PEDAGOGY

OF

COMPUTER

SCIENCE

Contents

Individualized Instruction

- Meaning
- Characteristics
- Procedure for developing individualized instruction material
- Advantages
- Limitations
- Suggestions for teachers

Programmed Instruction/ Learning

- Meaning
- Definition
- Characteristics
- Principles
- Advantages
- Limitations
- Styles/Types of programmed instruction

Individualized Instruction

Meaning

It is an instructional system suited to the need and abilities of the learner. The teacher works on a personal one-to-one basis with the learner. It gives scope to the learner to work at his own pace. An instructional system is individualized when the characteristics of each learner play a major role in the selection of objectives, materials, procedures and time.

Characteristics of individualized instruction

- The instruction is tailored according to the needs, abilities and interests of the learners.

- The learner is given freedom to go ahead at his own pace.

- The learning outcome or the terminal behavior, which we aim to achieve is specified in operational terms.

- The learner is led to the terminal behavior gradually step by step.

- Mastery over an instructional sequence is possible if the learner is given time and properly sequenced material.

- Repeated testing and immediate scoring serve as proctors.

Procedure for developing Individualised Instructional material

The material can be in the form of printed materials, films, machines, laboratory sets, etc. The materials are developed in the forms of small learning units called *modules*. The modules may be self-contained, partly self-instructional and include multimedia.

Step 1: Select a unit. Break it down into small manageable units.

Step 2: Prepare performance objectives for the learning units or modules.

Step 3: Identify the activities for the student to meet the objects.

Step 4: Determine through a pre-test the competency needed by the students.

Step 5: Prepare an outline study guide – the title, the objective and activities, some instructions to the students, exercises self-evaluation and time for teacher assessment.

Step 6: Try-out the module with a few students and see whether the sequence of instructions and available materials are adequate.

Step 7: Refine the module on the basis of your observation and comments of your students and your colleagues.

Advantages of Individualised Instruction

➢ Permits each child to progress at his own pace.
➢ Allows each child to learn according to his/her own interest, abilities and modes of learning.
➢ increases the experience of the child for investigation.
➢ Provides learning environment that encourages the child to be motivated intrinsically.
➢ Immediate feedback and frequent testing act as proctors.

Limitations of Individualised Instruction

➢ Requires small class.
➢ Time consuming in preparation and collection of materials.
➢ Materials are not readily available.
➢ Requires well equipped library, laboratory and class rooms**.**

Suggestions for the teachers

The teachers with limited resources can implement this new innovation in teaching-learning process:

1. Gives more opportunities to the students to express their ideas.
2. Recognise and accept different ways of responding to learners individual needs and styles.
3. Encourage the learner to discover and exercise his/her own resources to find out solutions for the problems.
4. Use techniques placing learner in different roles.
5. Clear the way for stretching learners minds and abilities towards creativity and self-fulfilment.

Programmed Instruction/ Learning

Meaning

Programmed instruction or programmed learning represents one of the effective innovations in teaching learning process. It is highly individualized strategy which has been found to be quite useful for classroom instruction as well as self-learning or auto-instruction. It has been coined from principles of operant conditioning which was formulated by *B. F. Skinner* and law of effect which was proposed by E. L. He claimed that desirable changes can be brought out by giving a continuous feedback or reinforcement for desired responses. It is also named as programmed instruction and instructional technology.

Definition

Skinner (1954), *"Programmed Instruction/Learning is the first application of laboratory technique utilised in the study of the learning process to the practical problems of education".*

Susam Markle (1969), *"it is a method of designing a reproducible sequence of instructional events to produce a measurable and consistent effect on the behaviour of each and every acceptable student".*

D. L. Cook, "*Programmed learning is a discipline used to clarify a broader concept of self-learning methods***"**

Stoffel, "*Programmed instruction of arranging small pieces of knowledge in a logical sequence".*

Characteristics of Programmed learning

- The content is broken into small easy step and each step is presented in several sentences, each called a 'Frame'.
- The frames are arranged sequentially.
- Most of the frames require that the learner make some kind of response – an answer to a question, an activity to demonstrate the understanding of the material.
- The student is provided with immediate reinforcement.
- Units are arranged in a careful sequence such that it shapes the behaviour of the learner.

- It is a teaching method and not a test. It helps the students in learning a material
- It is not an audio visual aid. It is a part of educational technology.
- It is not the solution of educational problems. It is a new instructional strategy for the behaviour modification of the learner.
- It cannot replace the teacher because only an effective teacher can prepare a good programme.
- It requires more creativity and imaginative efforts to develop highly individualized instruction.

