

PROGRAMMED LEARNING

Programmed Learning incorporates many principles of reinforcement theory, although the technique was not invented by a reinforcement theorist. The technique was originally developed by Sidney L. Pressey. Pressey's 'TESTING MACHINE' was effective but it didn't become popular. Pressey's idea was good but it was not appropriate to the spirit of his age at the time he proposed it. It was left to Skinner to rediscover programmed learning & make it popular.

Skinner's approach to Programming has been called linear & involves the following features derived from his theory:-

- (i) Small Steps : The learner is exposed to small amounts of information & proceeds from one frame, or one item of information, to the next in an orderly fashion. This is what is meant by linear Program.
- (ii) Overt Responding - The student is required to respond overtly so that his correct responses can be rewarded & his incorrect responses can be corrected.
- (iii) Immediate Feedback - Immediately after making a response, the student is informed as to whether it is correct or not. This feedback acts as a reward if the answer was correct or a measure of error if the answer was wrong.
- (iv) Self-Pacing - The student proceeds through the program at his own pace.

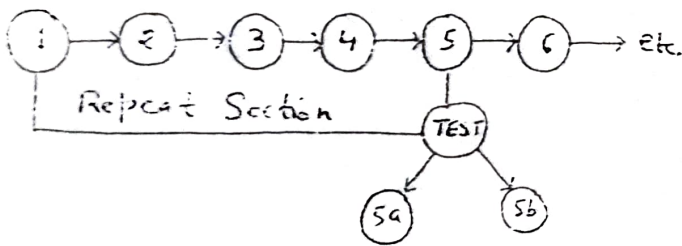
There are a ^{number} of variations of the linear program. For example, some provide the student with the opportunity to skip information that he is already familiar with. This procedure usually involves giving the student a pre-test on a certain section of program, & if he performs adequately he is instructed to advance to the next section.

Therefore, the answer seems to be that programmed learning is effective, at least in the areas where it has been tried thus far.

The question as to why it is effective is not so easily answered. At present, there is widespread disagreement concerning which aspect of programmed learning results in its effectiveness. For example, the Guthriens maintain that programming is effective because it assures that an appropriate response terminates each frame. It is this event, & not the rewarding of overt responses, as Skinnerians would claim, that makes for effective learning. (Dumsdaine 1964). Controversy also exists over the importance of all other aspects of programmed learning, for instance, the nature & importance of self-pacing. At this time it can be concluded that programmed learning is an effective teaching device, but the essential ingredients that make it effective are still a matter of speculation.

BRANCHING PROGRAMS

With the Branching program, the student's response is used more as a diagnostic tool than a learning device. Typically, ^{with} this kind of program student is instructed to move forward in the program if he answers a question correctly. If he answers incorrectly, however, he is instructed to different parts of the program depending on what kind of mistake the student makes. He may, for example, be instructed to repeat an entire section of the program or he may be directed to other information which attempts to clarify his particular type of misunderstanding. In either case he is again tested & thereafter he proceeds through the program in a manner dictated by his performance on the test.



(Diagrams of various programming techniques)

Is Programmed Learning Effective?

Schramm (1965) reviewed 165 studies of programmed learning. Of the 36 studies that compared programmed instruction with the more traditional kinds of instructions, 17 found programmed instruction to be more effective; 18 found both kinds of instruction to be equally effective, & only 1 found traditional techniques to be more effective than programmed ones.

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Additional Material On Programmed Learning

Learning

Perhaps the most publicized innovation in teaching technology in past few decades has been the introduction of programmed learning. Programmed learning frequently involve the use of so called teaching machines. The typical program consists of a carefully ordered series of questions presented one at a time. After writing out his answer to a question, the learner compares his response with the correct answer. If right, he goes on to the next question; if he is wrong, he can often arrange for the program to be presented again.

