PROGRAMS FOR TEACHING THINKING

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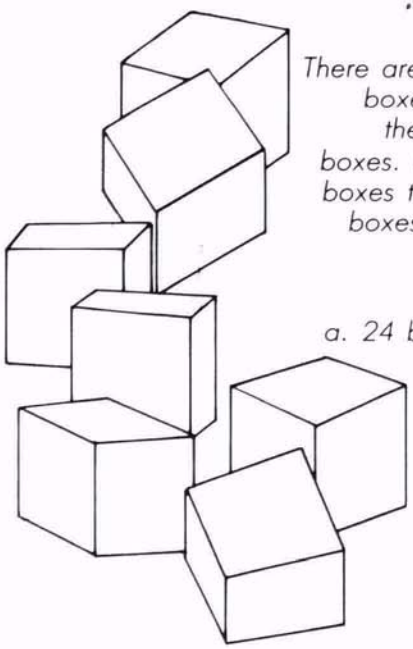

There are 3 separate, equal-size boxes, and inside each box there are 2 separate small boxes. Inside each of the small boxes there are 4 even smaller boxes. How many boxes are there altogether?

a. 24 b. 13 c. 21 d. 33 e. some other number

Imagine that students are confronted with this problem (Whimbey and Lochhead, 1980). The only mathematics required for the solution to the problem is simple addition. Nevertheless, many students who can add columns of numbers have difficulty determining which numbers they should add (some merely add 3 plus 2 plus 4). The correct answer requires several steps. For example, a student may first represent the three large boxes (perhaps by drawing them), next note that there are two medium-size boxes *within* each of the larger boxes, and then realize that each medium-size box contains four smaller boxes. The final step is to add *all* the boxes together in order to arrive at the answer "33." An alternative approach is to focus on one of the large boxes plus its contents and then multiply by 3.

To what extent do we help students explicitly analyze the processes involved in solving problems such as this one? Consider the types of feedback students usually receive after completing a series of exercises. One level of feedback includes information about each student's total score on the test or exercises; in this case the students receive no information about the particular problems they answered correctly or incorrectly. A second level of feedback includes information about the particular problems that were and were not answered correctly. This is clearly more informative than the first level, but it may still be insufficient. Students learn they made an error on a particular problem yet may have no idea why they made it.

A third level of feedback occurs when a teacher or text explains the steps necessary to achieve the correct answer to a problem. However, even this level of feedback can fail to help students learn about themselves as thinkers and learners. There are important differences between the ability to *recognize* a correct solution to a problem and the ability to *generate* a solution on one's own. Students need to be helped to analyze and evaluate their own thought processes so they can avoid potential errors.

Teachers frequently emphasize the content to be learned rather than the process of learning; they teach children *what* to think but don't help them learn *how* to think. Developers of "thinking skills" programs are attempting to remedy this situation by helping students learn about themselves as thinkers and learners.

To illustrate how these programs work, we will explore some of the similarities and differences among Feuerstein's *Instrumental Enrichment* program (1980); Lipman, Sharp, and Oscanyan's *Philosophy for Children* (1978, in press); and Whimbey and Lochhead's *Analytical Reasoning* program (1980).

Some Similarities Among the Programs

Each of these thinking skills programs emphasizes the importance of making implicit thought processes more explicit. The programs help students become aware of the thinking processes they use as they attempt to solve problems. This awareness is important because it prepares students to solve more difficult problems later on.

The programs use a variety of pro-

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Three programs for elementary and secondary schools help students analyze and evaluate their own problem-solving skills.

cedures to help make problem solving processes more explicit. Analytical Reasoning encourages a "think aloud" procedure. Pairs of students work together on problems; one student assumes the role of the problem solver while the other assumes the role of a friendly critic. Later the students switch roles. The problem solver verbalizes his or her thoughts while solving the problems. The critic monitors these thoughts to ensure that the problem solver reads the problem correctly, explicitly notes each step toward solution, and checks the accuracy of each step in thinking. The thinking aloud procedure sensitizes students to the need for precision and careful analysis by demonstrating how inaccuracies can occur.

Instrumental Enrichment and Philosophy for Children also emphasize the processes of thinking, but rather than requiring students to think aloud, they encourage them to analyze their strategies for solving various problems and to evaluate the strategies as a group. Students' errors often stem from their failure to adequately specify the nature of a problem and to identify the information relevant to its solution, so a great deal of emphasis is placed on problem definition. Students are also prompted to compare current problems with previous problems to identify similarities and differences and to evaluate how changes in a new problem may influence the types of strategies to be used.

Some Differences Among the Programs

In general, Instrumental Enrichment is designed for adolescents and preadolescents labeled retarded, learning disabled, and so forth, although it is also used with normal and even gifted students since the latter are frequently unaware of their own implicit thought processes. Philosophy for Children has several subprograms that have been used with students ranging from the fifth to the twelfth grade, and programs for younger students are being developed. Analytical Reasoning is designed for high school and college students who have difficulty with problem-solving exercises and with verbal comprehensive tasks.

The three thinking skills programs also differ in the knowledge and skills that are necessary to begin the program. For example, Philosophy for Children and Analytical Reasoning require relatively sophisticated reading skills. In contrast, Instrumental Enrichment requires much less reading; the problems are oriented toward the figural rather than the verbal modality. Instrumental Enrichment also presupposes less sophisticated conceptual and procedural knowledge than the other two; in general, it begins at a more basic level of cognitive functioning.

