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RAISING INTELLIGENCE IN THE PUBLIC SCHOOLS: A THEORETICAL MODEL

*The University of Arizona* PH.D. 1985

# RAISING INTELLIGENCE IN THE PUBLIC SCHOOLS: A THEORETICAL MODEL

by

Reed Frank Spencer

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GRADUATE COLLEGE

As members of the Final Examination Committee, we certify that we have read the dissertation prepared by Reed Frank Spencer

entitled Raising Intelligence in the Public Schools:
A Theoretical Model

and recommend that it be accepted as fulfilling the dissertation requirement for the Degree of Doctor of Philosophy.

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SIGNED: Reed F Spencer

This work is dedicated to my beautiful wife, Nada, whose unselfish dream for these years has been to see this dream come true for me; and to my wonderful children--Justin, Christy, Sally, Trevor, and Kip--who have so many times bouyed up their very human father with unquestioned love, and with patience and understanding beyond their tender years.

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ABSTRACT

The problem addressed in this theoretical study was that although current knowledge and research indicate clearly that intelligence can be raised in the regular classroom, there did not exist a model to guide teachers in doing so. The purpose of this study, then, was to construct a model which would guide teachers in adapting their instruction so that "teaching was thinking," or teaching to raise intelligence be deliberately addressed by the way existing subjects are taught, rather than (or in addition to) as a separate subject. In other words, the purpose of the study was to propose a model which would help teachers deliberately and systematically improve students' generic skills of intelligence in the course teaching normal curricular subjects--a way of teaching rather than a separate subject.

The first issue addressed is the historical context surrounding the debate over the construct of intelligence as alterable--that intelligence is not an immutable "amount," but the orchestration and use of malleable, teachable processes. Second, philosophic, psychological and educational foundations were laid and examined, and the model was proposed and discussed.

Particular emphasis was given discussion of model theory, including the need for and structural parameters of academically honest models.

Third is the review and discussion of research and writing relating to instructional attempts to raise intelligence. This review begins with seminal theoretical works, and progressing through to those with increasingly specific applications to actual instruction in the classroom. Fourth, the model was used to generate specific, substantive examples--lesson plans--of instructional strategies within various subjects. Although the content used is from elementary school curricula, the model is equally applicable to high school, college, or any other instructional arena. Fifth and finally, the problems and promises imherent in the attempt to implement such a curricular effort were examined.

# CHAPTER 1

## INTRODUCTION

The purpose of this chapter is to outline and set in historical context the issues surrounding the need for altering the curricular structure now practiced in most educational settings. It is the thesis of this paper that the present curricular focus on the simple transmission of content should and can be refined to focus on the more fundamental purpose of teaching: to increase the learner's ability to think--to focus instruction on improving the learner's ability to deliberately utilize basic skills of intelligence.

### Curriculum Practice in a Framework

> The great campaign against the American public school has now reached the stage of overkill. It is impossible to believe that anything new can be added to the attacks already delivered, for the schools have been assailed from every conceivable direction, with every conceivable motive. The coalition against them is such as to suggest that the one thing on which our people have reached unanimity is the evils of our system or public education. The coalition is a strange one, because the critics would not agree with, or even speak to one another on any other subject. Soft-hearted revolutionaires and hardhearted businessmen join... (Hutchins, 1972, p. 155).

For the professional educator, the latest onslaught of school evaluation and improvement studies, commissions, reports, polls ad nauseum offer a few a pat on the back, and fewer the feeling that what they do each day is good and right and helpful to the objects of their attention. In a profession where society has historically designated these pats as the rewards which compensate for low salary, this is a serious state of affairs, one that offers at least partial explanation for the current exodus of excellent people from the ranks of education.

Having endured criticism for generations, educators continue to examine their practices and the contributions of their professional peers with the goal of making schooling more effective. However, educators do not seem to be able to agree on the purposes, the appropriate content, the most effective instructional strategies, nor even the criteria for deciding any of these fundamental issues.

To add to the disagreements, recent research and writing suggest that conclusions drawn from quantitative, statistical research in the behavioral sciences heretofore accepted as "true" may have been declared so on very questionable premises (Mishler, 1982). Even if we forget, for a moment, these questionable premises, the conclusions and recommendations of most research have rarely made more

than a temporary impact on what is actually done in school (Goodlad, 1983a). It may be concluded that the usually reliable epithet "Change is constant" is a dismally inadequate way to describe the past and present pedagogy of public education in this country.

Continual, predictable and blistering criticisms from public or private groups from outside the profession have not led to substantive change. Accumulations of research from within the profession have not. Although most have made no more than ripples, some have made genuine waves (there is almost always a wave). Occastionally we may even see a tidal wave, but no person, no group, no piece of research has created the tsunami of improvement predicted, expected and looked forward to by so many. And in the end, all ripples and waves of change seem to subside and disappear.

The conclusion? Substantive improvements in public education in any pedagogical sense has wavered somewhere between agonizingly slow and nonexistent. As Goodlad (1983b) resignedly observed after evaluating the data collected in a monumental research project, "a school is a school is a school," and has been so for quite some time.

An explanation of the present state of curriculum practice must begin at the beginning. Since the decision

by the founding fathers that education was to be a responsibility of the individual states, and not the federal government, and the concomitant decision by the states that education would largely be controlled by the local community, no one voice, governmental or otherwise, has dictated curricular policy to the schools of the nation. Federal regulation of schooling has evolved only as the courts and federal regulatory agencies have intervened on matters of civil rights. Most of this regulation has effected administrative rather than curricular policy. The well spring of school policy, most especially with regard to matters of specific curricula, has always been lay-member local school boards. Never has there been agreement, voluntary or legislated, as to the aims of education for a group of students larger than that of a district, and rarely even in that case. In a nation where so much philosophic diversity exists, so many voices cry out with the right to be heard, and so much cultural and economic variety to be accommodated, curricular policy seems to have deteriorated in most cases to the lowest possible common denominator: the bare accumulation of content.

Of all the ripples and waves of educational change which have come and gone, one has thankfully persisted: the attempt to evevate the purpose of instruction from the

bare accumulation of content to the acquisition of skills and processes with which to order and utilize that content. Bloom (1964), Kirk (1958), Gagne (1965), Hunt, (1961), and others have insisted that improving a learner's ability to use skills of thinking is the only defensible purpose of education.

The logical extension of such a curriculum thrust is the object of this paper: to create an instructional model which provides the theoretical framework and direction with which to guide the development of materials and instructional procedures to focus instruction on improving the learner's ability to use skills of intelligence.

Saunders (1969) provides an appropriate conclusion to these thoughts. He states that "three learning frameworks" may be summarized as follows in terms of selected categories:

I. Traditional
Goal: fact description and collection, world as it is, wider experiences, subject matter skills, deduction from discovered truths.

Learning Theory: Association, conditioning, repetition (Thorndike, Herbart, Hull).

Educational Criticism: Can children pass tests on subject, feed back and describe the objects of their attention to the satisfaction of their critics? Do they have a wide experimental background? Older children have had more "experiences."

II. Current
Goal: classification, organization, world as seen by subject matters as instruments, induction into science as an inquiry system.
Learning Theory: cognitive learning theory (Ausebel, Anderson, Gagne, Bruner).
Educational Criticism: Can children see an object in its many subject matter possibilities as determined by the science flassicication involved? Can the child use an abstraction ladder and understand higher order principles? Have the students memorized the "steps of science method?" Children of all ages have "significant" experiences when and only when they are able to classify these experiences extensively.

III. Future
Goal: deliberate selective perception, relational thinking, legislation of possible meaning and the appropriate decision process; meaning by category and style, abduction and retroduction, boundary pushing at generic level.
Learning Theory: legislative by deliberate processing of stylizations and selective use of levels and context reference.
Educational Criticism: Can child retroduce any unit at any level and style required by some definitional type and extended goal? Has the student both "double thought" the issue and become habituated to generic style? Is he deliberate about his style? Can a student persist in "third level" question forms and know when he has changed levels or switched contexts or depths (pp. 88-89)?

In other words, while most instruction focuses on the transmission of content (Traditional--Category I), others have made an effort to elevate the purpose of instruction to the examination of the structure of that content, and using the scientific method to independently examine and investigate that content (Current--Category II). It is the purpose of this paper to explore, organize, and

demonstrate application of the principles of instruction described in the "Future" category above. The somewhat specialized terminology used in places of the "Future" will be examined in subsequent chapters.

The third curricular framework suggests that the purpose of education is to develop generic skills of thinking and intelligence in a deliberate and systemmatic way, rather than simply to amass information (Category I) or explore its structure and method of acquisition (Category II). First, however, a brief historical synopsis of some issues affecting an instructional attempt to raise intelligence will serve to contextualize this effect.

## Some Thoughts on Intelligence*

> What if we assume intelligence is not a magnitude or a quality, but a skill; not a thing, but a process of applying systems of integrating ideas? (Saunders, 1969, p. 6. Italics in original.)

In 1904, the Parisian Minister of Education asked Alfred Binet to construct a test to use for the identification of children in need of extra help. By 1905, Binet, along with his colleague, Theodore Simon, had developed a test. The original test was designed only for children

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*For more exhaustive information regarding the history of measurement of intelligence see Anastasi (1976), Hunt (1961), Peterson (1925), or other texts on the measurement of intelligence.

ages 3-11, but was adjusted for use with older children in the next few years. About the time of Binet's death at the age of 54 in 1911, Louis Terman at Stanford University translated the test and by 1916 extended it for use with all ages, including, for the first time, adults. This test, known as the 1916 Stanford-Binet, was the first general intelligence battery.

The evaluation and scoring of these tests became a center of debate early on. Binet and Simon, noting an improvement with age on their test (for example, ten-year-olds consistenly averaged higher than eight-year-olds) began in their 1908 revision to score the test by comparing a child's performance only to the performance of other children of the same age. By the 1911 revision, they introduced the concept of "mental age," using the absolute difference between mental age and chronological age to measure the extent to which the child was advanced or retarded.

Wilhelm Stern, however, noted that a person age six who scored a mental age of four was much more retarded than, for example a person age twelve who scored a mental age of ten. This led him to suggest using the quotient of mental age divided by chronological age as a more accurate descriptor of ability. Terman adopted this method

of scoring, and coined the term "intelligence quotient" (IQ) for use in scoring the 1916 Stanford-Binet.

Couched in the context of the behavioristic fervor of the time, the concept of intelligence became commonly perceived as a unitary dimensional quality, such as height, which was predetermined and fixed from birth. Empiricism, championed by Galton and his student Gattell, seemed to increase geometrically in acceptance until the science of psychometrics was consumed by its almost total reliance on the measurement of overt actions and characteristics as the sole criterion of judgment. Generally speaking, the behavioristic philophy of research, learning, and "knowing" in general, borrowed from the physical sciences, resulted in a near consensus among related professions that IQ was immutable and fixed.

An apparent paradox remains. Behaviorists in their "pure" stance holds that man is born with a "blank slate" upon which a person's environment writes the parameters of potential and ability. Such a position would seem to spawn the belief that IQ is alterable to the extent that the qualitative nature of environment and experience can be altered. In practice, however, these same principles applied to the science of psychometrics resulted in total reliance on the rigidity of observable, easily quantifiable behaviors which do not represent

the total spectrum of what intelligence is. Consequently, intelligence came to be defined, at least in practice and certainly in most lay and professional minds, by default, as the portion of that total spectrum which was easily measurable.

The important point is that such a notion was swept into the public mind through the back doors of historical accident and behavioristic philosophy. Those who originally conceived the construct of intelligence never believed or intended it to be considered a rigid or unalterable "amount." Binet (quoted in Hunt, 1961) himself believed that intelligence could be trained and improved, and that any belief to the offspring of philosophic rather than scientific parents:

> ...some recent philosophers appear to have given their moral support to the deplorable verdict that the intelligence of an individual is a fixed quantity.... We msut protest and act against this brutal pessimism.... A child's mind is like a field for which an expert farmer has advised a change in the method of cultivating, with the result that in place of desert land, we now have a harvest. It is in this particular sense, the one which is significant, that we say that the intelligence of children may be increased. One increases that which constitutes the intelligence of a school child, namely, the capacity to learn, to improve with instruction (p. 13).

Since these beginnings, the study of intelligence has traveled a full circle back to the beliefs of Binet and his associates--that intelligence tests measure

only specific abilities at a specific point in time. It has now been a full generation since investigators in psychology have believed that "intelligence" was meted out to each individual in indiscrete, unalterable amounts, a consequence of the genetic pool or divine whim. Indeed, the study of intelligence has received much attention from "opposite camps" contesting the issue as to whether and in what proportions intelligence is genetically or environmentally determined--i.e., the result of nature or nurture*

The polemic surrounding the nature of intelligence continues today on the variability of alterability. Some investigators (e.g., Elkind, 1979, p. 120) remain convinced that any measured improvement in IQ is artificial and temporary, that there never could be "true" or lasting or valid improvement. Others insist that intelligence is a malleable set of skills or processes of thinking which are developed largely as a result of the person's experiential history, including those experiences of an instructional nature.

