

The "Tutor"

Here Is A Description Of The "Tutor," One Of The First Available Teaching Machines

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The development of a machine capable of teaching human beings has been the goal of numerous research workers in recent years.

There are many devices, of course, which may be defined as aids to teaching. The printed page, motion pictures, slides, records and tapes all can be used to deliver information to a student or trainee. But to qualify as a true "teaching machine," a device must in some way incorporate two-way communication. That is, the student must respond to the information presented by the machine, and the machine must in turn recognize the nature of the student's response and behave appropriately.

Such a machine has been developed and has recently been placed on the market by Western Design, Division of U.S. Industries, Inc. It is called the "Tutor," and is capable of teaching any subject which can be treated on the printed page or in motion pictures.

The Tutor controls the learning process while permitting each student to proceed at his own pace. By means of

"intrinsic programming," it recognizes student errors as they occur, and corrects them before they can impede understanding of subsequent material or adversely affect motivation.

Most important perhaps, the Tutor presents its subjects so that the student must demonstrate his mastery of each point before he can proceed to the next point. No one can reach the end of a Tutoring sequence without earning the equivalent of an "A" in the course.

The Tutor is basically a combination microfilm and motion picture projector that shows numbered images in any order selected by the student. Here is how an intrinsically-programmed Tutoring sequence works:

The student, seated at the machine (See Figure 1), is confronted with an 8 x 11 inch viewing screen containing the first unit of information. He reads this material and finds at the bottom of the image a multiple choice question based upon what he has just read. He selects an answer and



Figure 1. The "Tutor" Teaching Machine

enters a code number corresponding to that answer into the keyboard of the machine. The Tutor searches for the image selected and projects it on the screen.

If the student answered his first question correctly, the next image he views congratulates him and presents him with more information. He then faces another multiple choice question, which he must answer to move to the third unit of information, and so on.

If the student selects a wrong answer, the image he sees will contain information appropriate to the error he made. His mistakes will be explained, and he may be sent back to the first

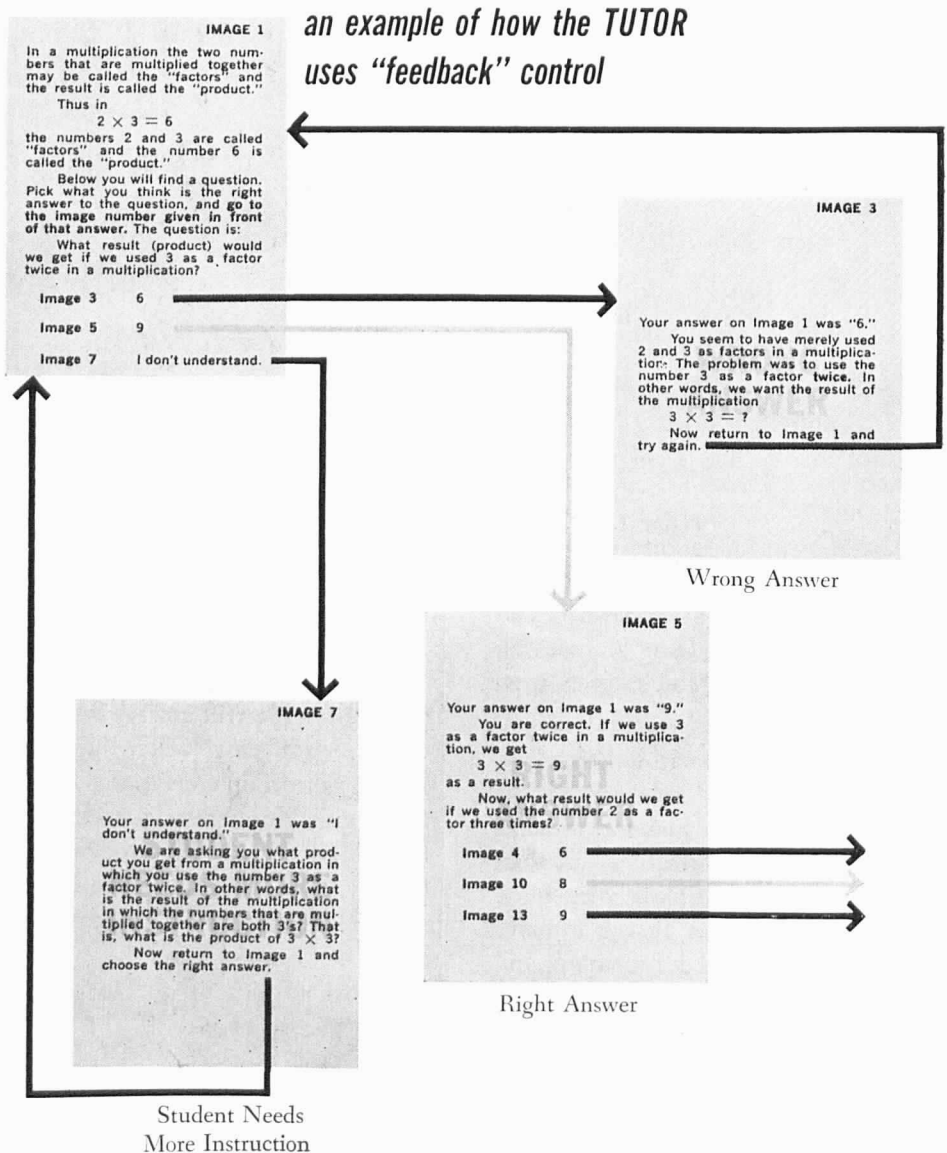
image to try another choice, or he may enter a lengthy sub-sequence of correctional material designed to acquaint him with the prerequisites of the course. He will emerge from the sub-sequence only when he starts making correct answers to the Tutor's questions. Progress by guessing will be short-lived, for the student will quickly reach material incomprehensible to him unless he mastered the earlier information and he will be sent back to pick up the basic facts he has glossed over.

