The collaborative efforts of the Connecticut State Department of Education, a testing corporation, and cognitive psychologists have produced a 4th grade mastery test that assesses thinking skills. They plan to follow up with curriculum and training materials.

Whether our focus is on classical education, the new math, or basics, the ultimate goal of education has been to teach children to think critically and independently. Hence, there is nothing faddish about educators' current interest in thinking skills, nor about the necessity of finding integrated ways to teach and test them.

Educators realize, of course, that it is the student's ability to understand and use information, not merely possess it, that makes the difference in performance. Unless test items measure that ability, they will miss the truly critical aspect of knowledge acquisition—the ability to retrieve information and apply it to solve problems.

What is new, however, is our enhanced understanding of thinking skills as a result of the research of cognitive psychologists. This understanding can bring substantial changes in our testing and training procedures. The time is ripe for two reasons.

First, we now have several fairly elaborate theories of thinking processes (Sternberg, 1985; Ennis, in press; Feuerstein, 1980; and Lipman, Sharp, and Oscanyan, 1977), which, although differing in many details, all attempt to model in related ways the mental processes that children use in solving problems. These theories have been successfully applied in both testing and training procedures. What is needed now are ways to implement them in statewide programs of assessment and training.

Second, educators are now more willing to use theories of thinking in developing tests and curriculums. Educators have justifiably been skeptical of previous offerings of psychologists; many innovations, including IQ tests, have proven at best to be mixed blessings. But with the growing awareness that our educational system is not altogether succeeding and the hard data of decreasing test scores, educators are realizing that intervention is needed to revitalize our system of instruction. When properly tested and used, theories of thinking offer a start toward accomplishing this goal.

We describe here a statewide attempt to use current theories of thinking in the development of a 4th grade mastery test for assessing thinking skills. The testing program is still in the formative stages, so it is too early to present a proper evaluation or even a complete description of what the program will ultimately look like. It is possible, however, to show how educators from a state department of education have worked together with cognitive psychologists to devise a testing program in which both parties, representing very different points of view, can take pride.

A Three-Way Collaboration
This effort began when the Connecticut State Legislature passed legislation calling for a statewide mastery test. The idea to include a thinking skills component came from officers of the Bureau of Research and Evaluation in the Connecticut State Department of Education. These officers consulted with several cognitive and educational psychologists regarding possible theoretical bases of and item types for an experimental test to be instituted at the 4th grade level. The result was a three-way collaboration among Joan Baron, E. Jean Gubbins, Douglas Rindone, and Steve Leinwand from the Connecticut State Department of Education; Mark Daniels from the Psychological Corporation, which was charged with overseeing the psychometric development of the test; and
Robert Ennis, Carolyn Callahan, Edys Quellmalz, and Robert Sternberg, who were to devise theoretical bases and applications of these theories for the development of the test.

It would have been possible, of course, to generate a test based on a single theory of thinking skills or even on no theory at all. (See Sternberg, in press, for a review of theories of critical thinking.) Using a single theory, however, would have posed several problems:

1. No one theory has won such predominant acceptance among psychologists or educators that its use would win the approbation of all.
2. Adopting any one particular theory would run the risk of missing out on important aspects of thinking since different theories tend to concentrate on different aspects.
3. There is no guarantee that any one theory applies equally well to all individuals. Indeed, it may turn out that how well an individual appears to think depends in part on the theory used to judge the individual and whether the theory is used explicitly or implicitly in making that judgment.

Realizing these disadvantages, most test developers have opted for using no theory at all. But the disadvantages to this approach are even greater.

1. There would be no psychological basis for claiming that the test measures thinking skills. Indeed, some tests that claim to do so actually seem to measure prior knowledge that has little or nothing to do with thinking.
2. There would be no criteria against which to validate the test.
3. There would be little rational basis for diagnosis and ultimately for training.

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Examples of Thinking Skills Abilities Evaluated on the Connecticut Statewide Mastery Test—Grade 4

Making Inferences about Advertisements

This item type requires students to recognize false assumptions or persuasive techniques used in advertisements of the kind frequently heard on TV or read in magazines and newspapers:

The Avon Supermarket advertises “low, low prices.” Can you be sure that the prices at the Avon Supermarket are the lowest prices in town?

(a) Yes, because otherwise the supermarket could not advertise “low, low prices.”
(b) Yes, because the prices are lower than low.
(c) No, because the advertisement is not truthful.
(d) No, because there is no indication that the prices are the lowest in town.

Completing Standard Number Series

The standard number series problem is found widely on tests of intelligence and inductive reasoning ability. It has been found to be an excellent measure of general intelligence.