Writers in support of this position are many, and growing in number. Chapter 3 is a review of efforts

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*The interested reader will find works by Hunt (1961), Jencks (1961), and Jensen (1972) to be informative sources for a lengthier examination of the nature vs nurture controversy.

in the training of thinking and intelligence. The contributions discussed in this paper, as well as those of earlier educators--such as John Dewey and Alfred North Whitehead--lend additional strength to the position of intelligence as nurturable.

In support of the assertion that intelligence can be increased, Anastasi (1981) legitimizes the training of intelligence as one of three categories of training interventions which affect test scores, and discusses the effect of each on test score validity. Anastasi discusses the similarities of the most commonly used aptitude and achievement tests, and suggests that the following summary applies to both. She groups instructional efforts to improve scores on these tests into the following categories. The first category, test-taking orientation, are those efforts to teach test-taking skills. Such strategies have traditionally met with good success, and actually increase validity by eliminating score differences due to test-taking ability rather than in the domain being tested. The second category, coaching, is typified by last-minute "cramming" and short-term, massive drill in items similar to those found on the test. "Insofar as coaching improves test performance, it does so without

corresponding improvement in criterion behavior. Hence, it thereby reduces test validity" (p. 1092).

The third category of training intervention Anastasi describes is training in the "broad cognitive skills."

> This type of program is thus designed to provide education rather than coaching. And it is concerned with the modifiability of intelligence itself. Contrary to the still popular notion regarding the fixity of the IQ, there is a rapidly growing body of evidence that the behavior domain sampled by tests of academic intelligence or scholastic aptitude is responsive to training (p. 1089).... Such training leaves test validity unchanged...(p. 1092).

Improvement on standardized tests resulting from efforts to increase intelligence, therefore, is valid improvement in every psychometric sense.

## Conclusion

By reading the term IQ as a skill, e.g., the "intelligencing" of John Dewey, the unnecessary complications of perceiving intelligence as an immutable, fixed entity can be eliminated. Evan a casual review of the literature today leads to the conclusion that the scales seem to be tipping toward the nurture stance in the nature vs. nurture polemic surrounding the concept of intelligence. Chapter 3 reviews this literature as it pertains to the improvement of IQ through instructional intervention. The issue, therefore, seems to be

no longer whether intelligence can be improved, but how and with what educational and societal implications and ramifications. The "how" and "implications" are the primary problems addressed in the study.

## Statement of the Problem

The problems addressed by this study are:

1. To develop a theoretical model as a methodological framework for designing instructional strategies and materials for raising intelligence (Chapter 2).
2. To demonstrate application of the model by suggesting specific instructional strategies and materials for the elementary school curriculum (Chapter 4).
3. To suggest and examine briefly some implications of such a curricular effort as it may impact educational arenas such as public and professional acceptance, long-term curriculum planning, teacher training, and student evaluation (Chapter 5).

# CHAPTER 2

## THE THEORETICAL MODEL: LAYING THE FOUNDATION

The purposes of this chapter are:

1. To recognize and briefly discuss the need for using and explicitly stating models which inform and, indeed, legislate their own results for any academic inquiry.
2. To set forth the minimal criteria for the integrity of models; and
3. In concert with these minimal criteria, to formulate a model designed to support the classroom teacher wishing to generate instructional material and strategies designed to expand those skills identified with "intelligence."

### The Need for a Model: Epistemological and Ontological Considerations

What we conceive or assume the mind to be is of determining influence, both in the field of method and in the realm of values or goals. Perhaps the most effective way to become intelligent about the business of education, in both its narrower and its broader aspects, is to explore the problem of learning with reference to its implications regarding the nature of mind (Bode, 1940, Preface).

The resolution of most polemics in and out of the world of academics awaits not an increased knowledge base, technological advancement or empirical verification entities, but philosophic clarity of the issues. So it is with the issue of models. Confusion about the use of models is not confusion of "facts," but failure to recognize how those facts are "known." That is, informed disagreement about the use of models is not a debate over "facts," but over how we "know" our facts and what constitutes a "model" fact.

In the first instance it will be helpful to refer to the discipline of philosophy proper. The needs and scope of this paper, however, do not warrant an exhaustive explanation of the categories of philosophy. The explanation is included to help the reader to explore the substructure of epistemology as it refers to the model issue.*

The category of philosophy concerned with the nature of knowledge and how man comes "to know" is epistemology. The traditional questions of epistemology refer to: (1) What you know; (2) How you know; and (3) How do you know that you know. These questions

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*Those interested in pursuing the issue in more depth would do well to read Model for Models for Models (Decker & Saunders, 1976, especially Chapter 2) as well as other sources herein cited.

usually arise in connection with another category of philosophy dealing with reality issues. Ontology is the branch of philosophy which addresses the question of "reality." These categories of philosophy change in meaning in terms of the major philosophic approaches and value basis for "knowing" and "reality." A brief discussion of Idealism, Realism and Experimentation will set the stage for the impact of these categories on the concept of models.

A typical idealist position holds that man comes to know through unfoldment. Since all knowledge exists "in the mind of God," He will give it to man as He see fit--that is, He will allow meaning to unfold in the mind of man. Another, slightly different, idealist explanation is that all knowledge exists in everyone's mind, but in a latent and universal form, which man learns slowly to uncover. Other explanations of this method of knowing are intuitionism and reminiscences. Since the only reality is spiritual truth, all knowledge exists within and is ordered by the single organizing force of the universe.

Hence, through the traditional category of epistemology, the idealist:

.knows that he knows absolutely and without question
.through a process of unfoldment from or insight
.into or from the mind of "God," or any other
monistically organizing force.

Since the physical world does not exist, or at best is not important, the idealists' use of models would be simple organization of whatever impressions of the universe had been "delivered" through the mind. These impressions need not and indeed should not be subjected to human manipulation, as they originated from a higher source. The idealist uses models as an explanation of the way things "are" as they have been delivered to the mind from "God." This posture provides little reason or process for public examination and shareability of the model components, as those components are but one piece of an "absolute" will which is not bound to the physical world for verification.

Historically, the major differences in model usage arise between those who represent the realist and experimental postures. The realist comes to know by verifying his perceptions in the physical world, which exists independently of a man's mind. Knowing is "an external relation between the knower and the known" (Saunders, unpublished memo, Philosophy of Education). The objects of the external world are real in themselves,

and meaning is commonly shared by any who empirically verify the facts in that external world. Through the categories of epistemology, then, the typical realist:

.knows particular fact

.through the truth-revealing method of empirical verification in the "real" world

.which is the final information here and arbiter, because its existence is unquestioned, and all discontinuities can be settled by reference to it.

The realist uses models as explanations of the way things "are" in the physical world. He knows things occur that way in nature because he has empirically verified them.

On the issue of epistemology, the experimentalist diverges from the realist by the insistance that data (rather than "facts") collected from the physical world are dependent on and given meaning by the instruments used to collect them. "Facts" are relative to the instruments of collection, and the interpretation of the facts relative to the "mental instrument" of the interpreter. Methods of scientific verification are used, just as in realism. However, all conclusions drawn therefrom are considered tentative, subject to change in a relative universe as instruments change and improve, and new data is gathered. The realist is shaken when a long-accepted scientific "fact" is

disproven and replaced by another, while the experimentalist, who never accepted the fact as "real" in the first place, is not.

The experimentalist, then:

.tentatively accepts

.what data is publicly shareable through the method of science

.on the premise of its relativity to instrumentation and the current state of discipline.

The experimentalist sees the use of models as necessary in order to satisfy the demands of maintaining "shareable" meaning in the method of science. He recognizes that the construction and use of a model to be the only defensible way to systematically state assumptions, and that those assumptions along with the model they qualify do not merely represent his interpretation of collected data, but legislate that meaning.

To illustrate this point in the context of the purposes of this paper, the model formulated later in this chapter represents but one interpretation of the issues and demands of instructionally raising intelligence. Because this is so, it inherently can lead only to its own end. That is, as the model does not represent all possible interpretations of those issues, the perspective it does suggest dictates the parameters of what can be

measured and verified after use of the model. Therefore, this model, or any other (from an experimentalist standpoint), determines what may be measured as its effectiveness is being evaluated.

In summary, those who have genuine, informed disagreement about the use of models do so out of philosophical positions which imply different beliefs about how we "know" the objects and ideas which are the content of models. The somewhat simplified demarcation between world philosophies and their individual perspectives on epistemology and ontology presented above was intended to accentuate these differences rather than to provide a detailed explanation of their complexities.*

In this search for meaning in modern inquiry, the debate would seem to turn to the issue of the nature and extent of man's participation in the construction of that meaning. As this paper assumes a decidedly experimentalist position in the use and understanding of models, a discussion of certain selected, relatively recent historical highlights and major arguments with

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*For a more detailed but very readable discussion of the traditional views of "knowing" and "reality" and their relationship to the mind of man, see Randall and Buchler (1971), especially Chapter 15.

regard to man's participation in that construction of meaning, is helpful to contextualize and support this position.

Locke asserted that categories and order exist inherently within nature, which is independent of the mind of man. These are objects (independently real material substance), mind (independently real spiritual substance), and ideas (the appearance of the object to the mind). Although appearances or ideas of the same object may differ for individuals, they may be unified by validating them against the "real" categories in nature.

Berkeley, realizing the awkward implications of Locke's view, asked "not only, How do we know that our ideas correspond to the real world? but actually, How can we be sure that there is a real world beyond the world of ideas? For we cannot get outside the screen of our ideas" (Randall and Buckler, 1942, pp. 220-221). Berkeley summed up his view in the maxim Esse est percipi ("to be is to be perceived"), the being of anything consists in its being perceived, in its being an idea in a "mind" (Ibid, p. 222).

Hence, a major contribution of Berkeley was to force the question of how we may know that anything exists truly independent of man, when there is no way independent of man to verify that it is so. He answered this solipsism by maintaining that all ideas of man exist as subsets of

ideas in the mind of God, and therefore man cannot "will" objects in or out of existence.

Kant made a major contribution to the debate by asserting that "[t[he experiencer thus contributes the factors determining the ordered arrangement of experience. What we 'receive' does not come ot us before it is formed or structured; it comes only as structured by us as knowers. ...the experiencer or knower is equipped with a structuring machinery or set of capacities through which he is able to provide form for the raw data given to him" (Ibid, p. 94). Thus, the categories and order of nature are not inherent in nature itself, but originate in s synthetic a priori in the mind of man. This is a priori "structuring machinery" is possessed by and is the same for all people. Therefore, although nature is not inherently ordered, the a priori mediation of nature will result in all arriving at the same conclusions when structuring the same part of the real world.

The philosophic analysis of the construction of meaning underwent its next major refinement with the formulation of experimentalism as a world philosophy during the late 19th and early 20th centuries. Most notably contributing to this formulation was Peirce, to whom all other writers in the experimental or

pragmatic philosophy recognize their indebtedness. Whether the instrumentalism of Dewey or the pragmatism popularized by James, the unifying characteristic is to recognize that the categories of meaning for each person are uniquely different, and that they determine or legislate the meaning of the object or idea being classified. The experimentalists' belief that each person's cognitive framework or categories for meaning are different from all others, and that these categories uniquely determine meaning for each person, would seem to preclude common agreement on the meaning of anything. This seeming randomness and complete relativity of meaning, however, is anchored by an insistence that all meaning be subject to the method of science to insure public shareability, and tempered by the belief that all such publicly verified "truth" or meaning is at best only tentative, subject to change upon further scientific investigation and verification.

C. I. Lewis (1929) in the monumental Mind and the World Order, addresses at length the experimentalist notion of the a priori. He refers to the individually unique construction of meaning as the "classifying attitude":

> The classifying attitude or mode of behavior which the mind brings to the given experience and which represents its meaning, dictates the explicit concept and implicitly possesses it already (1929, p. 88).

Each person's categories of meaning, therefore, are not only the parameters but the determiners of meaning for any given experience.

