THE EFFECTS OF A STRATEGIC THINKING PROGRAM ON THE COGNITIVE ABILITY OF SEVENTH GRADE STUDENTS

DISSERTATION

Presented to the Graduate Council of the

University of North Texas in Partial

Fulfillment of the Requirements

For the Degree of

DOCTOR OF EDUCATION

By

Joyce S. Houchins, B.A., M.A.

Denton, Texas

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This study used a posttest only design to determine the effects of a strategic thinking program on the Cognitive Abilities Test (CogAT, Form 4) scores of seventh graders who received direct instruction in Strategic Thinking Skills (STS) with the scores of seventh graders who did not receive direct instruction in STS. The study was conducted in a large suburban middle school in north Texas.

The experimental group of 257 students received five months of STS instruction through an STS class prior to taking the CogAT April 1, 1993. The control group of 270 students attended this middle school as seventh graders in 1991-92 without STS instruction prior to taking the CogAT April 2, 1992. The data collected from these tests were analyzed using three independent t tests, one for each of the three batteries of the CogAT: Verbal, Quantitative and Nonverbal, using a .05 level of significance. The three null hypotheses were retained, indicating that this study found no significant differences between the scores of seventh graders who received direct instruction in STS prior to taking the CogAT and seventh graders who did not receive STS instruction.

The results of this study did not support previous research demonstrating that intelligence scores can be modified by instruction, although a richer curriculum was offered for a longer period of time than in any of the previous studies. The author

concluded that three main factors affected the outcome of this study: (1) the delivery format used in the instruction, (2) the attitude of the students in STS, and (3) teacher effectiveness. As a result of this study, the middle school will continue to use the STS curriculum, by infusing STS instruction into the seventh grade content courses. This study offers a unique and extensive history tracing the introduction of formal ways of approaching modification of the thinking process that may prove helpful to other researchers.

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Zephyr Press allowed the author to include documents from Udall and Daniels' Creating the Thoughtful Classroom (1991), which were helpful in illustrating these strategies for the reader. Their cooperation is appreciated.

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CHAPTER I

INTRODUCTION

If one is alive, one thinks (MacLean, 1978). If this is true, then why should it be necessary for educators to consider the direct teaching of thinking (Dewey, 1933; Hart, 1975; and McPeck, 1981)? Despite this rhetoric, the teaching of thinking skills is being considered a vital component of instruction in schools all over the nation. Some worry that poorly understood methods of direct teaching of thinking may produce an inverse, or a deleterious effect (Baer, 1988; Carr, 1988; Hart, 1975; McPeck, 1981; Smith, 1990; and Sternberg, 1988).

In defense of the teaching of thinking, David Perkins (Beyer, 1987) likened thinking to walking, in that people acquire both skills naturally. Perkins reasoned analogically that the ability to perform sophisticated tasks which incorporate the basic skills of walking (such as mountain climbing, hiking, or marathon running) is only obtained after a person has mastered very specific and effective strategies and techniques through modeling, application and practice (Beyer, 1987). He inferred that the same may be true for thinking.

Among those concerned that students may not reach complex levels of thinking without some modeling and practice of effective strategies for thinking are the leaders in corporate America (Schlechty, 1990), the futurists (Benjamin, 1989), government officials influenced by results from the National Assessment of

Educational Progress, and the President and other leaders involved in America 2000 (United States Department of Education, 1991). Bombarded by the barrage of articles from these groups and the outcries for educational change and restructuring, parents were advised that their children may not be prepared for living and working in the 21st Century, unless "something is done" (Schlechty, 1990). Thus, the message to public education is to figure out what something is and to do it.

If one wishes to teach thinking skills, there are two basic choices: content-free or content-based instruction. The term content-free is intended to apply to general strategies such as Udall and Daniels' nine student behaviors that promote a thoughtful classroom (1991), Gordon's synectics methodology (1961), DeBono's CoRT techniques. In Marzano's (1986) Tactics for Thinking program, the introductory unit included activities such as attention control, where the student is taught the general strategy before applying it to specific content. The term content-based refers to the introduction of a skill within a subject area, as applied to a particular piece of content.

Additionally, one could choose to offer such instruction through a special stand-alone course, or to infuse the thinking skills into the regular curriculum (Beyer, 1988). Faced with these choices, one school developed a curriculum for a course that sought to blend the strengths of each option. The curriculum combined creative thinking (De Bono, 1986-87; Perkins, 1984), critical thinking (Ennis, 1962; Lipman, 1991; Paul, 1984), problem-solving (Whimbey & Lochhead, 1986), metacognition (Flavell, 1979) and Learning-to-learn (Marzano & Arredondo, 1986) skills.

Key elements from major curricular offerings have been arranged to form a menu of components that may be introduced and modeled in non-domain specific fashion. These process skills can then be applied to content area learning in interdisciplinary fashion by the teachers assigned to teach the Strategic Thinking Skills (STS) Curriculum in conjunction with the regular content area teachers. This study examined the effects of instruction in strategic thinking skills, using this curriculum, upon the cognitive ability scores of seventh grade students.

Purpose of the Study

The purpose of this study was to analyze the effect of instruction in strategic thinking on the cognitive ability scores of seventh grade students.

Hypotheses

To carry out the purpose of this study, the following hypotheses were made:

1. There will be no significant difference in the total scores on the Verbal Battery of the Cognitive Abilities Test between seventh graders who receive five months of instruction in strategic thinking skills prior to taking the test and those who do not receive this instruction prior to taking the test.

2. There will be no significant difference in the total scores on the Quantitative Battery of the Cognitive Abilities Test between seventh graders who receive five months of instruction in strategic thinking skills prior to taking the test and those who do not receive this instruction prior to taking the test.

3. There will be no significant difference in the total scores on the Nonverbal Battery of the Cognitive Abilities Test between seventh graders who receive five months of instruction in strategic thinking skills prior to taking the test and those who do not receive this instruction prior to taking the test.

Significance of the Study

Federal, state and local research and policies have placed pressure upon schools to find ways to encourage higher levels of thinking. Since the school chosen for this study implemented a specialized curriculum within a specific course, the principal wished to determine the value and potential of the innovation. The introduction of a new curriculum through a special course required the commitment of physical and financial resources, as well as assignment of personnel. Such decisions must be justifiable to the members of the school board, as well as to parents, in terms of cost efficiency and value to students.

The results of this study provided information regarding the effect of the innovation on cognitive ability as measured by the Cognitive Abilities Test (CogAT). If the innovation had been shown to raise CogAT scores, then this study would have provided a strong justification for continued use of the STS curriculum.

Definition of Terms

The following terms have a specific meaning and are defined for this study:

1. Strategic thinking designates a means for improving the quality of one's thinking by developing a repertoire of strategies or organizational frameworks that facilitate ways of thinking that are viewed as interrelated, rather than isolated. Using this designation, creative thinking, critical thinking, problem-solving, core thinking skills and metacognition would all fall under the more general term, strategic thinking (Jones, Palincsar, Ogle & Carr, 1987; Marzano et al., 1988; Udall & Daniels, 1991).

2. STS is an acronym that refers to the Strategic Thinking Skills Curriculum used in this study.

3. STS Class refers to the specific class in which the Strategic Thinking Skills Curriculum was implemented.

4. An STS teacher is the specific staff person assigned to implement the Strategic Thinking Skills Curriculum in the school in this study.

5. AGENDA is the name of a custom student assignment and calendar book that was required for use by each STS student.

Limitations

1. The unique characteristics of the school district limit generalizing the findings in this study only to other school systems with similar demographics.

2. The exclusive use of seventh grade students limits generalizing the findings in this study only to other seventh grade students.

3. As with any curricular intervention, the success of the innovation is slightly dependent upon the effectiveness of the instructor.

Assumptions

1. All students received equivalent instruction in strategic thinking skills in the classroom setting.

2. All students had equal ability to improve their own cognitive ability level.

CHAPTER II

REVIEW OF LITERATURE

This portion of the study includes four sections. The first section traces the antecedents to thinking skills through two philosophical viewpoints about the nature of thinking from 400 B.C. to the 1960's. Section two follows the influence of those two philosophical strands on present day theorists from 1960 to the present time. The third section explains some of the current thinking skills programs and reviews available research on those programs. The research and findings of closely related studies are detailed in the fourth section.

Antecedents to Thinking Skills Theory

Historically, the theories of one generation have influenced those that followed. Beginning in pre-Christian Greece, two strands of thinking can be traced throughout the development of thinking skills theory.

Strand one represents the Newtonian model of thinking (I. Gordon, 1965). This model viewed intelligence as fixed, and compared the brain's functioning with that of a telephone switchboard in that messages (information or stimuli) are incoming, but are only successfully received if a proper connection is achieved. Gordon (1965) described the Newtonian view as an interactional model because it implied that a learning situation is an operation of two or more independent entities.

If a child did not learn, it was attributed to his background, lack of ability, or lack of physiological readiness. Teacher-centered curriculum and instructional methods that manipulate environmental factors and learner behaviors evolved from this strand (Shuell, 1986).

Strand two represents the Einsteinian model of thinking (I. Gordon, 1965). This model viewed intelligence as modifiable and compared the brain's functioning with that of a computer because, in the brain, incoming messages may be routed many ways and may be modified. This is not to meant to imply that the brain is fashioned after a computer; the reverse is true, since the computer is very simple in comparison to the complexity of the human brain. Gordon described the Einsteinian view as a transactional one, which takes into consideration the idea that, at any given time, two entities who are engaged in some activity exist only in terms of each other, and their behavior cannot be understood apart from the situation in which it occurs. Here, the child is not only affected by the teacher, but affects the teacher as well (1965). Child-centered curriculum and instructional methods that stress the mental activities of the learner evolved from this strand (Shuell, 1986).

<u>Strand One: from Aristotle to Skinner</u>

Aristotle (384-322 B.C.) was a Greek philosopher who has been credited as the father of logic. Aristotle believed in an ultimate reality, but he thought that humans could not know it because they did not know how to measure it. A realist, Aristotle valued the process and the precision of scientific investigation. His writings were lost to much of the world from the fall of Rome through the Middle Ages (Frankena, 1965).

Thomas Aquinas (1225-74) learned of Aristotle's teachings and writings from the Moors. Aquinas blended Aristotelian logic with the teachings of the Roman Catholic Church. Branded as scholasticism or Thomism, his works reframed thinking about ancient societies by the church and rekindled an interest in formal learning that helped bring Europe out of the Dark Ages (Daley, 1966).

Sir Francis Bacon (1561-1626), an English Statesman, introduced his Scientific Method to a public re-enamored with scientific thinking. Bacon's deductive reasoning method became the model for proper experiments (Grun, 1991).

Rene Descartes (1596-1650) was a philosopher and scientist who tried to extend mathematical method to all knowledge in his search for certainty. Descartes is considered the father of modern philosophical inquiry. In trying to explain that the only thing he could not doubt was his own thinking, Descartes originated his famous statement, "I think; therefore I am." (Stoops, 1971).

John Locke (1632-1704) is most remembered for his tabula rasa concept: a child is born with a mind like a blank white tablet upon which all learning is written through experience (Axtell, 1968). Locke joined the Rationalists, a group of theorists who wanted to train an elite few to a point of mental discipline where the students would have complete freedom of intellect (Axtell, 1968).

Johann Freidrich Herbart (1776-1841) "emphasized the principle that learning must proceed from the known to the unknown" (Wilds & Lottich, 1970, p. 380), and elaborated it into the doctrine that new knowledge is always assimilated in terms of what the learner already knows.

Herbart's interest was the secondary school. He was especially interested in preparing teachers so that they might gain the child's attention. His five steps of instruction were used in writing lesson plans for much of the Twentieth Century. The steps were: "(a) preparation, or reviving relevant past experiences; (b) presentation, or providing a concrete model; (c) association, or assimilating new experiences; (d) generalization; and (e) application" (Wilds & Lottich, 1970, p. 380).

William James (1842-1910), an American philosopher and psychologist, was a noted professor at Harvard University for 35 years. During a lecture in 1907 James said: "The whole function of philosophy ought to be to find out what definite difference it will make to you and me, at definite instants of our life, if this world-formula or that world-formula be the true one" (Rippa, 1969, p.310-12).

G. Stanley Hall (1844-1924), a student of James', distinguished himself in many ways, but is probably most remembered for the cutting edge research facility and teams he developed and supervised during his presidency of Clark University, Worcester, Massachusetts. Hall's descriptions of his theories and works comprise a 14 volume series (Johnson, Collins, Dupuis, & Johansen, 1985).

Edward Thorndike (1874-1949) was, in turn, influenced by Hall. Thorndike became a leading figure in the developmental movement and also in the field of assessment (Daley, 1966). Thorndike attempted to interweave key elements from both strands in his works. These works had a profound effect upon cognitive education, and upon the field of psychometrics. Thorndike lent his prominence to Columbia University (Wilds & Lottich, 1970).

James Cattell (1860-1944) studied with James and Hall. Cattell worked with Thorndike in the area of applied psychology and testing (Johnson et al., 1985).

John Watson (1878-1939), heralded as the father of behaviorism (Grun, 1991), was strongly influenced by Pavlov's experimental methods. Watson espoused that given any infant, he could shape it into an intelligent, well-adjusted person. A popular psychologist, Watson relied upon conditioning, and rejected the concept of conscious or unconscious mental activity (Wilds & Lottich, 1970). The Watson-Glaser Critical Thinking Test he developed with Edward Glaser in 1940 is still in use today (Paul, 1984).

Burrhus Frederic Skinner (1904-1990) was a behavioral psychologist who greatly influenced the search to find out how people learn. Skinner's methodology was based upon conditioning. He said: "Learning is merely a change in the behavior of an organism" (Wilds & Lottich, 1970, p. 369).

Robert Ladd Thorndike was the son of Edward Lee Thorndike. A former professor at Columbia (1936-1978), he chaired or was president of many prestigious national and government research and assessment committees (Keyser & Sweetland, 1984). Together with Elizabeth Hagen, in 1968, he authored the Multilevel Edition of the Cognitive Abilities Test (CogAT). An updated version of that instrument provided the tool for this study. R.L. Thorndike's son, Robert Mann Thorndike, has followed his father's vocation, making the Thorndikes the only known persons who can claim to cover three generations of psychologists specializing in measurement (Keyser & Sweetland 1984).

Strand Two: From Plato to Bruner

Plato (427-347 B.C.) was a Greek philosopher, and teacher to Aristotle. Plato disagreed with Aristotle, however, on the nature of reality. Plato believed that if there was an ultimate reality, mankind could never experience it while bound by mortal senses. Plato advocated the individualization of instruction (Cornford, 1979).

Quintillian (35-96 A.D.) was a Roman orator and teacher. Quintillian was one of the first to address these concepts of current concern: "(a) readiness, (b) individual differences, (c) rewards to replace punishment, (d) interest and motivation, (e) relevance of lessons, and (f) socialization through public education" (Daley, 1966, p.38).

Comenius (1592-1670) was the founder of developmentally appropriate instruction that was child-centered, age-appropriate, and consistent. Comenius originated the use of textbooks when he copied a book for each of his students by hand (Sadler, 1969). His views on strategic thinking as a means to increase intelligence were expressed in this way:

> Over the amount of ability we possess we have no control. God has portioned out this mirror of the understanding, this inner eye, according to His will, but it lies within our power to prevent it from growing dusty or dim (Piaget, 1957, p. 80).

Jean Jacques Rousseau (1712-1778) shared many of Comenius' views. Rousseau believed children needed to be taught in humane ways, in accordance with nature itself. He believed in the common goodness of man. Although Rousseau himself never actually taught, he described a natural way of tutoring that influenced the thinking of Swiss educator Pestalozzi (Boyd, 1962).

Johann Heinrich Pestalozzi (1746-1827) ran large schools to educate vagrant children. These ventures were educationally successful, but financially disastrous. Pestalozzi's methods of teaching brought about many changes in content. He believed that all elementary subject matter could be grouped as dealing with "language, number or form" (Wild & Lottich, 1970, p.386). Using techniques now known as immersion, Pestalozzi forever changed the study of geography (1970).

Freidrich Wilhelm Froebel (1782-1852) developed action curriculum. He used children's play as a process for learning in his kindergartens (Johnson et al., 1985).

Maria Montessori (1869-1952) was a physician and educator who set up schools in Italy for underprivileged and handicapped children. Even though Montessori emphasized the use of sensory materials her methodology was in keeping with "the five basic principles of developmental teaching: (a) The Principle of Pupil-Activity (Self-interest), (2) The Principle of Motivation (Interest), (3) The Principle of Apperception (Preparation and mental set), (4) The Principle of Individualization, and (5) The Principle of Socialization." (Wilds & Lottich, 1970).

John Dewey (1859-1952) was one of the few philosophers ever to describe and demonstrate how his theories could be applied (Frankena, 1965). Dewey (1933) described himself as devoted to a scientific frame of mind, but he was not making use of the meanings attributed to behaviorists; he likened inquiry to a child's natural state of inquisitiveness. Dewey defined reflective thinking as "the kind of thinking that consists of turning a subject over and over in the mind and giving it serious and consecutive consideration" (1933, p.3). Dewey appeared to share Comenius' views about the use of reason to keep the mind in optimal condition and maintain one's level of intelligence. He urged teachers: "Abandon the notion of subject matter as something fixed and ready-made in itself . . . as if there is some gap in kind between the child's experience and the various forms of subject matter" (Dewey, 1902, p.10). He was one of the first to explain the benefits of strategic thinking:

> The various ways in which men think can be told and can be described in their general features. Some of these ways are better than others; the reasons why they are better can be set forth. The person who understands what the better ways of thinking are and why they are better can, if he will, change his own personal ways until they become more effective (1933, p.3).

