The Tasks of Instruction

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IN A recent paper, Bloom stated this hypothesis:

> Most students (perhaps over 90 percent) can master what we have to teach them, and it is the task of instruction to find the means which will enable our students to master the subject under consideration.[1]

To gain empirical support for such a hypothesis should become the common goal of teachers and researchers. To do so, however, will require changes in attitudes and educational practices. This paper will explore changes in attitude and practice that are needed in order to gain support for Bloom's hypothesis.

Changes in Attitude

Bloom claims that much teaching is self-defeating. That is, much instruction is begun with the feeling that large numbers of students will do average, poor, or failing work. It is usually expected that only a few students will do "A" work. Sure enough, it usually turns out just that way.

The studies of Rosenthal and Jacobson [2] are cited by Bloom to show how instructional expectations affect instructional outcomes. These studies showed that with both rats and humans, instructional prophecies were self-fulfilling; outcomes lived up to expectations. If this is the case, perhaps all that needs to be done to obtain support for Bloom's hypothesis is adoption of the attitude by educators that mastery of subject matter can be achieved by most students. Such an attitude change is probably a necessary but not a sufficient condition in achieving the goal of mastery.

Perhaps the intellectually less capable, like the poor, will always be with us. The argument might be made that many students are biologically incapable of achieving mastery. Ferguson [3] has suggested, however, that the range in human ability attributable to learning is so substantial that we should be more concerned with environmental than with biological limits. The biological limits still exist and fix limiting conditions, according to Ferguson.

Boyer and Walsh [4] have described several different models for human ability in relation to the requirements of society. In one of their models they assume some variation in potential human ability. However, this variation in potential ability occurs above the minimum level required for functioning in society. The fact that many individuals do not function at their level of potential ability is justification for intense educational efforts to improve their performance.

The arguments presented here are hardly

[1] B. S. Bloom. "Learning for Mastery." *Evaluation Comment*, Vol. 1, No. 2, May 1968; Center for the Study of Evaluation, University of California, Los Angeles.

[2] R. Rosenthal and L. Jacobson. *Pygmalion in the Classroom*. New York: Holt, Rinehart and Winston, Inc., 1968.

[3] G. Ferguson. "On Transfer and the Abilities of Man." *Canadian Journal of Psychology* 10: 121-31; 1956.

[4] W. H. Boyer and P. Walsh. "Are Children Born Unequal?" *Saturday Review* 51 (42): 61-79; October 19, 1968.

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conclusive in favor of adopting the view that environment rather than heredity is the dominant factor in determining human ability. What one can conclude, however, is that the argument is still unresolved. Rather than tie ourselves to the self-fulfilling prophecy that says many students are incapable of mastering the materials they study, we should consider alternative models. To consider the view advocated by Bloom, or the variants of this view described by Ferguson or Boyer and Walsh, is precisely the kind of attitude change needed.

Instructional Objectives

What are other changes that must take place in order to gain support for Bloom's hypothesis? Perhaps the most important of these has to do with the specification of instructional objectives. If the goal is to have most students master what we have to teach them, it is necessary to specify what constitutes mastery. The objectives of instruction which define mastery must be specified in terms of human performances. We need to say what it is that students can do when they have achieved mastery of any course material in order to guide their instruction intelligently.

It is important to emphasize that a commitment to objectives stated in performance terms does not commit anyone to a particular teaching technique nor to a particular kind of teaching outcome. It is possible to design a performance-based course which is taught by either a lecture-discussion method or by a laboratory-inquiry approach. Similarly, it is possible to design a performance-based course for which the desired student performances are as widely different as the memory of facts, the application of principles, or the acquisition of investigative skills.

It is also important to emphasize that the mastery of a specific subject (for example, tenth grade biology) need not and should not be tied to a fixed set of performance objectives. Instead, a large number of possible objectives for a particular course could be stated in performance terms. Schools could select from such a pool of objectives and implement performance-based programs with the goal of student mastery of the chosen objectives.

