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Restructuring Schools Through the Teaching of Thinking Skills

By incorporating into content areas the skills for learning, understanding, and reasoning, teachers can improve the cognitive abilities of *all* students.

The current perceived need for instruction in thinking skills is partly the result of the growing national awareness that society has changed—skills that were appropriate 15 years ago no longer prepare students for the world outside the school. Such popular works as *Megatrends* (Naisbitt 1982), *The Third Wave* (Toffler 1980), and *In Search of Excellence* (Peters and Waterman 1982) have argued that the very fabric of the business world has shifted from an emphasis on goods to an emphasis on information. Forbes (1984) states that technology is both creating and destroying jobs. Many clerical and middle management positions are being phased out with high tech replacements. However, the total number of jobs is increasing as technology opens up new work vistas. In short, societal changes are accelerating so rapidly that it is difficult to predict precisely what content to teach students if we define "content" as factual knowledge. The educational implication is that we must change our focus to teaching the skills essential to accessing, organizing, and using information.

Many educational theorists believe that without this instructional shift education will maintain its strong sorting function. For example, sociologist C. H. Persell (1977) documents extensive evidence that public schools are in the business of sorting and classifying students. In her report, Persell states that "...the institution of education is called upon to maintain, reproduce, and legitimate the inequalities of society" (p. 30). Additionally, Hutchins (1983) and Block (1985) have used data summarized by Persell to build powerful arguments supporting the assertion that schools decide which students qualify for a quality education early in the school experience, and then reinforce that decision throughout the K-12 system by use of teaching and testing practices that are operationally discriminatory.

The present high school dropout statistics are alarming. Approximately 25 percent of the nation's population between the ages of 14–18 years are no longer enrolled in school. Estimates of the size of this out-of-school population run as high as 40 percent in some larger cities where the majority of these youths are also members of minority groups. For example, in New York City, 50 percent of all high school age blacks and Hispanics have left school. Of these 40,000 teen-agers, only 9,000 will find jobs that match their skill levels. And of even greater concern are the vast numbers of high school graduates leaving school who are functionally illiterate, unprepared for existing jobs, and lacking in the knowledge to learn the skills needed to be productive members of society.

The small percentage of students presently leaving school with skills that are appropriate for functioning in our present (and future) society are able to do so because they have acquired critical thinking skills. Tragically, most of the students who acquire these skills come from the more advantaged socioeconomic strata and thus have the necessary background to glean a knowledge of thinking skills from classroom instruction. Those without such a background pass through the system without acquiring these skills. As school systems identify the thinking skills that ought to be taught, place them in the curriculum, explicitly teach these skills, and then test for skill development, *all* students will have the direct opportunity to acquire those competencies crucial to being successful in the information age.

The thinking skills model described here has the power to restructure schools by affecting the curriculum, instruction, testing, and student learning. Developed by Robert Marzano (for a discussion of the theory behind that model, see Marzano 1985a, 1985b), the model categorizes thinking skills as: (1) learning-to-learn skills, (2) content thinking skills, and (3) basic reasoning skills.

Learning-to-Learn Skills

Learning-to-learn skills facilitate the conscious control of learning. Within the research literature, these competencies are generally addressed within the area of learning strategies of study skills. There are a number of effective learning strategy programs (e.g., McCombs 1984, Jordan and Merrifield 1981), of which most include one or more of the following components: attention training, goal setting, cognitive restructuring, and self-evaluation.

Attention training involves creating students' awareness of when they are and are not attending to a task. Much of the research in this area has been conducted on impulsive children. The findings generally indicate that students can be taught an awareness of when they are and are not attending that can transfer to a conscious control of attention, which has a positive effect on achievement.

Over the past 40 years, the literature on goal theory has consistently shown strong positive relationships between goal setting and task performance. More recently, Brophy (1982) found that successful students set goals that challenge their capabilities. We also know that short-term goals are more likely to be completed than are long-term goals. The clear implication is that students should learn to set short-term learning goals within content area classrooms.

