory, teaching practice and testing frames.		Two types of frames are used in intrinsic programme: (1) Home page teaching and diagnosis. (2) Wrong page Remediation is given.
9.	**Response**: It employs the construct response The response is controlled by programmer not be the learner. Response is the internal part of learning		The multiple choice question is given to select the response. The response is controlled by learning not by the programmer.
10.	**Reinforcement:** This strategy is based on the theory of reinforcement. The confirmation of correct response provides the reinforcement to the learner. The continuous reinforcement is provided. The wrong response is ignored		The correct response is confirmed and approved to provide the reinforcement. The wrong response indicates the weakness of the learner and remediation is given the difficulties of the learner.
11.	**Error:** The student errors hinder in learning. The student will not learn if he commits error. The error-rate should be less than 10 percent in criterion programme.		The student errors do not necessarily hinder in learning but helps in diagnosing the weakness of the learning for which remediation can be provided The error rate should be more than 20 percent.

Space for Learners

12.	**Individual Difference:** The principle of self-pacing or freedom of time facilitates the individual variation in learning process.		The branches are provided to choose the path of learning by each and every learner according to his own needs and requirements. Every learner follow his own paths of learning.
13.	**Form of Text:** Linear programme text is same the conventional book. The content matter is presented into small units. The sequence is followed.		Branching programme text is known a scrambled text. It is different from conventional books. The sequence of page is not followed in it.
14.	**Machine:** Linear programme is presented usually rough teaching machine. Very simple cheap model of teaching machine is used.		It is rather difficult to use teaching machine in presenting the intrinsic programme A complex and costly model is required for this purpose.
15.	**Purpose or Use:** a. Modification of behaviour is the focus of linear programme. b. It can be effectively used for secondary level of students. c. Lower objectives of learning can be achieved effectively. d. It is very useful for average and lower intelligence students. It can be used for correspondence education lesson.		a. The main focus is to provide the remediation to the difficulties of the learner. b. It can be used effectively for higher classes. c. Higher objectives are realised by this strategy of programme d. High intelligence student learners better by branching Remedial instruction can be given to correspondence students.
16.	**Limitations:** a. It does not provide the freedom to the student to respond or to learn according to his own. b. It is based on learning theory which bas been formulated be experimentation on animals. Human go through it. The students do not prefer learning is different from animals branching programme learning. c. Every learning has to follow the same path. There is no remediation for wrong response.		a.It does not consider the learning process and its structure. It is problem solving device. b. The sequence of pages are not followed, hence students do not like to go through it. The students do not prefer branching programme. c.It gives more emphasis on remediation rather teaching Hence it is only tutorial approach of learning

CHECK YOUR PROGRESS-2

Que.7: Who developed Branching Programming?

.....

.....

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Que.8: Branching programme is _____ centred.

Que.9: What is the basic structure of Branching/Branched programme?

.....

.....

Que.10: What are the major forms of Branching Programme?

.....

.....

Que.11: Branching programme is also called _____

3.2.3 Mathetics Programming:

Thomas P Gilbert (1962) is the originator of the idea of mathetics. According to him, *"Mathetics is the systematic application of reinforcement theory to the analysis and construction of complex behaviour repertories usually Known as subject matter mastery, knowledge and skills. Mathetics, if applied diligently, produces materials that exceed the efficiency of lessons produced by any known method."*

The word 'mathetics' is derived from the Greek word 'mathein' which means 'to learn'.

There are two unique types of programming techniques: one stressing the subject matter and its action and the other stressing the behaviour. Mathetics falls under the second category.

Mathetics is eclectic in nature but it is exceptional in application. It analyses the deficiencies and tries to make up for them. The success of task analysis depends to a great extent on the capability and dependability of data. The term 'task analysis' suggests the breaking down of the task into its basic parts and involves detailed listing of component behavioural elements of a job or task. A task analysis is really an inventory to which knowledge; skills and attitudes are identified and isolated with a view to ultimately synthesising them into a hierarchical organisation relevant to the writing of learning prescription.

Task analysis is of three types:

(i) Analysis of topic, (ii) Analysis of job, and (iii) Analysis of skills.

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(A) Main characteristics of Mathetics Programming:

(i) Like any other well-thought out instructional plan, a mathetics programme begins with a thorough analysis of what is to be taught.

(ii) In mathetics, an exercise is the mechanical unit of learning instead of a frame as in linear or branching programming.

(iii) No constraint is put on the size of an exercise.

(iv) The size of the exercise is determined by how big a step a learner can practically take at a time.

(v) Each exercise assumes the reinforcement value of completion. In a mathetics style, a different strategy of reinforcement is employed, i.e., other than the 'knowledge' of results, which is the chief source of reinforcement in the linear programming.

(vi) Programme makes use of the techniques of retrogressive or backward chaining.

(vii) Learning instruction involves three principles: (a) Principle of discrimination, (b) Principle of chaining, and (c) Principle of generalisation.

The underlying principle of a mathetics programme is that the closer the learner is to reinforcement when he is taught, the more effectual the reinforcement becomes. The reinforcement, in the case, is the completion of the ask.

(B) Different areas most suited for shaping the behavioir through Mathetics Programming

(i) Behaviour needs chain.

(ii) Skills and multifaceted behaviour repertories.

(iii) Behaviour which shows dependence of one on the other.

Space for Learners

(C) Merits of Mathetics:

(i) It is a job and task-oriented programme.

(ii) Results can be linked to actual goals which we intend to achieve through a mathetics programme.

(iii) Its stress on learner-success at 90/90 criterion level of mastery to motivates the learner.

(iv) It makes use of the principle of backward chaining.

(v) It is relevant, significant, significant and suitable in the eyes of the learner and the programmer.

(vi) It can be applied to a wide range of subject matter but it particularly suits the teaching of skills where the main objective is transfer of training of skills from one condition to another.

(D) Demerits of Mathetics Programming:

(i) It is very mechanical in nature and as such demands a lot of expertise, training and labour on the part of the programmer.

