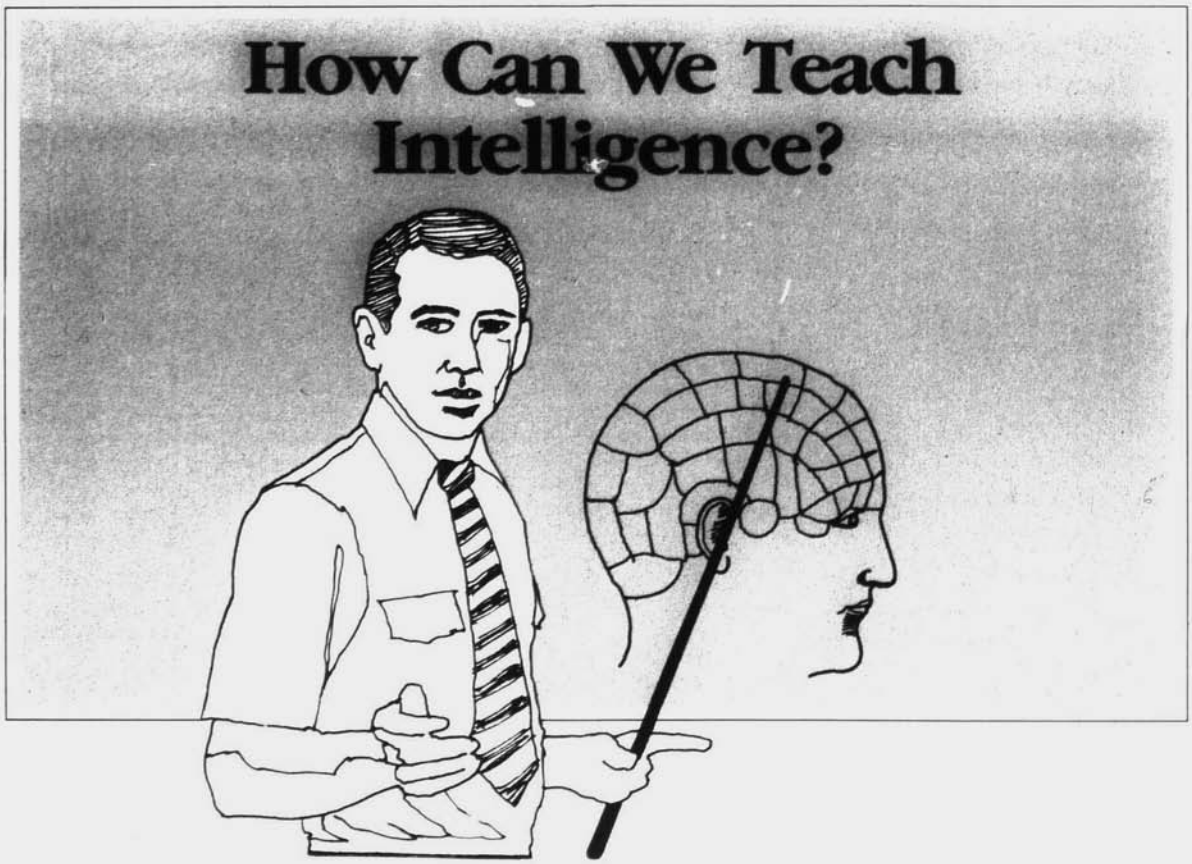
How Can We Teach Intelligence?



ROBERT J. STERNBERG

For most of the century, psychologists studying intelligence have been preoccupied with a single question, "How can we measure intelligence?" In retrospect, this preoccupation has turned out to be a grave mistake for several reasons. First, it has led to neglect of the more important question, "What is intelligence?" If intelligence tests have not improved much over the years—and the evidence suggests that they haven't (Sternberg, 1979, 1980)—one can scarcely be surprised. Better tests of intelligence could arise only from better ideas of what intelligence is; curiously enough, few psychologists have sought better tests through better understanding. Rather, they have sought better tests through small refinements of existing technology, which is limited by the inadequacies of the meager theory underlying it (Sternberg, 1977).

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Second, the preoccupation with testing has been based on certain assumptions, at least one of which is seriously in error. This assumption is that intelligence is, for the most part, a fixed and immutable characteristic of the individual. After all, if intelligence is constantly changing, or even potentially changeable, what good could tests be? With scores constantly changing, the usefulness of the tests as measures to rank individuals in a stable way over time would be seriously challenged.