Cognitive restructuring refers to a variety of techniques used to change an individual's self-statements as well as the premises, assumptions, and beliefs underlying them (Meichenbaum 1977). Commonly, cognitive restructuring involves using verbal mediation and affirmations. Verbal mediation is simply talking to oneself about a task. Apparently the act of "languaging" one's thoughts makes them more salient and consequently more manageable. Affirmations are positive statements meant to replace negative self-beliefs. If, through verbal mediation, students become conscious of negative beliefs relative to a task, they can intervene using affirmations and become more confident about completing the task.

Self-evaluation techniques usually involve monitoring progress toward a goal. Techniques used in self-evaluation include both planning and monitoring components. Such regulatory skills provide a basic structure for the development of positive self-control.

These learning-to-learn components can be introduced to students as independent elements or as a broad heuristic to follow while engaged in learning tasks. That is, each area can be presented to students as an isolated technique to be field-tested and evaluated, or the components can be combined into an overall instructional strategy to be used with any task (see Table 1).

The learning-to-learn strategy in Table 1 can be used as a framework for classroom activity, much as the Hunter (1984) model is used. That is, the beginning of class can be devoted to phases 1–4. During phase 5, students and teachers engage in regular classroom activities. A class period culminates with phase 6. Actually the strategy presented in Table 1 can circumvent the Hunter model. That is, the instructional activities suggested by Hunter (e.g., anticipatory set, modeling, guided practice, individual practice) all fit within phase 5. Thus the learning-to-learn strategy complements some very effective instructional strategies already developed.

Content Thinking Skills

Content thinking skills are those strategies that facilitate a student's understanding of subject area material.

What we refer to in education as content is referred to within cognitive psychology as domain-specific knowledge. Domain-specific knowledge

Table 1. Learning-to-Learn Strategy

1. Refocusing Phase
Students are asked to relax and end whatever previous activity they were engaged in.

2. Awareness Phase
Students are asked to notice:
a. their level of distraction (How much are you attending to thoughts unrelated to this class?).
b. their attitude toward the class (Do you believe the class is valuable or not valuable? Do you believe the class is interesting or boring?).
c. their attitude toward working (Are you committed to being involved in the class, or do you want to coast?).
d. their attitude toward their ability (Do you have a sense of power about your ability to perform well in this class, or do you have a sense of sinking?).

3. Responsibility Phase
Students are asked to:
a. hold off or "bracket" any thoughts unrelated to class.
b. generate interest and value for the class.
c. commit to being involved and exerting necessary effort.
d. take a stand that they can do well.

4. Goal-Setting Phase
Students are asked to:
a. set some specific goals for the class.
b. integrate the teacher's goals with their own.

5. Task Engagement Phase
Students are asked to:
a. be aware of whether they are getting closer to or further away from their stated goals.
b. make any corrections necessary in their own behavior or seek help to further the attainment of their goals.

6. Task Completion Phase
Students are asked to:
a. determine if their goals were accomplished.
b. evaluate what worked and what did not work relative to their goals.

consists of a well-formed network of valid information in an academic area and strategies for using that information (Doyle 1983). This view of content knowledge is quite consistent with two types of information stored in long-term memory—declarative and procedural. As Sylwester (1985) describes these two types of memory, declarative memory contains the who/what/where/when/why facts about the world. Procedural memory contains information about processes—how to do things. For example, a sailor would know such declarative information as the names of various parts of a boat and the characteristics of certain types of storms. He would also know such procedural information as how to raise a sail and how to tack.

Knowing content, then, is knowing the declarative and procedural knowledge relative to an academic area. Each of the two types requires specific instructional strategies. Declarative knowledge requires an understanding of basic concepts and large organizational patterns of information. Concepts are initially formed by organizing direct experiences under some label (word), which represents the concept. Initially, then, a child's understanding of a concept can be described as a set of images (e.g., mental pictures, kinesthetic, auditory, and emotional representations) with some linguistic description of the concept. That is, the child can talk about the concept, but his or her description does not resemble what would be called a formal definition. Over time, with repeated exposure to the concept, the child develops a linguistic description of the concept, which begins to approximate a formal definition.