(ii) It is not fit for learning the material of all subjects. Only concrete material and subject material involving psycho-motors skills can be gainfully programmed by means of Mathetics.

(iii) This programme makes insufficient provision for individual differences. All learners have to learn the same way.

(iv) It provides very little choice to the learners, as constructed responses are usually required.

(v) The learner encounters complexity in constructing the last response or mastery response in the beginning.

(vi) Mathetics cannot be used for factual content.

(vii) Mathetics cannot be used for higher cognitive and affective learning objectives.

(viii) Mathetics does not provide any curative help for the weaknesses and difficulties of learners.

(ix) Mathetics is not based on any sound learning theory.

CHECK YOUR PROGRESS- 3

Que.12: Who is the originator of mathetics?

.....

.....

Que.13: The term Mathetics is derived from the Greek word _____.

Que.14: What are the areas of behaviour most suited for shaping through mathetics programming?

.....

.....

Space for Learners

3.3 Application of Programmed Instruction in India:

Programmed instruction is still in its formative years in India. Programmed instruction as an optional or elective paper has been included at the B.Ed/M.Ed. level in a few universities in India. It also forms a part of the paper of Educational Technology/Educational Innovation. However, its actual classroom use is almost nil.

As far back as 1996, the Kothari Commission had suggested to develop programmed material in different subjects to test the appropriateness of the method in Indian conditions. An Association of Programmed Instruction was formed to organize the research being done at different centres in the country. The association also distributes the information on new studies through its journal issued from time to time. The *National Council of Educational Research and Technology* has also done some work in the field. In spite of all these efforts, it may be stated that the application of programmed instruction has yet to make any appreciable impact on our classroom teaching. Our methods of teaching remain traditional, largely.

Following are the important factors, which stand in the way of introducing programmed instruction in Indian schools:

Space for Learners

(i) Resistance to adjust.

(ii) Lack of good programmes and programmers.

(iii) Lack of facilities.

3.4 Use of primes, Prompts and Cues in Programming:

For helping the learner make the correct response and eliminate error, he is assisted in the form of primes' and 'prompts in the introductory frames. Priming is introduced in a frame though a process of copying the response given in the stimulus material.

A prompt, on the other hand, does not indicate to the learner the correct response in the imulus itself. A hint or cue is provided to help the learner to choose the correct response According to Skinner; prompts can be classified into two categories:

i. Formal prompt. (ii) Thematic prompt.

A formal prompt provides an indication of the form of response.

Thematic prompt depends on the general properties of the prompting stimulus.

It may be kept in view that the primes and prompts should be provided only in the initial step and thereafter gradually withdrawn.

Illustrative programmes in school subjects:

PROGRAMME No. 1: CIVICS CLASS X

Introduction: This is a programme meant for you for the study of salient features of the Constitution of India.

In this programme, you will find paragraphs which are called frames. Study each frame carefully and write down what is required. Answers are given at the end. After stating your answers, check them. If your answer is wrong or you do not understand anything, you can again go back to the frame. It is not a test but instead it is a self-study programme.

Frame 1: The Constituent Assembly of India was set up under the provisions of the Cabinet Mission Plan to frame the Constitution of India which was formally adopted on 26th Nov. 1949 and came into force on 26th January 1950. It took nearly three years to complete the work.

(a) What was the work assigned to the Constituent Assembly?

(b) Under what provision was it formed?

(c) When did our Constitution come into force?

(d) When was it adopted?

(e) How much time did the Constituent Assembly take to complete its work?

[Ans. (a) To frame the Constitution of India. (b) Provisions of the Cabinet Mission Plan. (c) 26th January 1950, (d) 26th November 1949, (e) Nearly 3 years]

Frame 2: The Preamble of the Constitution has a great significance but is not a part of the Constitution. The Constitution was framed by the people of India through their representatives It stresses the fact that the reins of political power ultimately lie in the hands of the people of India.

(a) Is the Preamble a part of the Constitution?

(b) By whom was the Constitution framed?

(c) In whose hands do the reins of political power ultimately lie, in India?

[Ans. (a) No. (b) The people of India through their representatives, (c) The people of India]

Frame 3: The Preamble of our Constitution is as under:

WE THE PEOPLE OF INDIA, having solemnly resolved to constitute India into a SOVEREIGN SOCIALIST SECULAR DEMOCRATIC REPUBLIC and to secure to all its citizens:

JUSTICE, social, economic and political,

Space for Learners

Space for Learners

LIBERTY of thought, expression, belief, faith and worship:

EQUALITY of status and of opportunity

and to promote among them all

FRATERNITY assuring the dignity of the individual and the unity and integrity of the Nation: IN OUR CONSTITUENT ASSEMBLY this twenty-sixth day of November, 1949, do HEREBY ADOPT. ENACT AND GIVE TO OURSELVES THIS CONSTITUTION

Note -Three new terms - Socialist, Secular and Integrity - were added to the original text of the Preamble when it was amended in 1976 by the 42nd Amendment.

The Preamble stresses the democratic basis of the Constitution by stating that the People of India gave to themselves this Constitution. It also states objectives like justice, liberty, equality and fraternity.

a) Who has given us the Constitution of India?

b) What kind of justice has been ensured by the Preamble?

e) What type of Republic is to be constituted?

d) What kind of equality has been given to its citizens?

e) How many types of liberty can a citizen enjoy?

Ans. (a) The people of India, (b) Social, economic and political, (c) Sovereign Socialist Secular Democratic, (d) Equality of status, (e) Five]

Frame 4: Another important feature of the Preamble is that the people themselves adopted and enacted the Constitution. Thus, the representatives of the people frame the laws of the country and they have the power to change or amend the Constitution.

a) Who frames the laws of the country?

b) Who has the power to amend the constitution?

[Ans. (a) Representatives of the people, (b) Representatives of the people]

Frame 5: The Constitution of India has many unique features which distinguish it from constitutions of other countries. The framers of the Constitution freely borrowed ideas but took care to adapt these to the needs of the country.