Third, and most important for concerned educators, both the preoccupation with testing and the assumption that intelligence is a fixed entity have led to neglect of an even more productive question, "Can intelligence be

Feuerstein's Instrumental Enrichment, *Lipman's* Philosophy for Children, *and the* Chicago Mastery Learning *program all train intelligence rather than merely measuring it.*

trained, and if so, how?" My research findings suggest that intelligence *can* be trained. Thus, the focus of this article is the question of "How?"

Because there is no unanimous agreement among psychologists as to the exact nature of intelligence, my own views are necessarily somewhat idiosyncratic. Nevertheless, they are accepted in large part by many specialists in the field, and especially those who have set their goal to train intelligence rather than merely to measure it (Brown, 1983; de Bono, 1983; Resnick, 1976; Detterman and Sternberg, 1982).

My "componential" theory of intelligence seeks to understand intelligence in terms of the component processes that make up intelligent performance (Sternberg, 1979). I will briefly describe the theory, then review three programs that train aspects of intelligence as specified by the theory. Then I will conclude with general remarks and suggestions on the adoption of an intellectual or thinking skills training program.

Components of Intelligence

The view of intelligence as comprising, in part, a set of processes differs in a fundamental way from the view that led to IQ tests. At the turn of the century, the traditional or psychometric view was (and for some continues to be) that intelligence comprises one or more stable, fixed entities (Cattell, 1971; Guilford, 1967; Vernon, 1971). These entities, called *factors*, were alleged to give rise to the individual differences we observe both in IQ test performance and in students' performances at school. The problem with this view is that it does little to suggest how intelligence can be modified. But if intelligence can be broken down into a set of underlying processes and strategies for combining these processes, then it is clear what we can do to improve it: we can intervene at the level of the mental process and teach individuals what processes to use when, how to use them, and how to combine them into workable strategies for task solution.

What exactly are these processes? My research suggests they can be divided into three types (Sternberg, 1984). The first type, *metacomponents*, are the higher order or executive

processes that we use to plan what we are going to do, monitor what we are doing, and evaluate what we have done. Deciding on a strategy for solving an arithmetic problem or organizing a term paper are examples of metacomponents at work. The second type of processes are *performance components*. Whereas metacomponents decide what to do, performance components actually do it. So the actual steps we use in, say, solving an analogy or an arithmetic problem, whether on an IQ test or in everyday life, would be examples of sets of performance components in action. The third type of processes are *knowledge-acquisition components*. Processes of this kind are used in learning new material; for example, in first learning how to solve an analogy or a given type of arithmetic problem.

This may seem very abstract, so let's take a concrete example: an analogy. An analogy provides a particularly apt example because virtually everyone who has ever studied intelligence has found the ability to see and solve analogies to be fundamental to intelligent performance. According to the traditional psychometric view, the ability to solve an analogy would be attributed to a static underlying factor of intelligence. Charles Spearman, a famous psychometrician around the turn of the century, called this factor "g," or general intelligence. Some years later, Louis Thurstone, another psychometrician, called the factor "reasoning." The problem with such labels is that they tell us little either about how analogies are solved, or about how the ability to solve analogous problems can be taught.

In contrast, a process-based approach seeks to identify the mental processes used to solve the analogy or other problem. (See Figure 1.) Consider the processes one might use in solving an analogy such as, "*Washington* is to *one* as *Lincoln* is to (a) five, (b) 15, (c) 20, (d) 50." First, we must decide what processes to use, a decision that is metacomponential in nature. Next we must decide how to sequence these processes so as to form a workable strategy for analogy solution, another metacomponential decision. Then we must use the performance components and strategy we have selected to actually solve the problem. It appears, through experimental data we have collected, that what people do is to *encode*, as they need them, relevant attributes of the terms of the analogy: that Washington was the first President of the United States, that he was a Revolutionary War general, and that his is the portrait that appears on a one-dollar bill. Next they *infer* the relation between the first two terms of the analogy, perhaps in this case recognizing that the basis of the analogy might be either Washington as first president or Washington as the portrait on the one-dollar bill. Then they *map* the relation they have inferred in the first part of the analogy to the second part of the analogy (that is, from the Washington part to the Lincoln part), perhaps recognizing that the topic of the analogy is some property of U.S. presidents. Next people *apply* the relation they inferred in the first part of the analogy, as mapped to the second part of the analogy, to the third term so as to select the best alternative. In this case, "five" is the preferred alternative, because it enables one to carry through the relation of portraits on currency (that is, Lincoln's portrait is on the five-dollar bill just as Washington's is on the one-dollar bill). Although this account is a simplification of my model of reasoning by analogy (Sternberg, 1977), it represents the kind of theorizing that goes into a process-based account of intelligent performance.