This implies that concepts should be first introduced to students at an experiential level. If direct experiences cannot be provided, they should be simulated through guided imagery much in the same manner that indirect visual, kinesthetic, auditory, and emotional experiences are used in sports training via guided imagery. Students should also be encouraged to describe (not define) newly learned concepts. Over time their descriptions should become more specific and detailed, until they evolve into technically accurate definitions.

Students can learn to recognize large organizational structures for information if we teach them "discourse patterns." For example, narration is a type of discourse pattern with specific elements expected by those readers who, through repeated exposure, have come to understand the nature of narratives. Marzano and Dole (1985) have identified five basic pattern types that can be used to organize information in narrative (stories) and expository material (information found in content area textbooks). Once students learn these patterns they become basic organizational tools to process large blocks of content.

Procedural knowledge includes knowing a process and when to use it. Current research (Fitts 1964, Anderson 1982) indicates that, when learning a procedure, a student will progress through three stages: (1) the cognitive stage at which the student can verbalize a process and perform a crude approximation of it, (2) the associative stage at which errors are detected and the procedure is gradually "smoothed out," and (3) the autonomous stage at which the procedure is refined and eventually reaches a level of automaticity where it requires little thought or energy for execution.

Procedural learning, then, is a long process and would appear to require many of the modeling, guided practice, individual practice, and review techniques recommended in the instructional models of Hunter (1984), Rosenshine (1979), and Good, Grouws, and Ebmeier (1983).

Basic Reasoning Skills

Basic reasoning skills, as defined within the model presented here, are those processes basic to cognition of all forms. It is actually a misnomer to call them reasoning or thinking skills since they are no more or less components of reasoning/thinking than any other skills within the model. However, these skills have recently come to the attention of educators as necessary yet missing components of instruction, and have been given the label of thinking skills or reasoning skills.

To understand the basic reasoning skills, consider figure 1, which portrays an adaption of Anderson's (1983) description of the basic processes that interact with declarative and procedural memory. According to figure 1, there are four functions that govern the use of declarative and procedural knowledge.

The storage process deposits permanent records of temporary work memory information into declarative memory. The retrieval process brings these records back into working memory. The match process selects productions (procedures) to apply to the contents in working memory. Finally, the execution process creates new working memory structures through production systems (Anderson 1983, p. 47).

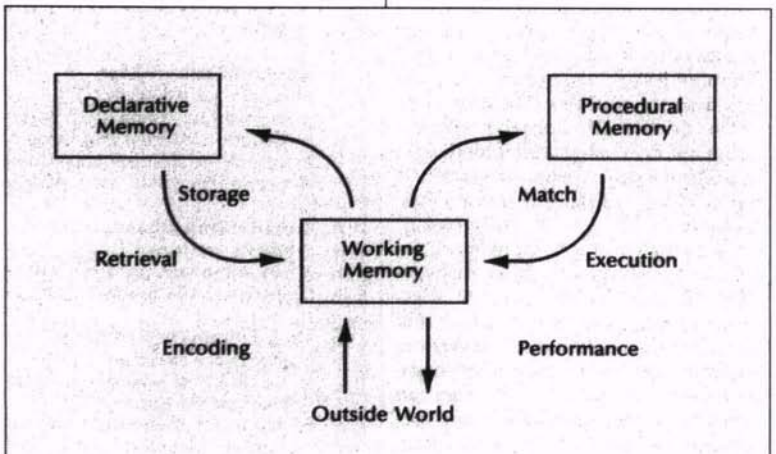

Fig. 1. Adaption of Anderson's Model

We might say that these four processes represent basic cognitive abilities.

1. *Storage and retrieval* skills are combined within this model because, as far as instruction is concerned, there is a great deal of overlap between them. That is, those instructional procedures that facilitate storage also facilitate retrieval. The most commonly used storage and retrieval technique is visual imagery mediation (or "deep processing"). It is simply the willful creation of aspects of imagery (e.g., mental pictures, kinesthetic, auditory, and emotional representations) for information to be remembered. Apparently, visual imagery mediation is basic to the operation of most memory techniques (Bellezza 1981, Paivio 1971).