The Constitution makes India a Sovereign, Socialist Secular, Democratic Republic. The word Sovereign means that India is completely free from external control. No outside power has the right to interfere either in her internal administration or direct her in the conduct of her foreign policy.

This was emphasized to ensure that India was no longer 'dependent on the British Empi as she had been before the Indian Independence Act 1947 or a 'dominion' as she had bees from 15th August, 1947 to 26th January 1950.

a) What kind of status did India enjoy during 15th August 1947 to 26th January 1950?

b) Was India sovereign between 15th August 1947 to 26th January 1950?

c) What is the meaning of the word 'sovereign"?

d) Does the Constitution of India have unique features?

e) Did the framers of the Constitution borrow ideas?

[Ans. (a) Dominion, (b) No, (c) India is completely free from external control, (d) Yes, (e) Yes]

PROGRAMME No. 2: BIOLOGY TAXONOMIC CATEGORIES CLASS XI

Introduction. (On the pattern of Programme No. 1)

Frame 1: We see several kinds of animals and plants around us. They all exhibit varying degrees of differences and similarities. One feels the need to arrange these numerous living things in some logical sequence. The method of arranging and grouping of animals and plants in various divisions is known as classification.

(a) All animals exhibit various degrees of …… and …….

Space for Learners

Space for Learners

(b) The numerous organisms can be better studied if they are ..... in some …….. sequence.

(c) ……. is the method by which various organisms are grouped.

[Ans. (a) Differences, similarities, (b) Arranged, logical, (c) Classification]

Frame 2: Organisms are classified according to certain characteristics. First they are placed in bigger groups. All living organisms have been put into two groups, viz., plants and animals. These groups are further divided and sub-divided into various smaller groups.

All these different groups are called categories. These categories have been given different names at different stages, e.g., Kingdom, Phylum, Class, Order, etc.

(a) The assemblage of organisms in the groups according to certain characteristics is said to form a …….

(b) ……. and ……. are names of two categories.

[Ans. (a) Category. (b) Kingdom, Phylum, Class, Order (Any of these)]

Frame 3: In classification, these categories are placed in a definite sequence. Some categories are higher than others, e.g., Kingdom is of a higher category than Phylum. Each higher category contains all the lower categories.

1. Is there any definite sequence in which to arrange the categories?

2 Which category will be studied first while classifying any organism? (higher, lower)

3. Study the sequence of categories given below:

Kingdom, Phylum, Class

(a) If Kingdom is the highest category, which is the lowest?

(b) Category Phylum will contain category ……. also.

(c) Will category Kingdom contains all the classes?

[Ans. 1. Yes 2 Higher 3 (a) Class (b) Class (c) Yes]

Frame 4: The arranging of the taxonomic categories in a logical sequence is called a hierarchy. Study carefully the list of categories given below in a descending order, i.e., the first one is the highest category.

Kingdom, Phylum, Class, Order, Family, Genus, Species.

This sequence forms a hierarchy.

i. If various categories are arranged in a sequence, it forms a.....

ii. Write whether the sequence of the categories given forms a hierarchy.

Order, Kingdom, Phylum, Genus, Class.

iii. Make a hierarchy of the categories given above.

iv. From the hierarchy made by you, answer the following:

a. ….....…. is the highest category.

b. ….....….is the lowest category.

[Ans. (1) Hierarchy, (ii) No, (iii) Kingdom, Phylum, Class, Order, Genus, (iv) (a) Kingdom; (b) Genus]

Space for Learners

3.5 Summing Up:

- Types of Programmed Instruction: (i) Linear Programming, (ii) Branching Programming and (iii) Mathetics
- Linear programming model was developed by B.F. Skinner of Harvard University. It has been defined by psychologists as "A programmed material sequence in which each student proceeds in a straight line through a fixed set of items." This type of programme is also called Skinnerian type of programming because for the first time he used this type of sequence to shape the behaviour of animals and prepared ground for human learning.
- The branching or intrinsic programming was originated by Norman A. Crowder. He has given its definition as: "It is a programme which adapts to the needs of the students without the medium of extrinsic

Space for Learners

device as a computer." It is called intrinsic because the learner within himself makes the decision, to adapt the instruction to his needs. The rationale of intrinsic programming postulates that the basic learning takes place during the student's exposure to the new material on each page.

- Thomas P Gilbert (1962) is the originator of the concept of mathetics. According to him, "Mathetics is the systematic application of reinforcement theory to the analysis and construction of complex behaviour repertories usually Known as subject matter mastery, knowledge and skills. Mathetics, if applied diligently, produces materials that exceed the efficiency of lessons produced by any known method."
- The word 'mathetics' is derived from the Greek word 'mathein' which means 'to learn'.
- Basic Steps in Mathetical Programmes-

  (i) Data collection and task analysis

  (ii) Prescription for mastery-characteristics of the trainees are assessed.

  (iii) Characterisation and lesson plan – deficiency is removed and plan is prepared to overcome the deficiency

3.6 Answers to Check Your Progress:

Answer to Q.No. 1: B.F. Skinner

Answer to Q.No. 2: True

Answer to Q.No.3: (i). Linear, (ii). Branching and (iii) Mathetics

Answer to Q.No.4: (i). Stimulus-Contextual Form, (ii) Response-Desired Behaviour Form and (iii) Reinforcement-Confirmation Form.

Answer to Q.No. 5: B.F. Skinner

Answer to Q.No. 6. Same path

Answer to Q.No. 7: Norman Crowder

Answer to Q.No. 8: Stimulus

Answer to Q.No. 9: The basic structure of Branching/Branched programme is:

(i) Home Page and

(ii) Wrong Page

Answer to Q.No.10: (i) Constructed-Response Question (ii) Constructed-choice Questions. (iii) Block Questions and (iv) Linear Sequence.

Answer to Q.No. 11: Intrinsic programme

Answer to Q.No. 12: Thomas P Gilbert

Answer to Q. No. 13: Mathein

Answer to Q. No. 14: (i) Behaviour requiring chain.