For example, Analytical Reasoning, as well as Philosophy for Children, includes exercises on formal analogy problems that require comparisons of complex sets of relationships. In contrast, Instrumental Enrichment helps students learn to compare simple sets of events before introducing them to tasks such as formal analogies. The appropriateness of each of the thinking skills programs therefore depends on students' initial level of functioning.

These programs also differ in the types of materials used to provide a context for students to learn about themselves as learners and thinkers. The problems used in Analytical Reasoning resemble those found on standardized tests such as the Scholastic Aptitude Test and the Graduate Record Examination. Students solve mathematical word problems, numerical progression problems, verbal reasoning problems, and formal analogy problems.

Philosophy for Children also uses exercises designed to help students develop formal and informal reasoning skills. These exercises constitute only one part of the program, however. Students begin each lesson by reading excerpts from a novel. Each novel provides numerous models of reasoning processes; the characters in the novel discover various principles of logic that apply to their everyday lives. Children discuss important principles from the novels and are helped to see how these relate to the exercises performed in class.

The Instrumental Enrichment materials are quite different from those usually encountered in academic settings. Feuerstein argues that students who have had negative experiences with traditional academic tasks need the chance to work with materials using a different approach. The problems are intrinsically interesting and are designed to require careful consideration of alternative strategies.

The programs are also designed to be used for different amounts of time. Whimbey and Lochhead say it takes 10 to 40 hours to complete the Analytical Reasoning program, although they point out that only the fundamentals of thinking can be taught in that length of time. Instrumental Enrichment is usually taught three to five times a week for a period of two years, but shorter and longer periods can be used depending on the particular needs of the student group. Philosophy for Children is usually taught throughout an academic year, although a more concentrated program could be taught in less time.

> *"Students' errors often stem from their failure to adequately specify the nature of a problem. . . ."*

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What Kinds of Changes Can One Expect?

Based on our experiences with the programs, and on the available evaluation data, we believe each program helps students develop more confidence in their own abilities. Students become aware that everyone has to go through specific steps when solving problems. Also, while the exercises are challenging, students learn to solve them. The ability to complete exercises that previously seemed enigmatic has important effects on students who lack confidence in their problem-solving skills.

Each program emphasizes basic concepts and skills necessary for solving particular types of problems. A program may teach skills for formal syllogistic reasoning, for example, or for solving mathematics word problems, following written instructions, and so forth. The available data suggest that students improve considerably when tested on problems similar to those emphasized in each program. Ideally, however, changes in performance should extend beyond the types of problems that are explicitly taught. This is the problem of transfer.

There are two ways to assess transfer. One way is to expose students to particular problem types and then assess the degree to which they can solve other types of problems. Thorndike (1913) argued that transfer seems to be specific rather than general. For instance, we would not expect students who had taken a thinking skills course to suddenly be able to translate passages written in a foreign language or to solve problems requiring skills and knowledge they had not learned. It is unrealistic to assume that thinking skills courses provide a substitute for academic concepts and skills needed for successful performance in particular domains.

A second approach to the issue of transfer is to assess students' abilities to *learn* rather than assess only what they already know. We favor this approach because the primary purpose of thinking skills programs is to enhance students' potential to be modified by educationally relevant experiences; to help them learn to learn (Bransford, 1979).

An excellent way to assess whether a thinking skills program is working in a particular school would be to divide the students in a particular class, such as remedial reading, into two matched groups and enroll one group in a separate thinking skills course. Those with the additional instruction in thinking skills should do better because they will understand the processes necessary for analyzing and evaluating their work and have greater confidence in their own abilities as thinkers and learners.

It is important to note, however, that the classroom must be structured so students can use their developing skills of analysis and evaluation. The ideal situation is one in which the content teacher helps students see how the thinking skills learned elsewhere are applicable in the present context. Given educational settings such as this, thinking skills programs can indeed help students learn to learn. ■

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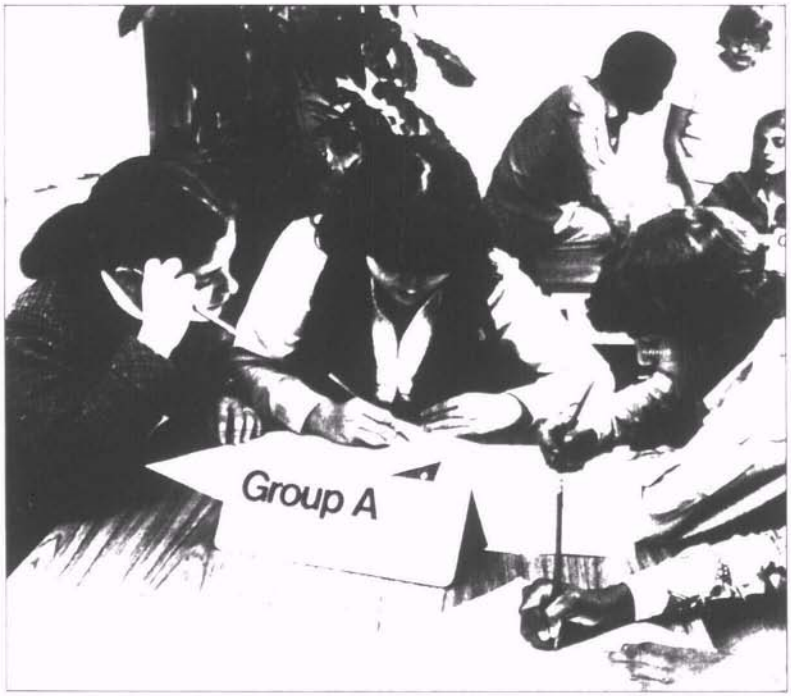

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