Jean Piaget (1896-1980), a Swiss psychologist, formalized the concept that "mental growth is inseparable from physical growth" (Piaget & Inhelder, 1969, p. vii). The four important concepts of Piaget's system were (a) equilibrium, (b) assimilation, (c) accommodation, and (d) schemes (Piaget, 1977). Equilibrium referred to a condition of harmony with the environment. Assimilation took place when one adjusted the environment to fit the biological or intellectual systems in place. Accommodation referred to the individual's adjustment of the biological or intellectual systems to fit the environment. Equilibrium was achieved when assimilation and accommodation were in balance. Piaget (1977) described schemes as patterns of behavioral or intellectual structures arranged hierarchically: (a) sensorimotor intelligence, (b) preoperational thought, (c) concrete operations, and (d) formal operations.

Benjamin Bloom and his colleagues tried to develop a way to describe differing complexity levels of thinking processes in an effort to figure out how one could evaluate and correlate learning tasks and learning processes. The resulting hierarchial levels, from simple to complex, are: (a) knowledge, (b) comprehension, (c) analysis, (d) application, (e) synthesis, and (f) evaluation. Bloom presented action descriptors that could help a teacher or an evaluator cue into the level of thought the task was likely to evoke (Bloom et al., 1956).

Hilda Taba (1962), like her contemporary Jerome Bruner, encouraged a discovery approach with the goal of teaching children to think. Taba's primary instructional strategy was questioning, with the teacher as facilitator or discussion catalyst; supportive but not judgmental. Taba considered that thinking could be taught, it could be taught early, and that it should be a basic educational goal (Taba, 1962).

Jerome Bruner is the key transitional link between past and present theorists. Like Piaget, Bruner (1966) was more interested in the nature of knowledge than in the psychological processes. Like Dewey, Bruner (1962) tried to tap children's natural curiosity as a motivation for investigation, but Bruner advocated the use of more guidance than Dewey had suggested, to accommodate examination of viewpoints other than the ones children develop of their own interests and of their own accord. Bruner is the acknowledged father of discovery learning (Grun, 1991).

Present Day Theorists

Modern theorists are an extension of strand one and strand two. They are divided into prescriptive theorists who follow the kinds of thinking in strand one, and brain-centered theorists, who follow the kinds of thinking in strand two. The works of these theorists first appeared in the 1960's, and continue to the present day.

Prescriptive Theorists

Current theorists were placed in this strand by several criteria: (a) their methods have a prescribed way of being carried out, (b) their approaches are process or skill-based, and (c) they generally attempt to assess successful acquisition of these processes or skills. Their materials and methods tend to be content or situation specific.

Robert Ennis (1962) authored a landmark article that offered a definition that remains the accepted delineator for critical thinking. Ennis is included here because of his psychometric interests. He is one of the few founders of the thinking skills movement to have published a test to measure critical thinking. Ennis has frequently reviewed assessment procedures in national trade and professional magazines (Costa, 1991).

Reuven Feuerstein is an Israeli theorist and practitioner who developed a content-free system of teaching thinking skills called Instructional Enrichment. Feuerstein originally developed his program to help intellectually challenged students, but efforts are in progress to adapt it for more able populations. The program was built upon a theoretical base of cognitive modifiability (or plasticity) of the brain, even during the teen years (Feuerstein, 1980).

Arthur Whimbey has been a firm proponent of the theory that intelligence can be taught (Whimbey & Whimbey, 1975). He has developed materials that are very specific in their approach. In a series of graduated materials, students learn strategies for increasing their comprehension and for solving problems. One specific book of exercises uses a think, pair, share method that is largely verbal; others are written and shared (Whimbey & Lochhead, 1986).

Edward de Bono is an internationally recognized authority on creative thinking. Inclusion of de Bono in this strand may seem to be an enigma, but the methodology in his CoRT Thinking Program is highly prescriptive, consisting of lessons and a manual of how to introduce and conduct the lessons (de Bono, 1986). Since many teachers will not attempt an innovation if there is no model or there is insufficient guidance (Hord, Rutherford, Hulig-Austin and Hall, 1987), the prescriptive nature is not regarded as a negative trait; merely as an attribute for categorization of the theorist.

Richard Paul is Director of the Center for Critical Thinking and Moral Critique, Sonoma State University, Robnert Park, California. Paul has favored dialectic methods, in the tradition of Socratic questioning, as a way to build critical thinking habits. Like Socrates, Paul (1984) perceived that building critical thinkers is akin to strengthening the nation. Paul has suggested that one should always imagine the strongest case that can be built against one's own views. Paul believed that the current microlevel skills being used to develop critical thinking are a good initial step, but they are only a short-term solution. He stated:

> It is not enough to recognize that all human thought is embedded in human activity and all human activity embedded in human thought. We need to recognize in addition that much of our thinking is subconscious, automated, and irrational. The capacity to explicate the roots of the thinking that is 'hidden' from us and to purge it when irrational are crucial (1984, p. 7).

Matthew Lipman is a professor at Montclair State College, New Jersey, and co-author of the Philosophy for Children program. He has stated his belief that the kind of thinking that philosophy provides develops reasoning skills in children that become core reasoning in adults. Thinking in Education (Lipman, 1991), is an excellent resource for finding out specifically about Lipman's program, and also for general information about theorists and programs within the critical thinking skills movement.

Art Costa (1991) is very involved with the teacher training aspects of thinking skills. Costa has concentrated on presenting attributes of a climate for thinking and on telling how a teacher can then elicit thinking. Costa's main thrust is on changing the school's environment so that thinking is at the core of every decision and policy (Martin, 1992).

Robert Sternberg, Professor of Psychology, Yale University, has conducted extensive research addressing the relationship between intelligence and thinking. Sternberg explains his triarchic theory of intelligence this way:

> There are three basic kinds of elementary information processes: (a) metacomponents, used in executive planning and decision making in problem solving; (b) performance components, which are lower order processes used in executing a problem-solving strategy; and (c) knowledge-acquisition components, which are lower order processes used in acquiring, retaining, and transferring new information (Horowitz & O'Brien, 1985, p. 51-52).

Sternberg is at the forefront of efforts to measure intelligence in more appropriate and meaningful ways. Sternberg has authored an amazing number of books, articles and studies concerning the nature of intelligence and examining the plausibility of thinking skills instruction (Sternberg 1977, 1983, 1985a, 1985b, 1985c, 1986, 1988).

Brain-centered Theorists

Just as their predecessors looked at children and tried to figure out how they behaved and learned and then tried to construct learning to support and guide those natural processes, some current philosophers, educators, neurologists and others are joining forces to figure out how the brain works naturally, so that they can try to construct learning to support and enhance those natural processes.

William J. Gordon designed a program for improving comprehension and creative thinking through the use of analogies. His program, Synectics, can be used in any subject area and in any situation. He developed the system because inventive geniuses like Bell, Edison and Einstein attributed their success to the use of analogical thinking as a problem-solving tool (W.J. Gordon, 1961).

Leslie Hart has been in the forefront of the movement to make learning completely brain-based, or brain-compatible. His Proster theory is based upon the research of Paul MacLean (Hart, 1983). Hart deals with the aspects that: (a) the brain changes with experiences daily, and (b) learning cannot ignore the whole environment and experience of the child (1983).

Paul MacLean is a neurological researcher who has presented a model of the brain and thought known as Triune Brain Theory (Caine & Caine, 1991). A very simple summary of his theory is that the brain is a composite of three brains that have evolved, one atop the other. They have some separate functions, but are very interrelated. The oldest brain MacLean called R-complex, for reptilian, because the most basic survival behaviors originate from this area. These ritualistic behaviors are also observable in many animals (MacLean, 1978). The middle structure, called the limbic system, acts as a regulator for the flow of information passing from the body and the R-complex to the new brain, or neocortex. The limbic system controls the emotions, and is inextricably connected to what has been considered formal thought

(Isaacson, 1975). The complex thinking takes place in the neocortex. One of the most significant discoveries about it is that whenever one perceives a threat of any kind, the limbic system sends out neural inhibitors. This produces an effect called downshifting that must be overcome or satisfied before the neocortex can function in any optimal way (Caine & Caine, 1991; Isaacson, 1975).

While most current leaders in the field of strategic thinking profess the common goal of creating situations where optimal learning and thinking can occur, Hart isn't even trying to marry his methodology with delivery systems of current educational institutions (Hart, 1986). He firmly states that these systems cannot work and are in need of being discarded (1975, 1983).

Howard Gardener, codirector of Project Zero at Harvard University, is actively involved in ongoing research and development for a methodology to address how to teach each of his seven currently identified intelligences: (a) linguistic, (b) musical, (c) logical-mathematical, (d) spatial, (e) bodily-kinesthetic, (f) interpersonal, and (g) intrapersonal (Gardener, 1983). Gardener's theory appealed to lay readers, and has done much to help dispel the concept of intelligence as a singular, fixed ability. Gardener also pointed out that existing intelligence tests only attempt to measure a few of the seven intelligences. Along with other theorists, he is searching for a methodology to more accurately and effectively identify intelligences. Gardener wants to find out how to elicit and enrich learning in ways specific to each intelligence (Perkins et al., 1987).

Barry Beyer is currently a professor of education at George Mason University, Fairfax, Virginia. He is a prolific author, and two of his books have been specifically designed to assist educators in developing systems for the teaching of thinking (Beyer, 1987, 1988). Beyer recommended that teaching thinking skills be the focus of instruction, that applications of thinking processes be applied in various contexts, and that thinking be used across the curriculum (1987). Beyer felt that the time required for a school to develop its own program (rather than purchasing a developed program) is offset by the strength and fit of the program, and by the amount of ownership exhibited by the teachers (1988).

Shirley Schiever (1991) has also believed in a synthesis of methodology. Schiever has attempted to compile and synthesize the best models from various notables in the field, including Bruner, Taba, Bloom, Piaget, Beyer, and Marzano. Her resulting Spiral Model is described and presented in her recent book (Schiever, 1991).

David N. Perkins, Co-director of Harvard University's Project Zero, urges the use of strategies for thinking. Perkins believes in creating designs for learning and thinking, and he is particularly interested in the area of creativity (Perkins, 1984). A prolific author, he was coeditor of several comprehensive collections of theory, research, and symposia among leaders in the field of thinking skills (Nickerson, Perkins & Smith, 1985; Perkins, 1986; Perkins et al., 1987).

Bob Marzano is the director of the Mid-continent Regional Laboratory and coauthor of Tactics for Thinking (Marzano & Arredondo, 1986). His program was a practical blend of processes for thinking in the forms of models, and formats for the development of lessons that can be used alone or in conjunction with any type of subject matter.

There are 22 tactics offered as a menu for educators, with Marzano's invitation and encouragement to practitioners implementing any of these in the field to add to the research and offer suggestions for modifications or additions (Marzano, 1986). The series comes with a training tape and a manual (Marzano & Arredondo, 1986).

Thinking Skills Programs

The availability of programs designed to address the improvement of thinking skills ranged from descriptors of thoughtful attributes and values to completely packaged instructional kits. Developers from both strands made the assumption that the quality of thinking can be improved (Nickerson et al., 1985). They varied in focus (types of thinking skills addressed) and approach (teacher versus learner responsibilities).

Categorization was based on kinds of thinking addressed by the program: "abilities, methods, knowledge and attitudes" (Nickerson et al., 1985, p. 323). In each category, research was conducted on only a few of the available programs.

Programs Addressing Abilities That Underlie Thinking

Reuven Feuerstein's Instrumental Enrichment program (IE) has shown significant, long-term gains in measured intelligence through instruction and mediation of deficit cognitive abilities (Feuerstein, et al., 1985). The program offered extensive materials (use spans 2-3 years) and teacher training. IE has a long implementation and evaluation history (Sternberg & Bhana, 1986), but some questioned whether there is transfer in situations that are out of the context with those in which the original learning took place (Nickerson et al., 1985).

Methods That Aid Thinking

The CoRT Thinking Program of Edward de Bono (1973) tried to elicit thinking that reshapes problems through lateral thinking. CoRt also offered extensive non-hierarchical materials that require little teacher training (de Bono, 1983). Edwards & Bauldauf (1983) reported that students who received less instruction and CoRT training demonstrated statistically significant improvements in learning. CoRT has produced admirable effects all around the world in special populations delineated by socioeconomic, cultural, racial and intellectual factors (Sternberg & Bhana, 1986).

Various studies were reported in the CoRT manuals (de Bono, 1973). The materials were adapted and extended for use in Venezuela with positive results appearing after three years of implementation (de Sanchez & Astorga, 1983). Overall, the results were favorable, showed transfer in similar situations, and appeared to help users generate more ideas, but the program's scope was limited to simple situations (Nickerson et al., 1985).

The Cognitive Studies project was a college-level study done by Arthur Whimbey and Jack Lochhead (1979). Their materials take a holistic approach to solving problems; modeling and applying strategies that good problem solvers use, rather than breaking problem solving down into components (Sadler & Whimbey, 1985). In an informal review of the study, Hutchinson (Segal, Chipman & Glaser, 1985) noted that some students appeared to feel threatened by the exposure necessary to think, pair and share. Hutchinson also noted that the program placed heavy language and communication demands upon the students. Many subjects received remediation through Feuerstein's IE materials before being able to proceed with the activities (Nickerson et al., 1985).

Philosophy for Children (Lipman, 1976; Lipman, Sharp & Oscanyan, 1980) was one program often mentioned and positively critiqued (Beyer, 1987; Nickerson et al., 1985; Paul, 1984; Perkins et al., 1987; Segan et al., v.1, 1985). In addition to smaller studies yielding significant gains in thinking as measured on selected sections of standardized achievement tests (Lipman, Sharp & Oscanyan, 1980), Educational Testing Service conducted an evaluation of a two-year treatment period, as reported in Lipman, Sharp & Oscanyan (1980, p. 218). Results obtained supported the premise that the program was effective in improving the intellectual performance of the subjects, but the actual reports contained incomplete or sketchy data (Lipman in Segal et al., 1985; Nickerson et al., 1985).

In their review of research on Lipman's program, Nickerson and colleagues were complementary of the author's assumption that children have a natural ability for philosophical thought, the richness of the materials, and the possibilities for improved self esteem (Nickerson et al., 1985). Nickerson voiced concern that the results may be teacher dependent, but couched that by commenting that this stipulation seemed to apply equally to all programs under review (1985).

There were no programs available for review that dealt specifically with metacognition; however, metacognition seems to be an inherent component in working with complex thinking skills (Udall & Daniels, 1991). In each of the programs reviewed, the learner was asked to reflect upon his or her thinking processes, and was often asked to share that process aloud or in writing.

Knowledge About Thinking

No specific program was reviewed, but within this study students were to receive current knowledge of the anatomy and physiology of the brain and how that relates to their thinking. The theory employed for understanding was that of Paul MacLean's Triune Brain as described in Caine and Caine (1991) and by Leslie Hart (1983). The concept that the brain is different every day as a result of the prior day's experiential effects on neural reconfiguration (Caine & Caine, 1991) was stressed, to empower students to consciously attempt to more fully engage the brain in their learning experiences. Learning how one learns and how to monitor one's thinking, as in controlling one's level of attention, is included as a component of the Marzano (1986) strategies used in this study.

Attitudes Conducive to Thinking

Creating a climate for thought was the central focus of Art Costa's articles for teachers and principals (Costa, 1991). Learning how to use attitude and monitor one's behaviors to attain a thoughtful classroom was addressed by Udall and Daniels (1991) via development of their nine designated teacher behaviors and nine designated student behaviors. Costa (1991) advocated making thinking the central focus of all teaching within the school.

Closely Related Research

Tactics for Thinking is a thinking skills program developed for use at any grade level K-12 by Marzano and Arredondo (1986). There are 22 tactics presented to the user as a menu for choices that fit the needs and objectives of the students and school. The tactics are grouped into three categories of skills: "(a) Learning-to-learn Skills, (b) Content thinking Skills, and (c) Reasoning Skills." (1986, p. 2-3).

The authors state that the program is based upon three assumptions:

> (a) The teaching of thinking should be overt, teacher-directed, and part of regular classroom instruction. (b) To a large extent, successful students have acquired the essential cognitive skills outside the explicit curriculum. (c) The direct teaching of thinking skills within formal education will necessitate a change or restructuring of curriculum, instruction, and assessment techniques (1986, p. 1-2).

To that end, the model was constructed to be as broad as possible, and to be used in conjunction with regular instructional settings, rather than as a separate course (Marzano, 1986).

A formative evaluation of 77 teachers' pilot studies was done by Marzano in 1986 for Mid-continent Regional Educational Laboratory (McREL). Marzano (1986) summarized data collected on 1900 students (K-12) from four sites of varying size and socioeconomic compositions. Teachers were trained in the use of the Tactics for Thinking program, and then allowed to select various tactics to use with their group of students (1986).