Curriculum Development

Another needed change in an effort to gain support for Bloom's hypothesis concerns the development of curriculum materials. The practice of writing curriculum materials in the logic of the scholar is not sufficient. The effectiveness of the materials should be demonstrated in terms of performance on specified outcomes. The concern should be for the development of validated instruction that will reliably produce mastery of specified outcomes provided certain entering behaviors have been met.

Glaser [5] has written about how such validated instruction can be produced:

> Modern curricula will no longer be built solely on the basis of an author's judgment of the effective design of curriculum materials based on his general experience. Rather, curriculum development is guided by detailed empirical tryout and redesign on the basis of data obtained from student and teacher use.

Gagné [6] has hypothesized that the attainment of knowledge is hierarchically organized. That is, to master some tasks it is necessary to master some component or subordinate tasks. The analysis procedure used to determine tasks subordinate to a specific final task can be called "deriving a learning hierarchy." The tasks that make up a learning hierarchy can serve as a starting place in the design of validated instruction.

An example will illustrate how a learning hierarchy for a specific final task can be derived. Suppose students are to learn to calculate the speed of a moving object by using the principle—speed equals distance divided by time. In analyzing this task we ask, "What would the student have to know

[5] R. Glaser. "An Individualized System." *Science Education News*. American Association for the Advancement of Science, Misc. Publication 6-67: June 1967. p. 3.

[6] R. M. Gagné. "The Acquisition of Knowledge." *Psychological Review* 69: 355-65; 1962.

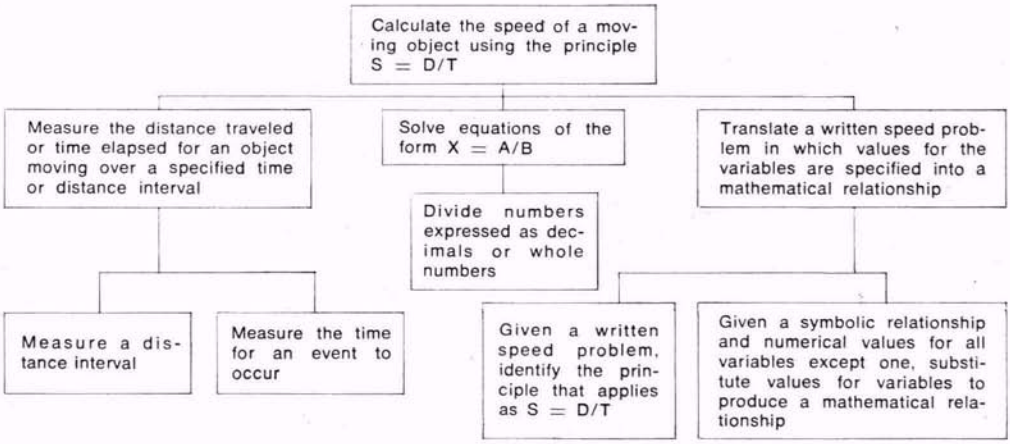

Figure 1. A Learning Hierarchy

how to do in order to learn to calculate the speed of a moving object using the principle, $S = D/T$?" He would probably have to know how to do three things: solve equations of the form $X = A/B$; measure the distance traveled or time elapsed for an object moving over a specified time or distance interval; translate a written speed problem in which values for the variables are specified into a mathematical relationship. Each of these tasks is considered to be subordinate to the final task of calculating the speed of a moving object.

Each of the three subordinate tasks that have been identified can be subjected to the same question as the final task. For example, what would a student have to know how to do in order to learn to translate a written speed problem in which values for the variables are specified into a mathematical relationship? We can speculate that he would have to know how to do two things: given a symbolic relationship and numerical values for all variables except one, substitute values for variables to produce a mathematical relationship; and, given written speed problems, identify the principle that applies as $S = D/T$. This analysis procedure can be continued for the other subordinate tasks that were identified. If the results of the analysis are put in more graphic form, a chart like that shown in Figure 1 is produced. The lines in the chart show the subordinate relationship the tasks have to one another. The chart can be referred to as a learning hierarchy or, more simply, a hierarchy.