Figure 1. Principal Abilities Underlying Intelligent Behavior.

1. Recognizing and defining the nature of a problem
2. Deciding upon the processes needed to solve the problem
3. Sequencing the processes into an optimal strategy
4. Deciding upon how to represent problem information
5. Allocating mental and physical resources to the problem
6. Monitoring and evaluating one's solution processing
7. Responding adequately to external feedback
8. Encoding stimulus elements effectively
9. Inferring relations between stimulus elements
10. Mapping relations between relations
11. Applying old relations to new situations
12. Comparing stimulus elements
13. Responding effectively to novel kinds of tasks and situations
14. Effectively automatizing information processing
15. Adapting effectively to the environment in which one resides
16. Selecting environments as needed to achieve a better fit of one's abilities and interests to the environment
17. Shaping environments so as to increase one's effective utilization of one's abilities and interests

Now, how can the metacomponents and performance components of intelligence be taught? How can we make students better at structuring and then solving problems than they would be on their own? I recommend three widely disseminated programs, each of which has a unique set of strengths and weaknesses.

Instrumental Enrichment

The first training program, Reuven Feuerstein's (1980) *Instrumental Enrichment (IE)* program, was originally proposed for use with children showing retarded performance; it has since been recognized by Feuerstein and others to be valuable for children at all levels of the intellectual spectrum. It is based on Feuerstein's theory of intelligence, which emphasizes what I refer to as metacomponential and performance-componential functioning.

Instrumental Enrichment is intended to improve cognitive functioning related to the input, elaboration, and output of information. Feuerstein has

compiled a long list of cognitive deficits his program is intended to correct. This list includes:

- Unplanned, impulsive, and unsystematic exploratory behavior. When presented with a number of cues to problem solving that must be scanned, the individual's approach is disorganized, leaving the individual unable to select those cues whose specific attributes make them relevant for a proper solution to the problem at hand.
- Lack of or impaired capacity for considering two sources of information at once, reflected in dealing with data in a piecemeal fashion rather than as a unit of organized facts.
- Inadequacy in experiencing the existence of an actual problem and subsequently in defining it.
- Lack of spontaneous comparative behavior or limitation of its appearance to a restricted field of needs.
- Lack of or impaired strategies for hypothesis testing.
- Lack of orientation toward the need for logical evidence.
- Lack of or impaired planning behavior.
- Episodic grasp of reality. The individual is unable to relate different aspects of his or her experience to one another. Feuerstein seeks to correct these deficits and, at the same time, to increase the student's intrinsic motivation and feeling of personal competence and self-worth.

What are some of the main characteristics of the Feuerstein program? The materials themselves are structured as a series of units, or instruments, each of which emphasizes a particular cognitive function and its relationship to various cognitive deficiencies. Feuerstein defines an instrument as something by means of which something else is effected; hence, performance on the materials is seen as a means to an end, rather than as an end in itself. Emphasis in analyzing *IE* performance is on processes rather than products. A student's errors are viewed as a source of insights into how the student solves problems. *Instrumental Enrichment* does *not* attempt to teach either specific items of information or formal, operational, abstract thinking by means of a well-defined, structured knowledge base. To the contrary, it is as content-free as possible.

The *IE* program consists of 13 different types of exercises, which are repeated in cycles throughout the program. Here is a sample of the materials in the program (Feuerstein, 1980):

- *Orientation of dots.* The student is presented with an amorphous two-dimensional array of dots. The student's task is to identify and outline, within this array of dots, a set of geometric figures, such as squares, triangles, diamonds, and stars. The student might see at the left a picture of a square and a triangle, with the triangle situated to the bottom right of the square. The student would have to use the dots to draw a square with a triangle below and to the right of the square.
- *Comparisons.* In one form of comparison exercise, the student is shown a picture at the left; for example, two small apples that have no internal shading or coloring. In one picture, the student might see a single apple, larger than the ones at the left, and fully shaded inside. In the other pic-