Experimentalism emphasizes the contextual nature of meaning--the fact that an object carries meaning only in terms of the context within which it is envisioned or investigated. Thus, the contexts are the determiners of meaning not the objects themselves. The spectrum within which this concept has application is a broad one: from the contextual nature of vocabulary (a hit record, getting hit by your brother, a hit in baseball, hit the bottle, hit the ceiling, hit the high note, etc.), to the legislative power of each person's uniquely different "synthetic a priori":

> It is not a question of the empirical qualities of any object. One could submit that experiences are limited to what is sensed. But the further point must be made that what is sensed is what is noticed, and what is noticed is what is selected by some prior (or synthetic a priori if you will) set of categories for meaning. These categories may be habitual or clearly determinate, capricious or methodological. But, in any case, the contexts employed, the structural forms, determine the characteristics the "objects" or the "experience" can have. The contexts make the objects possible. (Decker and Saunders, 1976, p. 27. Emphasis in original.)

The reconciliation of the apparently antithetical subjective and individual nature of the construction of meaning on the one hand, with the requirement of public verification on the other, must focus on the need for criteria. As explained by Belth (1070), these criteria must take the form of "conceptual agreements" housed in the model which informs the inquiry:

> The success of any attempt at explanation depends upon the uses of instruments and methodology. Without these, no explanation whatever can take place. If we attempt to build explanations with clues from nature itself, we must recognize that we must agree upon what shall be accepted as clues, and thus what shall be counted as evidence, what shall signify connectedness, what shall be entailed in similarities, and also agree upon what organized rules and conditions will serve as the models to explain whatever it is we are now confronting. These purely conceptual agreements may refer to empirical events but do not derive from them; thus the very status of knowledge, truth, and explanation, is postulational--a matter of agreement among inquirers, having no fixed or positive structure in the empirical world.... (1970, p. 32. Italics added.)

For the purposes of scientific inquiry, meaning exists only to the extent of the clarity of the criteria which, by common agreement among inquirers, become the determiners of meaning.

Construction and explicit statement and use of a model makes publicly shareable those criteria, along with the accompanying assumptions and definitions relative to the issue under consideration, structures

and defines the informing hypothesis, and goes on to actually determine or "legislate" the meaning of the objects, ideas or experience which are its content. Recognizing the legislative nature of models, Braithwaite (1053) cautions that "the prize of the employment of models is eternal vigilance" (p. 93). Lest this be perceived as a criticism aimed only at those who would consciously employ a model, it need be stated that the intensity of the vigilance must be heightened for those who say they use or need no model, or fail to address the issue entirely. The criteria which inform these persons' judgments are still individual and and subjective and come from personal, unstated "synthetic a priori," and are more damaging to the purposes scientific inquiry because they are left unstated and unrecognized, whether intentionally or through ignorance.

Decker and Saunders (1976) have constructed four general classifications of model users. Although lengthy, their reproduction here serves to help summarize the issues which have guided the previous discussion.

> 1. There are writers who do not seem to understand that there is a question about models.
>
> What I have said is the truth. It is real! Why do you pose those ridiculous questions? It is all just a matter of semantics. Too much theory and not enough practice.

> 2. There are those who do not consider a need for an analysis of the model being used even though they appreciate the necessity of a model in thought.
>
> There are certainly assumptions behind every theory and a model is back there behind everything. But, it would only distract us or take us on a wild goose chase to spend time peeking behind everything. It will not change anything just because we know about the model.
>
> Or again,
>
> ...the concept is too complicated. Books on models are usually written in foreign languages or are expressed in some new notation which requires a math or logic background to understand.
>
> 3. Then there are those who begin in a clear choice for a model or heuristic myth for explanation but forget they have only a convenient explanation and come to believe their myth as true.
>
> Assume the convenience of using a model which explains your thoughts on some topic. Owner's pride and a little ontological amnesia could produce a belief that "my model" is really a "true explanation of how the universe functions."
>
> 4. Finally, there are those who hold the position that the model not only organizes and guides the relationships between "things," but, that the model <u>determines</u> meaning and, indeed, possibly invents "reality" itself.
>
> You say there is a real world, but, you know the "real world" as a <u>product</u> of your own construction. Can you <u>know</u> what you know (pp. 36-37)?

In summary, then, the function of models is not only to organize content for effective future use. The data are organized in this particular way because it will help accomplish or explain stated ends. The model user

must, at the same time, understand the assumptions and criteria which constitute the "past" of the data--that the model is not a picture of reality, but a convenient systematization of data for a specified purpose--simply an "heuristic myth," with which we can and should work, but in which we must suspend belief.

## Criteria for Model Integrity

Although no two models are alike, all should conform to certain minimal criteria to qualify as true models (rather than mere taxonomies, classifications, or other less methodologically rigourous organizations of data). It will be helpful to picture and discuss these criteria in three successive sections or "levels," as a clear understanding of each is prerequisite to an effective understanding of the next. The organizing feature of each is:

1) definition,

2) structural integrity, and

3) value and purpose.

1) Definition: The language of the model must be defined in publicly shareable terms.

To say merely that one must define terms (or, indeed, that one has defined terms) leaves uncertainty as to what position within the broad spectrum of degrees and kinds of definition has been taken. Philosophers

have for generations fought with problems dealing specifically with and resulting from the multitudinous vagueries which have passed for definition. Comparatively recent responses to this concern, largely from experimentalist philosophers, have given good direction.

Upton, Sampson and Farmer (1978) detail seven different definition types they suggest be recognized and used appropriately. Dewey (1910) delineated three distinct types of definitions: denotative or indicative, expository and scientific. Denotative definition is the "act of experiencing directly the existence or quality in question" (p. 132). Expository definition is accomplished "[b]y taking better-known meanings and associating them" (p. 132). Expository definitions appeal to an existing store of common understanding such as by illustrating through like experiences, dictionary-type definitions, etc. Dewey is careful to point out that expository definitions "are second-hand and conventional" (p. 132), and do not suffice for the demands of scientific inquiry. "Scientific definitions select <u>conditions of causation, production, and generation</u> as their characteristic material.... Casual and genetic definitions fix upon the way an object is constructed as the key to its being a certain kind of

object, and thereby explains why it has its class or common traits" (p. 133).

Saunders (1068) has identified six uniquely different definition types, the ramifications of which have been discussed in the contexts of models in general (Decker and Saunders, 1976, pp. 135-141), and accountability models in particular (Engle et al., 1981, pp. 20-21). These definition types are listed in Table 1.

It is clear that the definition types of Dewey and Saunders have several categories in common; the denotative is analogous to the ostensive, the expository to the lexical and antonym/synonym, and the scientific to the theoretical. The additional types mentioned by Saunders (stipulative and genus differentia), however, do not seem to fit clearly into Dewey's categories, but represent a refinement. The organization of categories into which the definition types may be placed, are determined by the context in which that categorization is done. (See Table 1 for two examples.)

Being aware of the type of definition used gives an indication of the level of academic rigor maintained by a writer. One who constantly defines terms by saying what they are "like" or "not like" (antonym/synonym), or by simple dictionary definitions (lexical), should not be addressing a technical audience. Conversely,

Table 1. Definition types of T. Frank Saunders.

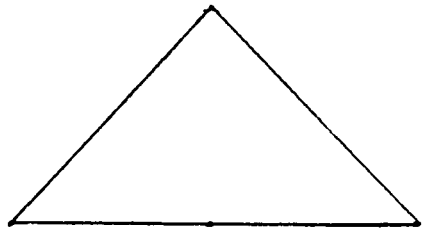
| | | |
|---|---|---|
| Intentional: | | |
| Lexical | a definition found in a dictionary; usually defines a word by stating a usage of the word; definition is reduced to its base morpheme | In Model for Models (1976), the definition types are arranged under the following categories for the purpose of comparing definition type to model type: |
| Antonym/ Synonym | definition by comparison with a more familiar word, the comparison can take the form of a similar term (synonym) or a term with an opposite meaning (antonym) | Hortative |
| Genus-Differentia | "definitions based on generic categories or meaning with specification of characteristics which differentiate the term from others with the generic category" (Saunders 1968a, p. 138). | Lexical<br>Synonym |
| Operational: | | Heuristic |
| Stipulative | a definition given to a term by an expressed demand or an arrangement among those who will use the term | Stipulative<br>Ostensive |
| Ostensive | definition given by either directly pointing at the object or situation being defined or by citing an example or the definition | Integrative-Reducible |
| Theoretical | "a process definition of a concept involving the determinate consequences that could be anticipated on the basis of a comprehensive, logical, and systematic analysis of that concept" (Saunders 1968a, p. 138). | Genus-differentia<br>Theoretical |
| From Engle, Saunders, and Blake, 1981, pp. 20-21. | | Decker and Saunders, 1976, pp. 138-139. |

theoretical definition types will certainly be used sparingly with a "lay audience," or any others unacquainted with the terminological scheme of the discipline which is the basis of the discussion. Thus, the definition type utilized carries with it a legislative function; the type of definition used not only sets parameters on the object of the definition, but determines the nature and direction of its practical utility.

Another dimension, and perhaps a new era of clarity for definition, was opened by Charles Sanders Peirce. Peirce gave structure to a systematic effort to assign meaning to contextual symbols--including, and specifically in this case, language--by structuring their usage. The Peircian Triad for meaning in language set the standard for others who followed:

> According to this view there are three requirements to be met in order that a symbol be present. First, there must be something which represented; and third, there must be something which makes the connection between the two. In the words of Peirce, 'A Sign, or Representamen, is a First which stands in genuine Triadic relation to a Second, called its Object, as to be capable of determining a Third, called its Interpretant...' (Champlain, 1960). See Figure 1.

The First: That which represents;
the sign or representamen



The Third: Something that
makes the connection;

The Second: That
which is represented;
the object

Figure 1. The Peircian Triad.

This triadic relationship has been expanded to recognize and account for the use of different definition types, as well as the systematic examination of assumptions underlying the symbols used in definitions (Decker and Saunders, p. 90; Engle et al., pp. 12-19).

Josiah Royce (Lewis, 1929) credited Peirce for his delineation of the "three grades of clearness about the meaning of terms:"

> We have the first grade of clearness when we are able appropriately to accept or reject any object of our acquaintance as belonging or not belonging to the class in question. The second grade of clearness involves, further, the preparedness to classify correclty objects not precisely like those with which we have previously been acquainted; that is, to make the dichotomy, X or not-X, not only for familiar but also for unfamiliar things, not only for all actual but also for all conceivable objects. The third grade of clearness consists in the ability to specify the criteria by which such classification is determined. This last, of course, is equivalent to definition, the explicit possession of the concept. That the mind may have the first or second grade of clearness without the third, is obvious (pp. 86-87).

The third grade of clearness, specifying the criteria, is that level of clarity aspiring model creators should seek. By use of an operationalized theoretical definition (see Table 1), this grade of clarity is achieved with the definitions utilized in the model formulated in the following pages of this chapter.

2) Structural Integrity: The components and categories of the model must conform to certain minimal standards.

Most models are made up of one or more broad components, each of which is in turn made up of several categories. In considering both the broad components to the whole model, and the categories to their respective component, the following minimum standards should be present:

a. Parsimonious - The spectrum of possible activity should be covered by the fewest number of categories, yet

b. Exhaustive - The components and categories must exhaustively cover the spectrum of possible activity which it/they represent.

The requirement that a model be parsimonious, yet exhaustive protects the opposite parameters of category or component inclusion in the model. Precision cannot be sacrificed to parsimony, the use of too few categories or components may oversimplify an issue which demands more categories to achieve adequate precision. For example, an hypothetical curriculum model could represent the complete spectrum of learners in the public schools by the following three categories: special education, normal, and gifted. Although these categories do, indeed, achieve parsimony, do all possible learners fit clearly with them? Although this question may most adequately be answered by

referring to the definitions stated for each (as in cut offs on certain tests), it may be advantageous for the purposes of evaluating such a model to recognize some finer distinctions among learners, such as:

A. special education students
   - intellectually handicapped
     (IQ score below 85)
   - behaviorally handicapped

B. normal students
   - IQ 85-100
   - IQ 101-115

C. gifted students
   - academic giftedness
     - IQ score 116-130
     - IQ score 131 and above
   - aesthetic giftedness
     - performing arts
     - creative arts
   - social giftedness

Each component or category used in a model must exist as a logical and necessary part of its whole, and must suggest some action, potentiality, or consequence uniquely different from the other categories along the continuum.

c. Mutually Exclusive - Each component or category must embody a characteristic which makes it clearly unique as a case from the other components or categories with which it is syntactically related.

d. Integration - The categories should be ordered or related according to a specified informing hypothesis or organizing principle; the syntax between the major components of a model, and/or the categories in a component, should be clearly and consistently related.

e. Replicability - The model, along with each of its components and categories, should be clearly replicable, given the precision of definition discussed above.

f. Topological Integrity - The topological representation of the model must accurately reflect the syntactical relationships, between the components and categories of the model.

3) Value and Purpose: The assumptions upon which the model has been built should be shared.