Since each student works through the material at his own speed, using the exact amount of instruction and extra help that he needs, the system brings a new

degree of precision and economy to training programs.

Heretofore, it has been accepted that efficiency demands the lecture system, supplemented by outside reading and

problems. Finally, a test is used to separate the trained from the untrained. But the Tutor operates on the principle that the only desirable goal is for the individual to finish and master all of



the course. Instead of giving a "passing grade" of 70 per cent or 75 per cent after a certain training period, the Tutor aims at 100 per cent comprehension, with the training period dependent on the individual's ability. In such vital fields as preparation for national defense or the handling of large capital investments in industry, responsibility will rest uneasily with even the "A" student who has demonstrated mastery of only 96 per cent of his training. In the ever-increasing complexity of modern technology the term, "passing grade," will be hard pressed to justify itself.

Besides this element of precision in training, the Tutor matches the instruction time to the exact requirements of each student. Bright students, or those merely reviewing material they have already covered will be able to move rapidly through the course, pausing on each frame just long enough to grasp the essentials. Perhaps only about one-third of the total number of images of course material will be used by these students. Those who need more instruction will go through correspondingly more material. Probably no one would make every conceivable mistake and thus be forced to read all of the material. Nevertheless every step is on the film strip, ready for use in answering problems, correcting misinterpretation of facts, and giving intensified instruction at weak points.

Fast readers and students of above average intelligence are relieved to escape the boredom and drudgery of superfluous explanations. Slow readers have been gratified to find themselves, perhaps for the first time in their lives, in an educational situation that does not

run away from them. The Tutor, of course, possesses endless patience.

By the use of material of increasing difficulty, based on facts and principles just learned and moving ahead in logical steps, the student is tested by the Tutor at every step of the learning process. This demand for logical thought makes the device eminently suitable for training in trouble-shooting techniques. In this function, the Tutor may show the diagram of the faulty apparatus and list the symptoms of the trouble. From a list of tests, checks, or terminal activities, such as replacement of a unit or adjustment, the student makes his choice. Any time he takes an inefficient or incorrect course of action, the material to which he is thereby exposed will explain to him, in detail, why his choice was incorrect and then will direct him to return to the previous choice page to select another possibility.

Material in this form has been prepared for trouble-shooting instruction on the bomb-navigation systems used in the B-47 and B-52. On a typical Bomb-Nav system, isolation of a malfunction usually will require from five to ten distinct tests or steps.

In this type of training the Tutor, in effect, simulates both instructor and equipment. It should be pointed out that this trouble-shooting training is not intended to explore every possible malfunction. Its function is to enable the student to demonstrate what he knows about the relationship of the several components involved.

One of the most significant aspects of the Tutor is that it overcomes the failure of the average student to concentrate on what he is being told.

In using the Tutor the student is motivated by a desire to get through the material as quickly as possible. Once he learns he can avoid time-consuming repetition of what has gone before, he stays alert; in an attempt to "beat the machine." Then, too, there is an undeniable "fun" element in pitting one's intellect against the course material.