Memory frameworks represent a second type of storage and retrieval technique. Actually, they are an extension of deep processing. Two common types of memory frameworks are loci methods (Ross and Lawrence 1968) and pegwood methods (Lindsay and Norman 1977). Basically, memory frameworks create "slots" with which students can associate information. A common example is the rhyming pegwood mnemonic: students first memorize a jingle that contains ten highly concrete and easily visualized objects; these objects represent memory slots. A student then "deposits" information into each of the ten slots using deep processing (visual-imagery mediation).

Storage and retrieval techniques are most useful in learning content area declarative knowledge. For example, they can be presented to students as study skills techniques especially useful in preparing for tests. They are also useful in the early stages of learning procedural knowledge.

2. *Matching procedures* are those that enable a student to identify how incoming information is similar to and different from information stored in long-term memory. Within this model are five types of matching strategies: categorization, extrapolation, analogical reasoning, evaluation of logic, and evaluation of value.

According to Mervis (1980), *categorization* is an essential skill because "by categorizing a person is able to render the unfamiliar familiar, and because one is able to generalize about an object based on knowledge about its category, one is able to know more about the object than just what can be ascertained by looking at it" (p. 279). During categorization, similar and dissimilar characteristics of concepts are matched. Within classroom instruction, categorization is most easily reinforced as a supplemental activity to vocabulary instruction (Marzano 1984). That is, students can be required to categorize new vocabulary words as an additional concept development activity.

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Extrapolation is the process of matching the pattern of information read or heard with that of information from a different subject area or context. For example, the process of baking a cake can be extrapolated to the process of making a car; similarly, the examples supporting a generalization about World War II can be extrapolated to the examples supporting a generalization about politics.

Analogical reasoning is one of the most commonly included elements within thinking instructional models. According to Alexander (1984), few intellectual skills are as pervasive or as essential as the ability to reason analogically. Within education, analogical reasoning has become synonymous with a type of reasoning problem of the Form *A: B: C:*. The working dynamic of such problems is for students to identify the relationship between *A* and *B*, and then find an element to coincide with *C*, which has a matching relationship to that between *A* and *B*. Sternberg (1977) has developed a four-step process for teaching analogical reasoning in the classroom.

Evaluation of logic is the process of matching the structure of information with some formalized system of logic. Most commonly, the system developed by Toulmin (1958, Toulmin et al. 1977) is used as the logic criterion. Toulmin's model is easily translated into a system for evaluating the logic of "claims." Students are taught to evaluate the data used to generate the claim, the warrants used to support the claim, and the backing used to support the warrants.

Evaluation of value is the process of matching information to some internalized value system and then analyzing the logic of that value system. Spiro (1980) has stated that this "attitudinal" characteristic of thinking is the central aspect of cognition. It allows one to see the information base from which judgments are created.

Each of the five matching procedures is easily integrated into the existing curriculum since each can be used in conjunction with content area declarative information. A statement taken from a social studies text might be used to reinforce evaluation of logic; a discourse pattern found in a science text might be extrapolated to a pattern found in literature; analogies might be created as a way of integrating information from different content areas.

3. *Executive procedures* build new cognitive structures or drastically restructure existing ones. There are three basic execution or knowledge-building procedures: elaboration, problem solving, and composing.

Elaboration refers to inferring information not explicitly stated in information read or heard. Within this model, three types of inference are proposed: elaboration of characteristics as defined in the early work of Hull (1920), elaboration of causality as described in attribution theory (Weiner 1980), and elaboration of general background as defined in van Dijk's (1980) description of a "fact." For all three types of inference the instructional process is basically the same. Information is selected from content area material, and one or more types

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of elaboration are applied to the same information.