(ii) Skills and complex behaviour repertories.

(iii) Behaviour which shows dependence of one on the other

3.7 Questions and Exercises:

1 Write about the different styles of programming.

2 What is Linear Programme? Describe its assumptions according to Skinner.

3 What are the characteristics of a good Linear Programme? How can this programme be used at secondary level?

4. What is Branching Programme? Discuss its assumptions.

5. Briefly discusses the limitations of Branching Programme.

3.8 References and Suggested Readings:

- Sampath.K and others *"Introduction to Educational Technology"*
- Chauhan, S.S. "*Advanced educational Psychology"*
- Mangal, S.K. *"Foundations of Educational Technology"*

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UNIT- 4
DEVELOPMENT OF PROGRAMMED INSTRUCTION MATERIALS

Unit Structure:

4.0 Introduction:

Programmed instruction is based on some psychological principles. Therefore, developing a good programme involves a number of techniques and devices are to be incorporated and require several specialized skills. The making of a programmer must have mastery over the subject-matter which he is intending to be programmed. He should also be well acquaint with a approaches and techniques of programming.

It is the assumption of programmers that a designer should have 75 percent mastery of the content and 25 percent skill and awareness of programming devices. The dynamics of programme development may be considered a cyclic process which never comes to end. The freshers have to be very careful.

There has been a changing emphasis of programmed instruction 1960 to 1970 which has greatly influenced the dynamics of programme development. As a result numbers of approaches of programme development are available in the literature. Some important approaches have been given in the following paragraphs.

4.1 Objectives:

Space for Learners

After going through this unit you will be able to –

- *discuss* about the steps of development of Programme Instruction,
- *to know* about the merits and demerits of Programme Development.

4.2 Design for development of Programmed Instruction:

It is evident from the details of steps of programme development that none of the approach is complete in itself. With the help of reviews of these approaches and recent terms of programmed instruction, a comprehensive outline has been evolved for preparing a programme most effectively. This approach is much more practical from development of a programme. In writing a programme a programmer has to be very pragmatic and skillful. The important stages in programming are as follows:

I. Preparation

II. Constructing or writing the plan

III. Try-out and revision

IV. Evaluation

V. Preparation of a manual of the programme

I. Preparation:

Peter Pipe suggests the following points before getting down to details:

i. Be prepared to find that preparation accounts for at least 25 per cent of your total time.

ii. Do not bother about attaining perfection in one step before you begin the next.

iii. There is no substitute for hard work. Preparation requires hard work.

iv. Do not rely on memory to keep track of new ideas.

Space for Learners

Steps at the preparation stage:

These are listed below:

1. Selection of topic is to be programmed.
2. Indentifying objectives in taxonomic categories.
3. Writing objectives (entering and terminal) in behavioural terms.
4. Content analysis and developing instructional sequence.
5. Construction of criterion test.
6. Deciding appropriate strategies and pardigm for the programme.

II. Construction or Developmental Phase (Writing frames and individual try out)

III. Try out and revising, editing and preparation of final draft with the help of group

IV. Evaluation of the programme and master validation.

V. Preparation of a manual of the programme.

Steps 1: Selection of Topic or Unit to be Programmed :

Lysaut and Williams have suggested six criteria for the selection of a unit or topic to be programmed:

(1) The topic selected for a programme should belong directly t programmers's own field of study or interest. He should be c enough to handle the topic independently. The programmer should have to the competent the understanding or mastery of the topic.

(2) The topic should be such that it can be handled easily. He should start with a simple and as fundamental approach as possible.

(3) The third criterion for the selection of a unit is its length. The programme length has to be such that desired objectives for the unit can be realized.

(4) Another criterion for most of programmers that has strongly influence the choice of the units to be programmed, has been depressed level of learning shown by many students.

(5) The fifth criterion is to be followed in the selection of a unit to be programmed is the logical order of material. It is very helpful for teacher to select a unit that certain logical sequence can be developed.

(6) Special student needs are also one of the important criterion in selecting a topic for a programme. The topic should be from the specialized field of study.

It addition to these criteria it is also essential that the topic should be stable and programme should be economical.

Step 2: Identification of Objectives:

The second step for the development of a programme is to identify the objectives in terms of ***Bloom's Taxonomic Categories***. Programmed instruction material is effectively used for achieving the cognitive objectives. Therefore taxonomy of cognitive domain is taken into consideration in identifying the objectives for the programme unit. **Bloom** has classified the *cognitive objectives into six categories-knowledge, comprehension, application, analysis, synthesis and evaluation.* The programmer identifies the objectives in these categories by considering the level of the student, entering behaviours, nature of the unit. The last three categories are also known as creativities categories or higher order of the objectives. The opinion of the subject-specialists can be sought for identifying the objectives of the unit to be programmed. The objectives decide the level and direction of the instruction.

Step 3: Writing Objectives in Behavioural Terms:

After identifying the objectives taxonomic categories it is essential to formulate objectives in behavioural terms but **Robert Magers** approach is best fitten into the programme strategy. It was Mager who emphasized the need and important of behavioural objectives in programmed instruction during (1962-63). He defined instructional objectives:

"A statement of instructional objectives is a collection of words or symbols describing one or more educational intents."

"An objective will communicate your intent to the degree you have described what the learner will be doing when demonstrating his achievement and how you will know when he is doing it."

Space for Learners

Space for Learners

In order to describe terminal behaviour what the learner will be doing, the following operations are needed:

(a) Identify and name the over-all behaviour act.

(b) Define the important conditions under which the behaviour is to occur.

(c) Define the criterion as acceptable performance.

The objectives should be stated as specific behaviour which can be observed in student performance. The actual procedure and examples of writing objectives in behavioural terms have been given in the Taxonomy of Educational objectives. The knowledge of taxonomy is essential for this purpose. The objectives are written in two forms:

(i) Entering behaviours as pre-requisite skills of the leaner in behavioural terms. It is also known as assumptions about the learners.

(ii) Terminal behaviours as desired behaviours which a learner will acquire after completing the programme instruction material.