The learning hierarchy of tasks derived here has limitations. It represents, at this point in development, a series of hypotheses of how certain tasks depend for their acquisition upon the previous acquisition of subordinate tasks. Until student performance data are acquired to use in testing these hypotheses, it cannot be said with certainty that the tasks in the hierarchy are complete or properly sequenced.

A learning hierarchy of tasks can serve as an aid in the development of validated curriculum materials. With a learning hierarchy in hand, the curriculum developer has before him a clear statement of the final performance expected of a student. He also knows which tasks should be mastered by the students and the sequence in which these tasks should be learned in order to attain the final goal. Instructional materials can then be selected or developed and sequenced according to the instructional map provided by the learning hierarchy. The goal is the production of instructional materials that are validated, which means that under specified conditions use of the materials will produce mastery of specified outcomes. The tasks and

their sequence are, of course, subject to modification based on student performance as the curriculum materials go through cycles of tryout and revision.

In addition to changes in attitude, in the specification of objectives, and in curriculum development, a fourth change that would aid in gaining support for Bloom's hypothesis is in the area of teacher training. To accomplish mastery, the job of the teacher needs to become comparable to that of a physician. This means teachers must learn to diagnose learning difficulties and prescribe educational treatments.[7] Statements of objectives in performance terms and the learning hierarchies which result from analyzing terminal objectives are the raw materials which the teacher uses to diagnose and prescribe.

Suppose that a teacher has selected some specific performance objective as one of the goals in his course. Suppose further that a hierarchy of subordinate skills has been validated for this objective and tests for all tasks in the hierarchy are available. A pretest on each of the tasks in the hierarchy can be used to determine precisely what each student can do and cannot do. The teacher can then decide where instruction should begin for the class. Under optimal conditions, if instruction is individualized, the decision can be made for each student.

After instruction is completed, for a given student, a second test on all the tasks in the hierarchy can be used to locate places of difficulty which require special instruction or review. Again, under optimal conditions, each individual student could be closely followed as he progressed through the tasks in the hierarchy with appropriate adjustments for any difficulties.

In order to carry out an instructional plan such as the one just described, it is presumed that:

1. Final goals which constitute mastery have been stated in performance terms

2. Subordinate tasks leading to the final goals have been identified

3. Tests are available to measure students' performance on the tasks in a learning hierarchy

4. Instructional materials are available to aid students in acquiring the capabilities represented by a hierarchy chart

5. Teachers have the skills required to diagnose and prescribe.

With limited exceptions, the above conditions cannot be met at this time. This fact suggests quite clearly the job that needs to be done by educators. College professors, teachers, supervisors, and curriculum developers have to begin the job of stating objectives in performance terms, determining subordinate skills, teaching instructors to diagnose and prescribe, developing tests of performance, and producing validated instructional materials. *These are the tasks of instruction.* Support for Bloom's hypothesis can be obtained if we carry out these tasks.

In summary, the hypothesis stated by Bloom that "most students can master what we have to teach them" is suggested as the goal toward which all people in education should work.

It is suggested that to gain support for this hypothesis several changes will have to take place. The first of these (and perhaps the hardest to accomplish) is a change in attitude. We must agree that it is possible to achieve such a goal.

Changes in the process of instruction, in the outcomes of instruction, and in the development of instructional materials are also needed. Mastery must be defined in performance terms. Having thus explicitly defined the end goal of instruction, the curriculum developer can proceed through cycles of revision and evaluation in an attempt to produce instructional materials that work.

Changes in the area of teaching are also needed. Teachers must operate in performance terms. They need to be taught the skills of diagnosis and prescription. If teachers think of student outcomes in terms of capabilities, they can find out what a particular student can or cannot do (diagnosis). Following this, they will be able to prescribe specific instructional materials to remedy a specific learning difficulty. □

[7] J. R. Okey. "Diagnosing Learning Difficulties." *The Science Teacher* 37 (5): 59-61; May 1970.