Problem solving occurs when an individual must "fill in" missing information. This is at the core of all problems: a goal is desired and information necessary to accomplish that goal is missing. Without missing information, no problem exists. This missing information might be procedural or declarative in nature. If an individual were trying to bake a cake but did not know how to separate egg whites from egg yolks, the problem would be one of a missing part of a process. If a student were asked to describe in detail the characteristics of squirrels but did not know their food-gathering habits, then the problem would be one of missing declarative information. Problem-solving algorithms have been developed for mathematics, physics, and general scientific application. These algorithms are easily adapted to emphasize the salience of missing declarative or procedural information.

Composing is the process of creating new linguistic information. Within mainstream education, composing is usually thought of as a process involving written language, although it can just as validly be thought of as an oral language process. Nickerson (1984) identifies writing as one of the key procedures for enhancing thinking skills: "Writing is viewed not only as a medium of thought but also as a vehicle for developing it" (p. 33). The constructive nature of writing (its generation of new cognitive structures) has been well documented. For example, Flower and Hayes (1980) assert that writing is a generative process that creates new ideas for the writer. Similarly, many professional writers report that composing is the process of finding out how the story turns out (Marzano and DiStefano 1984).

Again, all three executive processes can be integrated into a content area curriculum. Elaboration is commonly reinforced as a questioning strategy used with content material. Problem solving is generally done in the sciences and mathematics although more general applications have been developed that cut across the content areas. Similarly, programs such as Writing Across the Curriculum emphasize the use of composing as a tool for developing, synthesizing, organizing, and knowledge-generation skills in all content areas.

Restructuring Education

The direct teaching of thinking skills places educators in an arena where they must confront basic beliefs, values, and unstated assumptions about which students will succeed in schools and about the traditional sorting function of public schools. More specifically, "one result of the direct teaching of thinking skills will be improved learning for many students who, within the present system, would quickly be forgotten or labeled as 'unteachable.' " The teaching of thinking will drastically shake what Block (1985b) has called the basic assumptions holding the sorting system in place. The shock waves from this shake-up will take many forms. In this section, we describe some of the specifics of that necessary restructuring.

• *The learning-to-learn skills.* The direct teaching of learning-to-learn strategies represents a restructuring or change from teacher-centered responsibility for learning to student-centered responsibility. Basically, an emphasis on learning-to-learn strategies would convey the message to students that they must take an active role in the learning process. Baird and White (1982) contend that only minor improvements will be made on learning outcomes unless there is a fundamental shift from teacher to student responsibility via direct instruction in such megacognitive abilities.

The learning-to-learn skills appear to be a well-kept secret within education, while they approach the level of common knowledge outside of the educational arena. Many of the individuals considered successful in today's technological society are aware of the learning-to-learn skills and exert conscious control over them. Peters and Waterman (1982) cite numerous examples of top executives cultivating such metacognitive strategies as goal setting, monitoring feedback, and cognitive restructuring. Not surprisingly, many powerful training programs within business and industry (e.g., Tice 1976) use adaptations of the learning-to-learn process. However, within mainstream education, few components are systematically taught even though there has been a long-standing mandate from the research community that such metacognitive awareness should be a part of the education process. The impact of the learning- to-learn skills will be strongest on poorer students. McCombs (1984) asserts that this area holds the promise of unlocking a door for "those students whose deficiencies preclude them from enjoying the positive benefits of learning and self-development" (p. 216).

• *Content thinking skills.* The content thinking skills suggest restructuring in a number of areas. First, there appears to be a strong need for content area teachers to be aware of and explicitly teach those concepts key to their subject areas. This is not a new assertion. Indeed, it was Becker's (1977) recommendation, after a thorough analysis of the research on various interventions for the educationally disadvantaged, that systematic instruction in the basic concepts should be an educational priority. Becker specifically identified the educationally disadvantaged as the group that would benefit most dramatically from such instruction, although he believes a basic concept curriculum can be structured to benefit all students:

> By the use of carefully structured programs to boost vocabulary competency for low performing children in the early grades, the number of children in the

lower end of this range can be reduced. By structuring school programs to teach basic operations in the various areas of knowledge using basic words, the advanced children would not necessarily be held back (p. 539).