Robert Mager suggests three questions for writing objectives.

1. What will the student are doing when he is demonstrating his performance?
2. Under what conditions the behaviour will occur?
3. What is the level of acceptable performance?

(i) Entering Behaviours-The entering behaviours include those characteristics which are essential pre-requisites for the programme:

1. The pre-requisites knowledge and skill for programme are clearly identified and stated.
2. The required level of aptitude for the programme is too determined and explained.
3. The pre-requisite abilities are clarified interms of measurement.
4. The motivation level should also be identified and stated in clear term.

5. The pre-requisite information: Age levels, language comprehension level of the students are to be determined and stated.
6. The target-population should be defined for the programme.
7. The pre-test is constructed for ascertaining the pre-requisites of the learners who intend to take this programme. The academic records and diagnostic test and personal experiences are the other sources of entering behaviours.

v. Terminal Behaviours-The terminal behaviours include all those responses and behaviours which are helpful for achieving desired objectives. The cognitive objectives are given importance in programmed instruction material. These are also known as output of instructional strategy. The entering behaviours act as input aspect of the instructional technology. **Robert Mager's** approach is generally used in writing objectives in behavioural term. A criterion test is constructed for measuring the terminal behaviours after going through the programme.

Advantage of Behavioural Objectives-

Scofold has enumerated the following characteristics of behavioural objectives:

1. The objectives are specified in terms of behaviours.
2. It helps in preparing items for criterion test.
3. Teaching and learning activities are related easily for effective learning situation.
4. It helps in selecting appropriate devices and tactics for generating conducive learning situations.

The following are the main advantages of behavioural objectives:

(a) The criterion test is made objective-centered.

(b) The testing can be based on instruction or teaching.

(c) The appropriate tactics can be employed for desired learning situations.

(d) The activities of instruction and teaching can be made specific

Space for Learners

Space for Learners

Step 4: Content Analysis and Developing Instructional Sequence:

After writing the specifications of terminal and entering behaviours and the dimensions of the criterion test. It is essential for a programmer to develop a suitable content structure which would go with the programme as such. This task requires an analysis of the various items of information which will go with the subject and also the relationship which may be discovered among them.

The content is analyzed into units and units are broken down into its elements. These units are arranged in a logical sequence and elements of a unit are also organized into a learning sequence. Thus, content analysis involves both analysis and synthesis process. The structure of content should be reviewed by a subject expert. The authenticity of subject-matter has to be ensured. **Peter Pipe** suggested for developing a list of content:

(1) Concentrate on covering all objectives and on developing points in the right order at the right level.

(2) Comments of experts should also be involved for the instructional sequence.

This may yield useful information about the programme material. In developing a list of content relationship of teaching and learning should be observed. Core material is meant a straight prose narrative that covers all your objectives. It includes two aspects planning subject-matter to present to the student and language programmer intent to use in preparing the programme. The details of content analysis have been provided in the chapter of *Task Analysis*.

Step 5: Construction of Criterion Test:

After writing objectives in behaviour terms and developing instruction sequence of the unit to be taught. It is very essential to construct a criterion test. The purpose of criterion test is to evaluate construct a criterion test. The purpose of criterion test is to evaluate the effectiveness in terms of objectives to be achieved. The criterion test is constructed by employing the four steps; planning, preparing, try out and evaluation. Recently criterion referenced testing approach has be developed for constructing such tests.

Criterion referenced testing means such measures of achievement that can be expressed directly in terms of student performance on clearly specified educational task. It is a test used to certain an individual's status with respect to a well-defined behaviour domain? (W. Jomes Papham, 1975). The key word is **'behaviour domain'** which includes the concept of content popularly employed in the *norms referenced testing*. Although there is a relative scarcity of theory and research to guide this process, the following principles given by Norman E. Gronlund (1973) may be considered useful:

(1) Criterion referenced testing requires a clearly defined and delimited domain of learning task.

(2) It requires that instructional objectives be clearly defined in behavioural terms.

(3) It requires that standard or performance be clearly specified.

(4) It requires that student performance be adequately sampled within each area of performance.

(5) It requires that test items be selected on the basis of how well they reflect the behaviour specified in the instructional objectives. It requires a scoring and reporting system that adequately describes student performance on clearly defined learning task.

Generally criterion test includes objective type items. Every item measures one specific objective of the programme. It is objective-centered rather content centered. Achievement test is generally the content-centered. Recall and recognition type of items are prepared. After preparing the items individual try out is done for improving items. The first draft is tried out on a group of subjects and item analysis is done. The items are selected and rejected on the basis of difficulty value and discrimination power of the items. The final draft is prepared and its reliability and validity are estimated. The criterion behaviours are included to measure the terminal behaviours of the programme.

Step 6: Deciding Appropriate Strategy or Paradigm for the Programme :

Space for Learners

Space for Learners

After preparing a criterion test an appropriate strategy is decided regarding the programme. The following aspect are considered in finalizing a paradigm for the programme:

(a) Size of Frame: The size of frame is not fixed in linear programming. The learner takes at a time and comprehends easily, is known a size of a frame. In deciding the size of a frame age, class level, abilities of the students are taken into consideration. The entering behaviours or previous knowledge and understanding is the basis for deciding the size of a frame.

(b) Mode of Response: Various types of response modes are used in instructional frames. In linear programming usually construct response is used, but discriminant response, multiple choice response are also used. Multiple-choice response is employed in branching programming. The mode of response is decided by strategy of instruction and also by the content of the unit. The learning objectives are one of the most important consideration in finalizing mode of response.

(c) Types of Prompts: The additional or supplementary stimuli are used for assisting the learner for emitting correct response. It is known as prompt. In teaching frames formal and thematic prompts are used. Priming are used in introductory frames but no prompt is used in testing frames. There should be gradual withdrawal of the prompts.

(d) Ruleg System*:* The structure of the frame is developed with the help of 'ruleg system'. A frame consists of rule and example. The rule is given complete form and example is given incomplete form, the learner has to complete it by emitting a response. The form of a frame is also vice-versa. The learner acquires new knowledge by emitting a correct response.