The values and assumptions which have determined the purpose and form of the model should be shared, or at least shareable in some form in the model. Since the model represents only an "heuristic myth," and not a supposed picture of reality--of the way it "really" is--the developer of the model must accept the obligation to

share as much of what caused the model to take on its form and intended function as possible.

A final, but over-arching, test of "modelhood" is the extent to which the model suggests action and, indeed, legislates or determines the nature and direction of that action. A model is something more than a set of pigeon-holes" for collecting data. Rather than being a passive picture of whatever data is collected or represented, a model must have the active function of suggesting a course at action based on that data.

## Intelligencing: An Instructional Model

Although discussed in Chapters 1 and 2, it is appropriate before the formulation of the particular model of this study to briefly restate the premises which specify the values, assumption, and presuppositions which are its informing hypotheses:

1. That intelligence is determined neither by environment nor experience, per se; rather, intelligence is determined by the thought patterns which give the experiences within that environment signification.

2. That these thought patterns constitute a process, rather than a fixed amount of undefined ability; thus, intelligence is more accurately conceived as a verb (e.g., intelligencing) than a noun.

3. That the processes of intelligence can be learned, and conversely, can also be taught.

4. That instruction in the processes of intelligence should be the structure of curriculum in the public schools.

The model is built upon the following operational definitions:

Learning is defined as:

---the time it takes

---to place in a context

---some piece of information (Decker, 1974, p. 16).

A piece of information is placed in context by a process of abstraction:

Abstracting (as a verb) is defined as:

---using one or more specific processes

---to construct a relationship

---between two or more pieces of information.

Intelligence is defined as the use of:

---skills of abstraction

---in a systematic fashion

---for a specified purpose.

The use of operational definitions may, to some, be inappropriate in a theoretical treatise, the argument being that resting largely theoretical formulations on operational definitions sacrifices precision on the

troublesome alter of practicality. Do we lose academic rigor in the attempt to render relatively complex ideas into useable forms? The other side of this argument (and the one adopted here) is the contention that only operational definitions can have that sought-after academic rigor, as only in that form may their consequences be observed and evaluated as they "operate."

The theoretical framework which houses those definitions does not lose strength because of an operational format. In complex definitions, authors too often attempt to build the theoretical framework into the definition itself. This leads neither to clarity nor usefulness. If operationalizing, though an ostensive sacrifice of precision to clarity, is a beginning which leads to more widespread practice in the schools, then what is gained for children far outweighs what may be lost to the unfortunate tradition of needless complexity and verbosity in scholarly exposition.

A term in the above definitions which demands careful and precise definition is "abstract" and its derivative "abstraction." Webster's New Collegiate Dictionary (1981) groups the many definitions of "abstract" by grammatical usage: adjective (eight definitions), noun (three definitions), and verb (five definitions). Out of the various definitions which have arisen in lay usage,

we can "abstract" certain unifying characteristics:

1) As an adjective, something which has the quality of being abstract is typically disassociated in some way from an actual instance or object.

2) As a noun, an abstract usually refers to a written summary of the important contents of a longer document.

3) As a verb, to abstract is the process of synthesizing out of a larger whole or group of cases certain salient information, unifying characteristics, or relationships.

The very general definitions found in the dictionary (lexical and synonym/antonym definition types) provide the "lay" starting point for a theoretical definition of the term "abstraction." Such a definition must rest on its past and present within the disciplines which have concerned themselves with its usage--philosophy, psychology and education. These three disciplines were at the beginning of the twentieth century most often considered corrollaries of the same study, each essential to the others' practice and investigation. John Dewey, for example, founded the Laboratory School at the University of Chicago when he was chairman of the Department of Philosophy, Psychology and Education (Nathanson, 1951). Pikas (1966) notes that "[t]he age old association between philosopher and psychologist,

which began to be dissolved when experimental methods were introduced [especially the extreme behaviorism characteristic of the early twentieth century], proved to be very vigorous at the turn of the century. At this period it is often impossible to classify an individual scholar as either a philosopher or a psychologist" (pp. 9-10). The interdependence of these disciplines continues to the present. Arriving at a meaning of abstraction requires brief examination of each.

The philosopher's perspective of the study of abstraction is corollary to age-old debates such as the mind-body problem (hence, the seeming inseparability of the terms "concrete" and "abstract") and man's construction of meaning. The philosopher's dimension of concern is the logic of the epistemological and ontological arguments of how man comes to construct meaning (as briefly introduced earlier in this chapter).

The psychologist's perspective is the investigation of "how it works," how the process of abstraction takes place in the "mind." The syntactical connection between the two disciplines must be remembered, however. For it is the philosophical beliefs of the psychologist attempts to construct through experimental procedures a picture of what the processes of abstraction are and how they work.

The educator is left to decide how best to apply in an instructional setting the information given him by the psychologists. Traditionally, this exercise is referred to as "basing an instructional program on a learning theory." Educators' concern is to complete the cycle by using available information to improve students' ability to be successful in school.

Thus,

---the educator builds a pedagogical program consistent to learning theory" (see Bigge [1964] for a review of major learning theories and their related schools and psychology),

---which is based on "principles" which find their root in specific systems or "schools" of psychology (see Heidbredder [1935] and Wolman [1981] for detailed discussion and comparison of those systems to each other and their philosophical parents),

which are in turn

---based on specific philosophic orientations.

Of the three, the focus of this paper is educational.*

---

*The interested reader will find Pikas' (1966) Abstraction and Concept Formation to be an exhaustive history of the philosophical roots and psychological investigations of abstraction.

The argument can be made that the "mind" can process information only through the use of symbols, while the claim is also made that thought consists of something other than symbols, "deep structures" which preceed language. Price (1953) and Kaufman (1080) contain lengthy discussions of this dichotomous conception of "thought" from philosophical and psychological contexts respectively. Kaufman refers to it as the symbolist/ conceptualist dichotomy (p. 13).

In education, the differing views of the relationship of thought to language (language as the symbols) are perhaps most noteably championed by Vyotsky (1934) and Piaget (see Favell, 1963, for an excellent summary of Piaget's work). Simply stated, for Vygotsky, language and its abbreviated forms are the tools of thought. His book closes with these words:

> Thought and language, which reflect reality in a way different from that of perception, are the key to the nature of human consciousness. Words play a central part not only in the development of thought but in the historical growth of consciousness as a whole. A word is a microcosm of human consciousness (Ibid, p. 153).

For Piaget, there are clearly thought structures independent of language, which function as a way to translate personal meaning into shareable form. In Language and Thinking in School, Smith, Goodman, and Merrill (1970) discuss each of these positions at length, along with their

implications for education, and point out their differences by observing that "[f]rom Piaget the impression is gained that the schema or cognitive structures are pure thought connections involving language but not built of language necessarily, whereas from Vygotsky a picture of conceptual structures made of shorthand language is conceived." Smith et al., go on to suggest a "compromise" interaction position:

> This middle position embraces a concept of "dialogue" in which the language of children and the language of the adult teachers are brought into interplay at every stage of the development of language and thinking, including an initial "discovery" period. The collective language of the adults in a society is as potent a factor in the development of thinking as the child's own spontaneous formation of structures of relationships drawn from experience (p. 136).

This position is reminiscent of the writings of Benjamin Whorf, who determines that debate about the origins and structure of thought is moot, because in any case a person's language has the <u>effect</u> of controlling the very parameters of what thought may be to the person. Whorf (1956) writes:

> Every language is a vast pattern system, different from others, in which are culturally ordained the forms and categories by which the personality not only communicate, but also analyzes nature, notices or neglects types of relationships and phenomena, channels his reasoning, and builds the house of his consciousness (p. 252).

For the purposes of this examination of the word "abstraction" the symbolist/conceptualist debate may be

left to others. The present discussion will focus on those symbols called words--whether they be independent from or the very controller of thought.

For the purposes of discussion it is helpful to recognize the traditional (though arbitrary) placing of all words (vocabulary) into two categories: concrete and abstract. Educators asked to determine whether a word is abstract or concrete most often appeal to their understanding of Piagetian developmental psychology. The cognitive stage referred to as "concrete operations" is characterized by the child's ability to carry out operations mentally--"in his head." All words used and thoughts of the child relate back to concrete objects and experiences in the child's frame of refernece or experimental past.

The next Piagetian stage is "formal operations," labeled as such due to the child's newly developed ability to use abstractions in the thought process. They are now capable of "if...then" propositional type thought. The ability to use abstractions implies that the child is now able to project out of his/her own concrete experiences and to construct and understand situations without actually having experienced them. (For more information see Inhelder and Piaget [1958], the previously cited Favel [1963], or, for a more abbreviated summary of Piaget, Charles [1974]. Thus, for Piaget, to be in the category

of concrete, the child must be able to touch it or do it or look at it. If the child cannot or has not sensed it directly, it is abstract.

John Dewey (1920, Chapter 10 in general) discussed different definitions of the two terms. His discussion is predictably marked by relativism, criticism of dualistic thought, and focus on consequences which typify experimental philosophy. He writes that an idea which leads to action is concrete, while an idea which leads to another idea is abstract. An idea which is a means to an end beyond itself is concrete, while an idea which leads to more thinking is abstract. Another important dimension of his conception of the concrete-abstract continuum (rather than dichotomy) is that an idea is concrete to the extent that it is practical and familiar to its user, and abstract to the extent that it is unfamiliar and not intimately associated with practical concerns to its user.

> When thinking is used as a means to some end, good, or value beyond itself, it is concrete, when it is employed simply as a means to more thinking, it is abstract (p. 138).

True to the tenets of experimentalism, the state of being abstract or concrete is relative to the experience and purpose of the user.

As a beginning point for this paper, a word is concrete if it names something which may be pointed to--and hence shared by all--for a verification of its

existence. Considering the exclusion of the middle restrictions, one may consequently define as abstract those words which may not be pointed to for verification. A case may be pointed to, but not the thing itself. For example, one cannot point to anger, only to a case of it--to someone who is angry.

This definition invites further systematization by permitting diagnosis of the "concreteness" or "abstractness" of any word by its most accurate definition. If an ostensive definition type does the job best, the word is concrete. If, however, the definition type used is lexical, synonym/antonym, genus-differentia, stipulative, or theoretical the word must certainly be abstract (see Table 2). As is clearly evident, the syntax between categories exists in the fact that <u>defining abstract vocabulary requires reference outside the thing being defined--that a relation between two or more ideas be constructed</u>.

This operationalization of the terms "concrete" and "abstract" as they apply to words may be extended by construction of a model which systematizes the contents within which an abstraction may occur. An attempt at such a model appears as Figure 2. Utilization of such a model enables its user to plan informed instructional strategies

Table 2. Operationally defining concrete and abstract vocabulary by definition type.

| Concrete | Abstract |
|---|---|
| Ostensive | Lexical |
| | Synonym/Antonym |
| | Genus-Differentia |
| | Stipulative |
| | Theoretical |

| | Topical | Non-topical |
|---|---|---|
| technical | | |
| Inter-Cultural | | |
| (language) | | |
| lay | | |
| technical | | |
| Inter-Disciplinary | | |
| (language) | | |
| lay | | |
| technical | | |
| Single Discipline | | |
| (language) | | |
| lay | | |

Figure 2. Contexts and complexity of abstractions.

based on increasingly complex abstractions. Abstractions placed topologically in the model would increase in complexity as they approached the upper-right corner.

To this point the discussion has focused on an examination of the more traditional use of the term abstraction, the adjectiveal use. That is, determining what it means to say that a particular word or idea has the characteristic of being abstract. Operationally, abstract was defined in terms of definition types. Of greater importance to the purpose of this paper is the verb usage. To operationally define abstract as a verb refer back to Table 2 to the operational definition of abstraction as an adjective. By way of review, definition of abstract vocabulary requires reference outside the thing being defined--that is a relationship between two or more ideas or objects be constructed in the mind of the learner. A skill of abstraction, then, is any aid in constructing these relationships, any process which contributes to the manipulation of data into the categories, contexts and relationships which determine meaning for the unique purposes of the learner. Hence, the operational definition of abstracting stated above:

---using one or more specific processes

---to construct a relationship

---between two or more pieces of information.

## The Model

Various definitions of intelligence, along with related presuppositions and implicit values, will be examined in Chapter 3. The model presented now is based on the operational definition of intelligence presented above:

Intelligence is defined as

---using skills of abstraction

---in a systemmatic fashion

---for a specified purpose.