Data were obtained through a variety of anecdotal methods and teacher-made tests. "For the success rate and engagement rate data collected by the trainer a [sic, after] formal observation systems were utilized. The trainer also used a formal system of protocol analysis to analyze the information obtained from student interviews" (1986, p. 10).

All eighteen of the skills involved produced measurable results. Although the eighteen tactics were presented as one independent variable, each tactic was hypothesized to produce a different outcome, so the results were given according to the specific tactic employed (1986). The design of the study (one-shot case studies and pretest/posttest) weakened the strength of the findings, but, as shown in the literature review, few thinking skills programs have been adequately assessed (1986).

In 1989, Marzano published a summary of research conducted using the Tactics For Thinking program since the formative report. The report contained summaries of studies that employed either a single tactic or combinations of tactics. Within this summary, there is an important doctoral dissertation by Detrick (1988) in which she sought to determine "the extent to which students' scores on standardized tests would be affected by instruction in the tactics" (Marzano, 1989, p. 2).

In her study Detrick utilized six volunteer teachers in grades 1, 3, 4, and 6 at one particular school. The teachers received 15 hours of training and then selected the tactics they felt would be most useful to them. Other students in the school not receiving the intervention served as the control group. All experimental groups made significant gains except for the third grade (Detrick, 1988), but further analysis showed that the most significant gains were made by subjects who were below grade level on the Iowa Test of Basic Skills scores at the beginning of the intervention (Detrick, 1988; Marzano, 1989). Marzano stated:

> The results of Detrick's study imply that the general information processing skills presented in the Tactics program do transfer to the tasks within a standardized test. One would assume that the tasks to which they do transfer are those that require general information processing strategies. . . . This transfer seems particularly important for those students who are below grade level. . . . Although instruction in the tactics does not increase students' knowledge of the domain-specific information so prominent on standardized tests, it does help students acquire the general information processing skills utilized in those tests. (1989, p. 7)

Marzano (1986) also reported a separate study in which the analogies tactic was used. This particular skill proved effective in transfer of skills to the Stanford Achievement Test, form Q.

> The results of this study suggest that the Tactics are useful strategies for helping students process domain-specific information of the type that appears on standardized tests. That is, when the domain specific content within a standardized test is the focus of instruction, the tactics help students learn that standardized test (1989, p.9).

Other researchers found that intelligence scores can be modified by instruction (Baron & Sternberg, 1987; de Bono, 1982); Nickerson et al., 1985; Sternberg, 1984, 1986; Whimbey, 1975). Hansler (1985) found the teaching of cognitive skills to effectively increase scores of students on the Test of Cognition Enhancement Skills. Doris Matthews (1989) then measured the effects of such instruction on a cognitive abilities test, and produced similar results.

Matthews' study was of critical importance because her purposes and methodology closely matched those of this researcher in all but the choice of intervention, intensity of the instruction, and composition of the population available for study. Matthews (1989) reported that the administrators in her study felt the students might have experienced greater gains had they received more of the instruction. Matthews hypothesized that "students who take the Cognitive Abilities Test (CogAT) after an instructional course in critical thinking skills will tend to score higher than similar students who take the test prior to the instruction" (1989, p. 203). She tested her hypothesis using a pretest-posttest design, randomly assigning students to one of two groups. One group was administered the CogAT prior to receiving the intervention, and the other group was tested after receiving this instruction to control for test/retest bias (1989). Also, this design allowed the use of an independent t test in the analysis. The students were of middle school age, and received their instruction through a special period designed for Matthew's study (1989).

CHAPTER III

PROCEDURES

Research Design

The purpose of this study was to determine the effects of a strategic thinking program on the Cognitive Abilities Test (CogAT) scores of seventh graders by comparing the scores of students who received instruction in Strategic Thinking Skills (STS) with scores of students who did not receive STS instruction. The study was conducted in a large middle school in a North Texas suburban school district.

The control group was comprised of seventh graders who took the CogAT in 1992 and were in the eighth grade at the time of this study. The experimental group was made up of seventh graders who took the CogAT April 1, 1993.

The experimental group initially contained 295 seventh grade students. Nine were prevented from attending STS class by their Individualized Educational Plans, ten did not take the posttest measure due to various extenuating circumstances, and ten students' scores were returned incomplete, and therefore unusable. Scores from 257 experimental group students were available for analysis (mortality rate of 3.8%).

The control population initially contained 301 seventh grade students. For unknown reasons, thirty members did not take the CogAT on April 2, 1992, and one student's score was returned incomplete and therefore unusable. Scores from 270 control group students were available for analysis (mortality rate of 10%).

Because all students in the control and experimental populations were required to participate in the study a random sampling existed and a posttest-only design was appropriate (Borg & Gall, 1979; Mouly, 1970). Campbell and Stanley (1963) reported that there are no threats to internal or external validity with this design.

The CogAT was administered during the first week in April to the experimental and control groups. This was done to control for maturational factors. The conditions for the two test administrations were replicated to the maximum extent possible to control for extraneous factors.

Demographic data on students in the control and experimental groups was obtained from the Public Education Information Management System (PEIMS). PEIMS data is gathered annually in Texas and is used to help build a database for the Texas Education Agency. This data provided information on the makeup of the two groups.

Description of the Research Setting

The research took place in a large middle school located in a North Texas suburban school district. The school included individual classroom areas where instruction in Strategic Thinking Skills (STS) took place. The STS curriculum presented sets of strategies for use in approaching thinking and problem solving and offered opportunities for students to apply these to school work and to real life situations. All students in the school were required to take STS. In the experimental group, nine students in a special education transitional unit were prevented legally from attending STS. The same would have been true for any students who were similarly identified within the control group, had the control group been offered the treatment. This was the first time this course had ever been offered in the district.

In May of 1992, the principal originated the idea for a thinking skills improvement class and enlisted this researcher's services to develop the curriculum for implementation in August, 1992. Physical and financial resources were committed for the program, and the principal and assistant principal set the schedule for the STS classes. The STS curriculum was compiled and new material generated during the summer of 1992. The principal approved this study and another one at the sixth grade level (Shapley, research in progress). The principal and the STS teachers encouraged feedback from all the students in the school in regard to what the students found valuable about the STS program. The information from the students was gathered via class discussions and essay questions designed by the program developer and administered by the individual STS teachers at each grade level.

This researcher agreed to serve as a resource person for the teachers involved in implementing the STS course. The researcher was not directly involved in instructing the experimental group. The researcher agreed to train the STS teachers in the STS methodology, to assist and advise the teachers in the purchasing of necessary and appropriate materials for the course, and to assist in developing ways of assessing students' progress.

Each STS class was conducted by an STS teacher. At the seventh grade level students were randomly assigned to one of two teams, and one STS teacher was assigned to each team. STS instruction took place for the entire school year; however, the STS students received instruction with the intervention daily for five months (October 12, 1992 to March 31, 1993).

The STS teachers both had certification in reading and both had language arts backgrounds. Teacher A had seven years of experience in the district; Teacher B had eight years of experience within the district. The STS course was considered part of the STS teachers' normal duties and assignments. There was no extra stipend paid to STS teachers. The STS teachers had a common personal planning period and worked together closely in developing lessons and sharing ideas and materials so that students on the two teams received equivalent opportunities. The teachers were able to offer each other support in combined team meetings when questions arose about how other content area lessons and units might utilize or interface with the STS curriculum.

Each STS teacher received approximately 45 hours of training in the use of the STS curriculum. A minimum of 25 hours was devoted specifically to training in the use of procedures designed to elicit higher levels of thinking from students. Approximately ten hours of training focused on Marzano's (1986) Tactics for Thinking program (hereafter designated by the word Tactics) using a combination of taped and live instruction, discussion, lesson development and modeling that were facilitated by the researcher. The remaining ten hours were spent planning and practicing the other STS curricular components.

The Tactics portion of the staff development was based upon a series of tapes and a teacher's manual by Marzano and Arredondo (1986) that accompanied the program. Follow-up sessions were conducted to assist the STS teachers in the implementation of the Tactics. This training began in July, 1992 and continued throughout the year. The most intense specific training in the Tactics occurred between September 28 and October 17, 1992.

Daily instructional time with the students was usually 45 minutes in duration. The school utilized a flexible block system, so there were a few times when the STS teachers combined their instructional time with that of their teammates, working together with students for as much as 90 minutes per day.

Students received training in the use of the Tactics over a five month period, on a daily basis. Students were introduced to each Tactic, saw it modeled, and were given opportunities to practice it in their STS class. The students were shown ways to apply the Tactics to assignments in specific content area courses. Students were encouraged to apply the Tactics in their daily lives as well.

The Population

The study was conducted in one middle school in a large suburban school district in North Texas. The school district included a total of six middle schools. The total enrollment of the district was officially listed as 23,112 students in kindergarten through grade twelve, with 5,189 of those enrolled in middle schools.

The population of the middle school used was 857; 295 of these students were members of the seventh grade class.

On the basis of data obtained from the Public Education Information Management System (PIEMS) report of May, 1993, the groups have been determined to be alike in respect to academic performance, socioeconomic status stratification, numbers of students receiving special services, and distribution of gender and ethnicity. Academically, results from the Texas Assessment of Academic Skills (TAAS), analyzed at the .05 level of significance, showed that the reading achievement of the control and experimental groups was not significantly different ($X^2 = .756$, df = 1). The mathematical achievement of the control and experimental groups was significantly different ($X^2 = 4.791$, df = 1). The writing ability of the control and experimental group was significantly different ($X^2 = 6.954$, df = 1).

The ethnicity of the control group was as follows: approximately 93% of the students in the control group were Anglo, 3.95% Hispanic, 1.79% Black, .7% Asian, and .36% American Indian. The experimental group contained approximately 92% Anglo, 3.7% Hispanic, 3% Black, 1% Asian, and .3% American Indian students.

The population of both groups came from predominantly middle to upper middle class families. For the purposes of the district, students were considered economically disadvantaged if they were eligible for free or reduced price lunches. The end-of-year count for the control group was 108, or 36.6% of seventh graders in 1992. Of these students, 19% were eligible for free lunch; 17.5% for reduced lunch.

In contrast, the experimental group had 42 students listed as eligible for free or reduced lunch in 1993. Of these, 24% were eligible for free lunch; 19% for reduced lunch.

In the control group, the students were distributed by gender equally, 50%/50%. The experimental group had a similar distribution, at 47% males to 53% females. The same percentage of students in both groups received services through gifted/talented (14%) and special education (5%).

All 295 seventh grade students were eligible to participate in STS instruction with the exception of nine students whose specific Individualized Education Plans prohibited their attendance. All the experimental group, unless identified as ineligible by special education, or those for whom parental permission to test was denied, completed the Cognitive Abilities Test (CogAT). Special education students identified as ineligible within the control group also did not take the CogAT. Parental permission was not required for testing the control group because the CogAT was administered to all district students in 1992, under the supervision of the counselors. No control group students participated in the STS instruction during their seventh grade year, prior to taking the CogAT on April 2, 1992.

Instrumentation

The Cognitive Abilities Test (CogAT) Form 4, Level E, designated for use with seventh graders, was used as the posttest measure. The CogAT, developed by Robert L. Thorndike and Elizabeth Hagen, is a standardized measure of acquired mental aptitude. The first Multilevel Edition was developed in 1968, and the test has been widely used as an intelligence measure, although the authors have never defined their concept of intelligence (Keyser & Sweetland, 1984).

Students recorded their responses on machine-scorable answer sheets which were sent to the publisher, Riverside Publishing Company, to be scored. The raw scores obtained from the CogAT were converted to standard age scores, which are normalized standard scores with a mean of 100 and a standard deviation of 16 within age groups (Anastasi, 1989).

The CogAT consists of three batteries: verbal, quantitative, and nonverbal, and each has three subtests. All of the tests require the individual to use concepts that "he or she has acquired both in and out of school to solve tasks that have not been taught in school" (Technical Manual, 1987, 9-10).

The Verbal Battery is made up of three subtests: Verbal Classification, Sentence Completion, and Verbal Analogies. All three tests "measure inductive reasoning and verbal abstract reasoning" (Technical Manual, 1987, p. 9-10). The three components of the Quantitative Battery are: Quantitative Relations, Number Series, and Equation Building. The first subtest involves making judgments about relative size or quantity; the second is a test of inductive reasoning that forces the examinee to discover rules or principles; the last is a test of abstract reasoning and involves producing equations (Technical Manual, 1987).

The Nonverbal Battery also measures inductive and abstract reasoning, but does not involve words or numbers. Figure Classification, Figure Analogies, and

Figure Analysis are the three subtests of this battery. "The geometric and spatial concepts that are required to solve the items are acquired largely from out-of-school experiences" (Technical Manual, 1987, p. 10).

Each of the batteries requires 30 minutes of actual working time. Anastasi (1989) reported that each subtest uses one type of symbol: verbal, quantitative/numeric, or geometric/spatial; however, all the batteries use some pictures, especially at the lower levels.

Fuchs (1989) also reviewed the test, and reported that the results of the CogAT can be correlated with the Iowa Test of Basic Skills (ITBS) and the Tests of Achievement and Proficiency (TAP), since all were normed jointly. Fuchs quoted from the examiner's manual for the multilevel test that this allows one "to identify those students whose achievement deviates significantly from their level of cognitive development" (p.8), but he commented that the educational importance of this statement was never made clear by the authors.

The internal reliability (K-20) was reported by grade level, with the coefficients ranging from .82 to .94 (Technical Manual, 1987). The new Technical Manual (1987, p.34) reported the K-R 20 for Level E for seventh graders as: .93 for spring on the Verbal; .92 for spring on the Quantitative; and .93 for spring on the Nonverbal.

In the Technical Manual published later, specifically for the CogAT Form 4 (1987), the authors reported that some data were available based on retesting after an interval of approximately five months. Grade seven was one of the levels used in the study to determine stability over time. The authors stated: "The correlations were in the middle 80's for the Verbal Battery, in the low 80's for the Quantitative Battery, and in the middle 70's for the Nonverbal Battery" (CogAT Technical Manual, Form 4, 1987, p. 35).

Both Fuchs (1989) and Anastasi (1989) mentioned the qualitative and quantitative reviews for ethnic and gender bias, and neither made any negative comments about the panel of experts used in the final review. Items deemed unfair were discarded or revised to meet the panel's approval.

In terms of content validity, the 1987 Technical Manual stated that: ". . . clearly, there are types of ability which are not represented with these activities. 'Mechanical intelligence,' 'social intelligence,' and 'practical intelligence' are concepts with which the CogAT does not correspond well." (p. 39) The authors purported that the division of the test into three batteries was based partially "on a desire to achieve more homogeneity of content" (Technical Manual, 1987, p. 39). They intimated that each battery had content validity, but never presented evidence.

In regard to criterion-related validity, the authors stated, "One may anticipate that a test of cognitive abilities will predict a variety of outcomes important to society, and there is no one criterion that is uniquely appropriate" (Technical Manual, 1987, p. 40). Success in school is commonly measured through standardized achievement tests. The CogAT, Form 4, Level E, correlates with the ITBS in the following ways: (1) verbal composite, .85; (2) quantitative composite, .79; and (3) nonverbal composite, .69 (Technical Manual, 1987, p.41).

Although both reviewers acknowledged a lack of information in the preview manual, Anastasi (1989) relied upon the past history of the instrument and its authors somewhat more than did Fuchs. Anastasi indicated that she felt it was reasonable to assume that any changes that had been made would only improve the quality and accuracy of the CogAT, so that the validity information from previous reviews should be fairly representative of what could be expected from Form 4 Multilevel Edition (1989).

As in the 1992 administration, a pretest practice session was provided a week before the actual test, using materials provided by Riverside Publishing Company for that purpose. The two STS teachers administered the pretest practice sessions. All seventh grade students, for whom parental permission to test was obtained, completed each of the three batteries of the CogAT in one sitting on the morning of April 1, 1993. The CogAT was administered to the experimental group by all the seventh grade teachers during their first class period to provide optimum conditions for students, and to replicate, as nearly as possible, the conditions provided for the control test group on April 2, 1992. The school counselors did not provide makeup sessions during the 1992 administration, so none were provided in 1993.

Since seventh graders throughout the district were given the CogAT on April 2, 1992, the students were not expected to associate the test with STS class, but to view it as part of normal district procedures. However, the district did not plan an administration of the CogAT in 1993, so this testing constituted a special session. District policy therefore required prior approval of the study and the proposed testing procedure by both the central office administrators and the building principal. Written permission had to be received from the parents of any student who was to take the CoGAT prior to the administration of the instrument. The counselors and the district testing supervisor determined which special education students should be exempted from testing. Since similarly identified students took only specific portions of, or none of the CogAT April 2, 1992, it was important to observe the same guidelines to avoid skewing the results.

The central office administrator issued approval to the principal and to this researcher to conduct the study as outlined in the researcher's proposal. A copy of the parent permission letter, the permission reply form, a letter from the school counselor that describes last year's testing procedure, and a document to verify approval to administer the CogAT may be found in Appendix G.

Instruction

Instruction was based upon the materials contained in the curriculum guide developed for the STS class. The curriculum was divided into four components : (a) tools for learning, (b) critical thinking, (c) creative thinking, and (d) problem solving. The STS program developer indicated that these skills are interrelated and not isolated, so that they should be taught throughout the year and blended, rather than taught as isolated lessons. The STS program developer also indicated that process skills should be introduced and modeled in content-free ways, then applied to specific content areas in conjunction with content area teachers.