(e) Provision for Correct Response: A learner has to confirm his response by comparing with correct response. It is given somewhere in instructional material It may be given along with the frame, or beneath of the frame or along with next frame or on the next page. This is also decided so that learner cannot copy down easily.

Space for Learners

These are the important aspects for developing instructional material effectively. These are helpful in the deciding the paradigm of instructional material and specifying the strategy.

II. **Construction or Developmental Phase (Writing frames and individual try out):**

It is very challenging job to the programmer. It is therefore obligatory for a programmer, to take the preparation phase very seriously. In writing a programme he has to take his decision in respect of–

(1) Entering behaviours,

(2) Content structure,

(3) Strategy of instruction, and

(4) Terminal behaviours.

This needs mastery of content and skill of programmed strategy. In order that the desired terminal behaviours are produced, an appropriate programme paradigm has to be selected and employed. Suitable stimuli, form and sequence of presentation are necessary steps in the process of writing a frame.

'A frame or items is a segment of material which the learner handles at one time.' A frame varies in size form a few words or a sentence or two (linear), to a para or two full page or more (branching). A frame requires at least one response which may be overt or covert response and provides for knowledge of results before the leaner proceeds to next frame. A frame structure consists of three parts:

(a) **Stimulus**: the information is presented,

(b) **Response***:* the learner construct or selects a response,

(c) **Feedback or Reinforcement*:*** The knowledge of result (checking his own response with the given correct response).

A frame produces a learning situation which involves the following elements

Space for Learners

i. A stimulus or stimuli (S) which serves to elicit or cue for the desired response.

ii. A stimulus content (S) to which the occurrence is to be learned.

iii. A response(R) which the student supplies and which add to lead to the terminal behaviours of the programmes.

iv. Extra material which makes the frame more readable, understandable or interesting.

Before the programmer can actually start writing the programme, he must decide what information it should contain. The broad concepts or topics will already decide prior to the statement of objectives. It is now important that every single item information should be listed, in the smallest possible form so that nothing is omitted when writing the instructional sequence. Rules should be written:

(1) In simple sentence without punctuation.

(2) Without conjunction such as and but although (the use of a conjunction indicates that there are two rules present).

(3) As statements.

(4) Without qualification (qualifications are usually exceptions to the general rule and must be treated separately. Most of them will eventually be handled in the programme as discrimination items).

Characteristics of a Good Frame:

A good frame has the following characteristics:

(1) A good frame employs clear words which have the specific meaning.

(2) A good frame satisfies the needs of the learners.

(3) The response of good frame is meaningful.

(4) The correct response of good frame is the integral part of terminal behaviours.

(5) A good frame is stimulating as well as challenging, but the response is under the reach of the learners.

(6) A good frame employs the language and words which are easily understandable to the learner.

(7) The structure of good frame is such that it has only one correct response for the blank.

(8) A good frame increases the probability of learning.

(9) The appropriate and adequate prompts are used in good frame.

(10) The stimulus of a good frame is related to the response of proceeding frame.

(11) A good frame produces chain learning.

(12) A good frame is written in simple sentence without punctuation and conjunctions.

Space for Learners

Stages of Programme Frames*:*

There are four stages in a unit of a programme: Introductory,Teaching, Practice and Testing Stage:

(a) Introductory Stage-The introductory frames are full of demonstration St and priming 10 to 15 percent frames. The purpose of these frames is introduce the new content by linking the previous one.

(b) Teaching Stage-The purpose of teaching frame is to impart new knowledge. Thus, these frames present the content structure in terms of behavior specified for terminal objectives. The frames are heavily prompted by both formal and thematic prompts 60 to 70 percent frames.

(c) Practice Stage-These frames produce the frames for practicing the teaching content. These frames are half-prompted frames 15 to 20 percent frames.

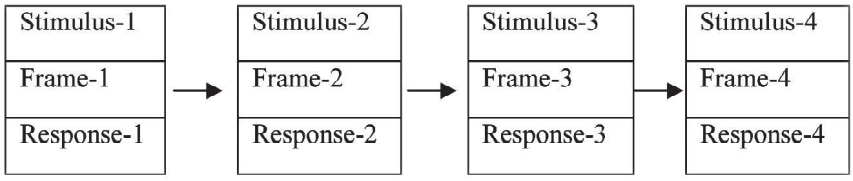
(d) Testing Stage-These frames are designed to ascertain the establishment of the behaviours. The frames are unprompted 15 to 20 percent frames.

These frames produce the gradual withdrawing learning situations.

Space for Learners

There are three very common approaches in designing of frame sequencing: Matrix, Ruleg and Egrule approach.

All these facts to be taken into consideration in writing the frames of programme. The content sequence is so designed that response of earlier frame may function as stimulus for next frame for developing chain learning. It has been shown with the help of following diagram:



The logical sequence of programme frames is developed for presenting the subject-matter. This sequence is perceived by the designer and it is subjected to modification. The modification is made on the basis of student's responses. The logical sequence is validated empirical through the student's responses on criterion test.

The first draft is prepared by considering about facts. It may be prepared on may cards. Each frame is written on a single card. The first draft involves the following types of errors:

(1) Copying frames or echo-type frames.

(2) Irrelevant responses is asked for.

(3) Irrelevant frame.

(4) Over loaded frames or lecture.

(5) Too many prompts or over prompting frames.

(6) Incomplete discrimination sequence.

(7) In multiple-choice frame poor alternatives may be used.

The first draft is improved and modified by individual try out. After individual try out revision can be done and it may be discussed with experts to seek their opinions for improving and modifying the frames. The purpose of individual tries out to improve the language ambiguity and difficulty of the

frames. The structure of the content can be evaluated by the experts. The subject-matter can be presented correctly.