1. Skills of abstraction. These are abstraction skills as defined above. In psychology, these are the methods used in the process of "concept formation" or "concept attainment."* Attempts to identify specific abstraction skills typically yield similar results. THey center around the mind's seemingly innate striving to identify similarities. Any attempt to analyze relationships is an attempt to identify, organize, and "make sense" of similarities among the objects or ideas under consideration for some particular purpose (hence, the second and third levels of the tripartite definition of intelligence). These commonalities and relationships

---

*See Bruner, Goodnow and Austin (1956) for an exhaustive reporting of studies regarding concept attainment.

occur in differing numbers and complexities. An attempt to hierarchically organize these different types of similarities is found in Table 3.

Table 3. Hierarchical subskills of similarities.

| Similarities | |
|---|---|
| Increasing number and complexity of common characteristics and/or relationships | 5. taxonomize<br>4. categorize<br>3. classify<br>2. sequence<br>1. sort |

The vehicle for use of these skills may be either language or non-language (spatial), each of which implies differences in skills of abstraction. For the tasks confronting the learner which require language, the implied skill is to build vocabulary through practice in generic or hierarchical progression. If the task does not require language, practice in building students' skills of spatial relations is implied. A task unique in its potential for utilizing both language and non-language related tasks, along with their common foundation of similarities, is the analogy. These skills and the tasks which require their

use are a leveled representation of these skills and tasks appear in Figure 3, hierarchically organized to represent specific tasks, with each level requiring use of the skills in the level beneath it.

A logical extension to the hierarchical sub-skills of similarity would be to add a sixth skill of projection or prediction. As relationships between the dieas of a system increase in number and complexity, they would at the same time become increasingly predictable. It is conceivable, therefore, to reach the level of internal consistency among data which suggests construction of a model by which to organize and explain existing information, and to predict future cases. This sixth step, to maintain grammatical consistency, could be named "modelize," and would contibute a logical ending point to the hierarchy of the skills of organizing similarities (see Table 4).

Table 4. Hierachical subskills of similarities: An ending point.

| Similarities: |
|---|
| 6. modelize |
| 5. taxonomize |
| 4. categorize |
| 3. classify |
| 2. sequence |
| 1. sort |

Level 3 WHICH CAN THEMSELVES BE HOUSED IN MORE ABSTRACT RELATIONSHIPS

ANALOGIES

---

Level 2 APPLIED TO CERTAIN TASKS

| LANGUAGE DEPENDENT | NOT LANGUAGE-DEPENDENT |
|---|---|
| VOCABULARY (GENERIC) | SPATIAL RELATIONS |

---

Level 1 SKILLS OF ABSTRACTION

SIMILARITIES:

5. taxonomize
4. categorize
3. classify
2. sequence
1. sort

---

Figure 3. Abstraction skills in a leveled model.

It is not suggested that the above skills of abstraction are inclusive of all possibilities. It is intended only that in the framework presented they are an effective beginning point for the organization of instruction, which is the purpose of the model. Just as a carpenter becomes more able to do his job as more and more sophisticated tools are acquired, so will the learner be able to do the job of thinking well as more and more sophisticated skills of abstraction--the tools of thought--are acquired.

2. In a systematic fashion. Just as the tools of a carpenter are useless when used in a random, non-patterned, or uninformed fashion, so are the skills of abstraction useless when used without pattern. The second dimension of the definition, then, is concerned with the patterned and systematic use of the skills of abstraction. The possibilities here include simple sequential step-by-step "recipes" for problem solving, as well as instructional implications of modes of thought, or thought-styles. These will be discussed later in this chapter, along with other contributions and considerations. The unique issue here, however, is that thought becomes effective to the extent that skills of abstraction are orchestrated in a deliberate manner.

3. For a specified purpose. Continuing the analogy of intelligence to carpentry, as the tools become useful only when used in a non-random and skilled pattern, so the object of that patterned use is determined by the purpose of construction. The goal or purpose of building a storage shed will dictate which tools we select, and their pattern of application. In carpentry, then, our purpose dictates the selection and use of specific tools. In the deliberate exercise of intelligence, our purpose (3), dictates the patterned use (2) of specific skills of abstraction (1). For the purposes of instructional planning, a deliberately chosen purpose should consciously dictate the means to its accomplishment. Too often educators select a "tool" and construct an "end" which is artificial and thus carries diluted potential for meaningful learning. For example, spelling is often selected as a useful "tool." Resulting instructional strategies are artificial, being of no real value or purpose to the learner, and the value of the lesson is diminished correspondingly. However, when a purpose is selected beforehand by the learner, the tools and patterns become logical and necessary means to its accomplishment. This idea is discussed by John Dewey many times and in many publications, and is, in fact, a hallmark of his philosophic contribution to education:

> An end which is the child's own carries him on to possess the means of its accomplishment. But when material is directly supplied in the form of a lesson to be learned as a lesson, the connecting links of need and aim are conspicuous in their absence (1902, p. 25).

At this point a model for teaching the skills of intelligence may be topologically portrayed by sequencing the three parts of the definition along a horizontal axis (see Figure 4). The carpentry analogy is included for clarity.

To complete the model, another dimension is needed to account for the differences in kind possible under each of the three parts of the definition. Surfacing first, perhaps, in the traditional categories of epistemology, is a three-level distinction in meaning. Washburn (1971) and Decker and Saunders (1976) detail the origins of and examples of other writers who have recognized and incorporated such a leveling into their works. Saunders (1967, 1969, 1973), in particular, has contributed to the eludication of these levels in the development of a generic system of integrating thought patterns called the Cube of Inquiry. From Model for Models (Decker and Saunders, 1976) we may paraphrase the following summary (see Figure 5. The three levels may be described succinctly (though not comprehensively) as:

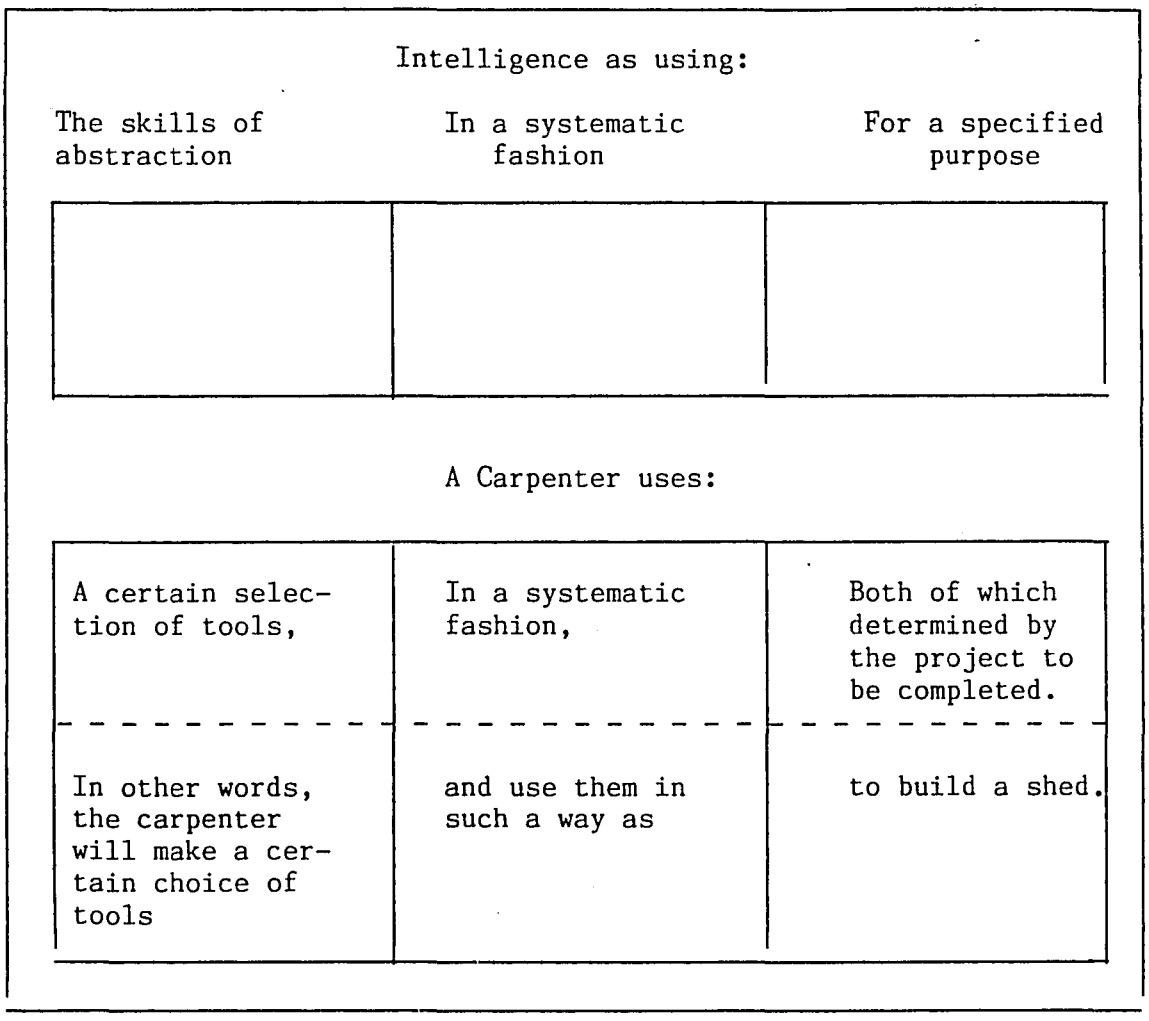



Figure 4. A first model for teaching intelligence.

| | | |
|---|---|---|
| 1.3 | 2.3 | 3.3 |
| 1.2 | 2.2 | 3.2 |
| 1.1 | 2.1 | 3.1 |

Figure 5. Structure of the Cube of Inquiry.

Level 3) the goal framework; a value or purpose determines which of many possible

Level 2) contexts for meaning are selected by the user to give meaning to a

Level 1) content of some sort.

Or, stated another way and in the reverse order,

1) a selected content is without meaning until placed in a specific

2) context, which, of the many possible contexts, is determined, selected or dictated by the

3) purpose(s), goal(s), or value(s) of the person.

John Dewey (1934) gave early voice to this idea in his description of the three levels or types of experience: the immediate or direct in experience; the mediate, or the placing of the experience in a meaningful context; and the valued mediate, or the use of some plan or value to give the experience its ultimate worth.

A couple of examples may be helpful to explicate the concept of lvels. A leveled examination of the issue of reading instruction might look like this:

Level 1) The term reading instruction is without meaning until placed in a context where its competing alternatives are recognized and set in contrast.

Level 2) Theories of reading instruction may be divided into 3 camps: holistic, eclectric, and phonic-centered. Discussion of reading instruction, therefore, requires recognition that these differences exist.

Level 3) Choosing one of these theoretical camps as preferable to another, thus giving meaning to the term reading instruction, is not a random choice. It is a choice spawned by philosophical preference. An over-simplification would see an educational experimentalist having to prefer a holistic approach to reading instruction, and a realist preferring a behavioristic, phonics approach to reading. Philosophical beliefs about learning and the learner would dictate choice of the theoretical camps of reading instruction.

Perhaps a more direct example, with the levels listed in the opposite order:

Level 3) For the <u>purpose</u> of getting an "A" from an avowed Freudian instructor in a psychology class, a very practical student

Level 2) chooses, from among the seven schools of psychology, to use a decidedly psychoanalytic perspective from which to write a paper on

Level 1) emotion.

Looking back, then emotion (Level 1) can be given meaning only within one of the seven schools of psychology

(Level 2), which school is decided upon according to a very specific purpose (Level 3) of the student.

In summary, criteria for first level membership are that the information be straight content, devoid of explanation or placement in a meaningful context. sriteria for second level membership include the placing of content in a meaningful context, and rules for the structural and categorical integrity of the content. Third level criteria imply the framework which dictates and selects the context in level two. Values, purposes and goals are the flagging terms and informing agents at this level.

Figure 6 is a topological representation of the leveled model, with brief row and column labels. With addition of levels, the expanded capabilities of each column of the model may now be explored.