The STS teachers taught prescribed curriculum from the researcher. Responsibility for one's own learning was stressed in every aspect of the STS curriculum. The Strategic Thinking Skills Curriculum table of contents can be found in Appendix A. Tactics for Thinking (Marzano & Arredondo, 1986), Organizing Thinking, Book I: Graphic Organizers (Black & Black, 1990), Creating the Thoughtful Classroom (Udall & Daniels, 1991), Individualized Communications Technology (ICTECH) by Carlson & Carlson (1987), and Triune Brain Theory (Caine & Caine, 1991), provided the structural and theoretical framework for the curriculum.

Module II of the STS Curriculum, "Inside the Mind" was based upon Triune Brain Theory, ICTECH and assorted memory systems technologies. This module was developed by the researcher. In addition to this module, individual units written by the researcher were drafted and then field tested by the STS staff before being printed as part of the STS curriculum guide by the STS program developer. A sample unit is provided in Appendix F.

Instruction in the use of 10 of the 22 Tactics for Thinking, a non-domain specific curricular package, was provided to students daily over a five month period as a major portion of the curriculum over a five month period. All seventh grade students received the instruction during a typical forty minute period from their STS teacher.

Teachers were to model and explain each of ten tactics: (1) attention control, (2) deep processing, (3) memory frameworks, (4) power thinking, (5) goal setting,

(6) the responsibility frame, (7) pattern recognition, (8) synthesizing, (9) analogical reasoning, and (10) evaluation of evidence. Each tactic had its own specific purpose, and comprised a stand-alone lesson segment. The 22 tactics were presented grouped into three sections entitled Learning-to-learn Skills, Content Thinking Skills, and Reasoning Skills (Marzano & Arredondo, 1986).

The first six tactics involved general skills that are applicable to any situation, and comprised what Marzano and Arredondo referred to as the Learning-to-learn segment. Attention control engaged students in monitoring their level of attention so that it could be raised when necessary. Deep processing provided students with a model for generating and exploring diverse aspects of thought. Related to this skill were memory frameworks that allowed for storage and retrieval of lists of information. In using power thinking, students appraised their attitudes about school, about learning, and about their relationship to both. Goal setting gave students a way of setting an explicit direction for learning and for gauging their progress. Finally, the responsibility frame provided students with a process with which they could assess and control the extent to which they assumed responsibility for their success in any activity (Marzano & Arredondo, 1986).

Pattern recognition enabled students to organize large amounts of information in meaningful ways. Synthesizing referred to a systematic process that could be used to restate and summarize information. Both were tactics from Content Thinking Skills, the second of three segments (Marzano & Arredondo, 1986). Three of the tactics are reprinted with Marzano's permission in Appendix B.

In the Reasoning Skills section, analogical reasoning was defined as "a generalizable skill that helped students identify relationships between relationships" (Marzano & Arredondo, 1986, p.3), via syllogistic format: A is to B as C is to D. Evaluation of evidence provided students with the skills to determine whether a claim was supported by what the authors termed "an adequate system of proofs" (1986, p. 3). It related closely to the annual study of propaganda techniques undertaken by the seventh grade teams at the school.

Research on the use of graphic organizers as a tool to facilitate learning was taken from the work of David Ausubel (1977, 1980). The presentation format of Black & Black (1990) was adopted for use in the STS classes because actual sample lessons for introducing the organizers to students were provided, along with blackline master graphs of all the organizational systems. A sample lesson and organizer are included in Appendix C.

Udall and Daniels (1991) offered a basis for developing nine student and nine teacher behaviors that can help create a climate for thinking within the classroom. A sample of the evaluative charts provided for teachers and students can be found in Appendix D.

Individualized Communications Technology (ICTECH) was based upon the premise that when students understand how they need to process and receive information meaningfully, they can reframe incoming information to suit their needs, and frame outgoing information to compliment the style of the receiver. The technology was unrelated to learning styles, but was thought of instead as an information processing style (Carlson & Carlson, 1987). Consult Appendix E for an example of one of these styles.

Triune brain theory was explained at some length in Chapter II in association with its originator, Paul MacLean. Applications for education from Caine and Caine (1991) were stressed. Students were taught about triune brain theory in terms of the inextricable relationship between their emotional and physical well being with that of their ability to use higher level cognition. These modules were to be covered by all teachers, as part of a core curriculum agreed upon for the first year's implementation.

Both STS teachers conducted a basic unit on personal organization, using principles explained in Tools for Learning: A Guide to Teaching Study Skills (Gall, Gall, Jacobsen & Bullock, 1990) and Making the Grade (Gall & Gall, 1988), and a special spiral assignment book (AGENDA) purchased by each student for the STS course. Working in conjunction with the school librarian, the STS teachers conducted a one week, hands-on unit in the effective retrieval of information from multiple sources. The students were also shown audiovisual equipment available for student use, so that the they might vary or enhance their presentations throughout the year.

Procedures for Collection of Data

Permission was obtained to utilize the 1992-93 seventh grade students for this study. They took the CogAT on April 1, 1993. They were the experimental group.

None of the control group of 271 students who took the CogAT April 2, 1992, received instruction in Strategic Thinking Skills prior to administration of the test.

All of the 267 seventh grade students who took the CogAT on April 1, 1993 received instruction in the Strategic Thinking Skills curriculum for five months prior to taking the test. Letters were sent to parents of the experimental group of seventh graders by the school principal, requesting permission to administer the Cognitive Abilities Test, Form 4, Level E to their children on April 1, 1993. All students whose parents agreed to allow them to be tested on the CogAT were included in the study with the exception of students who would not have had to take the CoGAT if it had been administered by the district, and nine students whose Individualized Educational Plans circumvented their access to the STS course. This was to protect certain identified special education students' legal rights in regard to testing. Any similarly identified students were likewise exempt from the April 2, 1992 administration.

The CogAT was administered by all of the seventh grade teachers. Since no make-up sessions were provided by the guidance counselors in 1992, none were provided in 1993. The CogAT was administered in one sitting consisting of approximately 120 minutes. The test booklets were machine-scored by a designated agent of Riverside Publishing Company. The scores derived from the three batteries of the CogAT constituted the posttest measure.

Procedures for Analysis of Data

The researcher used three independent t tests to analyze the differences in scores between the experimental and the control groups on each of the three batteries of the CogAT. The significance levels have been reported.

CHAPTER IV

PRESENTATION AND ANALYSIS OF DATA

The Cognitive Abilities Test (CogAT) verbal, quantitative, and non-verbal battery scores for the students receiving five months of daily instruction in the STS curriculum and for those students who did not receive any instruction in the STS curriculum were analyzed. Out of the total population of 295 seventh graders who could receive instruction in the STS curriculum, nine had conflicting Individualized Educational Plans and were not allowed to attend STS class. Of the remaining 284, the following problems occurred: three students were in in-school suspension; one student repeating the grade had already taken the same level CogAT, invalidating the results; one extremely disruptive student was removed from the testing environment and his answer sheet discarded; parents of seven students declined for taking the CogAT; five students were absent; one was extremely tardy; and one answer sheet was set aside by the examiner when the child left for an appointment before completing one battery. This left 267 tests to be sent for scoring. Of those 267, ten were returned with incomplete scores, leaving a total of 257 sets of scores that could be analyzed from this experimental group.

Of the 271 students in the control group that took the Cogat April 2, 1992, 270 sets of scores were utilized. One student lacked a score for the nonverbal portion.

An independent t test was applied to each of three hypotheses. The .05 level of significance was used to determine rejection of the three hypotheses being tested.

Results Pertaining to Cognitive Abilities

Hypothesis One

Hypothesis One stated: There will be no significant difference in the total scores on the Verbal Battery of the Cognitive Abilities Test between seventh graders who receive five months of instruction in strategic thinking skills prior to taking the test and those who do not receive this instruction prior to taking the test. When this hypothesis was tested, no significant difference was found in favor of either group as hypothesized.

The mean scores for the Verbal Battery for both groups are reported in Table 1. Independent t test results presented in Table 1 indicated a t value of .37 and a two-tailed probability of .711 that was not significant at the .05 level. The hypothesis was therefore retained.

Table 1

T-test Comparing Mean Scores for Verbal Battery of Cognitive Abilities Test

Group	n	mean	s.d.	t	2-tail p
Control	270	108.0852	13.890	.37	.711
Experimental	256	107.6338	14.068		

Hypothesis Two

Hypothesis Two stated: There will be no significant difference in the total scores on the Quantitative Battery of the Cognitive Abilities Test between seventh graders who receive five months of instruction in strategic thinking skills prior to taking the test and those who do not receive this instruction prior to taking the test.

The mean scores for the Quantitative battery are reported in Table 2. Independent t test results presented in Table 2 indicated a t value of 1.67, and a two-tailed probability of .095 that was not significant at the .05 level. The hypothesis was therefore retained.

Table 2

T-test Comparing Mean Scores for Quantitative Battery of Cognitive Abilities Test

Group	n	mean	s.d.	t	2-tail p
Control	270	110.4259	15.611	1.67	.095
Experimental	257	108.1406	15.686		

Hypothesis Three

Hypothesis Three stated: There will be no significant difference in the total scores on the Nonverbal Battery of the Cognitive Abilities Test between seventh graders who receive five months of instruction in strategic thinking skills prior to taking the test and those who do not receive this instruction prior to taking the test.

When this hypothesis was tested, no significant difference was found in favor of either group as hypothesized.

The mean scores for Nonverbal are reported in Table 3. Independent t test results reported in Table 3 indicated a t value of .97, and a two-tailed probability of .333 that was not significant at the .05 level. The hypothesis was therefore retained.

Table 3

T-test Comparing Mean Scores for Nonverbal Battery of Cognitive Abilities Test

Group	n	mean	s.d.	t	2-tail p
Control	270	109.3926	13.206	.97	.333
Experimental	257	108.2539	13.749		

Chapter Summary

In Chapter IV the data was presented and analyzed both in writing and in table form. Each hypothesis was stated and statements were made as to the retention or rejection of each hypothesis. Hypotheses One, Two and Three were retained. In this study instruction in thinking strategies had no significant effect upon the thinking ability of seventh grade students as measured by the Cognitive Ability Test.

CHAPTER V

FINDINGS, CONCLUSIONS, AND RECOMMENDATIONS

The purpose of this study was to determine the effects of a strategic thinking program on the Cognitive Abilities Test (CogAT) scores of seventh graders by comparing the scores of seventh graders who received instruction in strategic thinking with seventh graders who did not receive instruction in strategic thinking. The study was conducted in a middle school in a north Texas suburban school district. The experimental population of 257 students received five months of Strategic Thinking Skills (STS) instruction, through their STS class prior to taking the CogAT on April 1, 1993. The control group of 270 students attended this middle school as seventh graders in 1991-92 without STS instruction prior to taking the CogAT April 2, 1992. The data collected from these tests was analyzed using three independent t tests. The results obtained from this analysis of data were used as a basis for retention or rejection of the hypothesis. The hypothesis was rejected if the significance level shown in the independent t tests was equal to or less than .05.

Findings

Based upon the results of the three independent t tests, the findings for the study are given below:

1. The posttest scores for the experimental group for verbal ability, as measured by the verbal battery of the Cognitive Abilities Test, were not significantly different from those of the control group. The hypothesis was retained.

2. The posttest scores for the experimental group for mathematical ability, as measured by the quantitative battery of the Cognitive Abilities Test, were not significantly different from those of the control group. The hypothesis was retained.

3. The posttest scores for spatial reasoning ability, as measured by the nonverbal battery of the Cognitive Abilities Test, were not significantly different from those of the control group. The hypothesis was retained.

Discussion of the Findings

This study found no significant differences in the CogAT scores of seventh graders who received five months of instruction in Strategic Thinking Skills (STS) and the scores of those who did not receive STS instruction. The following discussion compares the findings of this study with other studies found in the literature.

Some researchers have found that intelligence scores can be modified by instruction (Baron & Sternberg, 1987; de Bono, 1982; Nickerson et al., 1985; Sternberg, 1984, 1986; Whimbey, 1975). Because intelligence tests measure mental ability, the Cognitive Abilities Test (CogAT), which measures mental ability in three areas was chosen as the instrument for this study.

Matthews (1989) showed an increase in scores on the CogAT after using what she described as the Glade and Rossa Strategic Reasoning curricular package. Her treatment was administered over a six week period. The findings of this study were not consistent with Matthews' findings.

Detrick (1988) reported significant scoring gains on the Iowa Test of Basic Skills (ITBS) by elementary children who had received training from one or more of Marzano's Tactics for Thinking (hereafter referred to solely as Tactics). The ITBS measures achievement instead of mental ability. The ITBS, however, was normed jointly with the CogAT and both instruments are marketed by the same publisher (Thorndike & Hagen, 1987).

Marzano (1989) reported that the kind of results obtained by Detrick lent credibility to his contention that the general kinds of thinking strategies presented in the Tactics program may not add to a student's base of content knowledge, but should transfer over to the kinds of thinking required of that student on many standardized tests. This study did not confirm Marzano's predictions.

Conclusions

The following discussion of conclusions is divided into five categories: (1) Related Research, (2) Verbal Reasoning, (3) Mathematical Reasoning, (4) Spatial Reasoning, and (5) School Climate.

Related Research

Detrick's (1988) study was conducted in an elementary setting, where certain teachers self-selected one or more Tactics to teach, making this a novel experience for the children involved. Because no mention was made of any attempt to statistically allow for this, it is possible that a certain amount of "Hawthorne Effect" (Borg & Gall, 1979) may have been present. Only select groups of students participated in the above mentioned research. In contrast, all students attended STS as a required course, except for nine who were exempt by law. Tactics instruction occurred on a regular basis over a period of five months for the STS experimental group as part of their normal coursework. Most of the other research that has been published on the Tactics for Thinking program utilized by the Detrick study was conducted by its author, Robert Marzano, or in conjunction with him (Marzano, 1986, 1986; Detrick, 1988). Much of Marzano's research was one-shot, case-study methodology, and he attempted to relate each specific tactic to the related skill area one might find on a standardized test. One example of this was the case in which increased scores on the Stanford Achievement Test, form Q (Marzano, 1986), were elicited after the subjects received instruction in the use of the analogies tactic, showing a transfer of that specific skill. The Marzano Tactics (1986) were introduced by the STS teachers as tools the students could apply to all learning situations, not as specific strategies for improving test-taking abilities.

Although it is not clear from the studies of Marzano (1986, 1989), Detrick 1988, or Matthews (1989), the schools in which their research took place seem to be using traditional scheduling. The school in which the STS instruction took place offered flexible blocks, teamed and interdisciplinary instruction, and had many innovative programs in operation. Traditional, teacher-directed instruction was not common in the school for the STS study, which emphasized instead student-centered, cooperative learning situations.

The STS research differs from that of Marzano and Detrick in three ways. First, the outcome of the STS study depended upon a whole curriculum, not just upon one innovation, such as the Tactics program. Second, the STS teachers were assigned to their positions and required to introduce nine of the Tactics; the Marzano and Detrick participants volunteered to choose one or more tactics with which they were comfortable, and introduce that tactic in their own way at a convenient time. Third, the Marzano studies employed a series of interviews, whereas this study and Detrick's utilized standardized measures.

Verbal Reasoning

Results that were obtained from an independent *t*-test on the Verbal Battery of the CogAT indicated that the group of students who received STS instruction over a five month period demonstrated no significant difference in verbal ability scores compared to those made by students who did not receive STS training. One possible explanation for this lack of change was a district directive that required this skill to be addressed and nurtured within the regular curriculum for Language Arts as a preparation for the Texas Assessment of Academic Skills (TAAS) at the seventh grade level.

Two language arts teachers of control group subjects were very proficient and creative in their teaching of verbal reasoning strategies, even though they received no STS training. Many control group members who had had either teacher as their English or reading teacher, and experimental students receiving STS training, may have had approximately equal opportunities to sharpen their analogical reasoning and build vocabulary.

The control group had separate classes for English and Reading. The experimental group's reading and English instruction were combined into one language arts course. The control group therefore had received approximately twice the amount of time devoted to language arts instruction. The STS curriculum reinforced language arts instruction, but it also stimulated thinking in other areas.

The STS teachers were expected to provide strategies for improving verbal reasoning and offer opportunities for applying these strategies. A Chi Square analysis of the TAAS writing scores for the two groups indicated that the scores in the experimental group were significantly higher than those of the control group at the .01 level ($X^2 = 6.954$, df = 1). Language arts teachers concentrated on the writing process. Proficient writers must use good verbal reasoning to succeed. Perhaps the test items in the CogAT were not as valid as the TAAS in indicating verbal reasoning ability as taught in STS.

Mathematical Reasoning

The results reported using an independent t test indicated that the group of students who received STS instruction over a five month period demonstrated no significant difference in quantitative ability scores than those who did not receive STS training. By district directive, mathematics teachers of students in the experimental group were responsible for preparing their students for the TAAS. Many of the skills and reasoning powers tested by the TAAS were also prevalent on the CogAT. A Chi Square analysis of the TAAS mathematics achievement scores for the two groups indicated that the experimental groups' scores were significantly higher than those of the control group at the .05 level ($X^2 = 4.791$, df = 1). Perhaps the Quantitative portion of the CogAT was not as valid in portraying the aptitudes developed by STS.

