A COMMON misconception about programed instruction is apparent in the following interchange.

"At last I'll have some help in teaching history to those wiggly eighth graders."

"What can programed instruction do that you can't do better yourself?"

"It will make students repeat all the facts so many times that they will never forget them."

"And since when has memorizing facts been the purpose of teaching history? I thought we were trying to teach our pupils to understand today's problems in terms of past events, to weigh evidence for and against proposed actions in relation to historical precedents, and to appreciate the privileges and responsibilities of our democratic society. I'm worried that programed instruction is going to be used to teach things we don't want to teach and make us forget to teach the really important things."

Both teachers are operating under the false assumption that programed instruction is only useful for drilling pupils on facts and cannot be used to reach the most important objectives of education. Unfortunately, these teachers may have been misled by some of the early programs, too many of which consisted merely of repetitive drill on simple concepts. But more important objectives also can be taught through programed instruction.

Four Critical Areas

One of the four critical areas where research in programed instruction can have practical payoff for education is this very problem: How can programed instruction help us attain the really crucial objectives of education? A second area concerns curriculum revision. A third basic problem concerns implications for teaching methods. And the fourth important area of research involves adapting instruction to individual differences.

Before getting into the specifics of each of these problem areas, let us consider one kind of research in programed instruction that is not needed. Comparing programed instruction with conventional classroom instruction is a useless endeavor. Schramm reported that, of 36 such comparisons, 18 showed no significant differences between program instructed groups and conventionally instructed groups when both were measured on the same criterion test. Of the 18 reports which did show a significant difference, 17 favored the group which had programed instruction, and only one favored the conventional classroom instruction.

Such comparisons are futile because:

1. Classroom teachers vary so widely

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in their "conventional" instruction that we have no stable basis for comparison; (b) programs themselves vary widely in their scope and quality of writing; (c) the criterion test may have been designed to measure only a limited objective; (d) no matter which way the results come out, no action will be taken because we cannot abandon either teachers or programed instruction; and (e) we remain without useful information as to how either programed or conventional instruction can be improved.

We need to focus our attention on the kind of research which will make a difference in educational practice. Programed instruction may prove to be of most value because it is a convenient tool for conducting educational research. Programed instruction provides for the controlled presentation of educational material under standard conditions so that precise experimental studies can be conducted. Since these studies can be done in real classroom situations (instead of laboratories) with human beings (not rats) and with meaningful material (not nonsense syllables), results may be used with more confidence to answer some important questions of interest to educators.

Attaining Important Goals

How can programs be written to attain the most important objectives of education? The crucial question which any educator should ask when choosing a program (or textbook, or film) is simply this: If a student uses this material, what will he be able to do or say differently as a result?

One of the important contributions of programed instruction has been its emphasis upon defining educational goals in terms of the behavior we expect of students. If a student can do or say something differently as a result, we must still ask whether this new behavior is progress toward one of our important objectives. Does the changed behavior reflect attainment of a crucial educational purpose? An arithmetic program may merely provide drill on specific arithmetic skills, but it could be written to provide some insights into the basic fundamentals of our number system. A science program may teach students to memorize the valences of chemical elements, but it could be written to help students think the way a scientist thinks by asking them to induce relationships from raw data.

Every program which claims to teach important objectives may not realize its goal. It is still necessary for teachers to try out programs which claim to bring about certain important behavior changes and assess the extent to which the changes actually occur. We need to experiment with different ways of writing programed materials which encour-
age students to think. Asking students to make trivial kinds of responses in programmed materials will not enable them to make the critical responses which we ultimately expect. The program itself must lead a student to perform in a manner similar to the way in which we hope that he will eventually be able to perform.

**Determining Curriculum Sequences**

How can optimal curriculum sequences be determined through experimentation in programmed instruction? One major problem in curriculum construction is determining which skills should be taught prior to which other skills. What are the prerequisites that need to be mastered prior to learning each new skill? Programed instruction seems to offer a convenient tool for experiments designed to determine what prerequisite experiences are necessary for each new learning. The model for such experimentations has been provided by Gagné and his associates. Hierarchies of learning sets were identified. Higher level learning was found to depend on mastery of certain subordinate learning sets.

