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# A Comparison of the Success of Teaching Machines and the Programed Text to that of the Traditional Teaching Based on a Survey of Literature and Research Reports

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A COMPARISON OF THE SUCCESS OF TEACHING MACHINES AND  
THE PROGRAMED TEXT TO THAT OF THE TRADITIONAL  
TEACHING BASED ON A SURVEY OF LITERATURE  
AND RESEARCH REPORTS

BY

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A research report submitted  
in partial fulfillment of the requirements for the  
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College of Agriculture  
and Mechanic Arts

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RBC

## TABLE OF CONTENTS

Chapter	Page
I. INTRODUCTION . . . . .	1
<u>Statement of Problem</u> . . . . .	2
II. HISTORY OF THE TEACHING MACHINE . . . . .	3
III. THE TEACHER IN THE MACHINE . . . . .	7
IV. THE PSYCHOLOGY OF LEARNING AND THE PROGRAMED TEXT . . . . .	15
V. YOUR SCHOOL AND THE TEACHING MACHINE . . . . .	22
VI. SUMMARY AND CONCLUSIONS . . . . .	31
VII. RECOMMENDATIONS . . . . .	34
LITERATURE CITED . . . . .	36

## CHAPTER I

### INTRODUCTION

Programed learning, still in the embryonic stage, has brought with it new hope for some of the answers to our mass educational problems of a rapidly expanding curriculum, broadened individual differences, and an increasing pupil teacher ratio. It has been suggested that teaching efficiency may be brought to an optimum level by the discovery of some new psychological principle of learning.

A more practical aspect, from my point of view, as a solution to our educational problem was brought to the foreground in the middle of the 1920's with the construction of the teaching machines and programed texts as developed by S. L. Pressey. However, the general public and educators themselves expressed little interest in the teaching machine and the behaviorial attitudes labeled successful by some of the leading educators and psychologists of that time.

It is the purpose of this study to evaluate the potentialities of the programed text by a survey of current literature and research findings. Programed learning has stirred the imaginations of psychologists and educators the nation over in the past few years. Programed instruction may be the answer to the science of learning, by relieving the teacher of much that is routine, the teacher will again be provided the opportunity to exercise more efficiently the skills of the profession.

A basic problem confronting all educators today is how to most effectively help each student develop himself to his greatest potentialities. Insufficient motivation is often given as a reason for the poor

development of the learning processes. A second reason often heard in the educational circles is the lack of individual attention brought about by the rapidly increasing numbers. A third problem of importance is the time element. We are all aware of the lengthening of the time required to obtain the education needed in the various phases of formal education. It has been suggested that improved instruction could do much to help our pupils along the paths of formal instruction.

Psychologists and leading educators believe that the programmed text is a key that will aid in development of the fullest potentials of the future generations. Eugene Galanter, professor of psychology stated, "In general, the teaching machine has all the advantages of the private tutor. In addition, there is an increase in the over-all time efficiency of the learning process that, in the studies so far available, suggest a factor of about 3 to 1."<sup>1</sup> Galanter further stated, "The only effect that the teaching machines seem to have on the children is to enlarge their vision. In addition, the machines have the advantage of returning to the child the opportunity for private and independent study . . . ."<sup>2</sup>

#### Statement of Problem

The aim of this study is to compare, by a survey of literature and research findings, the success achieved in teaching by machine and programmed text to that of traditional teaching in our public school system.

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<sup>1</sup>Galanter, E., The Mechanization of Learning, Journal of the National Education Association, National Education of the United States, Washington, D.C., Vol. 50, Number 8, November, 1961.

<sup>2</sup>Ibid.

## CHAPTER II

### HISTORY OF THE TEACHING MACHINE

Programed learning is based on the individual instruction method and often referred to as Socratic Teaching; is learning by questions and small steps of facts followed by immediate reinforcements. Learning is further enhanced by the "law of recency," which simply stated purports that the last answer selected by the learner is always the correct one. A second factor influencing learning is that after a set number of correct responses, the learning is reinforced by a token reward for the correct response.

The concept of programed learning is as old as learning itself. Devices to aid the learning process go back to the finger mark in the dust by the Egyptians to tally herd numbers. The abaci of the early eastern civilizations are examples of devices for learning which, in a limited sense, are self-instructional. Perhaps one of the earliest mass mechanical devices used as a self-instructional machine was a rig used to teach proper trigger squeeze for the training of soldiers in World War I.

As early as 1926, S. L. Pressey, Director of the Ohio State University Research Foundation, began advocating the use of the mechanical devices to cut down on the teacher's load of busy-work. About a dozen teaching machines were invented by Pressey and some of his students. Studies were conducted to test their effectiveness. The machines were labeled successful in papers written by Brigs, Jones, Eittle, Peterson,

Pressey, and Severin.<sup>3</sup>

In 1927, an article by Pressey<sup>4</sup> described a keyboard, multiple choice machine for drill subjects similar to some of the machines currently in production. However, little progress was made in the application of machine teaching until World War II when the armed services used training devices in aviation, radar, and firing at rapidly moving targets. The first proposals for the use of teaching machines and programming on a large scale date back only to 1954, when B. F. Skinner published his article in the Harvard Educational Review. In that now famous article Skinner said, "The necessary techniques are known. The equipment needed can easily be provided. Nothing stands in the way but cultural inertia."<sup>5</sup>

The teaching machines of today are based on the same learning principles as those earlier established by Pressey. The machine has a keyboard similar to that of a typewriter, generally using a four-multiple-choice type of questioning to teach the fact as presented by the text. The machine is readily adapted to using true or false statements by confining the answers to the first two keys of the keyboard.