To this end, Becker, Dixon, and Anderson-Inman (1980) identified the 7,800 basic words that should be part of a 12th grader's set of working concepts. In a similar vein, Marzano (1984) organized the concepts found in elementary school textbooks into 61 "instructional clusters."

What is clearly implied here is that content area curriculum should be restructured to make key concepts salient and to explicitly teach those concepts in a manner consistent with the way students naturally learn. Herein lies another area for restructuring.

A growing body of research suggests that knowledge is stored in two primary forms: images and words. Kaufmann (in Sheikh 1983) states that these are the two primary tools of thinking. Yet within formal education, there is a lack of both attention to and trust of nonverbal aspects of cognition in spite of the growing evidence to support their central role in information processing. What we are suggesting here is that teachers highlight and model for students the nonverbal aspects of learning and, in many cases, pay as much attention to them as they do to verbal aspects.

The emphasis on pattern recognition within content area declarative knowledge also suggests some restructuring issues. We know that the more higher-level organizational patterns are made salient in written material, the easier the information is to process and retrieve. Unfortunately, most textbooks are not written in a format that makes those organizational patterns obvious to students (Pearson 1981). Similarly, information presented orally in content area classrooms is not organized into easily assimilated patterns. For the most part, then, the burden is on the student to create some type of organizational structure for information read or heard. Better students look for or "create" patterns as a basic comprehension strategy, while less successful learners do not appear to have this metacognitive awareness. This suggests that content area teachers should act as guides in helping students see the various ways of organizing information within the content area. Rather than viewed as static data to be learned as presented by the teacher or textbook, content should be viewed as fluid information that can be arranged to best fit with the student's prior knowledge.

• *Basic reasoning skills*. In their review of the research on instruction as it relates to the teaching of reading, Pearson and Tierney (1983) state that the current instructional paradigm most commonly used has the following characteristics:

1. use of many practice materials;
2. little explanation of cognitive tasks;
3. little interaction with students about the nature of specific tasks; and
4. emphasis on one correct answer to the extent of supplying the answers for students if they exhibit problems with or confusion over a task.

Pearson and Tierney imply that this is perhaps a general model used in all content areas at all grade levels. If this is true, current instructional practice violates what appears to be necessary for effective teaching and learning of basic cognitive abilities, specifically the intervention of a teacher between a task and the students. Feuerstein (et al. 1985) asserts that cognitive ability is modified most effectively during "mediated learning experiences"—those in which the teacher acts as buffer between the students and the academic tasks presented to students.

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Direct instruction in the basic reasoning skills presented in the Marzano model necessitates such intervention. That is, students cannot be taught how to store and retrieve information, match information, and build new cognitive structures without the teacher directly stepping in between the student and the task. Hence the teaching of basic reasoning skills would require a shift or restructuring from an instructional model that is primarily product oriented to one that is primarily process oriented.

• *Testing and evaluation*. The final area of restructuring is testing and evaluation. Doyle (1983) states that accountability drives the academic tasks presented to students. As a result, students are especially sensitive to cues that signal accountability. They tend to take seriously only those tasks for which they are held accountable (Carter and Doyle 1982). This implies that the areas described in this model should be included in academic assessment. However, many of the competencies described above cannot be assessed via objective, multiple-choice formats (e.g., students' abilities to use basic reasoning processes), and some competencies have no "correct answer" to use as a criterion (e.g., evaluation of value). Consequently, the inclusion of many of the components of this model would necessitate a shift in the scope and practice of assessment. Specifically, assessment would use nonquantitative data-gathering techniques commonly associated with qualitative research (e.g., Miles and Huberman 1984). We believe that without such a shift, formal education will remain entrenched in current testing practices that discriminate against certain socioeconomic groups.

In summary, schools can and should be restructured in order to effectively educate young people to live successfully in the information age. The Marzano thinking skills model addresses the critical areas in school programs and methodology that must be changed. Any practitioner knows that the gap between theory and practice can be a wide one. In the following article we describe how one district has implemented this thinking skills model and is addressing the consequent restructuring processes.□

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