Programs for Teaching Thinking

Instrumental Enrichment

Developer:	Reuven Feuerstein
Goal:	Develop the ability to become an autonomous learner.
Sample skills:	Classification/comparison, orientation in space, recognizing relationships, following directions, planning, organizing, logical reasoning, inductive and deductive reasoning, synthesizing.
Assumptions:	• Intelligence is dynamic (modifiable), not static. • Cognitive development requires direct intervention over time to build the mental processes for learning to learn. • Cognitive development requires *mediated* learning experiences.
Intended audience:	Upper elementary, middle, and secondary levels.
Process:	Students do paper and pencil "instruments," which are introduced by teachers and followed by discussions for insight to bring about transfer of learning. The teacher becomes the mediating agent. The cognitive tasks in the materials of instruction are not subject-specific but parallel the subject matter being taught by the teacher.
Time:	Two to three hours a week (plus bridging to subject matter and life skills) over a two- to three-year period.
Available from:	Curriculum Development Associates, Inc. Suite 414, 1211 Connecticut Ave., NW Washington, DC 20036

ture, the student might see three apples rotated to an upside-down position that are also larger in size than the two apples at the left. The student's task is to indicate, in each picture, which of the attributes of direction, number, color, form, and size differ between the picture at the left and each of the pictures at the right.

• *Categorization*. In one categorization task, the student is shown pictures of common objects and is asked to name each one. After the student has done so, he or she is asked to list those names of objects that fit into each of a set of categories, such as means of transportation, clothing, and footwear, objects that give light, tools, and furniture.

• *Temporal relations*. In one problem of this type, the student is confronted with pairs of temporal durations, such as "one year" and "11 months" or "a quarter of a year" and "four months." The student is asked to indicate whether the first duration is greater than, equal to, or less than the second duration.

• *Numerical progressions*. In one kind of numerical progression problem, the student is given the first number in a sequence and a rule by which the sequence can be continued, for example, +3, -1. The student then has to generate the continuation of the sequence.

• *Instructions*. These tasks require a student to understand and follow instructions. For example, the student might be told that he or she should do the following: "On a line draw a triangle, two squares, and a circle, not according to size order. The squares are to be equal in size; the triangle is to be larger than the square and smaller than the circle; and the largest figure is to be on the left side."

• *Representational stencil design*. In these tasks, the student must consider mentally, not through motor manipulation, a design that is identical to that in a colored standard. Colored stencils, some of which are solid and some of which are patterned, are printed on a poster, and the student recreates the given design by referring to the standard stencils that must be used and specifying the order in which they must be mentally superimposed on each other.

• *Transitive relations*. In this task, the student must recognize relations between nonadjacent items in an underlying mental array. For example, the student might be told that "Adam likes math more than history, and history less than geography. Is it possible to know which Adam likes more, math or geography?"

What are the strengths and weaknesses of the *IE* program? On the positive side, it (a) can be used for children in a wide age range (from the upper grades of elementary school to early high school) and for children of a wide range of ability levels (from the retarded to the above average) and socioeconomic groups; (b) is well liked by children and appears to be effective in raising their intrinsic motivation and self-esteem; (c) is well packaged and readily obtainable; and (d) appears effective in raising children's scores on ability tests. Indeed, most of the training exercises contain items similar or identical to those found on intelligence and multiple aptitude tests, so that it should not be totally surprising that intensive practice and training on such items should raise these test scores.

On the more negative side: (a) the program requires extensive teacher training, which must be administered by a designated training authority for the duration of the program; (b) the isolation of the problems from any working knowledge or discipline base (such as social studies or reading, for example) raises questions regarding the transferability of the skills to academic and real-world intellectual tasks, especially over the long term; and (c) despite Feuerstein's aversion to IQ tests, the program trains primarily those abilities that IQ tests tap rather than a broader spectrum of abilities that go beyond intelligence as the tests test it.

To sum up, then, Feuerstein's *Instrumental Enrichment* program is an attractive package in many respects, although with limitations in regard to breadth of skills taught and potential power for generalization. Nevertheless, it is among the best of the available programs that emphasize thinking skill training. Probably it has been the most widely used and field-tested program, both in this country and abroad. As a result, it can be recommended both for members of the majority culture and for members of other cultures and subcultures as well.

Philosophy for Children

Matthew Lipman's *Philosophy for Children* program is about as different from *Instrumental Enrichment* as it could be (Lipman, Sharp, and Oscayan, 1980). Yet it seeks to foster many of the same intellectual skills, albeit in a very different manner.

Philosophy for Children consists of a series of texts in which fictional children spend a considerable portion of their time thinking about thinking and about ways in which better thinking can be distinguished from poorer thinking. The keys to learning presented in the program are identification and simulation: through reading the texts and engaging in classroom discussions and exercises that follow the reading, the author's objective is for students to identify with the characters and to join in the kinds of thinking depicted in the program.