The various questions of a program can appear in a simple work book or even machines can be used for the same purpose. The advantage of the machine is that it can be constructed to control cheating. The learner may be unable to write his response to the question once he has been exposed to the correct answer. Similarly, the machine may prevent the learner from advancing to the next question until he has attempted the one at hand. Another advantage of mechanical accessories is that they can often be used in presenting programmed materials to those who cannot read or write. These lessons can be arranged so that the learner may simply push a button in an effort to match one of the several answers (given in the form of pictures) with a question (also in picture). Finally mechanical ~~g~~ gadget.

to a very few trials. However, total RI reached max after about 20 interpolated trials, & there was a slight decline in total inhibition as practice on second task continued. When Melton & Irwin came present reasons for this result, they drew upon additional data. They tabulated the number of errors which occurred during the recall of the first list. They were particularly interested in these errors that were actually correct syllables from the second list. These interlist intrusions are the failures of recall of the first list can definitely be traced to competitions from items learned during practice on the second list. These errors are common during early trials of practice on the interpolated but decline thereafter. Melton & Irwin argued that this was so because, as the interpolated list is better learned, it was more easily differentiated from the original list & therefore less likely to produce intrusions during recall of the original list.

The problem, however, is to account for the fact that retroactive inhibition continues to be strong after overt competitive intrusions have declined. How do we account for sustained high retroaction. Melton & Irwin labelled the difference between retroactive inhibition attributable to overt competition & total retroaction to "factor X". This

The Development of Interference Theory

'Retroaction'

McGeoch (1932) stated the original version of interference theory. He assumed that original associations remain intact, while new associations are acquired during interpolated learning. This has been called independence hypothesis, since it suggests that two sets of related associations may exist in storage without mutual interference. According to this theory, the cause of forgetting is not the failure of storage; rather, competition between alternative responses causes forgetting at recall.

The Independence hypothesis was undermined in a famous study by Melton & Irwin. These experimenters determined the influence of amount of practice at the interpolated task upon the retention of the first task in a retroaction experiment. The material the subjects learned consisted of NSS learned by the method of serial anticipation. All subjects practiced the original list for five trials. They were then either rested or were given 5, 10, 20 or 40 trials of interpolated learning. Thirty minutes after original practice all subjects were required to re-learn the original list to a criterion of two perfect recitations. The amount of retroactive interference (RI) was computed by subtracting the recall score, on the first & relearning trial, of each experimental condition from that of the resting control condition.

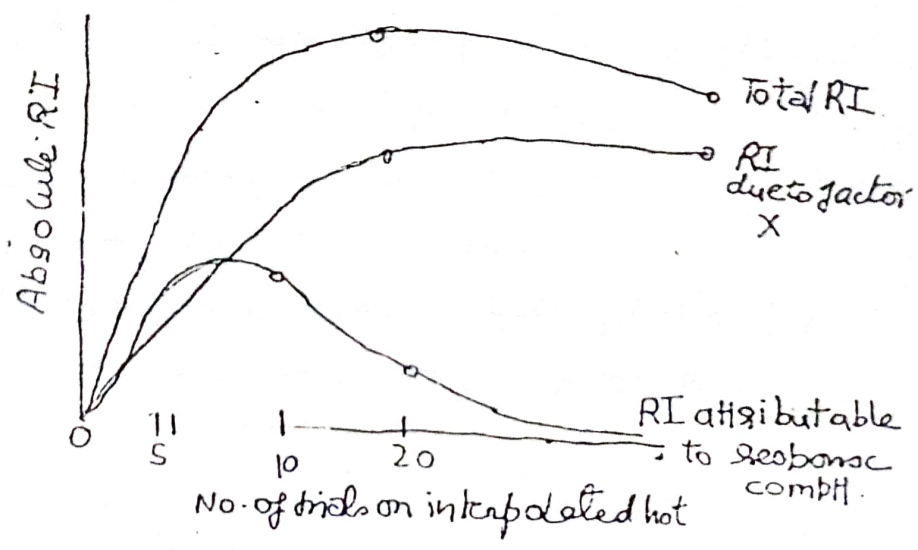
Total RI increased rapidly as the amount of practice on the interpolated task increased from zero

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factor X continues to increase as a result of additional practice on the interpolated task.