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<sup>3</sup>Fattu, Nicholaw Q., The Encyclopedia of Educational Research, 3rd edition, p. 1592, December, 1958.

<sup>4</sup>Pressey, S. L., School and Society, Vol. 25, p. 549-552, Society for the Advancement of Education, New York, May, 1927.

<sup>5</sup>Skinner, B. F., The Science of Learning and the Art of Teaching, Harvard Educational Review, Vol. 24, pp. 86-97, Harvard University, Cambridge, Mass., Spring, 1954.



Skinner developed several different types of teaching machines, but his greatest contribution to learning was the establishment of psychological behavioral patterns of the learner and the development of programing of content for shaping those responses. The most important feature of the machine learning is that of programing. Skinner, speaking of the difficulty of programing states,

It is not easy to construct . . . a program. Where a confusing or elliptical passage in a textbook is forgivable because it can be clarified by the teacher, machine material must be self-contained and wholly adequate. There are other reasons why textbooks, lecture outlines, and film scripts are of little help in preparing a program. They are usually not logical or developmental arrangements of material but strategems which the authors have found successful under existing classroom conditions. The examples they give are more often chosen to hold the student's interest than to clarify terms and principles. In composing material for the machine, the programmer may go directly to the point.<sup>6</sup>

The National Academy of Sciences, the Naval Research, the Department of Defense, the Air Force, the National Education Association, Bell Telephone Laboratories, Western Data Processing Center, The Center for Programed Instruction, as well as many other groups and individuals are working on the best procedure which will make programed learning a reality of our educational system. The research developments have a promising effect for improvement of educational instruction procedures. The greatest impact may be on organization, such as, content and methods of teacher education.

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<sup>6</sup>Skinner, B. F., Teaching Machines, Science, Vol. 128, October 24, 1958.

### Summary

The age of the devices for learning date back to the early development of cultures. The abacus is one of the earlier devices and, in light of present understandings, it had a limited individual automated learning value.

The teaching machine of the modern age dates back a few years to Pressey in the middle of the 1920's. Another forty years passed before the teaching machine was given much attention. It is worthy of note that only little interest was shown in the teaching machine. One should be cognizant of the fact that only between ten and twenty papers were written during that period.

The study of programmed learning really came to the national foreground when we, as a nation, felt that our educational system seemed to be behind when compared on an international basis. Programed learning has been given a good second look; industry has spent much money on research. The Armed Service schools and the Federal government have carried out a number of research projects in hopes of finding some of the answers to the national educational problems.

Machine learning, young in experience, may hold a helping solution to our educational problems.

## CHAPTER III

## THE TEACHER IN THE MACHINE

Machines of today solve in seconds mathematical problems that previously required hours of study and work. Machines are used to translate languages and have shown a limited capacity to learn from the person taking instructions; thus, designing new programs that may be the best study procedure for that individual or perhaps for a great many individuals. Pressey, "the father of the modern teaching machines," is somewhat responsible for the term, although this may be a misnomer as it tends to put in the eye of the general public a cold brainwashing robot. Let us open the teaching machine to see what is inside. Here we find the real teacher; not a cold, hard, unhuman affair, but the warmth of the classroom teacher. A more diligent search reveals that this is no ordinary teacher, but a combination of the experts in the fields of learning psychology and education. The pupil himself may be responsible for part of the structure. Mr. Lauback, some thirty years ago, advocated that we should prove to the student that he can learn regardless of his age and that learning can be done easily, quickly, and delightfully if the material were presented in small easy steps. The learning should be so arranged that the student is neither pushed nor retarded from learning.

The programed text is a carefully selected sequence of statements containing learning facts. The text, of necessity, calls for structures that are psychologically sound from the learning point of view. These texts have been constructed along two paths of learning and, although programing is a new science, psychologists and educators in general are

rapidly choosing sides.

We shall examine the two schools of thought. B. F. Skinner has developed his program text as a linear program. The linear program is often referred to as straight line, nonbranching sequences. These programs consist of a fixed sequence of items, unalterable and identical for each learner. No allowances are made for individual differences or flashes of brilliance. Each student progresses through the same number of steps and in the same order.

The linear program uses an outside agency to determine the pattern for the learner. This may be the study supervisor or perhaps it is built into the machine itself. The general appearance of the Skinner device is similar to the original Pressey machine. It uses a number system in which the learner presses out his own answer rather than a selection from a multiple choice. The Skinner device then presents the pupil an opportunity to compose his own answer. The programed text will supply the correct response for comparison by the pupil. This opportunity to learn the correct response is called feedback and is of great value to the learner in the form of reinforcement.

Reinforcement may be given in several different ways. It may be in the form of bell ringing, or the flashing of a light to signify progress to the next step, or in the form of a tape-recorded voice giving praise.