Lipman has listed 30 thinking skills that *Philosophy for Children* is intended to foster in children of the upper elementary school, generally grades 5–8. A representative sampling of these skills includes the following:

• *Concept development*. Students clarify their understanding of concepts by applying them to specific cases, learning to identify those cases that are within the boundaries and those that are outside. For example, when considering the concept of friendship, children are asked whether people have to be the same age to be friends, whether two people can be friends and not like each other very much, and whether it is possible for friends ever to lie to one another.

• *Generalizations*. Given a set of facts, students are to note uniformities or regularities and to generalize these regularities from given instances to similar ones. For example, children

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might be asked to consider generalizations that can be drawn from a set of given facts such as, "I get sick when I eat raspberries; I get sick when I eat strawberries; I get sick when I eat blackberries."

• *Formulating cause-effect relationships*. Students should discern and construct formulations indicating relationships between causes and effects. For example, students might be given a statement such as "He threw the stone and broke the window," and then be asked whether the statement necessarily implies a cause-effect relationship.

• *Drawing syllogistic inferences*. Students should draw correct conclusions from valid syllogisms and recognize invalid syllogisms when they are presented. For example, they might be given the premises, "All dogs are animals; all collies are dogs," and be asked what valid inference they can draw from these premises.

• *Consistency and contradictions*. Students should recognize internal consistencies and inconsistencies within a given set of statements or other data. For example, they might be asked to ponder whether it is possible to eat animals if one genuinely cares about them.

• *Identifying underlying assumptions*. Students should recognize the often hidden assumptions that underlie statements. For example, they might be given the following sentences: "I love your hair that way, Peg. What beauty parlor did you go to?" and be asked to identify the hidden assumption underlying the question.

• *Grasping part-whole and whole-part connections*. Students should recognize relations between parts and wholes and avoid mistakes in reasoning based on identification of the part with the whole, or vice versa. For example, students might be asked to identify the part-whole fallacy underlying the statement, "If Mike's face has handsome features, Mike must have a handsome face."

• *Working with analogies*. Students should form and identify analogies. For example, they should be able to solve an analogy such as Germ is to Disease as Candle is to (a) Wax, (b) Wick, (c) White, (d) Light.

The skills trained through the *Philosophy for Children* program are conveyed through a series of stories about children. Consider, for example, the first chapter of *Harry Stottlemeier's Discovery*, the first book in the program series. In this chapter about the consequences of Harry's not paying attention in science class, children are introduced to a wealth of thinking skills. For instance:

• *Problem formulation*. Harry says, "All planets revolve about the sun, but not everything that revolves about the sun is a planet." He realizes that he had been assuming that just because all planets revolve about the sun, everything that revolves about the sun must be a planet.

• *Nonreversibility of logical "all" statements*. Harry says that "a sentence can't be reversed. If you put the last part of a sentence first, it'll no longer be true." For example, he cannot convert "all model airplanes are toys" into "all toys are model airplanes."

• *Reversibility of logical "no" statements*. Lisa, a friend of Harry's, realizes that logical "no" statements can be reversed. "No submarines are kangaroos," for example, can be converted to "No kangaroos are submarines."

• *Application of principles to real-life situations*. Harry intervenes in a discussion between two adults, showing how a principle he had deduced earlier can be applied to disprove one of the adult's arguments.

Each chapter contains a number of "leading ideas." In Chapter One of *Harry Stottlemeier's Discovery*, for example, the leading ideas are the processes of inquiry, discovery, and invention. The teachers manual provides a discussion plan and a series of exercises corresponding to each leading idea. For example, one of the exercises under the "discovery and invention" leading idea provides students with a number of items such as electricity, electric light bulbs, magnetism, magnets, television, and the Pacific Ocean. Students are asked to classify each item as either a discovery or an invention and then to justify their answers. Another exercise directs stu-

"Feuerstein's *Instrumental Enrichment* program is intended to improve cognitive functioning related to the input, elaboration, and output of information by an individual."

dents to write a paragraph on a topic such as "My Greatest Discovery" or "What I'd Like to Invent."

The nature of the *Philosophy for Children* program may be further elucidated by comparing it to Feuerstein's program. The notable similarity between the two programs is that both seek to teach thinking skills, especially what was referred to earlier as executive processes (metacomponents) and nonexecutive processes (performance components). But given the basic similarity of goals, the differences between the programs are striking.