Principles of Programmed Instruction/ learning

✓ **Principle of small steps**

This is based on the assumption that one learns better if the content matter is presented in a suitable small steps. Hence a programmer while preparing a programme should try to arrange the subject matter into properly sequenced meaningful segments of information called frames. It helps students to learn and grasp the material given in each frame. The aim of this arrangement is not to test the student but to improve the quality.

✓ **Principle of active responding**

A student learns better if he/she actively participates in the lesson. Programming provides opportunity for a learner to respond frequently. It is an integral part of learning.

✓ **Principle of immediate confirmation**

The psychological phenomenon of reinforcement is the basis of this principle. One learns better when one is motivated to learn by receiving information of the result just immediately after responding. The confirmation provides the reinforcement to the learner.

✓ **Principle of self-pacing**

It is a technique of individualized learning. It is based on another assumption that learning can take place better if an individual is allowed to learn at his/her own pace. This principle is controls individual differences in the process of learning.

✓ **Principle of student-testing / evaluation**

Continuous evaluation of the learning process helps in maximizing learning is the base of this principle. This record helps in revising the programme and also provides feedback to the teacher about the student's progress.

Advantages

- To help students to learn by doing.
- To provide the situation to learn at his own pace.
- To help student to learn without the presence of a teacher.
- To present the content in a controlled manner and in logically related steps.
- To study by himself and assess his own performance by comparing it with the given answer.

Limitations

- Demands specific skills to develop a good programmed learning material.
- Focuses only on cognitive domain.
- No opportunity for learner to think out of the box, creative thinking….
- Developing a program is not economical.

Styles/Types of programming

Propagator	Programming Type
B. F. Skinner	*Linear or Extrinsic Programming*
Norman A Crowder	*Branched or Intrinsic programming*
Thomas F. Gilbert	*Mathetics programming*

A. Linear or Extrinsic Programming

The linear programming style was propagated by *B. F. Skinner (1955)*, which is directly related with the theory of '*Operant Conditioning'*.

- It is based on the assumption that human behaviour can be shaped or modified gradually, step by step with suitable reinforcement for each desired response.
- The instructional material is arranged into a number of meaningful small steps called *frames*.
- Frames are presented to the learner in the arranged order one at a time.

- The learners have to respond actively to each step, which makes them active participant throughout the learning process.
- After the response, information about correctness of the response is given to the learner.
- This reinforces the learner behaviour, and motivates them to learn the next frame in the arranged sequence.
- Every learner starts form the initial frame and ends at the terminal frame.
- The learner must go through each and every frame in a straight line manner – hence it is called as *linear programming.*
- Learner has the freedom to complete the programme at his/her own learning speed and ability.

Principles of Linear Programming

- ❖ **Principle of small steps**
- ❖ **Principle of active responding**
- ❖ **Principle of immediate reinforcement**
- ❖ **Principle of self-pacing**
- ❖ **Principle of student-testing**

Characteristics of Linear Programming

1. **Linear:** Every learner follows the same path. The learners starts from the initial frame and goes to terminal frame.
2. **Small steps:** programme is composed of small steps which contain a single idea, example or rule.
3. **Controlled response:** the responses and the order are decided by the programmer and in each step only one response is required.
4. **Response is emphasised:** importance is given to the response and the learner must (forced) give respond in each frame.
5. **Provision for cues and prompts:** to minimise the errors, provision for cue and prompts are given especially in the beginning frames.
6. **Feedback is quick:** immediate feedback is possible and hence the learner is able to compare the response with the programmers answer.
7. **Self-pacing:** each learners work at his\her own speed and is discouraged from cheating.

8. **Active response:** The responses are to be given after a critical observation and comprehension of the frame and learner can proceed further only after responding. Hence no learner can be a silent spectator.
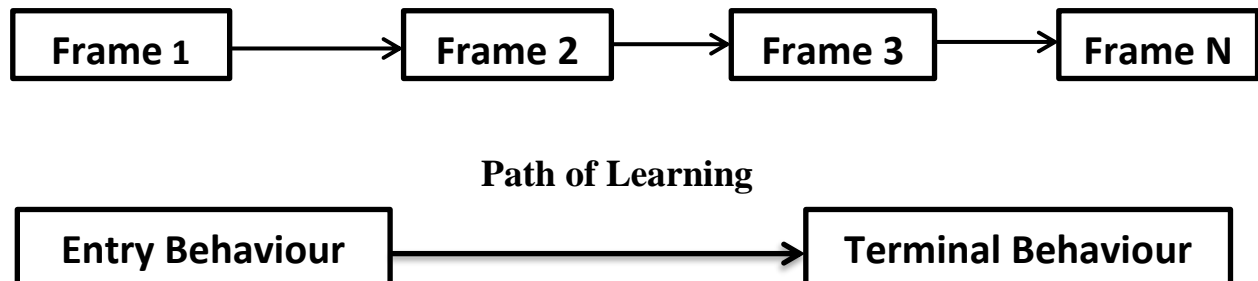
| Frame 1 | → | Frame 2 | → | Frame 3 | → | Frame N |