Column 1: Skills of abstraction: The addition of levels provides a format to recognize the syntactical differences between the skills of abstraction as portrayed in Table 4. The leveling suggests, also, that each skill can be exploded to include possibilities at each level. For example, data may be categorized according to similarities based on:

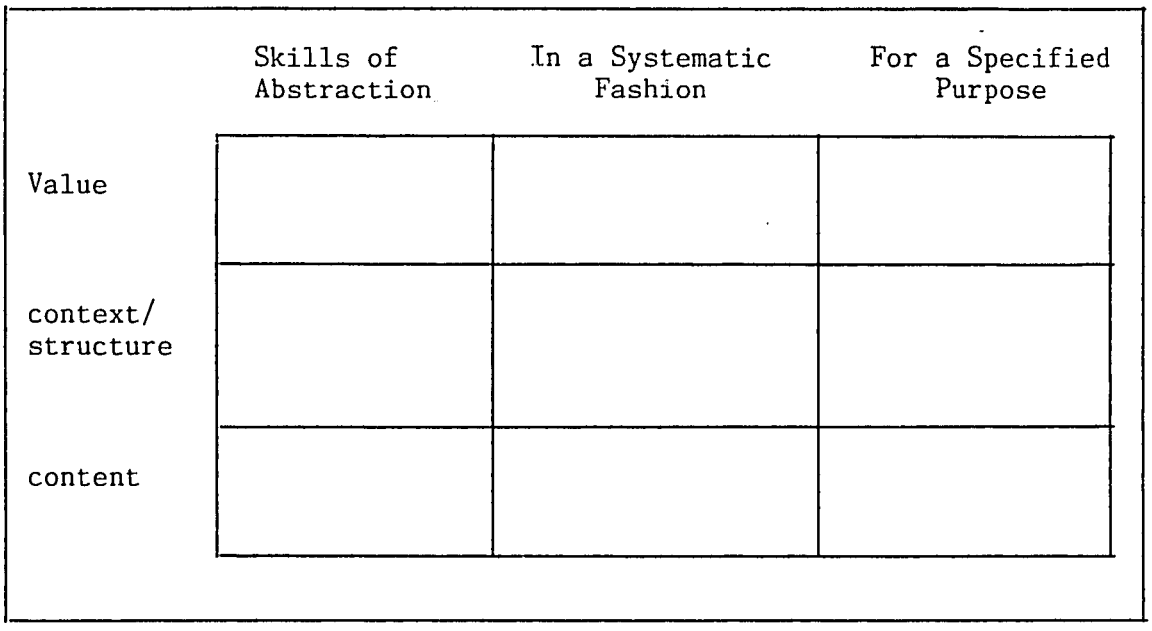



Figure 6. A model for teaching skills of intelligence.

Level 1) physical characteristics;

Level 2) function; or

Level 3) a value-laden purpose unique to the organizer.

Analogies may require comparison of data and/or relationships on the basis of:

Level 1) lay or common terms ;

Level 2) technical terms found in the terminological scheme of a particular universe of discourse; or

Level 3) terms requiring understanding of a cultural norm, two or more universes of discourse, or the values of particular persons or groups.

There are endless possible examples.

Column 2: In a Systematic Fashion. Leveling this column provides a ready format for the introduction of different types of systematic thought. A typical first level orchestration of thought would be to learn and use one or more of the many step-by-step "recipes" for problem solving. Hunt (1982, Chapter 7) reviews many of the prominent contributors in the study of problem-solving. Other suggested problem-solving sequences include a twelve-step sequence by Nickerson (1981) and a nine-step process outlined by Sternberg (1981). Although mentioned in Hunt (1982), the works of Rubenstein (1975) and Newell and Simon (1972) are of particular note due to the longevity and widespread use of their theories and methods.

An important category of systematic thought is the introduction of thought-styles, which also may be separated into the three levels. the pioneer investigations of Sigel (1965) have resulted in common reference to the thought styles as (Level 1) descriptive-analytic, (Level 2) categorical-inferential, and (Level 3) contextual-relational. Saunders and Decker (1973) have detailed roughly analogous modes of thought as (Level 1) lineal, (Level 2) lateral, and (Level 3) retroductive. They offer an analogy to modes of transportation which portrays the relative possibilities of each style:

lineal--a train-track

lateral--a freeway interchange

retroductive--a helicopter

Other types of cognitive style are impulsive versus reflective thinkers (Kagan, 1965), "field-dependence" versus "field-independence," and how broadly or narrowly people categorize what they see.

An excellent third level example of the patterning of thought is the Cube of Inquiry (Saunders, 1967). This model provides a generic format for systematic consideration and examination of alternatives before selection of the one appropriate to whatever purposes, goals or values are informing the inquiry. An important assumption regarding thought-style or cognitive style for the

purposes of the model is that students should be able to recognize and use whatever thought-style is appropriate for particular needs. For example, a very lineal thought-style may need to be adopted in order to complete meticulous (e.g., bookkeeping) or monotonous (e.g., assembly line type work) tasks (Level 1). Many situations may lend themselves to a lateral thought-style, where the task requires fresh new approaches (e.g., advertising) to old problems, or the generation of alternatives of any kind (Level 2). Some tasks may require more than the generation of alternatives, one may benefit by being able to step completely out of the context of the problem (e.g., Do we want this advertising job, anyway, because....) (Level 3).

Column 3: For a Specified Purpose. The possibilities in this column are so broad and diverse they defy systematization. Those possibilities may be eliminated by describing a few within the context of instructional application. Building on the pervasive principle that the purpose in the school task should be the students' own, a teacher is left to construct leveled opportunities for those student purposes. A level one purpose may be the mere accumulation of facts, a level two purpose to construct relationships using the same data, and a level three purpose to teach the rules by which those relationships are created and patterned--learning to learn.

Specific assignments may also be leveled by appealing to the model. For example:

Level 1) Write a report on the presidency of John F. Kennedy, (straight content)

Level 2) Write a report comparing the presidencies of John F. Kennedy and Dwight D. Eisenhower, including sections on domestic financial policy and foreign relations. (structure; comparison)

Level 3) Do the same assignment, writing from the perspective of a staunch Democrat or Republican (choose one). Or, attach to the end of your paper a brief statement discussing the value of acquiring such information and considering such issues in the first place. (conscious use of an informing value or purpose)

The model suggested here is content-free by design. Such a format enables adaptation of the processes it dictates to virtually any subject. Chapter 4 contains specific examples of the model used in a variety of content areas. While many specific instructional strategies can and should be produced through the use of the model, the ideal application is to the very teaching style of the teacher. To the extent that this change in teaching style occurs, the skills of intelligence--the most basic of the basics--will take their rightful place as the objects of the instructional program.

# CHAPTER 3

## RELATED LITERATURE

The purpose of this chapter is to review literature which is the historical framework for the thesis of this paper--that intelligence may be deliberately raised through instructional intervention in the public schools, and that such instruction may be carried out in the regular content areas under the guidance of an instructional model such as the one suggested herein. It is not a purpose of this review to attempt a restatement of the ongoing debates concerning the nature of intelligence, but rather to discuss contributions which are the foundation and building blocks of programs now available for "teaching thinking skills," as well as to discuss some of those programs themselves.

Selections incorporated will be sequenced from those most removed from the position to be used in this study, to those that will be used as the "jumping off point" for the proposals set forth herein. Such a sequence can be framed into three categories, each of which carries unique implications regarding the nature of

intelligence, and the task of building curricular programs for improvement of the same. Analogous to the curricular levels and their concomitant "learning frameworks" cited in Chapter 1 (pages 4-5), these categories can be leveled, each being generic to or including the one before it--that is, each level utilizing the significant features of the one before it in a more comprehensive and meaningful way. They are: 1) content, 2) specific skills, and 3) systematic contextualization.

Level 1: Content. Those subscribing to this notion of intelligence maintain that intelligence is a function of "how much you know." The more facts, content, and information you accumulate, usually through rote memorization, the more intelligence you possess. Instructional implications, therefore, consist mainly in the accumulation of facts in the most efficient manner available, and somehow the "ghost in the machine" (Ryle, 1949, p. 15) will make them meaningful and useful. Although very few theorists in education or psychology currently defend such a position, it reamins deeply entrenched in our educational system, and is, indeed, epitomized by the traditional curriculum model practiced in most schools today. Perhaps a reason this conception of education has persisted is that the "ghost in the

machine" has, without guidance or specific instruction, managed to make some sense of the massive amount of data and content it encounters. The purpose of the type of educational procedure proposed in this study is to make this process more effective by making it more systematically deliberate.

Level 2: Specific Skills. This conception of intelligence holds that intelligence is a composite of specific thinking skills. The instructional implications for this level is that once these specific skills are identified, instructional strategies need to be devised to increase the learner's efficiency in using each one.

Contributions in this level will be sequenced according to the extent to which they address the subject of specific instructional strategies and materials, beginning with those who have done pioneer writing with regard to "thinking about thinking," to those who have produced actual programs and materials for "teaching thinking" or raising intelligence. For the purposes of this review, the contributions within Level 2 have been separated into five groups as follows:

Group 1. This group addressed the subject of "thinking" without making suggestions for instructional application. THese include writers who have done seminal writing with regard to metacognition--thinking

about thinking--and whose work provides much of the foundation for those who followed.

Group 2. These writers produced works, again, of a foundational and theoretical nature, but in the context of education. For the most part they did not, however, contribute specific instructional strategies.

Group 3. The unique characteristic of this group of contributors is their attempts to eliminate or lessen the slum-related retardation of pre-school age children from low-income homes. These studies were actively involved in instruction, but not instruction of school-age children or of children with "normal" or middle-class socio-economic background.

Group 4. These are writers who suggest certain lists of thinking skills which should be taught, but do not couch them in specific instructional programs.

Group 5. The last group of contributors within Level 2 are those who have published specific instructional packages designed to teach processes of thinking. THese are programs which are typically intended to be taught as separate "subjects," based on lists of specific thinking skills and/or conceptions of intelligence as identified by their creators.

Level 3: Systematic Contextualization. This third level of definition, as previously stated, is genetic to

or contains the essence of the previous two levels. It is the point at which this study at once diverges from and builds upon the work of others reviewed herein, both in theoretical construction and concomitant instructional application. It maintains that intelligence is the degree to which a person organizes any and all experience, including that of an instructional nature, in a systematic and significant manner. Content is a part, specific skills are important. But content is merely the object and skills the tools in the structured, systematic signification of experience. In other words, it is the patterned, systematic use of the skills that is important, rather than the artificial discreetness of skills used in isolation of each other. Instructional implications include the need for students to develop the habit of processing information through a consistent conceptual framework or structure, and that such instruction can and should be done by altering instructional styles and materials in the existing content areas--that is, now new "subjects" need be added to the already crowded curriculum.

## A Background for Review

Before beginning the review as described above, it is appropriate, perhaps, to suggest general sources

the interested reader will find to be invaluable as a background, foundation, and preamble to a more extended study.

Intelligence and Experience, (Hunt, 1961). This monumental work raised a lot of academic eyebrows, and was a major force in turning the tide within academe away from the belief that intelligence was a fixed product of genetic heredity. It remains today a classic work which continues to pave the way toward the now more accepted notion that intelligence, as the title of the book implies, is more a function of experience and can be altered--for better or worse--depending on the experiential history, both instructional and otherwise, of the learner. A must for the serious inquirer, this work is an academic review of the studies and general history surrounding the investigation of intelligence from the ealry 1900s to the late 1950s. Because it so ably and conclusively pointed out that intelligence was not a fixed quantity and could be altered, this book played a major role in legitimizing, and, indeed, reawakening and hastening efforts to find how best intelligence may be raised.

How and How Much Can Ingelligence Be Increased?, (Detterman and Sternberg, 1982). This book provides a logical sequel for the interested educator or psychologist

to the Hunt book. It is a collection of technical articles written to provide an updated, "state of the art" review of instructional strategies for raising intelligence as well as extensive theoretical examination of the issues involved. Of particular interest are the tables on pages 48-50 and 56-59, which are an exhaustive listing of early intervention studies, ordered chronologically from 1925 to 1978. Since the majority of efforts to instructionally improve IQ have been attempted with preschoolers, particularly those from low SES environments, these lists alone are a valuable resource. The articles contributed share concensus in the fact that intelligence is instructional modifiable. There seems also to be quite a pragmatic concensus in the admission that such efforts are only in their infancy. This book will bring its readers up-to-date on many of the theoretical as well as practical issues and concerns involved in the raising of intelligence.

Revolution in Learning, (Pines, 1967). This landmark work is a very readable book done by a free-lance reporter. It is a non-technical review of a number of efforts up to that time to raise IQ and improve the child's ability to learn in general. This work was among the first to arouse public attention to the fact that improving a child's ability to learn was possible--was in

fact happening in certain projects--and the need for society to make such an effort a priority. The pioneers of ealry instructional interventions and their work are discussed in an entertaining yet informative and precise manner. Written for the lay population, this work is a quick introduction to early efforts to raise intelligence, and was followed up by another volume by the same author entitled The Brain Changers: Scientists and the New Mind Control (1973).

Intelligence Can Be Taught, (Whimbey and Whimbey, 1975). While Revolution in Learning focuses on early intervention efforts (birth to age six), this book reviews the next ten years of that work as well as selected pedagogical efforts to raise the IQ of learners of all ages (see especially Chapter 3). Whimbey provides a good discussion of the whole issue of the nature of intelligence, its modificability, and specific methods to carry out this "cognitive modification." The book is written with a satisfying combination of lay and technical language, and is an excellent general source to begin an in-depth investigation of the issue of teaching intelligence.