The reinforcement is further strengthened when one considers that another important learning principle is involved; namely, "the law of recency" in which the psychologists theorize that the last response reinforced is the one that is learned. A corollary is that the more

rapidly a response is reinforced, the better it is learned.

Linear programming is often referred to as extrinsic learning. The true value of reinforcement in the learning process is somewhat doubtful in actual practice. The psychologists experimentation is generally based on animal life. However, Skinner states,

In all this work the species of the organism has made surprisingly little difference . . . . Comparable results have been obtained with pigeons, rats, dogs, monkeys, human children, and most recently . . . human psychotic subjects.<sup>7</sup>

The second school of thought that has received much approval and a large number of followers is the branching type of program. The branching type program is referred to by Crowder as intrinsic learning. The branching program steps beyond the linear program in that the machine has a built-in alternate program. A sequence of correct answers will permit the student to skip the following section. The earlier the pupil grasps the concept being presented the more frames or items he will be permitted to omit. The branching program has an alternate program for the slow learner. When a given pre-determined number of errors occurs within a given framework, the pupil is referred back to the principles not mastered earlier. The second attempt, when presented ideally, will follow a similar pattern in a different line of reasoning. However, if the pupil still fails to grasp the concept, the machine will refer the pupil to the teacher for further instructions.

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<sup>7</sup>Skinner, B. F., The Science of Learning and the Art of Teaching, Harvard Educational Review, Vol. 24, pp. 86-97, Spring, 1954.

Programed teaching recognizes individual differences by beginning where the learner is and permitting him to proceed at his own pace. Programed learning requires the pupil to be active in the learning process; he must constantly make a response. Learning by doing is an old educational slogan and it is still a good one. Gaining an education by study and discussion of a given text permits the pupil to be a very passive or an inattentive pupil. Programing requires that the pupil take an active part, and he is further reinforced by immediate knowledge of the correctness of his answers. In a research report, L. D. Eigen and P. Kenneth Komoske concluded that "the teaching process by either mechanical teaching machines or the programed textbooks were equally effective." In this study they also came to the conclusion that "the grade level had little effect on the learning process by means of the automated teaching methods."<sup>8</sup> It was further noted that the more advanced in grade level the better the students could generalize from the studied texts.

For a long time educators, and people in general, thought that it was impossible to learn without making numerous errors. Recent developments in education using teaching machines and programed texts have demonstrated that students can proceed to mastery of a subject with a negligible number of errors along the route. If positive learning is to happen, the material from which the student learns must be carefully prepared, or programed in a special way.

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<sup>8</sup>Eigen, Lewis D., and P. Kenneth Komoske, Research Summary number one, Collegiate School Automated Project, June, 1960.

The basic idea of the teaching machine or programed text is that the most efficient, pleasant, and permanent learning occurs when the student proceeds through a course by a large number of small, easy to take steps. This is the idea put into use when the teaching machine was developed. It appears to me that this coincides with present-day educational theories which emphasize positive thinking and learning.

As one examines the materials used in the programed text, certain basic differences from conventional study procedures become evident. The student using a programed text goes through a carefully graded sequence of material which has been demonstrated to produce learning. The programs, which can be inserted into teaching machines or used independently in hard covers or page form, are not lists of random questions, but are expertly organized and worded so that students answer correctly most of the time. The important distinction is that students do not move on to new material until they have mastered what has gone before. If too many errors are made by a class of pupils testing new programs, the programs are revised. In the experimental trials of the programed text a single item incorrectly answered by a great percentage of the pupils is reconstructed. The reconstruction is based on the theory that the pupils are not all wrong but that the frame or item was improperly constructed.

We note that a great many people are involved in the construction and experimentation of the programed texts. P. Kenneth Komoske, director of one of these projects, has said,

When subject matter has been well programed, students make an astonishingly small percentage of errors as they learn. The pressure for quizzes and tests is reduced and confidence in learning is increased. When a student uses a program as a homework

assignment he may miss only five out of a hundred items--and further, he will be able to interpret his five mistakes. As a result he comes to class with his homework not only completed but corrected.<sup>9</sup>

Pupils using the programmed text are actively engaged in the learning process. As each step in a program requires one or more specific written response, the instructor can be confident at the end of the program that the student has been responding actively to the materials. No comparable assurance is possible when a student has merely attended a lecture or has read a textbook.

Another very important aspect of learning is brought about by the fact the student is provided with immediate knowledge of results as to correctness of his answers. In this way, the confidence of the student grows; he can see that he is correct on almost every response.

The programmed text will do much for the gifted, as the student is provided with a method of proceeding at a rate of his own choosing. The gifted student will no longer be held back. He may proceed to new topics and can also broaden his field by utilizing the time saved from the curriculum study. On the other hand, the more methodical student can take as much time as he needs without being embarrassed by the fact that others are proceeding at a more rapid rate. The slow learner is also provided the opportunity of correcting his errors in private.

Herbert E. Krugman, social psychologist, has stated,

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<sup>9</sup>Komoske, P. Kenneth, What About Teaching Machines? Parents' Magazine and Better Homemaking, XXXVI, p. 44-45, February, 1961.