If an entire curriculum were constructed according to this model, it would be possible to analyze the skill level of each individual student and place him into the curriculum so that he could attain each subordinate skill necessary before tackling the next most difficult problem. A number of small scale studies are needed first in each subject matter area. Experiments could be performed by constructing various prerequisite skill programs before teaching a more difficult task. It would then be possible to see which combination of initial skills is necessary before the final skill could be learned.

So far the research on sequencing of materials has not produced dramatic differences. In fact, several studies have reported that the sequence designed by the program writer is no better than the identical frames arranged in a random order. But short programs and insensitive criterion instruments may make it difficult to produce reliable differences. In certain subject matter areas, sequence may not be of importance. We need to know in which subjects sequence is important; and within each subject we need to know what arrangement of material will produce the most efficient learning.

**Improving Teaching Methods**

What improvements in teaching methods can be derived from research in programmed instruction? Here are just a few of the many questions which have been asked in regard to programmed instruction but which need to be asked again in the larger context of general teaching methods.

1. What is the relative effectiveness of prompting a student to give the correct answer before he gives it, in comparison to providing him with knowl-

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edge of the correctness of his response after he has tried? Is there some optimum combination of prompting and confirmation which produces the most learning?

2. How much material should be given to a student before asking him to attempt a response? Should the size of each step vary depending on the stage of progress in learning and the degree of interest of the student?

3. Should each student be required to keep the same pace, or should students be allowed to go at their own rate of speed?

4. Is it always wise to provide knowledge of results or is this important only when the learning material is difficult and the error rate in learning is high? Is there some optimal schedule by which students should be reinforced? Should continuous reinforcement be given during the initial learning period and irregular reinforcement be given afterward to promote long term retention?

5. Must students respond overtly to material or can covert mental responses be equally effective?

6. Will a student learn as well by constructing his response as he will by choosing a response from a list of alternatives?

7. Should learning tasks deliberately minimize the number of errors that the student makes during learning? What is the optimum level of difficulty? What specific ways of constructing learning materials produce the optimum difficulty level?

Questions such as these need to be answered for educational methods in general. Programed instruction is merely a convenient tool for experimentation, but there is no reason why similar experimentation should not be done in connection with educational films, textbooks, TV, and the behavior of the classroom teacher.

Research on some of these questions in practical settings with meaningful material has been reviewed by Krumboltz, but such research literature is sparse. A great deal of experimental work needs to be done in classrooms to test the effectiveness of different methods of designing and using educational materials.

Adapting to Individual Differences

What modifications in instructional materials are needed to adapt them to the individual differences of pupils? Teachers have long been aware of the wide range of individual differences in their classrooms. Programed instruction offers one possible device for adapting to the problem. Different programs can be provided for students at different levels of skill, or students may be allowed to progress at their own rate of speed through the same material.

A provocative study by McNeil showed that boys in the first grade learned better under programed instruction than girls, but that girls learned significantly better than boys under the female classroom teachers using conventional methods. The reasons for this difference remain undetermined, but speculation might turn up a number of testable hypotheses. Are programed materials themselves more suitable for (Continued on page 49)

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worth its weight in gold" for those interested in a scientific approach to problems of instruction.

Although focused on the teacher as its central concern, the vast majority of material is relevant to the teacher in the process of instruction. The quality of the contributions is consistently high with perhaps the chapters on History, by Brondy; Theory, by Gage; Teaching Methods, by Wallen and Travers; and Social Interaction, by Withall and Lewis, and the whole of Part IV, "Research on Teaching Various Grade Levels and Subject Matters," of most direct concern for instruction. This volume represents a milestone in our quest for an understanding of the knowledge, procedures and problems relevant to the study of instruction.

References


—James B. Macdonald, Professor of Education, University of Wisconsin, Madison.

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one type of person than another? Are they more acceptable to certain types of personalities than others? Do programed materials motivate slow learners better than fast learners? How can programed materials be modified to those types of persons for whom the conventional programed format produces less than optimum results? How can programed materials be constructed to meet variations in the way boys and girls respond to different types of teacher behavior?

Needed Experiments

Experiments are needed in combining the use of programed instruction with other instructional methods such as laboratory experiments, field trips, homework of various types, classroom discussions, drill, and motion pictures. There may be optimum combinations of instructional methods best suited to various types of individuals. The various combinations of variables to be studied are innumerable.

In summary, the method of programed instruction offers a unique opportunity to experiment under controlled conditions in realistic settings. The goal is to find that combination of materials and procedures which enables each individual to attain the most important objectives for himself and for his society.