## Raising Intelligence: Categories of Curricular Purpose

Level 1: Content. The very study of thinking and intelligence in a pedagogical context is naturally presupposed by the assumption that how students learn (more specifically, how they think), rather than what they learn, is the object of instruction. This presupposition makes this category (content) an empty one for the purposes of a review of instructional strategies for teaching thinking or raising intelligence. All who have attempted to raise intelligence have, of course, focused on the process of how such a thing can be done. Therefore, as stated previously, the content students accumulate is only the data utilized in the specific processes suggested by each different writer. This is not to imply that content is unimportant, for such is not the case. Rather, it is to suggest that by itself, the bare accumulation of content results in a potentially inert, though in some cases large, store of facts.

Level 2: Specific Skills. In the second level of curricular purpose with regard to thinking skills are programs which suggest that the purpose of instruction is to increase students' ability to use specific thinking skills, such skills increasing the efficiency with which content or data may be accumulated, stored, and used. The

work of most popular and widely read writers in the area of teaching thinking and raising IQ fit in this category. Of the innumerable studies and writings done, naturally only a few may be presented here. Those selected are ordered according to the extent to which they contribute most directly to the object of this work--classroom instruction--suggest and lead to a patterned, interrelated, and systematic use of those skills, which will bring us to Level 3 as discussed on previous pages.

The work of a first group of writers and researers are united by several common characteristics. Although spanning a great many years, their work addressed a subject (thinking about thinking) well beofre its time of general acceptance as an important pedagogical issue. Also, these earlier books addressed the subject of thinking without giving many suggestions for classroom instruction. They were for the most part theoretical treatises by philosophers rather than educators. Such a list may begin with the classic How We Think (Dewey, 1910), and include such significant works as Critical Thinking: An Introduction to Logic and Scientific Thinking (Black, 1946), How We Learn (Bode, 1940), and An Introduction to Logic and Scientific Method (Cohen and Nagel, 1936). These treaties legitimized the effort to examine the

process of thinking and paved the way for the next group of writers. An excellent listing of ealry books on thinking appears in Burton, Kimball, and Wing (1960, pp. ix-x).

Following, and building upon, the ideas of those mentioned above came writers who recognized that knowledge about the process of thinking must find its ultimate application in the schools, and so produced writing and research designed to be read and used by educators. These books encourage the teaching of thinking skills, build theoretical justification,s give "how to" examples, and in general were the early responses to the growing recognition that schools were for something more than the transmission of selected content--that educators carried the obligations to teach the objects of their attention to think with greater power. These ealry, more general works include the previously cited Burton et al. (1960), Hullfish and Smith (1961) and Raths and Wasserman (1967). Each of these contain excellent bibliographies.

Three other well known writers have made contributions which fit in this category, with the added strength of providing more theoretical structure than their predecessors. Bloom's (1956) "Domain's" and their concomitant Taxonomies of Educational Objectives (see

Table 5), Gagne's (1965) Six-Stage Hierarchy of Learning Types (see Table 6, and Guilford's* (1967, 1972; see also Meeker, 1969) Structure of Intellect model (which isolates fifteen different skills and processes, and suggests 120 combinations of the same--see TAble 7) each imply and have resulted in many specific instructional strategies. Although based on theory, none of these quality in any theoretical sense as true models according to the criteria set forth in Chaper 2. They have deficiencies with regard to unstated assumptions and definitions. Gagne's learning types have serious problems with vertical syntactical equivalence. For example, are "concepts" prerequisite to "rpinciples" in the same sense that "S-R connections" are prerequisite to "verbal associations?" The categories of Guildford's Structure of Intellect do not meet minimum requirements of structural integrity. For example, are evaluation and memory (both on the same axis) related in a systematic and predictable way? Are they both cases of the same generic category--operation? Such minimum requirements are not present. Bloom's domains and their internal categories lack mutual exclusivity--that is, does not emotion (from the Affective Domain) involve thinking (from the Cognitive

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*See Guildford and Hoepfner, 1971, Chapter 2, for a concise description and history of the Structure of Intellect model.

Table 5. Bloom's Taxonomy of Educational Objectives: An Outline Summary. (Note: The Psycho-motor Domain was never developed).

| Cognitive Domain | Affective Domain |
|---|---|
| KNOWLEDGE | |
| 1.00 Knowledge | 1.0 Receiving (Attending) |
| 1.10 Knowledge of Specifics | 1.1 Awareness |
| 1.20 Knowledge of Ways and Means of Dealing with Specifics | 1.2 Willingness to Receive |
| 1.30 Knowledge of the Universals and Abstractions in a Field | 1.3 Controlled or Selected Attention |
| INTELLECTUAL ABILITIES AND SKILLS | 2.0 Responding |
| 2.00 Comprehension | 2.1 Acquiescence in Responding |
| 2.10 Translation | 2.2 Willingness to Respond |
| 2.20 Interpretation | 2.3 Satisfaction in Response |
| 2.30 Extrapolation | 3.0 Valuing |
| 3.00 Application | 3.1 Acceptance of a Value |
| 4.00 Analysis | 3.2 Preference for a Value |
| 4.10 Analysis of Elements | 3.3 Commitment |
| 4.20 Analysis of Relationships | 4.0 Organization |
| 4.30 Analysis of Organizational Principles | 4.1 Conceptualization of a Value |
| 5.00 Synthesis | 4.2 Organization of a Value System |
| 5.10 Production of a Unique Communication | 5.0 Characterization by a Value or Value Complex |
| 5.20 Production of a Plan, or Proposed Set of Operations | 5.1 Generalized Set |
| 5.30 Derivation of a Set of Abstract Relations | 5.2 Characterization |
| 6.00 Evaluation | (Source: Krathwohl, Bloom, and Masia, 1964, pp. 176-193.) |
| 6.10 Judgments in Terms of Internal Evidence | |
| 6.20 Judgments in Terms of External Criteria | |

Table 6. Gagne's Hierarchy of Learning Types.

**Gagne distinguished the "varieties of learning" as:**

1. Signal Learning: the conditioned response.
2. Stimulus-Response Learning: acquisition of precise responses to discriminated stimuli.
3. Chaining: two or more stimulus-response connections are made.
4. Verbal Association: learning of verbal chains
5. Multiple Discrimination: clarification of different identifying responses to many different stimuli.
6. Concept Learning: common response to a class of stimuli.
7. Principle Learning: a chain of two or more concepts.
8. Problem Solving: two or more principles are confirmed by a higher-order principle; thinking.

He indicated that each variety of learning is a "prerequisite" for a subsequent variety:

Problem Solving . . .
requires as prerequisites:

Principles . . .
which require as prerequisites:

Concepts . . .
which require as prerequisites:

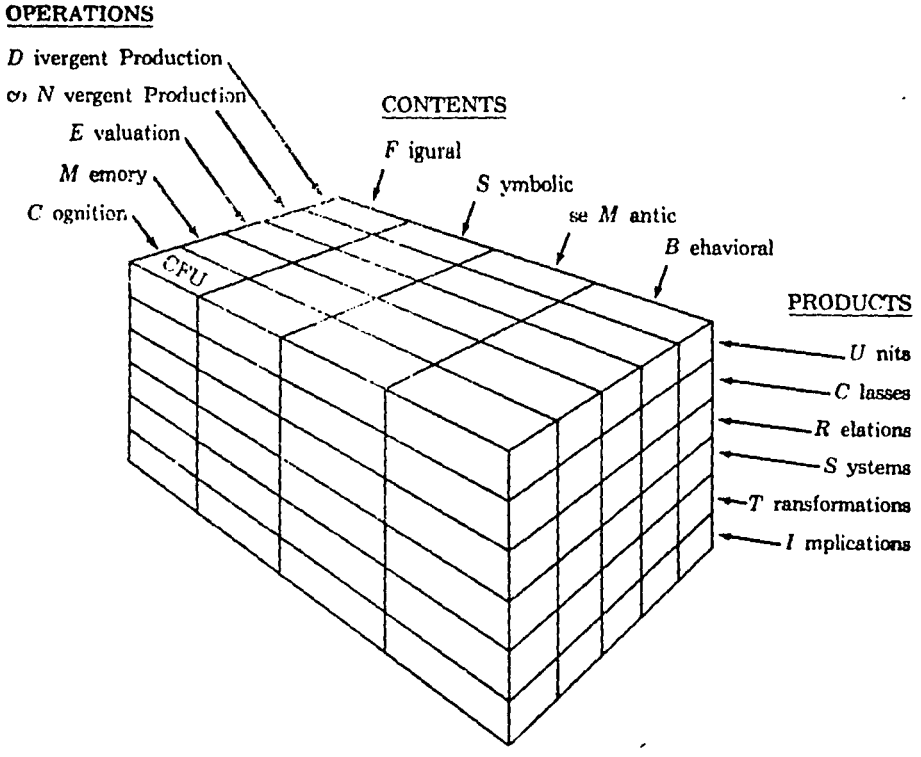
Multiple Discriminations . . .
which require as prerequisites:

Verbal Associations . . . or other chains . . .
which require as prerequisites:

Stimulus-Response Connections . . .

(Source: Gagne, 1965, pp. 31-57 & 60.)

Table 7. Guilford's Structure of Intellect Model.



Domain)?. It must be said in Bloom's defense, however, that he realized his domains and their internal parts were at best a taxonomy, and perhaps only a loose classification (Krathwohl, Bloom, and Masia, 1964, pp. 3-14). He never claimed the more strict level of "modelhood" for his domains and their resulting taxonomies.* Although these writers did not suggest specific instructional strategies, each did begin to move the focus of instruction away from content toward process and thinking skills.

A third grouping of contributors to the field of teaching thinking and raising intelligence are those which have attempted to halt and reverse the process of slum-related mental retardation. A great leap in understanding occurred when these and other researchers demonstrated that improving a student's ability to think actually raised the general academic ability commonly referred to as IQ. Referred to as family-, cultural-, or slum-related mental retardation, as well as other terms, this general category of inability to be successful in school and measuring low on IQ tests is the phenomenon of retarded ability as a function of an early environment--

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*See Chapter 2 herein, and Decker and Saunders, 1976, especially pp. 58-63 for more detailed criticisms of these works in terms of their models and the criteria for model construction.

especially the home environment. Although many have continued into longitudinal studies, all began by intervening in the early experiences of the child, some as early as three months of age, some actually before birth. Instructional interventions idffered from study to study, but shared quite a number of similarities. Rather than testing the efficiency of specific instructional strategies, researchers for the most part addressed themselves to general areas of development (language acquisition and ability, number ability, etc.), general academic areas (reading readiness, math readiness, science-sotical studies, etc.) and a few with specific thinking skills not normally found in the depressed home environment.

A major focus which all studies attempting to eliminate the negative effects of poor early environment seem to share, is to overcome the effects of the "restricted code" spoken in the homes. This restricted code refers to the impoverished, shorthand language usually spoken in the homes of economically disadvantaged homes with parents of low IQ. In middle and upper-class homes a richer, deeper language is spoken both earlier and more often, whereas in the high-risk homes an inordinate proportion of the communication takes place through means other than language, such as body language

of one kind or another (a slap on the head is a very definite form of non-spoken language). This focus on extensive examination and development of oral language will surface again in the review of studies programs currently used in the public schools. Preschool intervention studies are numerous, and the following are included here because of their particularly significant contributions.

Bereiter and Engelmann (1966) at the University of Illinois conducted a series of replicated experiments (which have been replicated many times) with preschoolers at risk for mental retardation using a method which Pines (1966, Chapter 4) aptly calls "the pressure cooker approach." The evident predecessor of the Distar reading and math programs, the instructional strategies were high-powered, intense sessions of drill, with highly animated teachers leading extremely structured discussions characterized by strict discipline and continuous, overt, in unison responses by the group. The discussion (an example of an actual dialogue appears as Appendix 2 in Whimbey, 1975), is built on pre-determined goals and objectives, as well as predetermined suggested dialogue. The class size was maintained at 15, with three teachers per class, each responsible, during

a two-hour period, for 20 minutes of his or her specialty--language, reading, or arithmetic. For each of the three academic areas, there were goals of developing 1) basic patterns of reasoning, and 2) increased academic knowledge. There were fifteen specific "minimum goals" of the program. Participants were judged to have a better attitude about learning and school when entering school, as well as scoring one full year above the national average on standardized tests, while their control group counterparts were scoring well below the national average. Bereiter reports that in four different replications the average IQ gains were consistently around 15 points.