Perhaps the most important aspect of the teaching devices mentioned above is that they offer students alienated from the educational world an educational experience devoid of public shame. If the student makes a mistake, he knows it and the teacher may know it, but other students will not. Thus, the opportunities to like learning are enormously increased.<sup>10</sup>

Our economy is not supporting the demand for a steadily increasing number of teachers with a sufficient sum of money, so we must look elsewhere for the solution to our educational problem. B. F. Skinner said,

There are more people in the world than ever before, and a far greater part of them want an education. The demand cannot be met simply by building more schools and training more teachers. Education must become more efficient. To this end, curricula must be revised and simplified, and textbooks and classroom techniques improved.<sup>11</sup>

The rate at which new knowledge is being generated is of such proportions that the textbook teaching will grow an old man before he can prepare for himself a place in the fields of the new technology.

#### Summary

In the opinion of the author the use of the programed text is not a cold brainwashing robot but truly democracy in action. The pupil is provided a learning opportunity best suited to his capabilities and rate of learning. The pupil will be justly rewarded for his efforts and

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<sup>10</sup>Krugman, Herbert E., Education and the New Learning Devices, NEA Journal, Vol. 51, Number 4, p. 52, April, 1962.

<sup>11</sup>Skinner, B. F., Teaching Machines, Science, Vol. 128, October 24, 1958.

will be able to develop himself to his greatest potential. The gifted using one third the time for basic skills will have the opportunities to explore and to generalize further from what they have learned and thus maintain their superiority; the slow learner will still learn to solve the problems.

## CHAPTER IV

## THE PSYCHOLOGY OF LEARNING AND THE PROGRAMED TEXT

The psychologists in their experiments on learning have been more concerned with group situations rather than the individual learner. The studies have provided little information on the interaction effects between learner variables and methods variables. It seems evident that persons with equal mental capacity may have different patterns of learning. If one were to use an I.Q. score as a basis of comparison, a glance of the eye would reveal that the test is comprised of items covering a vast number of subjects and that the I.Q. is an average of the over-all test. Therefore, it is conceivable that individuals with identical scores could have their strong or weak points in entirely different fields of learning. Krugman states, "Two individuals could have the same I.Q. and yet have quite different patterns of ability; for example, one might be more eye-minded, so to speak, while the other was more ear-minded."<sup>12</sup>

The Navy has taken advantage of these variations and set up a two-track training program text for aviation mechanics courses. One teaches "why before how" and the other teaches "how before why." The results of this teaching show that each program has its own merits. The program ideally suitable for one student may be of no value to another, in which case the alternate program would be used. It was noted that the speed of learning was significantly increased for both groups. Krugman further

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<sup>12</sup>Krugman, Herbert E., Education and the New Learning Devices, National Educational Association Journal, Vol. 51, number 4, p. 56.

states,

By helping the intelligent and skilled to become more skilled, we will make room for the less skilled to "trickle up" to take their places. This will increase our productivity and decrease unemployment.<sup>13</sup>

Individual differences in the rate of learning apparently are a function of a number of separate factors. Perhaps one of the more important is that of motivation. It is generally recognized that the motivated learner learns more readily than the nonmotivated learner. High motivation may produce rapid learning of the simple tasks but may interfere with the rate of learning the more complex tasks.

Teaching machines may produce an anxiety or a motivational state different than that produced by textbook or the human teacher. The toy-like quality of the teaching machine may have an enhancing effect upon the motivation thus contributing to improved learning. Additional motivation can easily be built into the programed text by use of discovery which is the method of modern educational trends. It has also been noted that recitation seems to have an effect on motivation. It is the opinion of the writer that all who have worked in the classroom have noticed the motivational effect of interaction within the group. The motivational effect of interaction is well suited to the construction of the programed text. The fact that the learners are in a responsive state would indicate that they are in a more motivated state than the passive textbook student.

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<sup>13</sup>Ibid.

The programed text using a tabulation system of scoring for purposes of feed-back or branching type program, where the pupil actually competes with his own past record or a previous performance, would be an important motivational condition of a very desirable type.

W. D. Edwards said,

That all students on whom he (Skinner) so far tried the machines find operating them so much fun that no further reinforcement is needed, and he is not now doing any work on the question of how to use reinforcements in connection with such machines.<sup>14</sup>

As one speaks of the motivation necessary in the use of programed texts the thought that comes first to my mind is the pacing of learning. Externally paced machines may effect the motivation of the learner. It is possible that there are optimum levels of motivation associated with particular rates of presentation. On either side of the optimum, externally paced programs could produce poorer learning.