First, whereas Feuerstein's program minimizes the role of knowledge base and customary classroom content, Lipman's program maximizes such involvement. Although the introductory volume, *Harry Stottlemeier's Discovery*, is basically philosophical in tone, the subsequent volumes—*Mark*, *Pixie*, *Suki*, and *Lisa*—emphasize infusion of thinking skills into different content areas: the arts, social studies, and science.

Second, whereas the material in Feuerstein's program minimizes the use of written language, the material in Lipman's program is conceptually abstract but is presented through wholly verbal text that deals with highly concrete situations.

Third, although both programs involve class discussion, there is much more emphasis on discussion and interchange in Lipman's program than in Feuerstein's. Similarly, the written exercises are less important in Lipman's program.

Fourth, Feuerstein's program was originally designed for retarded learners, although it has since been extended to children at all points along the continuum of intellectual ability. Lipman's program seems oriented toward children of at least average ability on a scale of national norms. Moreover, the reading in *Philosophy for Children* can be a problem for children much below grade level in reading.

What are the strengths and weaknesses of *Philosophy for Children*? The program has outstanding strengths. First, the stories are exciting and highly motivating to upper elementary school children. Second, it is attractively packaged and easily obtainable. Third, tests of the program have shown it to be effective in raising the level of children's thinking skills. Fourth, the infusion of the thinking skills into content areas should help assure durability and at least some transferability of learning attained through the program. Finally, the thinking skills taught are clearly the right ones to teach for both academic and everyday information processing—no one could possibly complain that the skills are only relevant for IQ tests, although, in fact, the skills are also relevant for performance on such tests.

The *Philosophy for Children* program, however, has some limitations that ought to be considered prior to school adoption. First, students of below average or even low average intellectual capabilities may have difficulty both with the reading and the reasoning involved in the program. Second, students from lower-class and even lower-middle-class backgrounds may have trouble relating to the characters in the stories, who come across as very middle- or even upper-middle-class in their values and orientations. Students may also find the story characters quite removed, for example, from the problems of growing up in a tough inner-city environment. Third, the success of the program will probably be at least as dependent on the teacher as on the specific materials. This program could work outstandingly well with a gifted teacher but fail miserably with a mediocre or below-average teacher who may not be able to engender the attitude of classroom inquiry the program needs. Indeed, some teachers may themselves have trouble with the thinking skills taught by the program.

In summary, although it is limited somewhat by the range of students for whom it is appropriate, no program I am aware of is more likely to teach durable and transferable thinking skills than *Philosophy for Children*.

Chicago Mastery Learning Reading Program

Whereas *Instrumental Enrichment* and *Philosophy for Children* empha-

size thinking skills (metacomponents and performance components), the *Chicago Mastery Learning Reading Program* emphasizes learning strategies and study skills (knowledge-acquisition [Jones, 1982] components)—a fuzzy but nevertheless useful distinction.

The *Chicago* program, developed by Beau Fly Jones in collaboration with others, equips students with the learning strategies and study skills they need to succeed in school and in their everyday lives. Like *Philosophy for Children*, this program is written for children roughly in grades five through eight. There are four books (tan, purple, silver, and gold), each of which teaches somewhat different skills. The emphasis in all four books, however, is on learning to learn. Within each grade (color) level, there are two kinds of units: comprehension and study skills.

Consider, for example, the purple (Grade 7) sequence. The comprehension program contains units on using sentence context, mood in reading and writing, comprehending complex information, comprehending comparisons, analyzing characters, and distinguishing facts from opinions. The study skills program contains units on parts of a book, graphs and charts, preview-question-read, studying textbook chapters, major and minor ideas, and outlining with parallel structure. The silver (Grade 8) sequence for comprehension contains units on figurative language, word meaning from context, reasoning from facts to complex inferences, analyzing stories and plays, completing a story or a play, signs, and symbols. The sequence for study skills contains units on supporting facts, research aids, notetaking in outline form, summaries and generalizations, comprehending road maps, and understanding forms and directions.

The *Chicago* program is based on the belief that almost all students can learn what only the best students currently learn, if only the more typical or less able students are given appropriate learning opportunities. Mastery learning is described as differing from traditional instruction primarily in the systematic and frequent use of formative and diagnostic testing within each of the instructional units. Instruction is done in groups, with individual assistance and remediation as necessary. Because students typically enter the classroom situation with differing skills and levels of proficiency in the exercise of these skills, instructional units begin with simple, concrete, literal, and familiar material and proceed gradually to the more complex, abstract, inexplicit, and unfamiliar material.