What is factor X? Melton & Irwin argued that it might be unlearning the material from the first list. They pointed out the analogy to the experimental extinction of instrumental responses. As subjects learn the second list, items from the first list occasionally ~~inter~~ intrude. That is, people think of, or even give, overly give, items from the original material during practice with the interpolated list. Such responses are incorrect during the learning of the second list, & so they go unreinforced or may even be punished. Therefore, the tendency to give items from the first list is weakened during ~~the~~ ^{the} learning of the second list. The more the practice on the second list the greater is the cumulative of the first. Thus in contrast to McGeech's explanation of retroaction which is based on just the factor of response competition, Melton & Irwin proposed a two-factor theory based on both response competition & unlearning.



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in his book "Programmed Instruction; Techniques & Trends" classified principles of programmed instructions in two groups.

(i) Mandatory principle, and

(ii) Optional principle

We would discuss each of these principles in brief:

(1) Mandatory principles:

(i) Objective specification :- The programme, while developing a programmed instructional material, specifies the objectives of the programme in behavioural terms. It identifies the terminal behaviour which the learner is to be able to show at the completion of the programme. He further specifies the conditions under which the terminal behaviours are to be manifested & states the city restrictions to be imposed. The standard of judgment of the acceptable performance is also mentioned in detail terms.

(2) Empirical testing :- Programmed material is empirically tested material. The programmer, after writing a few initial draft of the programme tries it out in the following three phases:

PROGRAMMED LEARNING

Programmed learning is essentially an instructional procedure that requires represents an application of learning principles to educational practice. This instructional procedure requires learner participation, provides immediate feedback & permits each individual to progress at his or her own pace.

According to DL Cook programmed learning is a term sometimes used synonymously to refer to the broader concept of auto instructional method. According to Fred Stoffel, "The arrangements of the tiny bits of knowledge into a logical sequence is called the programme & its process is called programmed learning"

Principles of Programmed Instruction:-

The principles of programmed learning are as follows:-

Small Steps:- The materials to be programmed are divided into meaningful segments & are presented through small steps.

Immediate Confirmation or Feedback:- As soon as the learner proceeds through programmes, his response, is programme immediately confirmed as to be either correct or incorrect by knowledge of results (KR) and feedback is immediately provide

Active Responding:- For the success of any programme the learner has to anyhow respond. Response is core of programmed learning that keeps the learner busy throughout the programme.

Self Pacing:- An individual learner proceeds through a programme at his own pace without care for the group.

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(b) Empirical testing:- Programmed material is empirically tested material. The programmer, after writing a few initial draft of the programme tries it out in the following three phases:

(a) Individual try out — The first draft of the programme is tested on an individual in face to face testing. The reactions of the individual recorded for each frame.

(b) Small group try out :— After modifying the programme on the basis of individual try out, the programme is tested on five to ten representative students of the class for which it is developed.

(c) Field try out :— At the third stage, the programme, after modification on the observation of small group, is administered in actual class room conditions.

3) Self-pacing :— In programmed learning, the learner decides the rate at which he progresses through the programme. He adjusts the pace of the work to his own ability + motivation level. He is not forced to work with the speed of other students of the class. The principle of self-pacing incorporates the concept of individualised instruction.

1) Optional Principles :—

(1) Overt Responding :— The learners are asked to respond frequently to explicit or implicit questions as they progress through the programme. The overt response requirement of programmed learning insures that the learner will become and remain active + attentive to the instructional material. The active involvement of the learner increases the learner's motivation.

(2) Immediate Feedback :— Feedback is information fed

Limitations of Programmed Learning:-

Though the supporters of programmed learning make high claims & point-out many advantages, there are limitations in programmed learning which require the help of the teacher.