It has been indicated that immediate confirmation of the correctness of the answer has an enhancing effect upon the learner using the programed text. The use of the programed text material encourages more careful reading than in studying a conventional text where the consequences of attention or inattention are so long deferred that they have little effect on reading skills. Progress in learning will come to a standstill for the student on the programed text if each step is not mastered and responded to. Robert Glaser speaks of the word seeding in

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<sup>14</sup> Edwards, W. D., Skinner's Teaching Machines, Unpublished Laboratory note, Maintenance Laboratory, AFPTRC, Lowry Air Force Base, Colo., May, 1956, (based on his interview in the spring of 1956).

connection with the construction of the programed text and states that, ". . . the seeding of review material at various points in a program to insure the maintenance of learning."<sup>15</sup>

The more complicated types of teaching machines have received little testing to date. The research findings lead the writer to observe that the machines do need greater mechanical efficiency before they can be used extensively in the classroom. When the programed text is presented in the machine form, the machine must be foolproof if it is to be successful. Gordon Pask has worked with machines and devices of a fairly simple design of the same general prototype of the Skinnerian and Pressey group. He has employed small analog computers as control centers and has used a game-playing technique to teach recognition of radar blips, airplane configurations, and even elementary mathematics. Pask concluded that, ". . . the motivation to learn in this manner is tremendous, and that trainees stayed at these devices long after training time is over."<sup>16</sup>

It has been suggested that the programed text be paced by machine, or by some other external means such as the teacher. If the learning is to be externally paced, much of the motivational effect may be lost.

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<sup>15</sup>Glaser, Robert, A Report Prepared Under Cooperative Research Project number 691 (9417), U.S. Office of Education, Dept. of Health, Education, and Welfare.

<sup>16</sup>Pask, Gordon, Teaching Machines, Unpublished paper, Solartron Electronic Group Limited, 1958. This paper is published in Teaching Machines and Programed Learning, a source book by Lumsdaine and Glaser, Appendix I, p. 671, Department of Audio-visual Instruction, NEA.

The external pacing would require much research to determine the optimum level at which learning will take place. Trainees report that the effects of the program learning were so acceptable that they found themselves bone-weary when concluding their study. Edwards' own reaction at the time is expressed in the following comment,

I believe that the general notion of using teaching machines is the most important development in applied psychology since aptitude tests--indeed, it is potentially the most important development since intelligence tests.<sup>17</sup>

In view of the apparent psychological soundness of using the programmed text as a means of providing education for the masses and its acceptance for teaching all ages as well as all subjects, races, creeds, native abilities, and physical conditions, we should view the learners' evaluation of the materials. A programmed text in the study of psychology based on the Introduction to Psychology by B. F. Skinner was tested in the learning situation at a university. Dr. Holland reported the students' responses to machine instruction on the material as follows,

Sixty-two per cent felt programmed learning made the text much easier to understand, while thirty-seven per cent felt it was of some help. For the same time and effort, thirty-two per cent felt they learn much more on the machine, while forty-six per cent felt they learned somewhat more. If the machines had not been used, seventy-seven per cent felt they would have gotten less out of the course. For future introductory courses, sixty-seven per cent would prefer to have the programmed text.<sup>18</sup>

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<sup>17</sup>Edwards, W. D., Skinner's Teaching Machines, Teaching Machines and Programmed Learning, a source book by Lumsdaine and Glaser, 1960, National Education Association of the United States, Appendix I, p. 613.

<sup>18</sup>Holland, J. G., Opinion and Fact, Aid for Educational Training, INRAD, Los Angeles, California, p. 37, August, 1961.

Adaptations of the machine would be expedient in teaching the blind since it would have infinite patience. The programmed text will be as effective for the home-bound, institutional-bound, and the public school pupil. In the age of rapidly advancing technology, it will teach new skills and provide the education necessary for professional growth regardless of the age of the learner. The effect of the programmed text and the teaching machine is much like that of a private tutor, yet, with proper design and the branching program, the text must be mastered before the learner moves on to the next step. Many potentially capable have lost out on an education because of lectures and textbooks which left them behind in a passive state.

#### Summary

In summary the writer would like to point out that much evidence indicates that regardless of present day evaluations, pupils that have similar abilities and capacities to learn do not all learn equally well under any given type of tutorship. The programmed text may be the salvation of many pupils who have passed up the opportunities for an education because of the passive nature of the textbook and the uninspiring lecturers.

The motivation of the programmed text seems to intensify learning; however, it is the opinion of this writer that more research is needed in this field, especially in the form of long term studies. The program text offers opportunities to build in many forms of motivation, such as rivalry, deduction, and reward by various methods. The satisfaction of learning in small progressive steps should provide for the needs of many.



The programed text is based on the latest behavioral patterns which agree with the present learning theory which infers that learning should be of the deductive rather than the inductive.

Much of the research concerned with the programed text is very recent. Only a small fraction of the experiments were of more than one year duration. Most of the experimentation involved small groups and short periods of learning. It is interesting to note that the programed learning is as successful as the traditional textbook procedure, although the time required for learning is markedly reduced. Learners tend to prefer the use of programed learning either assisted by a teacher or on their own.

## CHAPTER V

## YOUR SCHOOL AND THE TEACHING MACHINE

The field of education, like all other fields of endeavor, will have a few very conservative at the one extreme of the continuum and an equal number of "New Dealers" at the other extreme. Dr. Simon Ramo<sup>19</sup> is perhaps the most "New Deal" extremist about the impact of teaching machines on the future of education. In an article by Ramo, "A New Technique of Education," he pictures a student in a learning situation that identifies a pupil only on a card. All learning will take place in a room or rooms of machines that may or may not be attended by a human teacher.