The basic function of the machine is to select and project any one of the 10,000 stored images which may be used in a tutoring sequence. Standard 35 mm motion picture film is used in the Tutor. When the code number of any specific frame is selected on the keyboard of the Tutor, the machine moves the film directly to that spot and projects the picture. The search speed of the machine from one frame to another is the standard 24 frames per second, making it possible to include short motion pictures for study and analysis. The picture can be run forward or backward, or it can be stopped at any point for observation. When no motion sequence is desired the viewing screen remains blank during the search.

A paper tape on which is printed the time taken at each step and the sequence in which images are selected is the feature that makes the Tutor especially valuable for student analysis by an instructor or personnel administrator. From this permanent record, the observer can determine such things as which students are fast and accurate in their thinking, which make foolish mistakes, or which are finding the work too hard. Careful study of the trainee's approach to the Tutor's material should give the personnel man a good idea of how the trainee would operate on the job.

The first modern device which might be called a Teaching machine was introduced in 1927 by Dr. Sydney L. Pressey of Ohio State University. He developed what might best be described as a "testing machine." His device offered the student a series of multiple-choice questions. Each time the student made a correct answer the machine moved to the next question. If the student chose incorrectly, the machine did not react. As a reward for success, five correct answers delivered a mint candy to the student!

Pressey's machine did not present subject matter and did not correct errors. It was an auxiliary device to be used with ordinary training methods, and was primarily a means of allowing the student to evaluate his own knowledge.

Dr. B. F. Skinner of Harvard has been working on a number of devices to present subject matter to the student in small steps, so arranged that the student is required to practice his newly-acquired knowledge. However, the sequence of material presented does not depend to any great extent on the student's responses.

The Tutor which responds to student errors is in the tradition of the Socratic teaching method. Socrates' greatness was in his talent for drawing the truth out of his conversants with a series of brilliant questions. In fact, our word "educate" comes from the Latin phrase that describes this method (*e duco*, "I draw out"). Such individual tutoring, while most effective, is hardly practical in today's massive training programs. Good teachers just do not have time to give individual attention to students. But just as an experienced teacher can lead a student down the path of orderly

reasoning, so can the Tutor "listen" to the student's recital, correct his mistakes, and arrive at the desired destination.

Programming the Tutor to handle a subject is an exacting job. The writer must know exactly what new data he is providing at any stage, why the student is being told this, and what the student is expected to do with it. In framing the multiple choice question, the writer must discern just what errors of logic or comprehension the student may make. The goal for each course must always be kept in mind as the writer leads the student forward.

Within the next few years, Western Design expects to complete the job of placing most basic scientific knowledge into the automated tutoring format and is moving ahead rapidly to prepare specific training courses for industrial and military use. Subject matter in current preparation includes algebra, trigonometry, electronics, trouble-shooting technique, and the game of contract bridge.

An interesting sideline of the automatic teaching system is the "Tutor-Text." This contains basically the material that might be programmed for the Tutor, but it is in book form, one image to the page, instead of on microfilm. The book is not read in normal page sequence. Thus, the problem on page 4 might confront the student with answers on pages 16, 22, 28 and 34. One answer would be right and would lead to the next step in the sequence. The others, the wrong answers, would carry the student to further explanation of the subject before returning him to the "main stream."

One such book already prepared is "The Arithmetic of Computers." This book covers concepts ranging from an

explanation of the decimal system up to and including multiplication in a digital computer. Like the comparable material on the Tutor, not all of the material will be used by the average student. Most students probably would see fewer than half of the pages in completing the course; the bright student would need fewer still. However, at the completion of the course even the slow learner should have mastered the entire body of material.

Considerable use is expected of the TutorTexts, particularly for home study. The Tutor, itself, has the advantages of keeping records of students' progress, structuring the situation, and accommodating a larger quantity of material on microfilm.

Perhaps the most common question asked about the Tutor is whether it is expected to replace the human instructor. Its designers feel that it will not—any more than the invention of printing replaced the word-of-mouth instruction that had been the principal method of communicating human knowledge until that time. Insofar as the process of passing on factual information can be turned over to a machine, the good teacher will be freed to provide the essentially human functions of guidance, encouragement, inspiration, and the recognition of distinctive, creative effort by the student. It may very well be that the most significant teaching work of the future will be done by the skilled educators who continue seeking to improve the approach, wording, descriptions and explanations, and even the very philosophy of systematized teaching methods. The student will have at his disposal, any time he is free to use it, the best teaching that skilled specialists can provide.