Space for Learners

II. Revising, Editing and Preparation of Final Draft with the help of Group Try Out:

The first draft of the programme is revised after empirical try out. The sample of subjects who take the programme at this stage are carefully selected from the target population on the basis of entering behaviours to confirm to the eventual uses. From 15 to 40 or more students are selected from the target population for the empirical try out of the programme. In contrast to the try out of short sequence students should be tested on a carefully prepared detailed diagnostic performance test after completing the programme units. Testing students before and after taking the programme provides a baseline against which student performance can be assessed.

After this try out, the frames are again analysed and the success with which g terminal behaviours have been attained as indicated on the criterion test, is determined. The student responses are analysed to improve frames. A list of common errors is made. A high error rate on a particular frame often points to a need for revision. At this stage the programme may undergo several try out and revision cycles. After revision of the programme editing work is done for preparing the final draft of the programme.

Editing of a Programme-The main objectives of editing of the programme are:

- To eliminate the ambiguities, complexities and other inadequacies before any student sees the programme.
- To improve the logical sequence of the frames.
- To sharpen and smoothen the programme.
- To improve the technical accuracy aspects of the programme.
- To modify the frames of high error rate.
- To examine the proper use of promotes, cues and primes.

Space for Learners

Types of Editing-There are three types of editing through which the fir draft of the programme is processed. The three types of editing are:

(1) Technical Accuracy,

(2) Programme technique, and

(3) Composition editing

All three types of editing cannot be done simultaneously therefore, he has to perform editing in hierarchical order so that no time is wasted in repetition. It has been suggested by the experts that 'technical accuracy edit should be done first because it is most important in all the three types of edits. The second type of edit in hierarchy is programming techniques edit. The final edit is the composition so as to give a concrete shape of the programme.

(1) Technical Accuracy Edit:

In this type of edit, the subject-matter checks the programme to ascertain whether or not the material presented is technically accurate. Even a programmer who considers himself an expert in the subject-matter areas his programming, should have his material checked by some one else who is an expert in the field. Too often, a programmer fails to find out his own errors. Probably while programming he may omit certain items. It is so doing he may cause the student to develop an inaccurate concept. This commission may not apparent to another expert.

For instance, if a definition is being taught, the programmer must be sure that it is not one he has modified or simplified to the points of inaccuracy simply for case of teaching. This is a common tendency-over simplification resulting is not technically accurate material.

Vocabulary should also be carefully scrutinized. Programmer should see that vocabulary of the programme is neither too difficult nor too easy for the leaner and that it is technically sound. (2)

(2) Programming Techniques Edit:

There are two sub-types of programming technique edit. One is to edit the programme as a whole and the other is the edit the frames of the programme.

(a) The Programme: Technique Edit of the Programme-There are several aspects of programming technique edit which apply to the programme as a whole. The continuity of the programme is one of them. The programme must flow from item to item. There should be inter-relationship between the different parts of the programme. The programmer should ask himself certain questions about the programme and development of the ideas within his programme for e.g.

(1) Is there an inter-relationship between the parts of the programme? Is the programme composed of individual unrelated sequences? If so, the continuity could stand improvement.

(2) Are the ideas logically and methodologically developed, with and adequate amount of supporting material?

(3) Have examples and illustrations been used aptly to develop ideas.

(4) Are the students familiar with examples and illustrations given in the Programme?

(5) Can the students follow the line of reasoning through the programme as the material is developed?

(6) Does the programme work steadily towards a conclusion?

These items should be considered very thoroughly and sincerely by the programmer and should modify his programme in the light of his answers, for they make the difference between a programme that apeals to the student and one that frustrates him.

Another consideration to the be made during a general programme technique edit is the size of steps within the programme. It has been suggested that too large a step-size will lose the student, and too small a step-size may drive him to distraction. The optimum step-size for a particular student population can only be guessed at, but the programmer must try to tailor his steps to fit his group. Though the question of step-size is under constant debate.

There are two types of frame, size which need proper consideration, the intra frame and the Inter-frame. Inter-frame step-size is the size of the

Space for Learners

Space for Learners

step from one frame to the next; how big a jump is being taken frames are teaching point to another teaching point? The intra-frame step-size is the size of the concept presented within a single frame. How much is the student expected to grasp in each frame? How difficult is it for him to apply the knowledge presented as his response to the frame? Another important consideration during the programming technique is followed throughout the programme. In the course of writing or rewriting, it is possible that a frame or two may have been left out inadvertently. Therefore, programme would check for various types of frames and their placement in the programme. Item to check for include: practice frame with no set frames, practice frames these have been placed a head of their respective set frames, terminal frames out of sequence, a frame incomplete etc.

The final aspect of programming technique edit in general, is the quality and aptness of the illustration used. The placement of illustrations in relation to printed material may also be a factor to be checked.

(b) Programming Technique Edit of the Frames-The purpose of the individual frame edit is to each obvious fault before they affect the performance of the programme. The programmer should frames individually, with no regard to the material that procedure each frame or is to follow it, may not be valid. In considering a frame individually inadequacies are suspected that exists only when that frame is taken out of the context. Earlier frames may have precluded the inadequacies. However, much benefit can be gained from examining each frame and deliberately looking for inadequacies.

Examples should be used when ever applicable in a programme, but the frame in which an illustration is used, must be so designed that the student is forced to make use of the illustration in one manner or another before forming his response. He must ensure that the student will make the use of the pictures, diagrams and charts used in the frames. Before using a picture or illustration in a frame, the programmer must ask himself about the illustration in any frame:

(1) Is the illustration meaningful?

(2) Is the student required to use illustration to make his response?

If the answer to either of their questions is negative, the need for particular illustration is meaningless.

The programmer should also check the art work of the programme. The picture and diagrams should convey idea which the programmer wants to convey He should show in illustration to illustration that conveys something other than what the programmer intends can do more harms than a thousand words.

The next step in a frame edit is to take a close look at the response required of the student. The response which a student makes should be relevant. For maximum programme efficiency and effectiveness, each response the student makes should be part of the terminal behaviour toward which he is being led.