Path of Learning

| Entry Behaviour | ————————→ | Terminal Behaviour |

Fig: Graphical Representation of linear programming

Limitations of Linear Programming

1. **Lack of Motivation:** The linear fixed nature of learning tends to make a dull , uninspiring and uninteresting.

2. **Time Consumption:** Since the steps are small and many, it consumes a lots of time to cover the subject matter.

3. **Freedom of choice is curtailed:** Since the responses are controlled and learners has to answer in a few words, the creativity of the learner is not brought out.

4. **Guessing**: The blank type of responses and cues generally help the learner to guess the answer.

5. **Costly:** The large number of steps makes the preparation and presentation costly as it requires lot of peoples.

6. **Applicability:** It can be used in few areas where responses are measurable such as mathematics and science.

7. **Scope of Flexibility is less:** The same programme may not be optimally effective for all learners. Learners differ both in previous experience and latent inherent abilities. Hence, the same sequence may at times prove counter productive**.**

8. **Learners' Honesty cannot be assumed at all times:** Since answers are available in the next frame we cannot expect all students to be honest at all times. We also cannot be sure that students don't skip frames.

9. **Variety is not ensured:** Learners do not search out concepts and think of various possibilities. Judgement and integration are not ensured**.**

10. **Rigid Following:** Learners are not allowed to diversity and all are expected to follow a rigid line prescribed by programme**.**

B. **Branched or Intrinsic Programming**

American Psychologist, *Norman A. Crowder (1954)* developing the branching programme hence it is also known as *Crowderian Model*. It is called intrinsic because the learners within themself make a decision, to adapt the instructions to his/her needs.

- The learner learns a thing better if it is presented in its totality or in the form of meaningful components or units.
- Learning takes place better if the students are made to learn on the pattern of traditional tutorial methods.
- The basic learning takes place during the students exposure to the new material.
- Wrong responses do not necessarily hinder the learning of a correct response. In a learning process, errors may occur.
- If an error occurs, it may be detected and corrected before proceeding further on the learning path.
- Learning takes place better if a learner is allowed sufficient freedom to take decisions for adapting the instruction to his needs.
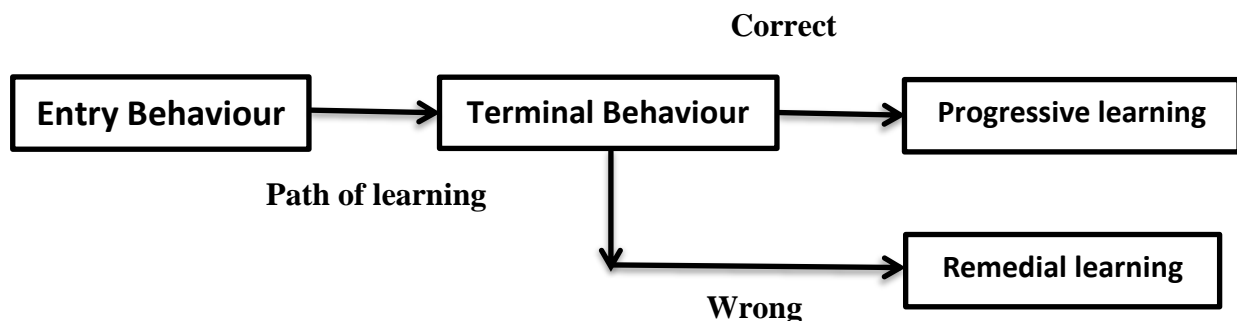
Correct

| Entry Behaviour | → | Terminal Behaviour | → | Progressive learning |

Path of learning

Remedial learning

Wrong

Fig: Graphical Representation of Branching programming

Principles of Branching Programming

✓ **Principle of Exposition:** it is based on the fact that the learner should perceive globally (the whole/complete phenomena) that matter to which he/she is exposed. The whole concept is presented to the learner in paragraph or a page on the home page.