- (I) In programmed learning students learn how to put out the facts needed for a given purpose. Eg. students can not develop the habit of using a dictionary or going to the library with the help of a teaching machine or programmed learning.
- (II) In the rapidly changing world new situations arise quickly. In order to function effectively in new situations and adjust accordingly, the students require to have certain personality qualities & social maturity.
- (III) The third limitation of the programmed learning is that it does not develop in students the ability to discover problems for themselves & solve them on their own.
- (IV) Programmed learning does not develop creativity among students to the extent a teacher can.
- (V) Teaching machines provide programmed learning in a scientific manner & thus programmed learning is the science of teaching. As regards the art of teaching it is possible only with the help of a teacher.
- (VI) Teaching machines & programmed learning ignore the human factor & do not provide opportunities for human relations, which is now regarded as the fourth R.

Advantages : - Programmed instructions has innumerable advantages over the traditional methods of learning that have been proved through research. A few of those are enumerated as under :

- (i) Foreign languages drill in spelling, factual information can best be taught through programmed instruction.
- (ii) Teachers being free from routine classroom activities can devote more independent time & think more creatively in case of programmed instruction.
- (iii) Social & emotional problems, especially in the West, have been effectively dealt through programmed instructions in the classroom. The self instructional materials have successfully eliminated the problem of indiscipline inside the class.
- (iv) It caters for the individual needs through individualised instruction & self-pacing & can better serve a heterogeneous population of learners.
- (v) It helps the teacher to clearly diagnose the needs & problems of the individual learner & correct those on personal basis without any delay that is quite absent in a traditional classroom of uncountable students.
- (vi) Learning becomes interesting through programmed instruction. It provides challenge to the individual learner to utilise his ability to the full extent. Confirmation of correct responses provides sufficient motivation to proceed at a quicker speed towards cent-per-cent mastery.

Limitations of Programmed Learning:-

Though the supporters of programmed learning make high claims & point out many advantages, there are limitations in programmed learning which require the help of the teacher.

- (i) In programmed learning students learn how to memorize the facts needed for a given purpose. Eg. students can not develop the habit of using a dictionary or going to the library with the help of a teaching machine or programmed learning.
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- (vi) Teaching machines & programmed learning ignore the human factor & do not provide opportunities for human relations, which is now regarded as the fourth R.

3- Rs being reading, writing, & arithmetic.

vii) Another limitation in programmed learning is that it does not help in socialisation of students. It is in peer groups, play groups & work groups that social development of children takes place.

Application of programmed Learning :-

Programmed instruction can be applied where ever learning occurs, whether in the classroom or in the industrial setting. In the classroom it helps in regular instruction, enrichment of learning & for remedial instruction. In industry, it helps disseminating the technical innovations through refresher courses for up-to-date professional development. This can also be applied in teaching military sciences & in defence. As for example teaching of electronic troubleshooting course to naval trainees becomes easier & effective through programmed instructions.

The use of programmed learning finds application in the following areas -

Teacher's training :- Programmed material can be used at all levels of teacher education programmes. Many teachers need to keep abreast with knowledge & latest developments in the field. In these areas programmed instruction is of considerable aid.

Correspondence Courses :- Education through correspondence courses or distance education is becoming very popular. It is emerging as a very successful media for educating the masses as well as those who want to continue their education.

goal by presenting carefully structured material in small steps provided each step is reinforced or rewarded by favourable experience.

Linear programming has the following characteristics:-

- (i) Linear Programming; generally involves breaking the information in small steps of 40 to 50 words each. This is called as a frame. The learner must respond to each frame in succession by filling in words or phrase in a blank.
- (ii) The material are arranged in order. In such a programme, the learner advances in a single series of short steps which are designed to ensure a high rate of correct responding to the questions (frames). Same path is followed by each learner. The learner starts from his initial behavior to the terminal behavior following straight line sequence. All learners pass through the same path.
- (iii) In a linear programme, responses are controlled by the programmer. The responses and their order are fixed. The learner has no choice to respond in his own way.
- (iv) In linear programme, the emphasis is laid on response. The learner must respond to each and every frame in order for the learning to occur.
- (v) As soon as the learner responds to the frame he immediately compare his response with the response programmed. There is quick feedback.