Ramo uses as an illustration a pupil engaged in the study of trigonometry. Certain periods of the week will be spent with other children at work on the same subject. The pupil will place his card in the machine and the punched card will connect him with his personal record file in a central office. This will serve as a check on attendance and will record his progress in the study.

The lesson may be presented on an animated film or a machine that will require a push-button reaction. The pupil in the push-button classroom will have to respond to questions; sometimes restatements will be made, and he may even be asked by the machine whether, in his opinion,

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<sup>19</sup>Ramo, Dr. Simon, A New Technique in Education, Engineering and Science Monthly, Vol. 21, University of Southern California, Los Angeles, California, October, 1957. Dr. Ramo is currently executive Vice-President of Thompson Ramo Worldridge, Los Angeles, California.

he understood what was being presented.

The machine continues presentations of the learning principles and will ask for answers. The pupil's immediate response will determine his understanding. If the pupil meets with success, the machine will continue presentation, or it may repeat based on the pupil's answer.

Dr. Ramo further speculates,

The examples I have presented here illustrate what I think is the most important point that can perhaps be contributed to a discussion of the relationship of the technological revolution and the educational process.<sup>20</sup>

The educational world, of necessity, must probe the most remote possibilities if our culture is to provide the world leadership, which today is in great demand. Ramo is credited with a statement which could well be the watchwords of our National Educational Leaders. Ramo states, "Don't be ashamed to propose a ridiculous idea. Though worthless today, in ten years it may be of no value whatsoever."<sup>21</sup>

The programed text in the hands of the psychologists and educators holds great promise. The dream machines of Ramo are a possibility in our advanced state of electronic technology and engineering science, and they may be a cause for concern. The objectives of the science technologies are not wholly compatible with those of the pure science. A. W. Melton, seeing no cause for great alarm in Ramo's view of automatic teaching, commented,

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<sup>20</sup>Lumsdaine and Glaser, Teaching Machines and Programed Learning, a source book, Department of Audio-visual Instruction, p. 381, \_\_\_\_\_, 1960.

<sup>21</sup>Ibid., p. 381.

However, I do see a basis for worry if there is failure to recognize that a taxonomy of educational objectives other than the acquisition of knowledge and skills. I refer, of course, to such objectives as the inculcation of socially acceptable attitudes and motivations; the inculcation of motivation to achieve, to create, to invent, to think independently; and the development of skills in interpersonal relations.<sup>22</sup>

Although, in the early stages of development, the programmed text has shown that it does have great possibilities of imparting knowledge and skill in an efficient manner. The social structure of our nation is not totally dependent on knowledge and skill as such, and we need ever be mindful that the educational objective "educating the whole man" must be carried out lest we become the slaves of the machine, controlled by a few master push-button superiors.

It is possible that our society could support the high cost of an electronic educational system which could result in a neglect of the furtherance of the basic knowledge and theory, the backbone of educational progress. Melton cautions us,

Some of you will perceive, I am sure, that I am a bit worried lest automated education become a fad, to take its place alongside progressive education, the mental testing movement, and the guidance movement.<sup>23</sup>

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<sup>22</sup>Melton, A. W., Some Comments on the Impact of Advancing Technology on Methods in Education, (An unpublished paper). Comments by Dr. Melton, following the address of Dr. Ramo at the Annual Convention of the American Psychological Association. The comments are printed in Lumsdaine and Glaser, Teaching Machines and Programed Learning, a source book, Department of Audio-visual Aids, p. 660-664, \_\_\_\_\_, 1960.

<sup>23</sup>Ibid.

We should be on the alert working in research and program development to avoid the over commercialism so often found in our national society.

New York City public schools have used programmed material almost solely for remedial work in conjunction with an experienced teacher, and have found this procedure very successful. Roanoke, Virginia public schools have used a ninth-grade mathematics program with and without teacher assistance. The class covered a year's work in one semester, and forty-one per cent of the pupils surpassed the average made by ninth-graders on a national test. Queried, only sixteen per cent of the students wanted to return to conventional classroom teaching.

At a state university, a group of students scored ninety per cent on the problem-solving portion of the final examination. One may conclude that the problem-solving portion of the course was successful; however, no mention was made regarding the other portion of the test.

The Manhasset, Long Island school used a programmed text in an eighth-grade English course. Assistant Superintendent Henry M. Brickwell summarized the Manhasset experience as follows, "Although it is becoming evident that programmed instruction can teach without a teacher's assistance, it seems to us that its greatest promise lies in its use by an able, enthusiastic teacher as one of several tools."<sup>24</sup>

John Mac Gowan, the Manhasset teacher involved in the English programmed learning, lists four advantages of this type instruction:

- (1) Each student can complete his work in grammar at his own pace.

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<sup>24</sup>Komoske, Kenneth P., What Are the Schools Doing? National Educational Association Journal, Vol. 50, Number 4, p. 30, NEA Office, Washington, D.C., 1961.