There was a new and less experienced mathematics teacher at the seventh grade level in 1992-93. Approximately one-half the experimental group students received their math instruction from this teacher. It was noted by the researcher that many of the experimental group who had the more experienced math teacher tended to score much higher than any of the control group.

In the STS curriculum, a short series of lessons on analogical reasoning involving mathematics was offered to the STS teachers, but neither teacher reported that they felt comfortable enough to present them. The lessons were somewhat complex, and although the trainer offered suggestions and provided materials and ideas, some of the lessons required confidence in one's own mathematical ability in order to present them to students. The researcher could not counterbalance the lack of mathematical confidence in the STS teachers, despite attempts to offer nurture and support.

It is unknown whether the mathematics teachers for the control group presented or modeled more strategies for solving figural analogies than the teachers for the experimental group. If the control group did receive more spatial instruction, it could have had an effect on their scores.

Spatial Reasoning

The results reported using an independent t test indicated that the group of students who received instruction in strategic thinking skills over a five month period demonstrated no significant difference in nonverbal ability scores than those who did not receive this training. As described in the previous set of findings, the seventh grade STS teachers were not very comfortable with the lessons in teaching figural analogies. The lessons were presented to the experimental students, but perhaps not in the depth required to reflect as a difference in the scores on the CogAT.

The art, industrial arts, and homemaking teachers also presented lessons in spatial reasoning. There had been a change in the structure for presentation of electives in the school, and all electives teachers reported that they did not have the same amount of time to go into the depth that they had used with the control group. Within the control group, students who were in art or industrial arts, in particular, scored high in this battery.

School Climate

The school in which the study was conducted had an administrator who was a strong instructional leader. The administrator modeled and supported risk-taking and innovation, and consistently helped find ways to finance teacher projects designed to help students. The principal was designated "Administrator of the Year" by the district.

The general atmosphere of the school was warm, secure and supportive, and conducive to the success of the STS program. The school was selected as a national model school during the course of this study.

At the time this study was designed central office personnel had indicated that the CogAT would be administered district-wide, and that scores for seventh graders from other schools were to be available. If that had been the case, the experimental group should have made no obvious connection between STS and the taking of the CogAT. However, the students were easily able to deduce that they were taking the CogAT at their parents' discretion at the time the letters for permission were distributed. There were reports of some students being very unhappy about taking a test that had not been scheduled for the whole district. Teachers of the experimental group expressed concerns to the researcher that some students who did not like the STS teachers or course may have seen the CogAT as an opportunity to cast a poor reflection upon the STS course or the STS teacher.

Additionally, the principal annually sets an achievement level goal with the seventh graders. If they meet the goal, the entire grade level earns a reward such as a field day, movie, or dance. There was no incentive given for taking the CogAT. There is a chance, then, that some students may have produced scores that are not indicative of their true ability, whether they purposely attempted to score poorly, or did so as a function of their attitudes.

The school in which the study was conducted is scheduled by grade levels, so that the researcher/program developer had little or no common planning time with either of the seventh grade STS teachers. Training and support sessions had to be planned for before or after school, and on afternoons following district in-service presentations. It seems reasonable to assume that having had more common time for sharing and planning with the program developer would have been helpful for the STS teachers.

Because of a strong conviction about the value of the STS instruction, the researcher, teachers and administrator will continue to use the curriculum. Through class discussion and essay opportunities, students have indicated that they particularly value the following: the Tactics, ICTECH, graphic organizers, personal organization, learning about the brain and how humans learn, information retrieval/research skills, and speech-making.

One of the administrative goals is to train sufficient teachers in the use of the STS curriculum so that strategic thinking will become a part of every classroom, instead of having to be taught as a stand-alone course. The research-based curriculum appears to offer potential; however, it was difficult for teachers to reach a level of comfort with the curriculum in the first year of its implementation. The majority of the faculty have expressed positive attitudes toward having had the STS program. The sixth grade staff decided unanimously to keep STS as a separate class for incoming students to help them prepare for middle school demands.

Perhaps the delivery system needs to be modified for the upper grades. The course could be for a shorter duration, integrated into one or more other courses, or appropriate portions of the curriculum could be applied to specific content, and all teachers could be trained in the use of the major strategies over a three year period. The administrator decided to infuse the STS curriculum into the seventh and eighth grade content instruction next year. The majority of the faculty recommended that STS should only last one semester if offered as a separate course.

Recommendations

Based upon the findings and conclusions of this study, the following recommendations are offered in terms of further educational research:

(1) It is recommended that the school develop a survey to distribute to teachers and students, asking which parts of the STS curriculum they have found to be of the most and least value, and allow them to offer suggestions for modifications, additions or deletions.

(2) A future study to monitor longitudinal progress of the experimental group by comparing thinking skills scores to those of age peers in other schools within the district that have not received the STS instruction is recommended.

(3) During this era of educational restructuring, the changing needs of the school and its population will warrant consistent monitoring of the STS course and its curricular components so that STS may continue to evolve and become fully implemented.

APPENDIX A

TABLE OF CONTENTS OF THE STRATEGIC THINKING SKILLS

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         b. Architecture, engineering, chemistry, etc.
         c. Translating a set of directions into a product
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APPENDIX B

SAMPLE MATERIALS FROM

TACTICS FOR THINKING

UNIT 6. THE RESPONSIBILITY FRAME

***The responsibility frame* is a tactic that provides students with the necessary awarenesses and strategies to increase their performance on any task by taking responsibility for the essential elements of the task.**

Student Objectives

1. Students will be able to describe the impact of their control over and active participation in the learning process.
2. Students will be able to explain why it is important for them to assume responsibility for the learning process.
3. Students will be able to describe the steps involved in using the responsibility frame.
4. Students will be able to demonstrate each phase of the responsibility frame.

Background Information

An underlying goal of all the learning-to-learn skills is to communicate to students the need for them to take responsibility for their own learning. Certainly the teacher has a responsibility to optimize the learning situation. However, a more important responsibility is held by the students—to bring all of their talents, desires, and energies to the learning process. In short, students must be actively involved in the learning process. If not, little or no learning will occur in spite of brilliant teaching and superbly structured curriculum. The responsibility frame is a highly structured tactic intended to provide students with the necessary awarenesses and strategies to handle that responsibility. The responsibility frame has six phases:

1. *Refocusing*—students relax and end whatever previous activity they were engaged in.
2. *Awareness*—students notice:
   a. their level of distraction (e.g., how much they are attending to thoughts unrelated to the class),
   b. their attitude toward the class (e.g., if they believe the class is valuable or not valuable, interesting or boring),
   c. their attitude toward working (e.g., their commitment to the class),
   d. their attitude toward their ability (e.g., a sense of power about their ability to perform well in the class or a sense of sinking), and
   e. other attitudes.
3. *Commitment*—students:
   a. hold off or "bracket" any thoughts unrelated to the 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, and
   e. make other commitments.
4. *Goal setting*—students:
   a. set some specific goals for the class and
   b. integrate the teacher's goals with their own.

From: Tactics for Thinking by Marzano & Arredondo, 1986

5. *Task engagement*—students:
   a. monitor whether they are getting closer to or further from their stated goals and
   b. make any corrections necessary in their own behavior or seek help to further the attainment of their goals.
6. *Task completion*—students:
   a. determine if their goals were accomplished and
   b. evaluate what worked and what did not work relative to their goals.

The responsibility frame incorporates many aspects of attention control, deep processing, power thinking, and goal setting. It is not meant to replace those tactics; rather, it is a system for using many of the most powerful aspects of those tactics in a unified, holistic way.

At first the responsibility frame should be highly teacher-directed. That is, the teacher should guide students through each phase of the frame. Over time, students should be expected to employ the responsibility frame on their own without overt direction from the teacher.

Why teach the responsibility frame?

To communicate to students the need for their active participation in the learning process.

When do you use the responsibility frame?

This process can be used as an overall framework for instruction in any content-area class activity. Instruction can begin with phases 1-4. During phase 5, students are engaged in traditional classroom content instruction, which would then end with phase 6.

Sample Strategy for Introducing the Responsibility Frame

1. Relate a story from your personal life about the need to take responsibility for learning. Explain that a strong sense of responsibility can overcome many factors that work against success.
2. Ask students to identify a time when they were really responsible for their own success, and have them share their experiences with the class.
3. Explain that the responsibility frame is a way of putting together many of the learning-to-learn skills into a unified whole.
4. Present and model the responsibility frame.
5. Explain that you will be using the frame as a general system for teaching and learning. Emphasize that, even though you will not always explicitly go through all six phases, you expect students to go through the phases in their own minds.
6. Slowly and overtly use the responsibility frame in the next lesson you teach. At the end of the lesson, allow students to discuss their reactions to the process.
7. Systematically use the responsibility frame in your teaching.

Classroom Examples

- At the elementary or secondary level, begin the day with a brief refocusing activity using deep processing. For example, have students see a blue ball in their mind's eye. Have them rotate the ball, change its colors, change its position, and so on. After the activity is completed, remind students that they were engaged in "refocusing their attention"—the first phase of the responsibility frame. Next ask students to be aware of some of their attitudes about the day. Ask them to write down some of their more prominent attitudes and determine for each whether it will help them do well during the day or hinder their performance. Have students rewrite the attitudes that will hinder them as positive affirmations. Next have students take responsibility for their attitudes by saying the affirmations to themselves and imagining what the day would be like (using deep processing) if the affirmations came true. Allow students to discuss their affirmations and describe their visualizations. Remind students that they just went through the awareness and commitment phases of the responsibility frame. Next present students with your academic goals for the day. Ask students to write those goals in their own words, then invite them to write a few personal academic and nonacademic goals for the day. At this time the classroom climate should be well established for learning. For the remainder of the day, present content in the regular manner. However, occasionally go back to the goals that were set in the morning and discuss with students whether any modifications have to be made in their behavior to make sure that the goals are accomplished by the end of the day. Before the school day ends, have students reread their goals and for each one determine whether it was accomplished or not. Also, have students identify what they did that aided the accomplishment of each goal as well as what they did that did not work relative to the accomplishment of each goal. Allow students to discuss what effect the responsibility frame had on their performance.

- Use the responsibility frame overtly for a few days and then stop guiding students through the six phases. Have students compare and contrast their behavior when you overtly used the frame with when you did not use it.
- As an experiment, have students use the responsibility frame on some hobby outside of school. Ask them to keep a journal of their reactions to and experiences with the responsibility frame. Allow students to report on their findings in class.

UNIT 9. PATTERN RECOGNITION

***Pattern recognition* is a tactic for identifying organizational patterns in information you read or hear.**

Student Objectives

1. Students will be able to name and give examples of the different types of patterns.
2. In reading material, students will be able to identify salient patterns, describe the parts of each (e.g., the generalization and the examples, the concept and its characteristics), and suggest patterns that are not obvious from the text information.
3. Students will be able to describe the process of pattern recognition.
4. Students will be able to identify situations when it is useful to use the pattern recognition process.
5. Students will be able to evaluate their use of pattern recognition.

Background Information

Pattern recognition is seeing organizational patterns in information you read or hear. To illustrate what an organizational pattern is, consider the following:

> In the morning I have a regular routine. First I brush my teeth, then I put my jogging suit on, then I run for two miles, then I take a shower and change into my work clothes. After that, I . . .

Here there is a definite ordering of information. We are told about events that happen one after another. We call such an organization a sequence pattern. Recognizing patterns of information allows you t tore information in large chunks. For example, if you had no prior experience of information being presented in a sequential pattern, you would have a difficult time processing the paragraph above as a unit of information. The information would appear as unrelated or loosely related statements. The extent to which students have experience with the basic ways that information is organized in patterns strongly influences their ability to process information. In this unit we will consider five basic patterns:

1. Concept Patterns. Concept patterns describe the characteristics of a single concept (word or phrase). They are commonly about persons, places, things, and events. For example:

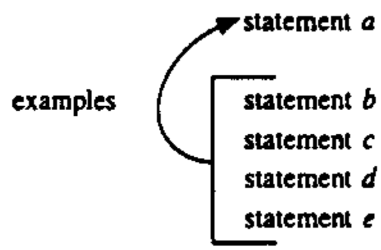
> Let me tell you about my car.
> It is one of the nicest on the block.
> It does the quarter mile in 9.6 seconds.
> It is red with whitewall tires.
> It . . .

A distinguishing feature about a concept pattern is that the information presented all relates to a single word or phrase. In the passage above, all of the information is about the concept "my car."

2. Generalization Patterns. Generalization patterns are those in which a set of statements has an example relationship with a single generalization.

a. At times life gets difficult.
b. Finances become a problem.
c. A period of poor health may develop.
d. Family problems can crop up.
e. Work may become dull and boring.

Here *b*, *c*, *d*, and *e* are examples of the generalization in *a*. As a set, they have an example relationship with *a*:

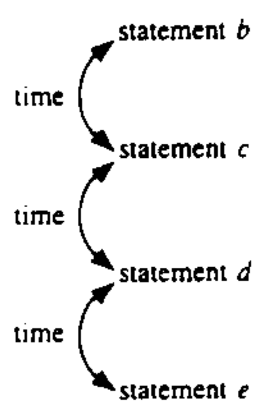


To better understand generalization patterns, contrast this with the concept pattern above about the car. In that pattern, all of the information was about the concept "my car." However, in the generalization pattern the information in statements *b*, *c*, *d*, and *e* is not about the concepts "life" or "difficulty." It is about the statement, " At times life gets difficult."

3. Sequence Patterns. Sequence patterns use repeated time relationships as the basic link among statements.

a. I have a regular routine in the morning.
b. First I brush my teeth.
c. Then I get dressed.
d. Next I eat breakfast.
e. Finally I go to school.

Here the relationship among ideas might be diagramed in the following way:



Here the underlying pattern is that sets of ideas are similar:

statement *c* is likened to *b*
statement *e* is likened to *d*
statement *g* is likened to *f*
statement *i* is likened to *h*

Dissimilarity patterns are those in which the unifying theme is that ideas are different. This is done through the use of contrast relationships.

a. The two fighters were very different.
b. The first one entered with a great deal of bravado.
c. In contrast, the other entered with little fanfare.
d. The first one wore a brightly colored robe.
e. The other wore black.
f. The first fighter used fancy footwork and quick jabs.
g. By comparison, the quiet one protected himself and waited for an opening.
h. The first one scored many points on style.
i. The quiet one won by a knockout.

Here the overriding pattern is that of contrast:

statement *c* is contrasted with *b*
statement *e* is contrasted with *d*
statement *g* is contrasted with *f*
statement *i* is contrasted with *h*

Once students have learned the different types of organizational patterns, they can be used to organize information read or heard. A key point here is that most information can be organized using two or more patterns. Also, most information contains small patterns embedded within larger patterns, some of which are embedded within even larger patterns. Consequently, if students find themselves looking for the "right" pattern, they are not using the tool properly. That is, the basic patterns should be freely used by students to structure information in ways that make sense to them.

The process to teach students for pattern recognition is quite simple:

1. **Look for one of the five patterns in information you read or hear.**
2. **If you can't find a pattern, adapt (or invent) one that helps you organize the information.**

As stated in step 2 of the process, if students can't find one of the basic patterns, they should feel free to adapt one of the patterns to make it "fit" the information, or invent a whole new pattern that is different from the five basic patterns.

Why teach pattern recognition?

- Pattern recognition allows students to store and retrieve information much more efficiently.

- Before students read a chapter, identify the way you want them to interpret the information by specifying which patterns you want them to see in the information. Then describe to students in a fair amount of detail the patterns you want them to look for in the chapter. ("On pages 17-18, look for a concept that is being described. On pages 20-24, be aware that they are describing a process. Make sure you can list the steps in the process. On page 27, the information presented actually supports a generalization not explicitly stated. Identify what that generalization might be.")
- Present students with a passage that has a fairly obvious pattern, and have them identify the pattern. Next have students rewrite the passage, this time using a different pattern as the organizing structure. Have students discuss how different patterns bring out different information.
- Have students analyze the questions at the end of the chapters in their textbooks to identify what type of pattern the questions are getting at.
- Have students diagram the different layers of patterns within a passage.
- Have students describe themselves in terms of a concept pattern, a generalization pattern, a sequence pattern, a process pattern, and similarity and dissimilarity patterns.

- The process of pattern recognition facilitates student learning in content areas and can significantly enhance their academic performance.

When do you use pattern recognition?

- When reading or listening to something you want to remember.
- As an outlining technique.
- As a study technique.

Sample Strategy for Introducing Pattern Recognition

1. Present students with a passage that contains two or more of the basic patterns. Have them read the passage, and then ask them to describe the basic idea behind the passage. (Don't use the term "main idea" for this activity.)
2. Have students share their descriptions with the rest of the class. As they share their ideas, write a few of them on the chalkboard, trying to state each description as one of the basic patterns.
3. Next, describe for students at least two ways you can see to organize the information. These two ways should represent two basic patterns.
4. Ask students, "Why can we see so many ways of organizing this information that make sense?" As students state their opinions, emphasize two points: (1) the way you organize information is somewhat subjective, and (2) even if two people use different organizational schemes, they will still probably include much of the same information in their organization.
5. Explain to students that you will be presenting them with a few basic organizational patterns to be used as tools when reading and listening to information.
6. Present clear examples of two or more of the basic patterns (sequence and concept are the easiest to introduce).
7. Have students generate their own examples of the two patterns.
8. Present and model the pattern recognition process using the two patterns the students have learned.
9. Have students read a passage and identify both patterns within the passage.
10. Describe situations in which you will be asking students to use the pattern recognition process.
11. Gradually introduce more patterns following steps 6 and 7 above.