In addition to the relevance of the response, careful consideration should be made of the response made that is used. Following check list given by Susan Mayer Markle (1969) may be applied for the purpose of frames editing

(3) Composition Edit: Editing a programmes for composition is the same as editing any other written material for composition. The programme is checked for grammatical for composition. The programme is checked for grammatical mistakes, languages of the frames, spelling, the ability to communicate, aptness and punctuation etc. Also examined are such mechanical aspects of the material as the length of the blanks, uniformity of numbering systems placement of illustrations, and adherence to same basic construction rules. The entire programme will present a more favorable appearance to the student if it is compositionally correct. Errors will probably influence some students to think poorly of the programme and to questions an ability of the programmers.

A second factor that requires emphasis is the importance of maintaining a consistency through the programme from the stand point of what the student is expected to do.

Space for Learners

Space for Learners

If necessary, the student should be instructed within each frame as to what his action should be. The method of answering should be uniform in one type of frame. If one discrimination frames tells him to put an 'X' in the space to the left of each correct response, then all discrimination frames in the programme should ask him to do this. Needless to mention that it is confusing for a student to make a check in one frame, to make a 'X' in the second and circle the correct answer in third.

Some basic construction rules given below may be observed as guide lines for the programmer:

(1) Single blank should not be continued on the next line.

(2) Frame should be contained entirely on one page.

(3) Blanks should be placed at or near the end of frame.

(4) A programme may develop his own style to suit his own particular type of programmes, but he must be consistent through the programme that he develops.

STOP TO CONSIDER

The three types of editing are:

(1) Technical Accuracy,

(2) Programme technique, and

(3) Composition editing

III. Evaluation of Programme or Master Validation:

This is the final step of programme development. The characteristics of programme material are evaluated in this step to ascertain its effectiveness or workability. The evaluation is done on the basis of empirical evidences obtained from student's response. It requires selection of a representative sample of the target population. The sample consists of 50 subjects or more. The entering behaviour is the basis of their selection. The entire

programme is administered to a larger group more than 50 students. The same criterion test is used as pre-test (before the programme) and post-test (after the programme) to ascertain the net gain through the programme material. It is also known as field testing. The ultimate object of field testing is to ascertain the level of its effectiveness in terms of some criteria. These criterion measures can be broadly classified into two categories.

(a) Internal Criteria-These are related to the characteristics of the programme. They are of four types:

(i) Error rate,

(ii) Programme Density or Type Token Ratio (TTR)

(iii) Sequence Progression, and

(iv) Frame Inventory.

(b) External Criteria-These are related to the performance gain and attitude of the learners. They are of three types:

(i) Performance level,

(ii) 90/90 Standard criterion, and

(iii) Attitude coefficient.

If a programme meets these types of criteria in field testing, then it is considered valid and it is ready for use. The detail description and analysis of these criterions have provided in the following chapter of the book.

The field testing is done to change or modify and aspect of the programme but its subject is to validate the existing programme to determine its optimal use in an instructional settings. This try out may be used to indicate the best role for the instructor and organization of the curriculum material in terms of the sequence of programme material i.e., validation stage of the programme. The evaluation of the programme provides the feedback to the designer.

IV. Manual of a Programme:

When a programme is published for classroom use, it should be accompanied by a manual which provides the user with adequate

Space for Learners

Space for Learners

informations. Without a good manual programme can not be used effectively. A good manual provides the following informations:

(1) Specification of objectives (Terminal behaviours),

(2) Programme pre-requisites (Entering behaviours),

(3) Description of the criterion test,

(4) Detail description about the programme,

(5) Evaluation of the programme,

(6) Testing conditions and student sample,

(7) Effectiveness of programme, and

(8) Instructions for using the programme.

4.3 Merits of Programme Development:

The steps of Programme Development should have the following characteristics:

(1) There should be a flow in the steps of programme development.

(2) The steps should be more practical.

(3) The steps provide a guide line for programmer to develop a programmed material.

(4) The steps provide a scientific basis for the programme development.

(5) The logical sequence of content structure is validated empirically on the basis of student's responses.

4.4 Demerits of Programme Development:

The following are the demerits of programme development:

(1) It is a challenging rather difficult task to prepare good programme.

(2) It requires training and practice for developing programme frames.

(3) It is very time consuming and costly exercise.

(4) It is difficult job to incorporate all the suitable programme techniques and devices in writing good programme frames.

(5) Generally over prompting frames are used to avoid the errors or reduce the error rate of the programme.

(6) In writing frames, main emphasis is given to complete the blank rather than to produce learning conditions.

(7) Usually relevant response is asked these are not related to the new knowledge or terminal behaviours.

(8) In developing linear programme completion type of items are written rather than construct response frames.

CHECK YOUR PROGRESS-1

Que.1: Programme instructional material is used for _____. (Fill in the blank)

Que.2: Topic is to be selected in Conceptual form. True/False (Tick).

Que.3: Who gave the steps for developing programme?

.....
.....
.....
.....

4.5 Summing Up:

- The important stages in programming are as follows: i. Preparation, ii. Constructing or writing the plan, iii. Try-out and revision, iv. Evaluation and v. Preparation of a manual of the programme.
- Empirical approach is used in preparing programming.
- Robert Mager approach wrote the objectives in behavioural term.
- The frame structure consists of contextual stimulus, response and reinforcement.

Space for Learners

Space for Learners

4.6 Answer to Check Your Progress:

Answer to Q.1: Cognitive Objectives

Answer to Q.2.: True

Answer to Q.3.: Patricia Calendar, Petter Pipe, Joh P. Dececco

4.7 Questions and Exercises:

1. Write the various stages of a programme development. What are the specific skills that are needed at various stages?

2. What are the principles of making of programme? Show their application in a school subject in which you have specialized.

3. Enumerate the criteria for evaluating the programme instruction. Write the merits and demerits of programme development.

4.8 References and Suggested Readings:

- Sampath.K and others *"Introduction to Educational Technology"*
- Chauhan, S.S. "*Advanced educational Psychology"*
- Mangal, S.K. *"Foundations of Educational Technology"*

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