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ABSTRACT

This brief review lists the major features of teaching machines and programed instruction. The ideal learning situation has these factors: 1) division of the subject into steps small enough to be grasped immediately; 2) specific, clear, sequential questions; 3) means for the student to proceed at his own pace; 4) means of causing the student to be a constant active participant. Teaching machines meet these qualifications better than the traditional classroom situation. (JK)

INFORMATION REGARDING

TEACHING MACHINES AND PROGRAMMED LEARNING

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INFORMATION REGARDING TEACHING MACHINES AND PROGRAMMED LEARNING

Programmed Learning is the result of years of research by experimental psychologists. Such research has sought a greater understanding of the learning process and consequently a foundation for increasing learning efficiency. Research data indicate that an ideal learning situation must have the following elements:

(1) Division of the subject into steps small enough for a student to grasp immediately;

(2) Specific, clear, sequential questions that will reduce to a minimum the possibility of incorrect answers so that the student is constantly reinforced for being correct;

(3) Some means by which each student can proceed at his own pace and thus avoid the boredom of bright students and the frustration of slow students in the classroom;

(4) Some means of causing the student to be a constant, active participant in the learning situation.

It is clear that one teacher handling classes of at least 30 students cannot provide the ideal conditions listed above. So, the search was on for a device of presentation—a machine that could provide ideal conditions.

Several machines with the required characteristics have been built and tested. Sets of separate presentations or "frames" of visual material are stored on disks, cards, or tapes. One frame is presented at a time, adjacent frames being out of sight. In one type of machine the student composes a response by moving printed figures or letters. His setting is compared by the machine with a coded response. If the

two correspond, the machine automatically presents the next frame. If they do not, the response is cleared, and another must be composed. The student cannot proceed to a second step until the first has been taken.

In another machine, material is printed in 30 radial frames on a 12-inch disk. The student inserts the disk and closes the machine. He cannot proceed until the machine has been locked, and once he has begun, the machine cannot be unlocked. All but a corner of one frame is visible through a window. The student writes his response on a paper strip exposed on a second frame. By lifting a lever on the front of the machine, he moves what he has written under a transparent cover and uncovers the correct response in the corner of the first frame. If the two responses correspond, he moves the lever horizontally. This movement punches a hole in the paper opposite his response, recording the fact that he called his response correct, and alters the machine so that the frame will not appear again when the student works around the disk a second time. Whether the response was correct or not, a second frame appears when the lever is returned to its starting position. The student proceeds in this way until he has responded to all frames. He then works around the disk a second time, but only those frames appear to which he has not correctly responded. When the disk revolves without stopping, the assignment is finished.

The machine itself, of course, does not teach. It simply provides for the student the skilled teachings of the person who composed the material it presents. It is a labour-saving device because it can bring one programmer into contact with an indefinite number of students. This may suggest mass production, but the effect upon each student is surprisingly like that of a private tutor. The comparison holds in several respects as follows:

(1) There is a constant interchange between programme and student. Unlike textbooks, lectures, and the usual audio-visual aids, the machine induces sustained activity. The student is always alert and busy;

(2) Like a good tutor, the machine insists that a given point be thoroughly understood, either frame by frame or set by set, before the student moves on. Lectures, textbooks, and their mechanized equivalents on the other hand, proceed without making sure that the student understands and easily leave him behind;

(3) Like a good tutor, the machine presents only the material for which the student is ready. It asks him to take only the step which he is best equipped and most likely to take;

(4) Like a skillful tutor, the machine helps the student to obtain the right answer. It does this through the orderly construction of the programme.

(5) Lastly, the machine, like the private tutor, encourages the student for every correct response, and so holds his interest.

Development of Programmed Learning

The success of teaching machines depends on the material used in them. The programmes developed attempt to break down a particular area of knowledge into its smallest units. These units are put together in such a fashion as to flow easily and quickly from one to the other. A good programme has no large steps. Each frame (the step) is so small that the student is often unaware that a step has been taken. The high I.Q. student moves quickly through the frames and the low I.Q. student moves slowly. Each student, however, will have a firm grasp of the material he has completed. In the programmes, a large number of questions

are given which the student must answer. Each question, in turn, is answered in the subsequent frame. In this fashion the student knows immediately whether his comprehension is sound or faulty.

An expert in a given field begins the programme construction by defining the area he wishes to cover. Once the beginning and the end are established, he starts with the simplest proposition or explanation necessary for understanding the first frame. After he finishes a certain number of frames, he submits them to students. The results of the student testing come back to him. He notes where errors have occurred and then proceeds to add frames to eliminate the difficulties. During this process, it is often necessary for him to consult with other experts since his own involvement in the writing might make it difficult for him to see how students can make errors in places that seem to him to be self-evident and obvious. When the total course is finished, it is again submitted to testing by a larger number of students in an ordinary schoolroom. Again the results come back to the programme writer and again he corrects those portions of the programme which are producing errors.

The task of breaking a subject down into its smallest parts requires a true expert. A programme writer must know exactly what is involved in each step of a subject. He must understand all of the assumptions involved and he must have a complete analytical knowledge of the area he is programming and its relations with the rest of the subject. Programming is much more difficult than normal text writing since it allows for no vagueness and no ambiguity.

A programme can be printed in such a fashion as to require a "machine" or some kind of device that will bring each frame into view as

it is needed. However, there are no experimental data to indicate that a machine is more efficient than a textbook built on programmed learning. A machine tends to make cheating more difficult but then the programmed textbook soon shows the student that cheating is highly unprofitable.

The results of an initial study at Hollins College, Virginia indicate that the use of programmed learning is simply a more efficient way of presenting factual material than traditional textbooks or oral teacher plus blackboard methods. Programmed learning makes it possible for teachers to assume that students know the factual material when they begin to discuss implications and applications. The use of programmed learning could free the teacher from the time-consuming task of drill and review of facts. Relief of this kind could increase the excitement of teaching and the efficiency of each teacher.