Classroom Examples

- Have students identify the pattern that covers the most information in a passage. Then have students identify a pattern that covers the least amount of information.
- Have students identify patterns that are not explicitly stated but implied in a passage.
- Have students create their own basic patterns with which to organize information.
- Make colorful charts for each pattern. Use overheads with simple, interesting pictures. (Black line master from a coloring book is excellent.) Describe pictures in pattern frameworks. A picture of a father and son could be used for both a similarity and dissimilarity pattern. Walk around the room, using students' names in short stories built around a pattern. For example, "Laura looks like a Hobbit because..." The class then identifies the pattern. For evaluation, each student identifies the pattern in short, written vignettes that again use students' names.

UNIT 13. ANALOGICAL REASONING

***Analogical reasoning* is a tactic for identifying how one set of concepts has relationships similar to those found in another set of concepts.**

Student Objectives

1. Given an analogy problem, students will be able to:
   - describe the relationship between the two elements in the first set,
   - identify which element in the first set is most closely related to the single element in the second set, and
   - select an element for inclusion in the second set and defend the selection.
2. Students will be able to identify analogical relationships among content-area concepts.
3. Students will be able to evaluate their use of analogical reasoning.

Background Information

Any time you recognize that the relationship between two particular items is similar to the relationship between another set of items, you have identified an analogy. For example, if you notice that the way you interact with your students is similar to the way a coach interacts with his athletes, you have engaged in analogical reasoning.

On academic tests, students are commonly presented with analogy problems like the one below:

black : white :: sharp : _______

Answer: a) tall
b) short
c) blunt
d) straight

The process of solving an analogy problem has the following steps:

1. **Identify relationships between the two elements in the first set.**
2. **Identify which element in the first set is most closely related to the single element in the second set.**
3. **Identify an element that would make the second set of elements have the same relationship as the first set.**

To illustrate, consider the following analogy:

Set 1: man : boy
Set 2: king : _________

Answer: a) child
b) prince
c) queen
d) son

In step 1, we identify relationships between the elements in the first set. *Man* and *boy* are both human, male, and different in age. That is, their relationship is that both elements in the first set are male and there is an age difference between the two. In step 2, we identify which of the elements in the first set is more closely related to the single element presented in the second set. Here *king* is male and usually considered at the older end of the age scale. Hence, it is likely that *king* is most closely related to *man* in the first set. Finally, in step 3 we look for the missing element in the second set. In this case we are looking for an element that is male and younger than a king. Two alternatives that fit these requirements are *prince* and *son*. Since prince also shares the characteristics of royalty with *king*, it is the most likely choice.

In general, the most difficult aspect of solving an analogy is identifying the relationship between the elements in the first set. Below are listed nine types of relationships commonly found in analogy problems on aptitude tests (* denotes the correct answers):

1. Synonym or concepts with similar meanings.
   fly : soar :: yell : ________
   - a) whisper
   - b) shout*
   - c) swim
2. Antonym or opposite concepts.
   black : white :: rise : ________
   - a) run
   - b) lift
   - c) fall*
3. Concepts within the same class.
   cow : rabbit :: cup : ________
   - a) fork*
   - b) bird
   - c) blue
4. One concept is a class or category name and the other is a member of the class or category.
   utensil : fork :: animal : ________
   - a) spoon
   - b) spots
   - c) cow*
5. One concept turns into another or has a causal relationship with another.
   rain : mud :: bud : ________
   - a) wings
   - b) flower*
   - c) caterpillar
6. One concept performs a function on or for another.
   driver : car :: librarian : ________
   - a) blackboard
   - b) books*
   - c) shoes
7. One concept has a time or sequence relationship with another.
   morning : night :: 4 : ________
   - a) 1
   - b) 3
   - c) 6*

8. One concept has a quantity, size, or physical dimension relationship with another.
   tree : penny :: lion : ________
   - a) horse
   - b) sky
   - c) pencil*
9. One concept is part of another concept.
   wheel : car :: eraser : ________
   - a) paper
   - b) pencil*
   - c) lead

It is important to realize that analogical reasoning can be approached from two different perspectives. One is to make students aware of the different relationships commonly used in analogy problems on standardized tests (i.e., those nine relationships listed above). When this is your purpose for teaching analogies, it is important that students understand why the test maker stressed one relationship over another. The second perspective for teaching analogies is to use them to stimulate divergent thinking. In such cases the students are encouraged to identify relationships that go beyond the scope of those nine presented above. From this perspective, if a student can justify her answer, the analogy is correct.

Why teach analogical reasoning?

- People who can recognize analogical relationships gain better understanding of the world around them.
- Solving analogy problems prepares students for aptitude tests.
- Identifying analogies stimulates divergent thinking.

When do you use analogical reasoning?

- When preparing students for an upcoming test.
- As an activity to tie together different types of material.
- As an entertaining sponge activity.

Sample Strategy for Introducing Analogical Reasoning

1. Present students with a familiar analogy from their own environment. For example, you might state: "*Schools* and *students* have a relationship similar to the relationship between *homes* and *children*. Describe the type of relationship shared by these two sets of elements."
2. After discussing students' answers, explain that this type of reasoning is called analogical reasoning. Go over the format of an analogy problem.
3. Present and model the process for solving analogies.
4. Explain that some common relationships are used on tests.
5. Present the nine (or fewer) common semantic relationships to students, and have them create an analogy for each of the nine types.
6. Select one or more of the analogies students have created, and show how other relationships could be identified that would create other analogies.
7. Explain to students that sometimes you will ask them to create analogies that are examples of the nine basic relationships: other times you will ask them to create analogies where the relationships go beyond those nine.

Classroom Examples

- Have students create analogies that involve topics from different subject areas.
- Before beginning to use analogies in an elementary classroom, children could first play a game of "opposites" and "similarities," comparing many sets of two elements for their opposite and similar relationships. Focus the discussion on identifying the relationship between the items in the first set and matching that relationship with another set of items. Much work can be done orally and on an overhead before playing the analogy "games" on paper. The actual naming of the different types of analogous relationships can come as they are used and explained during the guided class discussions. A logical extension is to have the children devise and share their own analogies.
- Present the nine common types of analogies to secondary students as a tool useful in taking a··tude tests. Emphasize the process of solving analogies. Assign different students ..e task of creating practice analogy tests for the class to take.
- Use analogies to relate information read in stories to real-life situations. For example, in *The Cay* by Theodore Taylor, set during WW II, an initial incident in the story portrays Phillip and all the residents of Curacao standing on the banks of their island filled with hope and joy as they watch a tanker filled with aviation fuel steam out of their harbor to fuel the war effort. The tanker is torpedoed at the mouth of the harbor. Ask the students for a real-life example that would be an analogy for this incident. Emphasize that the elements in the first set of this analogy are the ship and the emotions generated when it was destroyed. Some students may identify the space shuttle disaster as an event that contains elements with a similar relationship.

APPENDIX C

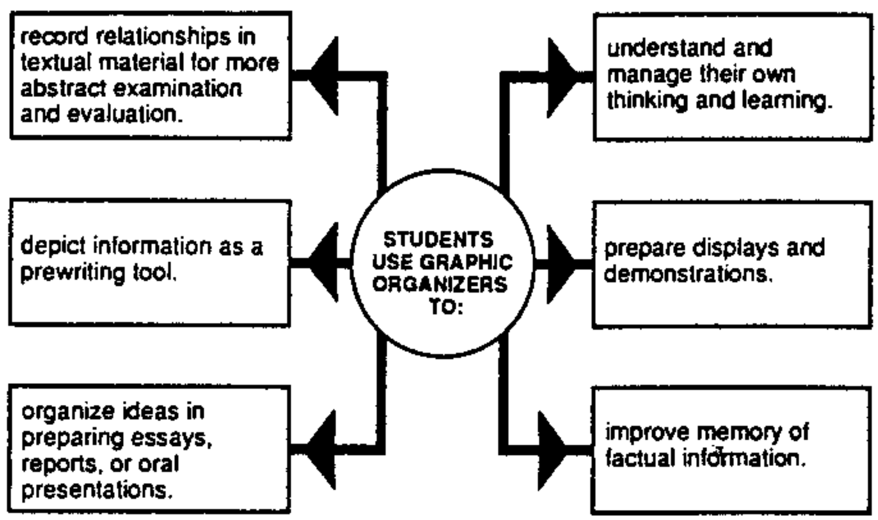
SAMPLE MATERIALS FROM

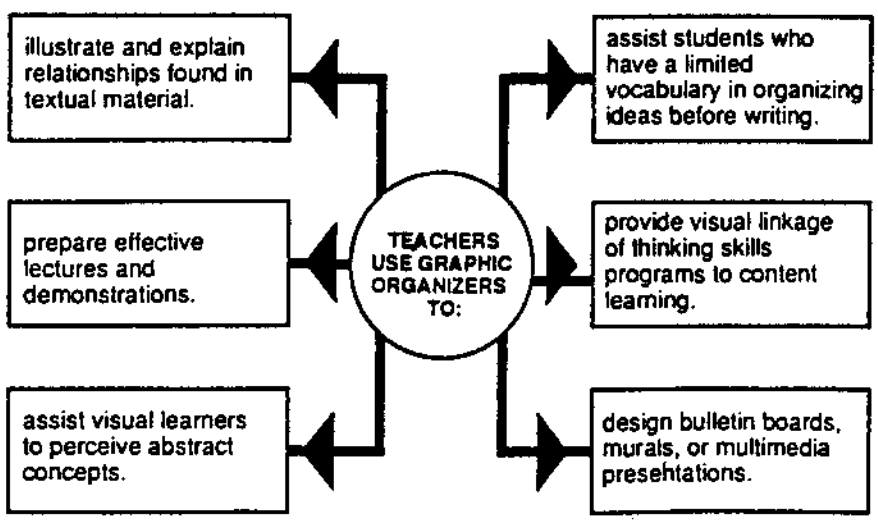
ORGANIZING THINKING

ORGANIZING THINKING

Organizing Thinking is a handbook of direct-instruction lessons to integrate the teaching of thinking skills into elementary school instruction. Central to all lessons is the use of graphic organizers to illustrate how information is related. These graphic organizers depict key skills (compare and contrast, sequence, part/whole relationships, classification, and analogy) and involve students in active thinking about textual information to promote clearer understanding of content lessons. Diagrams serve as "mental maps" to depict complex relationships in any subject and at any grade level. Thus, graphic organizers become a metacognitive tool to transfer the thinking processes to other lessons which feature the same relationships.

The use of graphic organizers encourages students to see information as components of systems or as contrasting concepts, rather than as isolated facts. Once information and relationships have been recorded on graphic organizers, students then use the pictorial outline to form more abstract comparisons, evaluations, and conclusions. These "diagrammatic outlines" help students organize their thinking for writing, for oral or visual presentations, and for problem solving.





USING A CENTRAL IDEA GRAPH

RATIONALE FOR CENTRAL IDEA ACTIVITIES

The central idea graph (sometimes called a "web" diagram) is used to depict the parts of, results of, or contributors to a central theme. Students often perceive the supporting points as disconnected fragments of information, rather than as a conceptual whole. Use this graph to prompt students that supporting data are not isolated facts and are related to the central idea. For example, in a classroom discussion of the United Nations, students will probably recognize that the General Assembly and the Security Council are divisions of the United Nations. As the discussion proceeds to include the Trusteeship Council or the International Court of Justice, use the central idea graph to remind students that these agencies are divisions of the United Nations, not separate institutions.

Central idea graphs are useful as a reading comprehension tool, a review aid, or a guide for designing exhibits or displays. In creative thinking and decision making activities, use them to depict alternatives, consequences, or related terms. These graphs can be used to depict a variety of relationships: part/whole, events/consequences, causes/effects, class/subclass, and concepts/examples. Because this graph is so versatile, it is commonly used as a prewriting tool. Several variations of the central idea graph are featured in the ***Thinking for Writing*** lessons.

The number of arms will vary. Four to six blanks have been provided to encourage students to consider as many divisions, examples, or alternatives as possible.

USE THE CENTRAL IDEA GRAPH TO:

- Depict a main idea and supporting details.
- Depict parts of a given object, system, or concept.
- Depict general classes and subclasses of a system.
- Depict factors leading to or resulting from a given action.
- Narrow or broaden proposed topics for a paper or speech.
- Organize thoughts in writing essay questions or in preparing a speech.
- Depict alternatives or creative connections in decision making and creative thinking.

TO USE THE CENTRAL IDEA GRAPH:

1. Write the central idea in the circle. Write each supporting detail on an arm of the diagram. Each arm may also branch to illustrate examples or subcategories.
2. To depict factors contributing to or resulting from a given event, mark each arm as an arrow. Direct the arrows toward the central idea to illustrate multiple causes; direct them away to illustrate multiple consequences or effects.
3. In decision making, enter the issue in the circle and brainstorm with students as many options or alternatives as they can suggest. Use the same graph to generate criteria that should apply to the most desirable solution. Examine each alternative regarding the proposed criteria.
4. To generate creative images or applications, write the subject in the circle. Brainstorm related ideas and record them on the arms. Each arm may branch to generate new connections. Examine the richness of ideas that the connections bring to the central idea. Select arms which are unusually imaginative or descriptive and use the ideas recorded there to create metaphors.

CENTRAL IDEA GRAPHS

USE CENTRAL IDEA GRAPHS TO DESCRIBE

PEOPLE

- Backgrounds
- Historical periods
- Achievements
- Ideals
- Challenges
- Life stages
- Contribution effects

PLACES

- Locations
- Land forms
- Significance
- Natural resources

THINGS

- Parts
- Measurements
- Kinds
- Uses
- Origins
- Operations
- Significance

ORGANISMS

- Structures
- Phyla
- Habitats
- Life requirements
- Physiologies

STORIES

- Significant characteristics
  - –Conflict
  - –Ideal
  - –Character
  - –Title
  - –Style
  - –Organization
  - –Novelty