✓ **Principle of Diagnosis:** refers to the need to identify the weakness of the learner. A multiple choice format is used to diagnose the short comings of the learner and the extent to which he could learn the concept.

✓ **Principle of Remediation:** remedial instruction is provided on the wrong page. On the basis of diagnosis, remediation is provided.

Limitations of Branching Programming

- Multiple choice questions provided in this programme may encourage guessing without understanding the subject matter given in the frame.
- Assists to provide to the needs and individual difference of all learners. It requires infinite branching which is not possible.

Types of Branching Programming

The two types of branching programming are:

1) **Forward branching**
   - The learner is always moving forward to a new frame respectively to his/her right or wrong response to the questions.
   - When the learner gives a wrong response, he/she is directed to a remedial frame where the mistake is explained.
   - After the remedial, the learner is asked another question and if gives the correct answer he/she proceeds to a new frame.
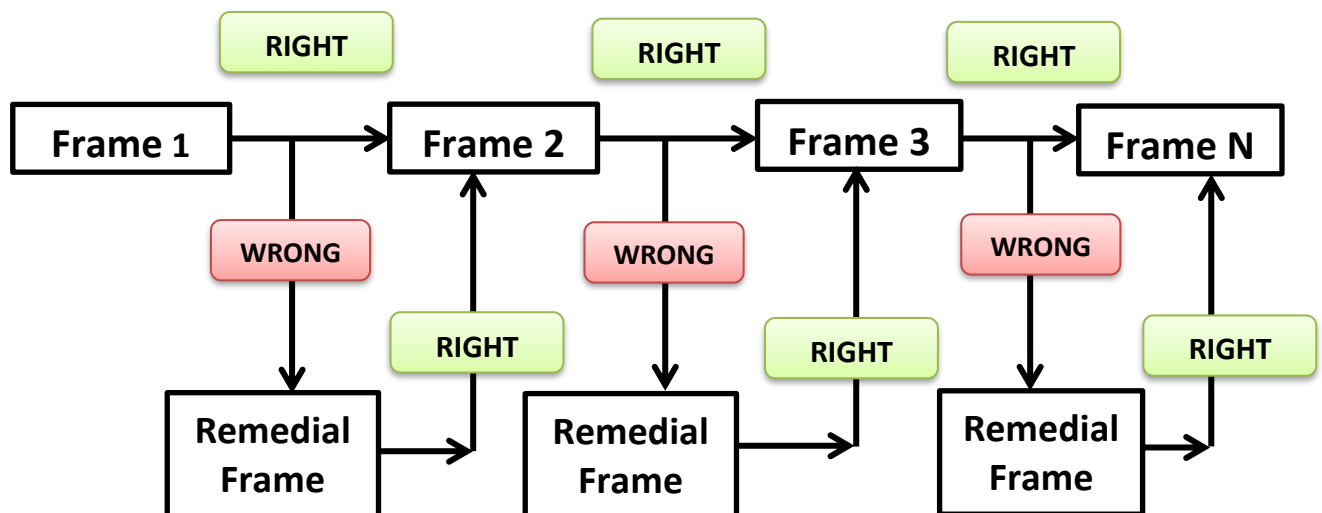

Fig. Graphical Representation of Forward Branching

2) **Backward branching**
   - The learner starts from first frame and moves to the second frame only if the given response is right/ correct.