- (2) Students--particularly the able ones--save time. The best students in the class are completing a year's work in grammar in twelve and one-half hours.
- (3) Programed materials eliminate the problem of loss of instruction resulting from illness and trips, as well as the problem of how to work a new student into classwork.
- (4) Student errors are pinpointed, with the results that study can be concentrated on the material which needs particular attention.<sup>25</sup>

The use of programed instruction is not all confined to the far-away places. At South Dakota State College, Dean Hinsvark has been programing nursing procedures. In a letter to the author, Dean Hinsvark stated,

There seems to be little or no doubt that programed learning is as successful in nursing as it is in other fields. During the three quarters of the 1961-62 school term, programed learning, presented through two different types of machines, was used to teach operating room technique to nursing students enrolled in medical-surgical nursing. Both students and teachers acclaimed this type of instruction. There seems to be good retention of materials with very little difficulty in transferring knowledge to the real situation. No fatigue was noted, although no testing was done to determine this factor.<sup>26</sup>

A further advantage of the programed text is that it provides immediate feedback indicating whether the student is right or wrong. Many of the machines used to present the programed text also tabulate the errors, thus making a continuing record of the student's progress. The tabulation will also serve the purpose of indicating the trouble spots of the learner, thus providing the information necessary to select

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<sup>25</sup>Ibid.

<sup>26</sup>Hinsvark, Inez, A statement in a personal note to the author dated July 9, 1962.

remedial work. The pupil using the text may set his own pace in learning which spares the slow learner from public scorn. Programed texts are adaptable to a wide range of intelligence and learning. Use of the machine can be suited to various age groups. A very interesting advantage of the teaching machine is the democratic form in which it presents the text. The machine has equal patience for the fast and slow learner. The text, as a private tutor, will respond to all learners regardless of economic or social standing, and is of equal service to all races and creeds.

To be ideally qualified, a good teacher gives reward when the pupil is right, is slow to anger and never scolds when the pupil is having difficulty, speaks with a soft tongue, and has a vast accumulation of knowledge. Programed teaching offers all these qualities as a private tutor reducing the over-all time required for subject mastery. The bright child can master subject matter and skills in about one-half the regular time for a given subject; the slow learner sets his own pace. The ability to give immediate reinforcement is also an important characteristic of the teaching machine. In school practice, the pupil generally must wait a twenty-four hour period to learn of the correctness of his answers and more frequently than not the time element, so important to learning, may extend over a longer period.

Programed learning emphasizes the organized nature of knowledge because it requires continuity between the first and easier step to the more difficult concept which follows. The programed learner must examine the subject matter very carefully in order to find out what has to be known before the next step is studied, thus he eliminates side issues

that do not lead to learning. The well-planned text will have built-in review with application in order to a sure learning in the progressive steps.

In the opinion of the author the programed text has enjoyed much success to date, but this in itself is no assurance that all is in perfect harmony. The early research has helped to bring the basic issues to the foreground. Some of the basic issues are:

- (1) What is the value of prompting, and what part does it play in the over-all behavior of learning?
- (2) What is the "best" method of programing, e.g., Skinner vs. Crowder?
- (3) What is the most effective tool, the programed text or machine teaching?

The observations of the author would indicate that programed learning has not received sufficient classroom testing to warrant a conclusive statement for evaluating prompting in the construction of the learning program. If we know what we want to teach in automated teaching, we should be able to determine whether or not the teaching is effective. The validity of both the Skinner and Crowder approaches still depends upon the goal of what is to be learned.

The programed text, as all other endeavors of mankind, must have its limitations, some of which have been brought out earlier. To reiterate, education does not consist only of learned facts of knowledge or the mastery of skills. A study by J. L. Evans indicates that some programs would be very effective on an immediate test, but on retention tests the effects seem to dissipate.



The efficiency of this teaching procedure is another aspect that will call for much research and investigation. The need for more extensive testing would be a limitation to the adoption of the programmed text. The machine does not teach, so it would indicate that the construction of the program must necessarily be in the hands of experts. Continued and larger samplings of classroom experiences are needed to insure that proper learning is taking place. Evans states that, " . . . good students seem to learn equally as well by traditional and machine, but in less time, and . . . poorer students seem to gain higher test scores."<sup>27</sup> This statement by Evans brings about a greater emphasis of the problem of modern education. We are now providing an educational program for the masses, but what about the future? The rapidly increasing numbers in need of education cannot be filled by building more school buildings even if the economy could carry the load. Can the public support the traditional form of education? In the opinion of the author the traditional system will find it difficult to provide the education necessary for future generations.

#### Summary

Technology in the field of electronics can build a machine to present knowledge and skills to fulfill the wildest dreams of automated teaching. The machine can present the materials in a most democratic, though somewhat inhuman, form. Machines are no respecters of intelligence

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<sup>27</sup> Evans, J. L., Principles and Problems in the Preparation of Programed Learning Sequences, A report prepared under Cooperative Research Project No. 691 (9417), The U.S. Office of Education, Department of Health, Education, and Welfare, September, 1960.

level, race or creed. The automated teaching devices have been developed to aid rote memory and so can provide for the mastery of basic skills. The opinion of the author, based on research reports, is that the machine is a time saver which is of great value to the gifted. It will provide time needed for broadening their horizons as they master basic skills. The ideal of all teachers, worthy of the name, is that of being a private tutor for each individual under his influence. The programed text, in a limited sense, will provide that opportunity.