EVENTS

- Participants
- Leaders
- Significance
- Causes
- Consequences

DECISIONS

- Goals
- Options
- Plans
- Actions
- Outcomes
- Criteria

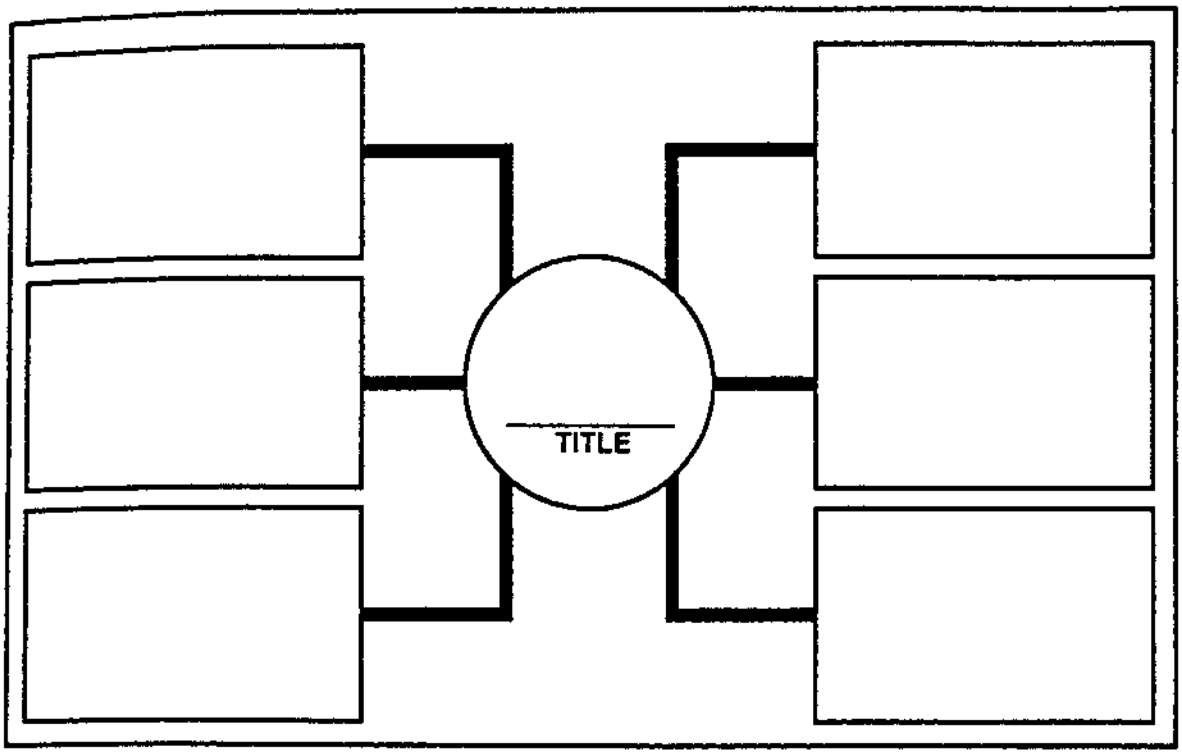
CULTURE

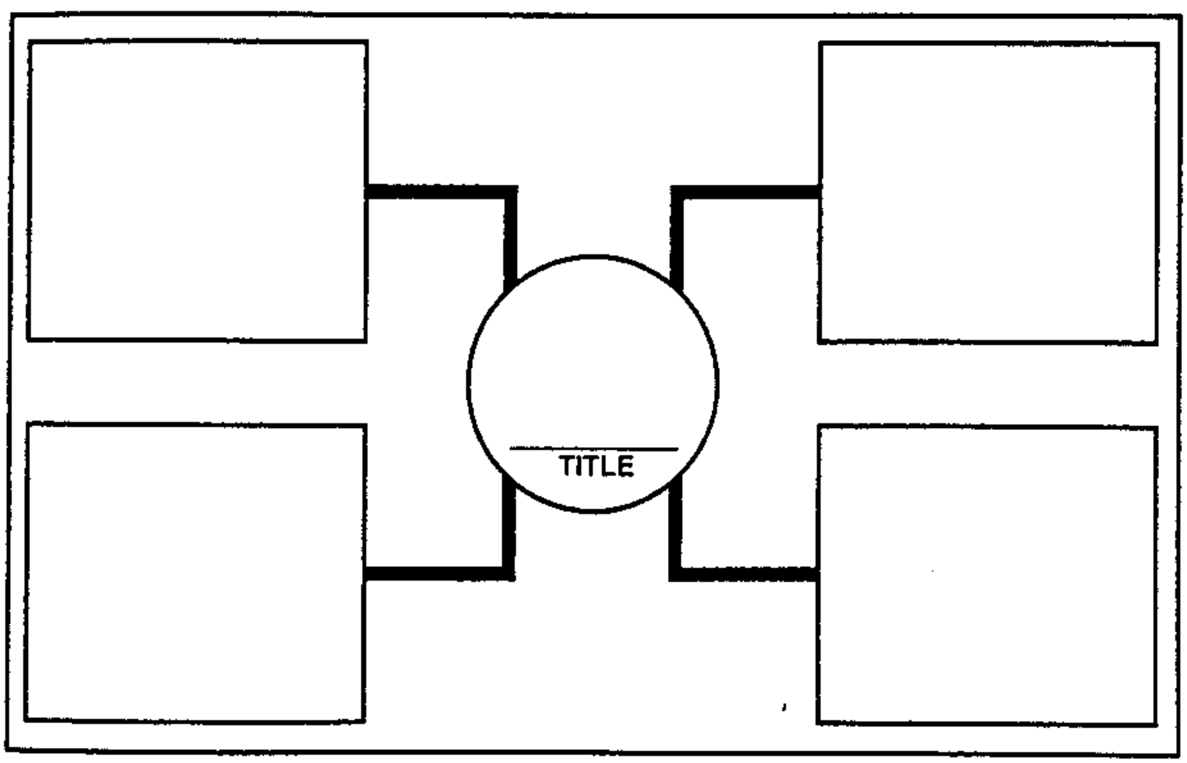
- Geography
- History
- Economic system
- Political system
- Leaders
- Technology
- Values
- Art

IDEAS

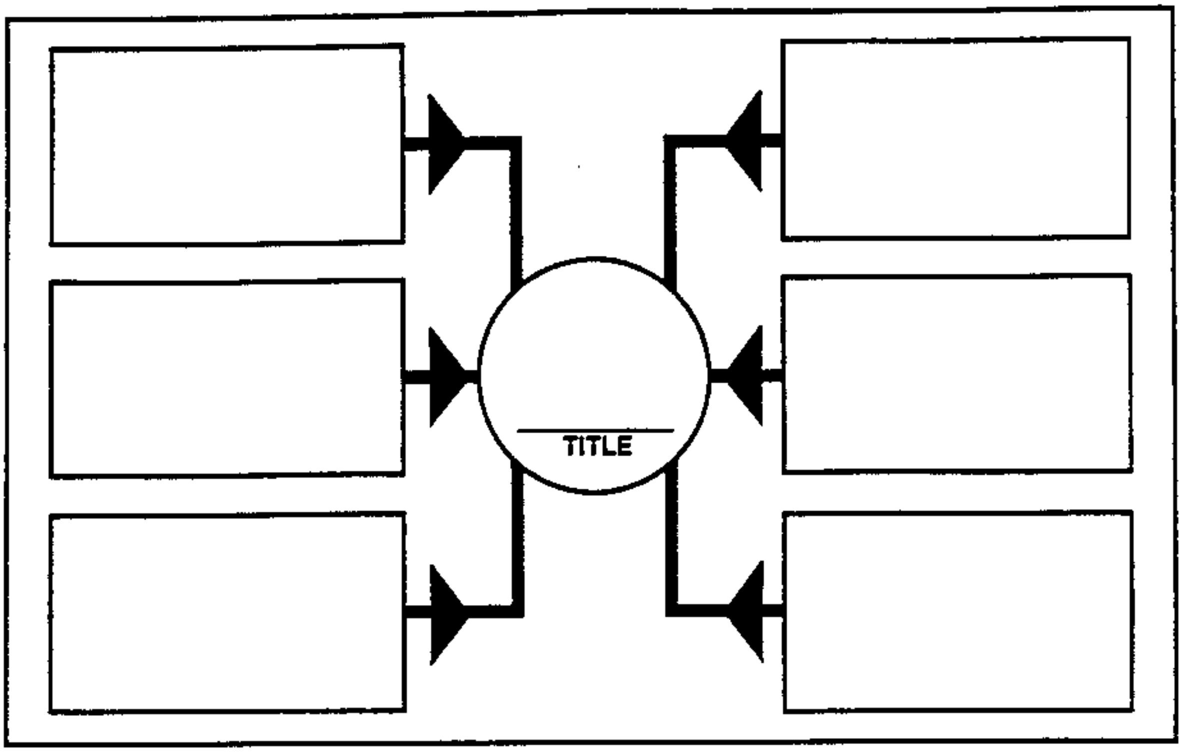
- Assumptions
- How developed
- Leaders
- Significance
- Implications
- Effects

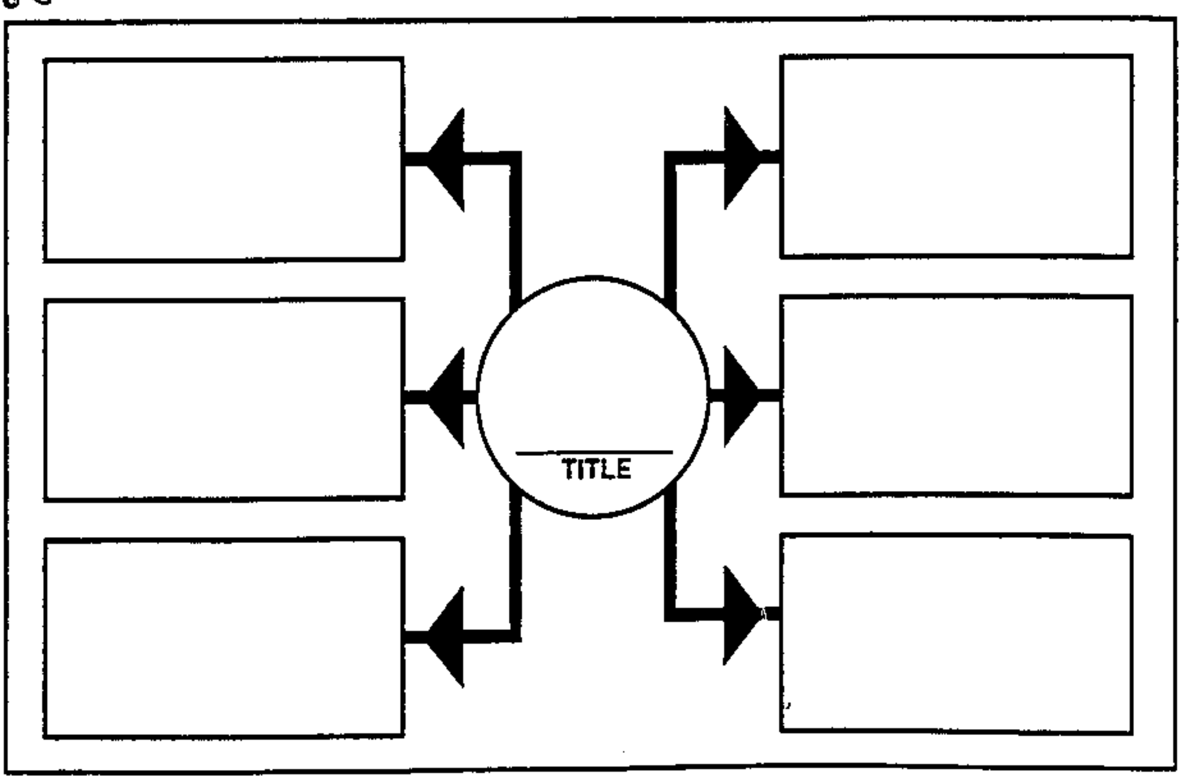
CENTRAL IDEA GRAPHS





CENTRAL IDEA GRAPHS





APPENDIX D

SAMPLE MATERIALS FROM UDALL AND DANIELS'

CREATING THE THOUGHTFUL CLASSROOM

Table 2 defines metacognition as we will refer to it and lists strategies and skills associated with it.

Table 2
Sample List of Metacognitive Skills

Metacognition: The consciousness of one's own thinking processes before, during, or following a complex-level thinking sessio·

KNOWLEDGE AND CONTROL OF ONESELF

Attitudes

This component includes such characteristics as learning from failure and belief in oneself.

Attention

This component includes the knowledge that different tasks require different attention levels, the ability to control our attention, and the use of selective attention skills.

Commitment

This component includes the ability to stay with a task even when it is difficult.

KNOWLEDGE AND CONTROL OF PROCESS

Planning

This component involves the deliberate selection of a strategy or plan of action prior to the activity.

Applying

This component involves the application of the selected strategy.

Regulating and Monitoring

This component involves checking your progress toward your intended goal. It also includes the ability to change or adapt your strategy as necessary.

Evaluation

This component involves determining the success or failure of your strategy and also assessing your current knowledge state.

This table compiles ideas from various sources including E. Bondy, "Thinking about Thinking," *Childhood Education* (March/April 1984): 234-38, and R. J. Marzano et al., *Dimensions of Thinking: A Framework for Curriculum and Instruction* (Alexandria, Va.: Association for Supervision and Curriculum Development)

Once you have a road map for use, there are other issues to contemplate before teaching. A major one focuses on the relationship of thinking to content areas.

TABLE 1
Complex-Level Thinking Skills*

Complex-Level Thinking: A type of cognition that requires basic thinking and is characterized by multiple possible answers, judgment on the part of the person participating, and the imposition of meaning on a situation. Types of complex thinking include critical thinking, creative thinking, and problem solving.

CRITICAL THINKING

A type of complex-level thinking characterized by the careful analysis of arguments, use of objective criteria, and evaluation of data.

1. Inductive thinking skills
- Determining cause and effect
- Analyzing open-ended problems
- Reasoning by analogy
- Making inferences
- Determining relevant information
- Recognizing relationships
- Solving insight problems

2. Deductive thinking skills
- Using logic
- Spotting contradictory statements
- Analyzing syllogisms
- Solving spatial problems

3. Evaluative thinking skills
- Distinguishing between facts and opinions
- Judging credibility of a source
- Observing and judging observation reports
- Identifying central issues and problems
- Recognizing underlying assumptions
- Detecting bias, stereotypes, cliches
- Recognizing loaded language
- Evaluating hypotheses
- Classifying data
- Predicting consequences
- Demonstrating sequential synthesis of information
- Planning alternative strategies
- Recognizing inconsistencies in information
- Identifying stated and unstated reasons
- Comparing similarities and differences
- Evaluating arguments

CREATIVE THINKING

A type of complex-level thinking that produces new and original ideas.

- Listing attributes of objects/situations
- Generating multiple ideas (fluency)
- Generating different ideas (flexibility)
- Generating unique ideas (originality)
- Generating detailed ideas (elaboration)
- Synthesizing information

PROBLEM SOLVING

A type of complex-level thinking that uses a number of sequential skills to solve a problem.

- Identifying general problem
- Clarifying problem
- Formulating hypothesis
- Formulating appropriate questions
- Generating related ideas
- Formulating alternative solutions
- Choosing best solution
- Applying the solution
- Monitoring acceptance of the solution
- Drawing conclusions

*Adapted from Gubbin's Matrix of Thinking Skills. Gubbin's Matrix compiles and distills ideas from Bloom, Bransford, Bruner, Carpenter, Dewey, Ennis, Feuerstein, Jones, Kurfman, Kurfman and Solomon, Lipman, Orlandi, Parnes, Paul, Perkins, Renzulli, Sternberg, Suchman, Taba, Torrence, Upton. The Ross Test, the Whimbey Analytical Skills Test, The Cornell Critical Thinking Test, the Cognitive Abilities Test, the Watson-Glaser Critical Thinking Appraisal, the New Jersey Test of Reasoning Skills, and the SEA Test.

From: Creating the Thoughtful Classroom, 1991

1. I WILL PARTICIPATE

DURING THE LESSON	*EVALUATING & IMPROVING MY THINKING*
• Listen to the focusing question. • Think about what other students say. • Try to give an answer when called upon. • If you cannot comment say, "I need more time to think (listen)." • Be aware of the number of times you participate. • If oral participation is difficult, you should ask the teacher if you may participate by writing answers.	• STUDENT SELF-EVALUATION–*Lesson* Your teacher will sometimes have you fill out a self-evaluation. Be honest. • STUDENT RESPONSE FORM–*Tally Participation* If your teacher has a student tallying responses, ask to see how many times you participated. • AFTER SCHOOL: Discuss news items with your parents. Get their point of view. Don't judge or give opinions—simply listen for another person's point of view. Ask for their reasons.

NOTES TO MYSELF:

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2. I WILL GIVE REASONS FOR ANSWERS

DURING THE LESSON	*EVALUATING & IMPROVING MY THINKING*
• Ask for clarification of focusing question/problem if you don't understand. • Ask questions about the focusing question. • Take a stand on one idea (answer). • Write down possible reasons for your idea or • Think about reasons before speaking. • Listen to other people's reasons. • Give reasons when called upon, using the sentence structure for reason statements.	• STUDENT SELF-EVALUATION–*Lesson* • STUDENT RESPONSE FORM–*Gives Reasons* AFTER SCHOOL: • Practice giving reasons for your opinions. • Identify opinion and fact when you listen to TV programs. • Practice using the sentence structure for reason statements: • "I believe __________ because (*reason*)."

NOTES TO MYSELF:

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3. I WILL USE PRECISE, SPECIFIC WORDS

DURING THE LESSON	*EVALUATING & IMPROVING MY THINKING*
• Teacher will model precise speaking, so listen to the teacher. • Think about what you wish to say before saying it. • Try to speak concisely: Put your thoughts in a "nutshell." • Take opportunities to practice speaking in a small group as well as in total class. • Try not to use "you know." • Note new vocabulary you hear. • Use new vocabulary in other situations.	• STUDENT SELF-EVALUATION–*Lesson* • STUDENT RESPONSE FORM–*Using Precise, Specific Words* • Ask a partner to script your responses in a discussion. After discussion attempt to reword your response for precision and clarity. • Practice rewording verbose sentences in writing. • Practice rewording another person's statements orally. • Listen for precision in teacher's speech.

NOTES TO MYSELF:

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4. I WILL TAKE TIME TO THINK ABOUT THE PROBLEM AND WILL BE COMFORTABLE WITH THE AMOUNT OF TIME AN ACTIVITY TAKES

DURING THE LESSON	*EVALUATING & IMPROVING MY THINKING*
• Concentrate on the problem. • If you can't hear, raise your hand and ask for the student to repeat. • Think about several solutions/answers to the question. • If you start to daydream, write down a few thoughts about the issue. • Actively listen to other students and think about what they are saying.	• STUDENT SELF-EVALUATION–*Lesson* • Be familiar with the requested student behaviors. AFTER SCHOOL: • Spend "quiet time" at home with no TV. • Read, plan something you will do, think about something that happened.

NOTES TO MYSELF:

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5. I WILL STICK WITH A PROBLEM, EVEN THOUGH IT IS DIFFICULT

DURING THE LESSON	*EVALUATING & IMPROVING MY THINKING*
• Decide not to quit even if you don't understand. • Listen for the parts you do understand. • Work increasingly difficult problems. • Talk to other students about how they solve problems.	• STUDENT SELF-EVALUATION–*Lesson* AFTER SCHOOL: • Do puzzles, models, or such projects at home. • Work alone on something. • Ask directions and attempt to figure things out for yourself. • Practice not quitting in sports. • Try to be independent in work. • Define the characteristics of successful people.