- If he/she makes an error, the learner is directed through a remedial frame.
- Where the learner is given extra help in understanding the concept and arriving at the right/ correct solution to the question.
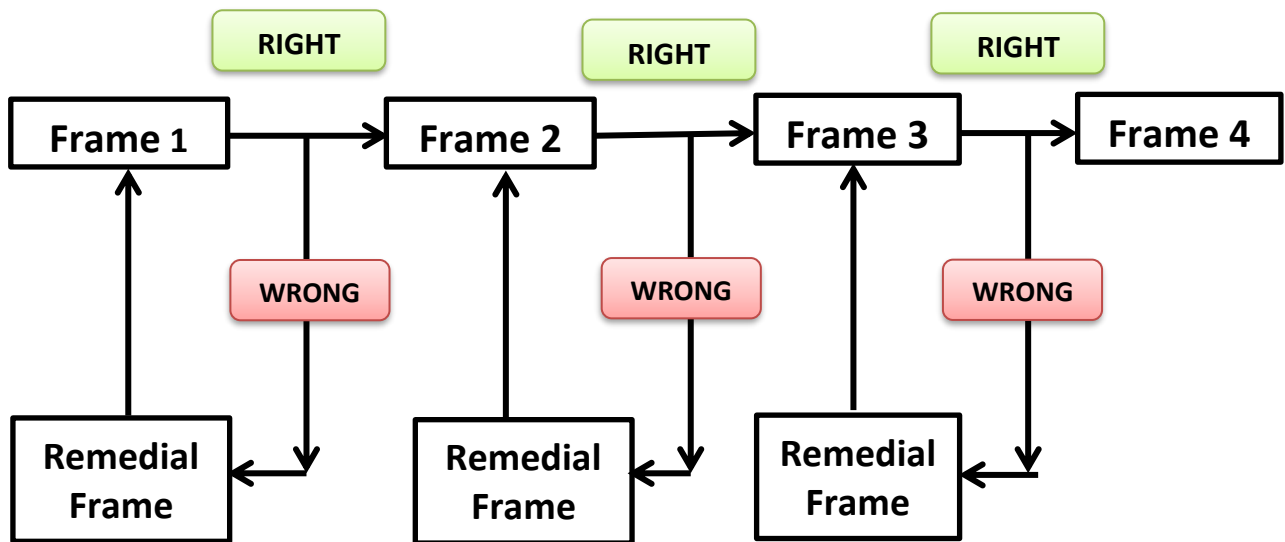- Then he/she is led back to the original frame for further learning.

Fig. Graphical Representation of Backward Branching

C. Mathetic Programming

Mathetic programming was formulated by **Thomas F. Gilbert** and the term is derived from the **Greek word "Mathein"** – meaning is *"to learn".* It is defined as a systematic application of reinforcement theory to the analysis and construction of complex performances which represent the mastery of subject matter.

Mathetic programme begins with an instructional plan and analysis of what is to be taught. Gilbert emphasises that the analysis must concentrate on learner activity and not subject matter coverage.

One of the basic concepts of Mathetics is to start with the most motivating task and generally it is the last or final step in any task. Hence, the leamer starts from the task and goes backward to finally reach the introductory part. The tasks or frames have to be carefully chained. Otherwise they will lose relevance, sequence and logic. Principles of Mathetics Programming

Principles of Mathetic Programming

a) **Principle of Chaining**: Elements of the content are presented in stimulus and response form. The stimulus and responses are arranged in a chain such that each response works as stimulus for the next.

$$S_1 \longrightarrow R_1 \longrightarrow S_2 \longrightarrow R_2 \longrightarrow \ldots\ldots\ldots S_n \longrightarrow R_n$$

b) **Principle of Discrimination**: The main idea here is that discrimination of situation of learning is generated by providing different stimuli having different responses. Every stimulus and response is independent of each other.

$$S_1 \longrightarrow R_1$$
$$S_2 \longrightarrow R_2$$
$$S_3 \longrightarrow R_3$$
$$" \quad " \quad "$$
$$S_n \longrightarrow R_n$$

c) **Principle of Generalisation**: The main idea here is to emphasise the fact that generalisation is a crucial situation of learning. In this type of situation, a group of stimuli emits a single response.
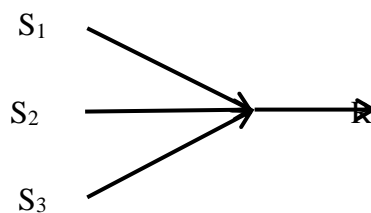
Mathetics is helpful in teaching complex chains to human learners. Each time a learner completes the total chain he is reinforced by the success. T type of programming provides opportunity for developing divergent thinking and skills in technical training.

Limitations of Mathetics Programming

- This programming is more technical in nature and demands much skill, training and labour on the part of the programmer.

- It is not suitable for learning the material of all the subjects and achieving all the instructional objectives).

- There is inadequate provision of individual differences in this programme. All have to learn in the same way.

- Challenging for some students especially to the slow learners.

Reference

Sandeep, J. M., (2014). *Teaching of computer science*, Neelkamal Publications Pvt. Ltd.,

   New Delhi, Hyderabad.

Mohan, R., (2011). *Teaching of physical science.* Neelkamal Publications Pvt. Ltd., New

   Delhi, Hyderabad.

e-resources

https://ncte.gov.in/oer/Forms/OERDocs/OERDoc/OERDoc_348_34375_10_08_2021.pdf

https://www.samareducation.com/2022/06/programmed-instruction-method-of-teaching.html