This type of problem measures essentially the same metacomponents as the analogy, and the same performance components, except that it does not require mapping. The problem measures inductive reasoning processes as applied to a numerical, rather than linguistic, mental representation. The item has been found to be construct- and empirically valid in psychometric and information-processing investigations. The item is slightly less entrenched than the analogy but, like the analogy, is academic in its orientation. Because of the similarity in processing requirements, differences in scores between this item type and the standard analogy will tend to be due to individual differences in representational and symbol-manipulation skills in the two content domains (verbal/numerical), both of which are important in the assessment of thinking skills:

Complete the following number series:
2 3 5 8 12 _______ (a) 15 (b) 16 *(c) 17 (d) 18

* Indicates correct answer.

Learning from Context

In the learning-from-context item, examinees must infer the meaning of an unknown word, using the context surrounding it as a basis for deciphering the word’s meaning.

This item type is primarily a measure of level of functioning of knowledge-acquisition components. The item type is moderately novel in its introduction of unknown words, and is highly contextually relevant to children’s lives, in that children constantly need to be learning meanings of words from context in their everyday reading and listening:

In the following passage, what does glick mean?
Traffic was heavy, and so the glick moved slowly.
The driver was carrying almost a ton of fruit from Florida to New Jersey and wanted to make sure that his shipment arrived intact. Thus, he made sure he stopped at red lights and avoided passing cars.

*(a) truck (b) car (c) orange (d) train

Using Insight to Solve Mathematical and Logical Problems

Mathematical and logical insight items require the examinee to solve fairly logical and arithmetic word problems that stress insightful thinking rather than prior knowledge.

I have studied this item type fairly extensively in my own research; it provides excellent measurement of knowledge-acquisition components in the context of a novel kind of task. Problems tend to be more highly correlated with inductive than with deductive reasoning. The items have been found to be particularly interesting to children. They are of only modest contextual relevance:

I have 5 black socks and 4 blue socks in a drawer. How many socks do I have to take out of the drawer to make sure I have a pair of the same color?

(a) 2 *(b) 3 (c) 4 (d) 5

* Indicates correct answer.
Theoretical Foundation

Therefore, we resolved to construct a test based on several alternative theories that were, in most respects, mutually compatible. We derived the main theoretical bases for the tests from the thinking skills theories of Ennis and Sternberg. These two theories proved to be compatible, yet they generated somewhat different item types and together provided the basis for assessing a broader range of thinking skills than would have been possible on the basis of either theory alone. We also drew on the research of Quellmalz and Callahan in formulating the test.

**Ennis’ Theory.** Ennis contends that there are two considerations when measuring the thinking skills of 4th graders: critical thinking skills and dispositions of critical thinkers. Critical thinking skills include the abilities to define and clarify, judge information, and infer—solve problems and draw reasonable conclusions. Each type breaks down into several more specific skills (see Figure 1). Ennis’ 13 dispositions of critical thinkers are listed in Figure 2.

The thinking skills can be directly measured through multiple-choice test items; the dispositions cannot. Nevertheless, it may be possible to measure indirectly the dispositions as well as the skills through standardized tests, bearing in mind that the measurement will be incomplete.

Ennis’ critical thinking skills were incorporated in two 20-item multiple-choice scenarios written for young children and incorporated into the Connecticut Reading Mastery Test. Several of these skills were eventually included in the Connecticut Mathematics Mastery Test.

**Sternberg’s Theory.** The second theoretical basis for the thinking skills test is Sternberg’s triarchic theory of intelligence, which views thinking skills as a subset of intelligent functioning. According to Sternberg, understanding and assessing thinking skills require the examination of all three aspects of the triarch of intelligence (see Figure 3). One must first identify the mental processes and representations underlying thought. Sternberg divides mental processes into three basic types of components—metacomponents, performance components, and knowledge-acquisition components—that work together during thinking to provide solutions to many kinds of problems (see Figure 4).

Second, it is necessary to consider the kinds of problems to which the thinking processes are applied. A performance component such as inference can be applied to a totally trivial problem—infer what day it will be...
“Through testing, we too often discover what children can do on intelligence or achievement tests, but not what they can do in other contexts.”

A Promising Start
Connecticut’s inclusion of a thinking skills component on its statewide Mastery Test is a positive first step in evaluating students’ thinking abilities. But unless testing is followed up by intervention, it will lead to frustration and information for which there are no concrete implications. Within the next year or two, we plan to develop and implement curriculum materials for teaching thinking skills in Connecticut schools. We believe that this effort provides a model of collaboration by state department officials, testing organizations, and psychologists in the application of theories of thinking to actual programs of testing and training.

References


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