Each instructional unit in the *Chicago* program contains several distinct parts: student activities, optional teaching activities, formative tests, additional activities, enrichment activities, retests, and subject-related applications. Students and teachers are thus provided with a wide variety of materials.

The number and variety of exercises is so great as to rule out the possibility of giving a fair sample of materials in the program. Thus, I can make no claim that the following few examples are representative of the program as a whole:

- *Using sentence context*. In one type of exercise, students read a sentence containing a new word for them to learn. They are assisted in using cues in the sentence to help them determine the word's meaning.
- *Mood in reading and writing*. Students are given a sentence from either expository or fictional text. They are asked to choose which of three words or phrases best describes the mood conveyed by the sentence.
- *Comprehending comparisons*. Students are taught about different kinds of comparisons. They are then given some sample comparisons and asked to elaborate on the meanings, some of which are metaphorical.
- *Facts and Opinions*. Students are taught how to distinguish facts from opinions. They are given a passage to read, along with some statements following the passage. Their task is to indicate which statements represent facts and which opinions.

The *Chicago* program is similar to the *Instrumental Enrichment* and *Philosophy for Children* programs in its direct teaching of cognitive skills. The

program differs in several key respects, however. First, it resembles typical classroom curriculum more than either of the other two programs. Whereas implementation of either of the others would almost certainly have to follow an explicit policy decision to teach thinking skills as an additional part of the curriculum, the *Chicago* program could very well be implemented as part of an established program, such as the reading curriculum. Second, the program does fit into a specific curriculum area that is common in schools, namely, reading. The Lipman program would fit into a philosophy curriculum, if any school offered such instruction. The Feuerstein program would be unlikely to fit into any existing curricular program, except those explicitly devoted to teaching thinking skills. Third, the *Chicago* program emphasizes learning strategies, whereas the emphasis of the other two programs tends to be on thinking skills. Finally, the *Chicago* program seems most broadly applicable to a wide range of students, including those who are above and below grade level.

Like all programs, the *Chicago* program has both strengths and weaknesses. Its most notable strengths are (1) the wide range of students to whom it can be administered, both in terms of intellectual levels and socioeconomic backgrounds; (2) the relatively lesser amount of teacher training required for its implementation; (3) the ease with which the program can be incorporated into existing curricula; and (4) the immediate applicability of the skills to school and other life situations. Students in the program have shown significant pretest to posttest gains in achievement from the program (Jones, 1982).

As for weaknesses, or at least limitations, compared to the *IE* and Lipman programs, (1) the materials appear less likely to be intrinsically motivating to students; (2) the skills trained by the *Chicago* program are within a more limited domain (reading and perhaps verbal comprehension) than in some other programs; and (3) the program is less clearly based on a psychological theory of cognition.

In conclusion, the *Chicago Mastery Learning Program* offers an attractive means for teaching learning skills in the context of a reading program. The materials are carefully prepared and

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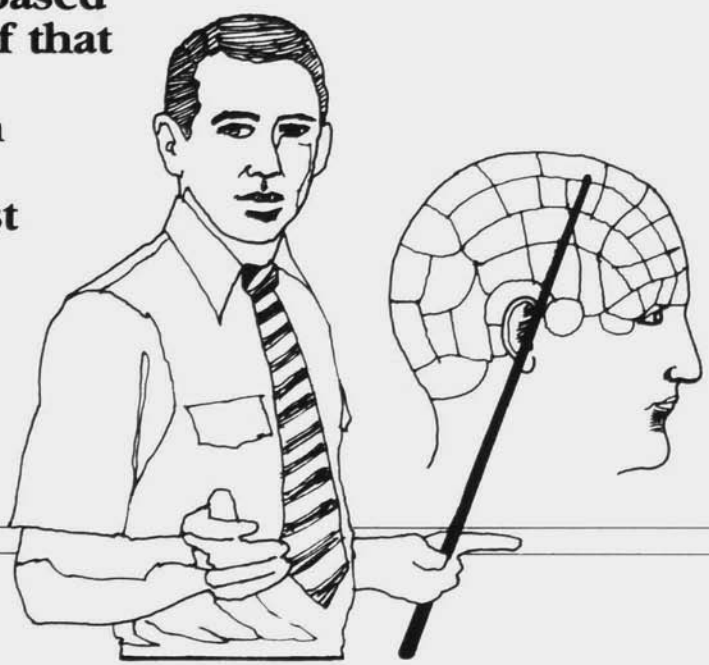

wide ranging and should meet the needs of a wide variety of schools.