There is much need for further research and evaluation of the best procedures to use for the development of the material to be used in programed or machine learning. The author feels it is not the time for a complete change-over to automated teaching, but we, as educators, need be constantly alert to new developments that may solve the dilemma of modern education.

The problems of programed learning are those entailed in anything new. It will take time to learn how to acquire the maximum good through usage and with a minimum of difficulty in the construction of the program and teaching materials.

## CHAPTER VI

## SUMMARY AND CONCLUSIONS

This study attempted to compare the effectiveness of traditional educational practices with those using the programmed text and the teaching machine. The survey of literature and the use of research findings were used as a basis for the comparison.

S. L. Pressey, the father of the "Modern Teaching Devices," found them to be successful from the standpoint of the psychology of learning. The time period during which Pressey and his associates carried out their research was labeled "The Age of Teaching Machines." Unfortunately the title "Teaching Machines" had an undesirable connotation and is gradually being replaced by the more appropriate term "Programed Texts." The years following Pressey's experiments were long, unproductive years for programed learning.

The advent of World War II brought about the demand for a solution to the problem of shortening the time it would take to train a man for war service by the most expedient means. The Armed Service schools and the Federal government spent much money for research and the development of teaching devices to be effective aids in training men for war duties. World War II did for programed learning what the Wright Brothers did for travel. It is hoped that programed texts, in the hands of experts today, will be of great service in a solution to our educational problem.

As a message to all parents, teachers, educators and all interested persons, the programed text will be a very effective tool in the

hands of a capable instructor. The programed text will give the young learner the opportunity to study beyond the basic skills. The time required to learn factual material is reduced from fifty to sixty per cent, thus allowing time for research in other fields of interest. The programed text, used in the general classroom, will be the result of much research. Founded on sound psychological principles of learning, it will contribute greatly to educational progress.

The programed text will not erase individual differences; however, it will adequately provide in a most democratic form the teaching which will educate the child to his greatest potential.

Programed learning does not limit itself to the teaching of the young learner. The potentialities of the programed text in training mature men gives new opportunities to many. Those who failed to get their education through neglect, lack of opportunity, or just the passivity of traditional education will now be challenged to seek higher attainments. We are all aware of the changing job positions resulting from automation. The programed text again offers the necessary job training to prepare the individual to take his place in our society with the least amount of hardship on the family.

In the opinion of this author, all of the classroom techniques used for the motivation of learning can be built into the programed text and will be very effective. The results of early research indicate that the programed text in its early stages of development have proven to be as effective as the traditional teaching procedures in the common classroom. At this point the author would like to give an account of a first-hand experience using the programed text as instructional material.

A pupil who was unable to attend the first eight weeks of regular class was provided with an Algebra I programed text to be used in home study. Following the eight-week absence, the pupil was able to join her class, which gives rise to the opinion that the programed text may be well on the way to replacing the private tutor.

The age of technology, with its scientific developments, can build the machine which could exceed the dreams of Ramo. The machine which respects no age, creed, social status, or intelligence level will truly work in a democratic tradition providing education for all who will avail themselves of the opportunity.

The problems of programed learning are those incurred in any new venture. It will take time to learn how to fully utilize the programed text and how to construct the program with a minimum of difficulty and expense.

The conclusions to be drawn from this study are:

- (1) The programed text is now ready to be taken out of the laboratory and placed in limited use in the classroom.
- (2) The programed text has proven of considerable use in reducing the learning time.
- (3) The programed text will teach what educators want it to teach and will be effective regardless of the learner's position, age, creed or his ability.

In summary the investigator feels that the programed text will be of great value in helping to solve our educational problems. The programed text effectively deals with the motivation needed for learning and decreases the time needed for mastery of given subject materials. It encompasses all studies and levels of learning.

## CHAPTER VII

## RECOMMENDATIONS

The results of the study as interpreted by the investigator would indicate that there is a need for additional classroom experiments of simple design and structure so that they can be objectively evaluated. The author concludes that evidence manifest in the studies thus far does not warrant making a final and decisive commendatory statement. The following points may be worthy of further deliberation:

1. Two fields of thought on the programed text do exist, the branching type by Crowder and the nonbranching of Skinner. More classroom experiments should be used to determine which program will provide a better learning situation.
2. Programed texts, whether presented in a machine or hard-cover form, need further classroom investigation to determine the optimum pace of learning.
3. A third area for further study is centered around the young learner. The idea that the motivational forces of the programed text may be of such magnitude that it could impede learning indicates that an optimum motivation must be built into the text.
4. The research reports of today cover limited subjects and short periods of time. It is recommended that further investigations of longitudinal nature be conducted so that they may be objectively evaluated.
5. Being cognizant of the inconclusiveness of the experimental data, the author would recommend that educators use the programed text to the extent that traditional teaching is augmented rather than replaced.
6. The author would recommend that educators with an eye to the future use limited commercially prepared texts in various subjects and grade levels in their classroom. Programed learning may become an effective tool which will permit the pupil to return to apparent independent study, and will provide an answer to the ever-growing problem of pupil-teacher ratio. As Glanter stated, "Whatever its

drawback, and there must be many, this method is one step toward assuring our children that they will be prepared to survive in the severe competition of tomorrow."

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