To achieve the objectives, the project staff utilised the programmed instruction adapting to the needs of individuals. The result of the project were very significant.

Programmed instruction and exceptional children :-
Programmed instructional material has been used on disturbed children + slow learners with great success. Eldred + his coworkers conducted a study on slow learners + under-achievers with programmed instructional technique. The students showed great improvement in their performance.

Special programmes should be developed for exceptional children. Abraham 1966 warned about the false assumption that a programme developed for so-called typical children will work for exceptional children, disadvantaged population, dropouts, delinquents + others.

Different type of programming :-

There are three different types of programmed learning:

- a) Linear Programming,
- b) Branching +
- c) Computer Assisted Instruction.

We would discuss each of these briefly.

Linear Programming :-

This type of programming was pioneered by B.F. Skinner. It is defined as "a programmed material sequence in which each student proceeds in a straight-line through a fixed set of items".

Skinner after extensive experimentation on rats + pigeons established that animals or human beings can be led to desired

goal by presenting carefully structured material in small steps. Each step is reinforced or rewarded by prompt experience.

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- (iv) In linear programme, the emphasis is laid on response. The learner must respond to each and every frame in order for the learning to occur.
- (v) As soon as the learner responds to the frame in the programme there is quick feedback.

(VI) In the beginning prompts or cues are supplied to facilitate learning to occur.

(VII) Cheating is discouraged by not revealing the answer to the learner.

(VIII) The linear types of programme is useful in that programmed learning, which aims at developing in the learner simple discrimination, learning tasks of both verbal + motor types, perceptual learning + sequential learning.

Limitation of Linear Programming:-

(1) Lack of motivation:-

It is alleged that learning becomes dull and learner experience monotony + boredom. It takes too much time to teach very few points.

(2) Freedom of choice is curtailed:-

The learner has no choice of his own to respond, thus it is alleged that creative imagination of learner is inhibited.

(3) Costly:-

It has been found that preparation of programmed material requires too much paper + time.

Branching:-

This form of programming was developed by Norman A Crowder. In this programme the learner is presented with a longer unit of materials followed by a multi choice-type item.

The response to ^{the} item determines which of several units he will be directed to work on next.

The branching type of programme is useful in developing the ability to do problem solving + perform various types of analytical tasks.

terminal consists only of a teletypewriter with a headset. The central computer, housed at Stanford University is connected by telephone lines to several terminals in several states as far away as Florida & Washington D.C. The learner's response history is by the computer to make trial-by-trial decisions regarding what instruction to present next.

A less costly & more widely applicable way of utilising computers in teaching is through computer managed instruction (Hembleton 1974). In such systems the learner does not interact directly with the computer. The role of the computer is to assist the teacher in carrying out a plan of individualised instruction which may use self-instruction package or more conventional types of instruction. A major contribution of the computer is to process the formidable mass of data accumulated daily regarding the performance of each student - in a classroom where each may be involved in a different activity - or to utilise these data in prescribing the next instructional step for each student.

drill & practice, problem solving simulation & gaming form of instruction, & certain forms of individualized instruction. To date computer-assisted instruction procedures have been rarely used in educational field in India due to its high cost.

Although long-range future developments (especially in reduced costs) may cause computer-assisted instruction to blossom as a training procedure in education, its use within the foreseeable future would probably be limited to special circumstances in which computer facilities are available & in which costs can be spread over many trainees.

Several universities have CAI centres, which are used chiefly for remedial programs. As a supplementary learning aid, or for particular courses in which this approach has proved effective. Some progress is being made in the introduction of CAI at the high school level. Adoption have been slow because of cost & because of problems involved in developing the required hardware & software & in training school personal in the use of such instructional systems.

An especially promising application at the elementary school level is illustrated by the Stanford University CAI reading program for children in the first three grades (Atkinson 1974). The object of this program was "to develop low-cost CAI that supplements classroom teaching & concentrates on those tasks in which individualisation is critically important". The student

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