Choosing the Right Program

Do we really need intervention programs for teaching students intellectual skills? The answer is clearly "yes." During the last decade or so we have witnessed an unprecedented decline in the intellectual skills of our school children (Wigdor and Garner, 1982). This is evident, of course, from the decline in scores on tests such as the Scholastic Aptitude Test (SAT); but college professors don't need SAT scores to be apprised of the decline: they can see it in poorer class performance and particularly in the poorer reading and writing of their students. Moreover, thinking skills are needed by more than the college-bound population. Perhaps intellectual skills could be better trained through existing curricula than they are now. But something in the system is not working, and I view programs such as those described here as exciting new developments for reversing the declines in intellectual performance we have witnessed in recent years.

How does one go about choosing the right program for one's particular school and student needs? I believe that wide-ranging research is needed before selecting any one of several programs for school or districtwide implementation. Which program to select will depend on the grade level, socioeconomic level, and intellectual level of the students; the particular kinds of skills one wishes to teach; the amount of time one can devote to training students; one's philosophy of intellectual skills training (that is, whether training should be infused into or separated from regular curricula); and one's financial resources, among other things. Clearly, the decision of which program to use should be made only after extensive deliberation and outside consultation, preferably with people who have expertise, but not a vested interest, in the implementation of one particular program or another.

The following general guidelines can be applied in selecting a program (see also Sternberg, 1983):

- The program should be based on a psychological theory of the intellectual processes it seeks to train and on an educational theory of the way in which the processes will be taught. A good pair of theories should state what processes are to be trained, how the processes work together in problem solving, and how the processes can be taught so as to achieve durability and transfer of training. Innumerable programs seek to train intelligence, but most of them are worth little or nothing. One can immediately rule out large numbers of the low-value programs by investigating whether they have any theoretical basis. The three programs described here are excellent examples of programs with both strong psychological and educational foundations.

- The program should be socioculturally appropriate. It should be clear from the examples described here that programs differ widely in terms of the student populations to whom they are targeted. The best intentions in such a program may be thwarted if the students cannot relate the program both to their cognitive structures and to the world in which they live.

- The program should provide explicit training both in the mental processes used in task performance (performance components and knowledge-acquisition components) and in self-management strategies for using these components (metacomponents). Many early attempts at process training did not work because investigators assumed that just teaching the processes necessary for task performance would result in improved performance on intellectual tasks. The problem was that students often did not learn when to use the processes or how to implement them in tasks differing even slightly from the ones on which they had been trained. In order to achieve durable and transferable learning, it is essential that students be taught not only how to perform tasks but also when to use the strategies they are taught and how to implement them in new situations.

- The program should be responsive to the motivational as well as the

"*Philosophy for Children* consists of a series of texts in which fictional children spend a considerable portion of their time thinking about thinking . . ."

"The decision of which program to use should be made only after extensive deliberation and outside consultation, preferably with people who have expertise, but not a vested interest, in the implementation of one particular program or another."

intellectual needs of the students. A program that does not adequately motivate students is bound not to succeed, no matter how excellent the cognitive component may be.

- The program should be sensitive to individual differences. Individuals differ greatly in the knowledge and skills they bring to any educational program. A program that does not take these individual differences into account will almost inevitably fail to engage large numbers of students.
- The program should provide explicit links between the training it provides and functioning in the real world. Psychologists have found that transfer of training does not come easily. One cannot expect to gain transfer unless explicit provisions are made in the program so as to increase its likelihood of occurrence.
- Adoption of the program should take into account demonstrated empirical success in implementations similar to one's own planned implementation. Surprisingly, many programs have no solid data behind them. Others may have data that are relevant only to school or student situations quite different from one's own. A key to success is choosing a program with a demonstrated track record in similar situations.
- The program should have associated with it a well-tested curriculum for teacher training as well as for student training. The best program can fail to realize its potential if teachers are insufficiently or improperly trained.
- Expectations should be appropriate for what the program can accomplish. Teachers and administrators often set themselves up for failure by setting expectations that are inappropriate or too high.

Programs are now available that do an excellent, if incomplete, job of improving children's intellectual skills. The time has come for supplementing the standard curriculum with such programs. We can continue to use intelligence tests, but we will provide more service to children by developing their intelligence than by testing it.□

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