NOTES TO MYSELF:

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6. I WILL OFFER DIFFERENT ANSWERS TO ONE PROBLEM

DURING THE LESSON	*EVALUATING & IMPROVING MY THINKING*
• Listen for open-ended questions and ask yourself: "How many ways can that be answered?" "What is something no one has said yet?" "How would my dad (mom, brother) answer that?" "What's an angle the teacher has not yet thought of?" • Write down several answers before volunteering answers.	• STUDENT SELF-EVALUATION–*Lesson* • STUDENT RESPONSE FORM–*Offering Different Answers to One Problem*

NOTES TO MYSELF:

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7. I WILL LISTEN TO WHAT OTHER STUDENTS SAY

DURING THE LESSON	*EVALUATING & IMPROVING MY THINKING*
• Look at the person who is speaking. • Think about what the other person is saying. • Agree or disagree in your mind as you listen to others. • Preface your comments by acknowledging other students' ideas when appropriate: "Jeff made me think of something . . ." "I disagree with Jeff because . . ." "I wonder if Jeff ever thought of this situation . . ." • Remember that disagreeing with a person's comments does not mean you find the *person* disagreeable. • Separate your personal feelings from the discussion. Because you do not "hang around" with another student does not mean that you should not listen to that person's ideas. • Sometimes reword another person's thoughts. For example: "I believe I understood Jeff to say . . ." "Do I understand you, Jeff, to mean . . ." • Do not interrupt another person. • Try not to raise your hand while another person is talking. • Comment on other people's statements only to the group—no side comments. • Be supportive of each other in their comments: "I see Jeff's point, but I believe . . ."	• STUDENT SELF-EVALUATION–*Lesson* • STUDENT RESPONSE FORM–*Tally for Acknowledging Other Students* AFTER SCHOOL: • Practice REALLY listening to your best friend. • Practice these behaviors at home with parents. • Listen to an assigned newscast, without taking notes, and write a synopsis.

NOTES TO MYSELF:

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8. I WILL THINK ABOUT MY THINKING

DURING THE LESSON	*EVALUATING & IMPROVING MY THINKING*
• Be able to tell how you solved a problem (not telling the answer). • Be aware of how you are thinking. • Try to understand how another person is figuring out a problem. • Map your thinking. • Study the brain.	• STUDENT SELF-EVALUATION–*Lesson* • Find a younger child, present him or her with a problem, and ask the child to tell how he or she solved it. Explain how to solve the problem to the child. • Tell what you thought about to answer the problem of how to ________________ • List the things you are best at naturally. • Think about "nothing" and write about what happens in three minutes. • Discuss dreams, déjà vu, premonitions, and other mental occurrences. • Discuss mental characteristics of your parents, brothers, sisters, and friends and relate them to yourself. • Compare your method to a partner's method of solving a problem.

NOTES TO MYSELF:

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9. I WILL ASK COMPLEX QUESTIONS ABOUT THE TOPIC

DURING THE LESSON	*EVALUATING & IMPROVING MY THINKING*
During the discussion: 1. Listen for parts of the topic you do understand. 2. Compare the topic to other things you know. 3. Listen to what other people are asking. When asking a complex question: 1. Begin the question with words like how, why, what, if. Sample questions could be: a. How is this different from . . . ? b. How does this compare to . . . ? c. What caused . . . ?	• STUDENT SELF-EVALUATION–*Lesson* • STUDENT RESPONSE FORM–*Asking Complex Questions* AFTER SCHOOL: • Ask your parents or brothers and sisters questions about something they know that you don't.

NOTES TO MYSELF:

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____________________ ____________________

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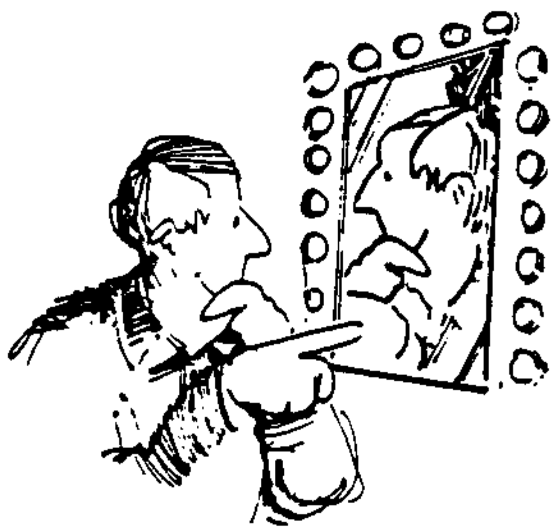
APPENDIX E

SAMPLE STYLE INFORMATION

FROM ICTECH



Description:

This style is most effective when new and original ideas are part of learning. Seldom will Non-Visuals enjoy working in highly structured conditions. They will question the sense of almost anything from the way the learning should be done – to the judgment of the teacher. If the situation seems illogical and there is no overriding factor (threat of punishment) to keep the Non-Visual working, he/she may attack what is perceived as poorly thought out demands. This style views the world as an observer asking, *"Does this make sense?"* They question the *why* of any and everything!

To get maximum results, present information visually; a picture, video, diagram, a sketch, or even hand drawn X's and dotted lines! Use the visual input to convey the message. Non-Visuals are *here and now* thinkers who do not look to past experiences or future possibilities to develop understanding. Consequently, they can be sources for fresh ideas and different viewpoints. They will always deal with the moment.

As learners, Non-Visuals can be fast and extraordinarily productive, but, they will walk away, with no guilt, if they lose sight of the reason for doing something. This style is best motivated by immediate rewards. Talking in concepts, logical explanations, and pictures is a perfect communication tool for getting their cooperation and helping them to be better learners. They will respond best to ideas that are presented as challenging and fun.

The ideal learning environment for Non-Visuals consists of independence and freedom to try original thinking. It is crucial to keep communications flowing and offer immediate visual or verbal feedback. They must see the picture. A major asset of this learning style is the capacity for originality and ability to explore new paths.

Attributes of Learning and Imagery Style

Non-Visual Imager

Motivation to WANT to learn:

Key: When the picture is visual and things make sense to him/her.

- Looks for logical sense of the material.
- Learning is fun, a challenge or a game.
- Keeps the reason *why* present.

The Learning process:

Key: Must be constantly involved or active in the process.

- Works with others for idea exchange and validation.
- Needs challenge and fun to remain evident.
- Needs regular reinforcement of the reason *why*.

To get them to finish:

Key: Is personally committed to the reason for completion.

- Keeps the concept clearly in mind.
- Finishes better with persuasion ... not force.
- Keeps the commitment to the challenge.

The Non-Visual believes that life is a process of discovery and doing. Knowing this will lead him/her to be able to make sense of life. The Non-Visual always looks for logic and stops when it no longer seems apparent. (Even if it is judged from a faulty base.)

APPENDIX F

SAMPLE UNIT AUTHORED BY RESEARCHER FROM THE

Strategic Thinking Skills Curriculum Guide

UNIT B: "MEMORIES" OR, BARBARA STREISAND WAS RIGHT: THEY DO LIGHT THE CORNERS OF THE MIND!

Goal: Students will be able to distinguish between natural (locale) and rote (taxon) memorization activities.

Description: Utilizing again, information from Caine and Caine, information will be shared regarding natural, or locale memory and memorization, or taxon memory systems. Some supplementary activities and exercises are provided for use now and throughout the year to "improve" or enhance meaningful storage and retrieval of information.

Information:

If we compare recalling a list of vocabulary words "learned" last year and recalling what our favorite piece of clothing is, we experience the difference between natural versus rote memory. What we usually think of when we speak of "memory" is actually memorization. Memorization requires effort, but we seem to ignore or take for granted our other kind of memory that recalls effortlessly thousands of bits of information accumulated during our daily lives.

The two types are going to be referred to in our coursework as the taxon and the locale memory systems. The first derives its name from lists or taxonomies of categories that represent a generic item, such as cats, the contents of categories, such as types of cats, and routines and procedures such as how to feed the cat or drive a car. The second is a spatial memory, and since everything that happens to us happens in space, it stands to reason that we are always in a physical context that affects us and affects learning and memory.

There are numerous taxon systems, such as the one that seems to allow us to remember faces, but all the systems have many characteristics in common. The most pervasive characteristic is that all taxon memories must be rehearsed, since we only hold about seven chunks of memory in short-term storage at any time. In order for us to transfer taxon tasks to long-term memory, they must be repeated until they are committed to long-term memory. Taxon memory is generally linked to extrinsic motivation (placed upon you from "outside"; by someone else) and powerfully motivated by external reward and punishment, as is witnessed by students trying to memorize for tests because they want to earn a good grade, not because they want to remember forever, etc. Taxon memory systems are quite resistant to change; that is why things stored via taxon systems are much more difficult to transfer to new situations or into other learning. Items in the taxon systems are relatively isolated, and much of what we store in them is not initially meaningful.

We are all born with the capacity to navigate through space. Every human being has a spatial memory system, and its capacity is virtually unlimited. (It would be interesting to determine whether students who are experiencing difficulty with memory, are utilizing their taxon system heavily, and failing to enlist their locale systems, wouldn't it?). Locale memories exist in relationship to where we are and what we are doing, and since they are ongoing, they are cumulative and have complete relationships between all items in storage.

O'Keefe and Nadel say that we form and relay on spatial "maps" to guide our movements and interactions within our surroundings. Caine & Caine give the example of someone having been in an airport before. When that person finds himself in a new airport, he will call upon his past experience and construct and update according to what is happening in the current experience to help him find his way through the new airport. These initial maps tend to form quickly, but we tend to update our maps on a continuous basis. Map formation is motivated by novelty, curiosity, and expectation; therefore, it tends to be intrinsically motivated. That means we want to make sense of our world for ourselves, not to please someone or avoid punishment. Locale memory is enhanced through sensory acuity, which means that the more aware of smell, taste, touch, sound and so forth a person is, the richer the locale memory system. Certain cultures and individuals value this more than others, as with the Native Americans, but it can be improved with practice.

Maps for specific places are sort of instant, larger, intricate maps may take a considerable amount of time to be formed, for they are the consequences of many experiences that only gradually come together. Locale memory is not limited to maps in physical space; there appear to be mental maps of information, existing as part of an interconnected pattern, or a from of "mental space". Our natural mental maps, therefore seem to be at the heart of thematic teaching which you should experience much more this year with your team teachers. This memory system is the one that is engaged when we use stories, metaphors, celebrations, imagery, and music, all of which are powerful tools for brain-based learning.

The two systems naturally interact, as do the parts of the brain. The stronger the connections, the greater the success of recalling stored information. We hope you will understand why we are making changes in the way we structure your learning environment and experiences in an attempt to utilize your natural memory system, instead of "overtaxing" your taxon system.

Take just a moment to write in your journal the ten things you remember most about last year in school. See how many of them are isolated pieces of information and how many are part of an experience. You may pair with someone and share your findings, or the teacher may ask you to form groups, or call upon volunteers to share.

After the students share, determine what was remembered. Ask them to again think about last year, and to tell the class any vocabulary words that they can still remember and define for the class. As the students remember the few words that surface, try to find out why that word stuck in their minds. It has been my experience that the teachers who make associations, or who incorporate the word into a rich learning experience offer the best retention.

Now ask the students to pair and have one person close his or her eyes. Ask the person with closed eyes to describe everything about the classroom that he or she remembers, giving as much detail as possible. Stop the pairs after 1 - 2 minutes. Have the partners switch roles, and now the person with closed eyes describes to their partner what that person is wearing. This clearly demonstrates that their memories were working even though they were not aware of it at the time.

The other two contrast activities that can be used as warm -ups to precede the discussion, are to have students list something like states and capitals, or counties in the state, countries in the world, etc. Find out why they remembered what they did. The general patterns so far have been that they learned it in a song, in an infusion lesson, or from having experiences associated with the place.

Now have the students turn their papers over and give every detail that they remember about dinner the night before: sights, sounds, smells, people . . . anything at all. For students who did not eat, choose a rote activity like brushing their teeth and getting ready for bed.

Students usually describe the taxon memory system as hard to use; the locale as very easy and fun to use. Any similar activity helps the learner develop a feel for the difference in retrieval processes and storage processes for both systems.

APPENDIX G

PERMISSION LETTERS FOR THE STUDY

Lewisville Independent School District

BARBARA STAGNER, Principal

Lina Milliken Middle School
2103 Savage Lane
P.O. Box 217
Lewisville, Texas 75067
(214) 436-7581

Sept. 18, 1992

Joyce Houchins
Milliken Middle School
Lewisville, TX 75057

Dear Ms. Houchins:

Please be advised that your request to conduct research at Milliken Middle School has been approved, as proposed. Students may be tested, as proposed, as long as parental permission has been secured in keeping with LISD Board Policy.

Let me take this opportunity to thank you for the work you have done in designing the curriculum for the Strategic Thinking Skillls course, and the work you will be doing in its evaluation. I believe this course will have a significant positive impact on our students. I am eager to see the results of your study!

Sincerely,

BmStagner

Barbara Stagner

Lewisville Independent School District

BARBARA STAGNER, Principal

Lina Milliken Middle School
2103 Savage Lane
P.O. Box 217
Lewisville, Texas 75067
(214) 436-7581

March 23, 1993

Dear 7th-grade Parent:

If you attended Orientation, you may recall my mentioning that some research would be done on the effectiveness of our new Strategic Thinking Skills course. This letter is my request of your permission for us to include your child in this study. Your permission will allow us to have your child take the COGAT(Cognitive Abilities Test), Form 4, Level E toward the end of the school year. His/her scores will be used only as a part of group data, not by name, and that data will be compared with the group data on the same test of last year's 7th-graders(who had not had this course) to see if this group demonstrates a higher level of reasoning/learning skills. The results of this study will not only become a basis for our evaluation/revision of our new curriculum, but will also be used as part of a doctoral study conducted by Joyce Houchins, a University of North Texas doctoral student. We are grateful to Joyce for her help in designing this course and its evaluation.

Evaluation of new courses is an essential part of our school improvement efforts. We hope that you will allow your child to participate, but please be assured that no student will be required to participate in the testing, and that his/her participation or non-participation will, in no way, affect his/her grade in the course.

Please indicate, on the attached form whether or not your child may participate in the testing. Then, please detach the form, and have your child return it to his/her Strategic Thinking Skills teacher by Thursday, March 25.

Sincerely,

Barbara Stagner
Principal

I do/do not give my permission for ______________________
(circle one) (student name)
to take the COGAT test on April 1, 1993 for the purpose of Milliken

Middle School's evaluation of the Strategic Thinking Skills course.

Signed ______________________

Dated ______________________

I do/do not give my permission for ______________________
(circle one) (student name)
to take the COGAT test on April 1, 1993 for the purpose of Milliken

Middle School's evaluation of the Strategic Thinking Skills course.

Signed ______________________

Dated ______________________

McREL
2550 South Parker Road
Suite 500
Aurora Colorado 80014
303/337-0990

June 14, 1993

Joyce Houchins
1912 Kingswood Court
Denton, Texas 76205
(800)598-8641
Public Fax # 817-383-1960 (24 hrs.)

Dear Ms. Houchins:

In response to your request to reprint certain materials from the Tactics for Thinking Teacher's Manual (1986), I hereby grant permission for you to use the specific materials listed under the condition that you are not using my materials in anything that you intend to market for personal gain or recognition. Please type "Reprinted with permission by Robert J. Marzano" at the bottom of each page used, thereby acknowledging my copyright.

In your Strategic Thinking Curriculum Guide (1992), you have my permission to reprint the lessons on Attention Control (pp.9-12), Deep Processing (pp. 13-16), Power Thinking (pp.22-24), and Goal Setting (pp.25-28) from the "Learning to learn" section.

In your dissertation The Effects of a Thinking Skills Program on the Cognitive Ability of Seventh Graders (1993), you may include units 6 (pp.29-31), 9 (pp.49-53) and 13 (pp.69-72) in your Appendix B to serve as examples of the lesson format and content from each of the three sections of the Tactics program.

Sincerely,

Robert J. Marzano

Robert J. Marzano, author
Tactics for Thinking

CRITICAL THINKING PRESS & SOFTWARE
formerly Midwest Publications

Critical Thinking Activities in Reading/Writing, Social Studies, Mathematics, Science, and Ethics for Remedial - At Risk - Average and Gifted students K-12

P.O. Box 448
Pacific Grove
CA 93950-0448
800-458-4849
Fax 408-372-3230

June 14, 1993

Joyce S. Houchins
1912 Kingswood Court
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(817) 243-1506
(800) 898-8641

Dear Ms. Houchins:

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June 14, 1993

Joyce S. Houchins
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Dear Ms. Houchins:

You are hereby granted permission to place pages 28, 29 and 117-121 of Udall and Daniels' Creating the Thoughtful Classroom (1991) in Appendix D of your dissertation, The Effects of a Thinking Skills Program on Cognitive Abilities of Seventh Graders (1993). We would like you to be sure to protect our copyright by typing at the bottom of each page the following statement: "Reprinted by permission of Zephyr Press, 1993".

Thank you for your interest in our company's products. We are glad that this book was helpful to you, and appreciate the recognition you have given us by using it in your study.

Sincerely,

Jane Brewster

Jane Brewster

Dr. Thomas S. Carlson
Linda Blew Carlson
293 RT. 377
Argyle, Texas
FAX # 871-464-7763

June 14, 1993

Joyce S. Houchins
1912 Kingswood Court
Denton, Texas 76205
(817) 243-1506

Dear Joyce:

This is to confirm our formal permission to include the two ICTech style sheets explaining the nonvisual style in Appendix E of your dissertation, The Effects of a Thinking Skills Program on the Cognitive Ability of Seventh Graders. We understand that you are not using these materials for personal gain or recognition, but merely to demonstrate our Individualized Communication Technology more clearly for your readers.

Please protect our copyright by typing at the bottom of each of the two pages "Reprinted with permission from Carlson & Carlson, 1993". We're glad you enjoy our technology and are pleased that it was a part of your study.

Sincerely,
Tom Carlson 6/14/93
Tom Carlson
Linda Carlson 6/14/93
Linda Carlson

REFERENCE WORKS

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