Klaus and Gray (1968), of the George Peabody College for Teachers, designed and carried out another project to ameliorate poverty-related learning disabilities. The Ealry Training Project worked with three-year-old children from the nearby Nashville area for three consecutive summers, ten weeks, five days per week, four hours per day. During the winter a weekly home visit was made to help parents learn to stimulate cognitive growth and language during regular activities in the home. This program, again, focused on the quality of the verbal exchange found in the home. While attempting to compensate for the poor level of verbal interaction by working with the children directly, they

diffusion," and has consistently surfaced in other projects of the same kind.

Karnes (1973) at the University of Illinois has conducted a number of programs for disadvantaged pre-schoolers. Following much the same format as other programs of this type, she maintained a 5:1 student/ teacher ratio, while working in intensive 20 minute sessions on math concepts, language arts, reading readiness, and science-social studies. Perhaps the most notable contribution of these studies was that the instruction was carried out by minimally trained paraprofessionals, such as teenagers and mothers, thus demonstrating an economically feasible way to provide such a service to more children who would benefit most from such intervention. Karnes demonstrated that such intensive procedures produced IQ gains of eight points greater than those who attended a Montessori-type pre-school, and 12 to 14 points over the academic year greater than those with no preschool involvement at all.

Blank and Solomon (1968), of the Albert Einstein College of Medicine, conducted a similar study with four-year-old children who attended a traditional nursery school in a low income and socially disadvantaged area of New York City. The unique contribution of this study was to substitute individual tutoring on a relatively short-term basis for small group instruction over a long

period of time. Instead of going over several years of summers, the project only covered several months.

> In one group each child was tutored individually for 15 to 20 minutes a day, 5 days a week over several months. The Stanford-Binet IQ of this group increased from 97.7 to 112.2--a gain of 14.5 points.
>
> A second group was tutored the same way, but only 3 days a week. The average IQ gains of these children was 7 points.
>
> A third group served as an untutored control. Each of these children met with the same teacher for an individual session 15 to 20 minutes a day 5 days a week, but he was not tutored. He was exposed to identical materials but was permitted to engage in activities of his own choice. IQ for these children improved only 2 points (Whimbey, 1975, p. 39).

Preschoolers involved only in the traditional (free-play) nursery environment were also tested and scored an average IQ gain of 1.3 points. Three important contributions surfaced from this study. First, individual tutoring seems to speed up the process of overcoming the effects of a cognitively depressed home environment. Second, the more time spent with each child the more they will improve. Third, intervention with specific instructional strategies is much more effective than simply providing an unstructured but "enriched" environment which the child may explore at will.

also tried to influence the parents to provide a better environment for cognitive growth. They addressed such general areas as number ability, concept formation, discrimination ability, and language. At the end of the three years, the experimental group scored nine points higher than the control group on standard measures of IQ. However, the most significant results of the study seem to have been picedk up in the follow-up studies years later. Three years after the termination of the project the experimental group retained their nine point advantage in the IQ measure.

More important than this, however, may have been "secondary" effects of the project. First, the test performance of the siblings of the children in the experimental group was significantly higher than that of the siblings of the control group, evidently showing that the child-rearing practices of the parents of children in the experimental group improved and effected the test performance of their other children. Second, the effects of the program apparently diffused into other households nearby and caused a matched sample of households to score significantly higher than the neighbors of the control group families. This phenomonon--other family members and close associates of control group members also improving in performance--has since been named "vertical

Ramey, MacPhee and Yeates (1982), of the University of North Carolina at Chapel Hill, conducted a project designed to prevent developmental retardation called the Carolina Abecedarian Project. This was a major effort, including many follow-up measures and studies, and based on their own "General Systems Model." The project began in 1972 "as an attempt to intervene with infants and children believed to be at high risk for school failure" (Ramey et al., p. 85). Four groups were admitted into the project between 1972 and 1977. Focusing, again, on the quality of verbal interchange and general language ability of the participants, the project also addressed other developmental areas as well. The center they established runs from 7:45 in the morning to 5:30 in the evening five days a week, 50 weeks per year. After five years, students in the experimental group retained a solid seven point advantage in IQ over their control group. Although this differential is not particularly startling, the most significant results seem to be, as with the previously cited study, within the area of vertical diffusion. Incredible things seem to be happening in the families of participants. Older and younger siblings are consistently measured to show improved ability to perform on standardized tests of all kinds over their control group counterparts.

Finally, perhaps the most well known effort at preschool intervention is the Rehabilitation of Families at Risk for Mental Retardation program known as The Milwaukee Project, conducted by an interdepartmental group from the University of Wisconsin, directed by Rick Garber (Heber, Garber, Harrington, Hoffman, and Falender, 1972; see Garber and Heber, 1982, for a lengthy look at the longitudianl effects of the project in retrospect). This team made up of specialists from education, psychology, psychiatry, speech therapy, and sociology established the Infant Education Center in Milwaukee in 1966 to see whether this slum-related form of mental illness could be prevented. A group of 40 mothers with IQ's no higher than 75 and a newborn infant participated on a voluntary basis. This group was divided into experimental and control groups. Each infant was visited several hours each day for the first 3 months, at which time the mother took the child to the center. Each child received perceptual-motor and language-cognitive training until the age of two, while the mother at the same time received parent-training, including homemaking, baby care, and various forms of vocational training. At the age of two the child was placed in a class with five other youngsters and three teachers, by age four the class size was increased to eight, and at

age five class size was increased to 11. At 66 months into the project, the experimental group mean IQ was 124, whereas the control group mean IQ was 94--an incredible 30 point difference. Some of the experimental group children scored as high as 135, especially remarkable when contrasted with their mothers' IQ of 75 or less. Later evaluations of these children report that the IQ differential between the two groups has remained at 20 points. However, as in the previously discussed projects, the most promising effects of the study are in terms of its vertical diffusion. Parenting practices seem to have been permanently changed for the better, and especially younger siblings are consistently showing significantly higher scores on all types of tests of academic and developmental ability than their counterparts in the control groups.

Though interesting alone, this body of research is included in this review to demonstrate that, at least with preschoolers from low socio-economic environments, intelligence as measured by IQ tests and school success can be instructionally improved. It was for those who followed to demonstrate that such intervention could be effective not only with those whose intellectual development had been retarded by a distinctly poor early

environment, but with virtually any group of learners in the public schools.

A fourth group of contributors can be formed by those whose unifying characteristic is that they are actively studying thinking and its instructional implications, and have suggested a set of specific skills which should be taught. Some being steps in a "thinking" or "problem-solving" process (e.g., steps in the scientific method), others are separate, individual skills which form the composite "whole" of necessary skills to be mastered. Robert Sternberg (1981) is a major contributor to the field. He states that "intelligence consists of a set of developed thinking and learning skills used in academic and everyday problem solving" (p. 18), and has identified nine skills he proposes as the basis of a training program for students:

> Although the following list of none such skills is neither exhaustive nor mutually exclusive, I believe it reasonably represents the skills needed for adaptive task performance in a great variety of situations.
>
> 1. Problem identification
> 2. Process selection
> 3. Representation selection
> 4. Strategy selection
> 5. Processing allocation
> 6. Solution monitoring
> 7. Sensitivity to feedback
> 8. Translation of feedback to an action plan
> 9. Implementation of the action plan
>
> (pp. 18-20).

Sternberg suggests that these (and other) skills can be separately diagnosed and taught. Endless other problem solving strategies and sequences have been published. The interested reader will find works by Newell and Simon (1972), Rubenstein (1974), and Tuma and Reif (1080) to be excellent sources in the somewhat specialized field of problem solving.

Hansen (1982) suggests that while we debate about the best way to teach thinking skills, we could at least begin to work on the following skills:

| | |
|---|---|
| analysis | interpretation |
| concept formation | assimilation |
| synthesizing | generalization |
| accommodation | problem solving |
| principal formation | application |
| divergent production | differentiation |
| transferability | inquiry |

Nickerson (1981) suggests that "a program to enhance thinking might reasonably focus on four types of objectives: abilities, methodds, knowledge, and attitudes.

> The term abilities is intended to connote specific things one might want students to be able to do. Methods refers to structured ways of approaching tasks and subsumes the notions of strategies, procedures, and heuristics. Knowledge refers to facts, concepts, or principles that one might want students to understand. Attitudes refers to points of view, perspectives, or opinions that one might want students to adopt (p. 21).

A fifth and final group of contributions to the literature of the instructional improvement of IQ within Level 2 (Specific Skills) are those who have constructed

specific instructional packages for use in the classroom. Rather than focusing just on preschool age children, and using assorted (and usually unrelated) strategies to address designated critical areas of cognitive growth, or simply proposing what "should be" done, these writers have "leaped into the abyss of reality" and produced actaul materials for use in the classroom.

If there could be considered a pioneer creator of instructional materials for this purpose, perhaps that pioneer would be Albert Upton. Beginning in 1938, Upton used his own Design for Thinking in the required freshman program at Whittier College. The apparent success of the program of training in the meaningful use of words led him to test his conviction that such a program could, indeed, improve basic mental abilities. After eight months exposure to the program, the students' average IQ improved from 109.5 in October of 1959 to 120.0 in May of 1960--a 10.5 point improvement. This prompted a front page article in the New York Times of June 27, 1960 by Education Editor Fred M. Hechinger entitled Student IQ's Rise in California Tests," which caused widespread publicity. Soon the ball was rolling, and Stanford University Press published the seventh edition of Design for Thinking (Upton, 1961). Creative Analysis (Upton, Samson, and Farmer, 1961) was published soon after as a

workbook for the program. Samson (1965) published The Mind Builders as a general volume for the lay public, incorporating the same type procedures and principles.

Upton and his associates have produced a system which focuses heavily on clear definition, hierarchical category building, and elaborate analogical reasoning. Although language building is the stated purpose of the activities, many structural, non-language activities are included. The volumes contain many pages of exercises, and can (and have in many schools) be used as a textbook in an instructional setting (Upton et al., 1961, see preface).

A second instructional program in widespread use currently is the Instrumental Enrichment program authored by Reuven Feuerstein. Designed originally for retardates and learning disabled students, the program is now being used in classrooms of a wide variety of ages and abilities, including normal and gifted groups. Feuerstein has published two volumes (1979, 1980) which are the theoretical justification for the program. Students are first given the "Learning Potential Assessment Device" (LPAD) which diagnoses specific deficiencies to be addressed in the formal instructional program, the "Feuerstein Instrumental Enrichment" (FIE).

> The Feuerstein Instrumental Enrichment program consists of 15 instruments made up of paper-and-pencil exercises, providing materials for 1-hour lessons three to five times a week for 2-3 years. These are no set pieces but systematic guides to creative teaching. Each instrument focuses on a specific cognitive deficiency and provides experience in overcoming it. Instruments are selected to fit deficiencies identified in the prior learning potential assessment (Hobbs, 1980, p. 568).

Feuerstein (1980) cites research supporting the claim of increased IQ as a result of participation in the program. Instructional materials are designed for use by adolescents.

A third program is Philosophy for Children, built on the work of Matthew Lipman, and described in a book entitled Philosophy in the Classroom (Lipman, Sharp, and Oscanyan, 1980; see especially Chapter 5 for a description of the specific curriculum). The amterials are published by "The Institute for the Advancement of Philosophy for Children," and include instructional materials for a complete K-12 curriculum. The materials include six specially written novels and accompanying teachers' manuals which structure and guide discussions. The novels portray normal young people discovering the processes of reasoning in the course of their usual daily activities. Heavy emphasis is on formal as well as informal logic. Included are analogical reasoning and many other skills leading to efficient and accurate

reasoning ability. The program starts with very simple forms of reasoning and classification introduced through the teacher's reading of stories and ensuing discussion and materials (K-2), and ends with sophisticated philosophical specializations--ethics, epistemology, metaphysics, aesthetics, and logic--in the program for grades 11-12 (Lipman et al., 1980, pp. 51-54). An appendix in the book lists extensive quantitative data accumulated to show that following the program has resulted in the improvement of student IQ.

Another instructional program currently being used is Problem Solving and Comprehension: A Short Course in Analytical Reasoning by Whimbey and Lockhead (1980). Designed for high school and college use, this program "encourages a 'think-aloud' procedure."

> Pairs of students work together on problems; one student assumes the role of the problem solver while the other assumes the role of a friendly critic. Later the students switch roles. The problem solver verbalizes his or her thoughts while solving the problems. The critic monitors these thoughts to ensure that the problem solver reads the problem correctly, explicitly notes each step toward a solution, and checks the accuracy of each step in thinking. The thinkina aloud procedure sensitizes students to the need for precision and careful analysis by demonstrating how inaccuracies can occur (Vye and Bransford, 1981, p. 27).

Whimeby (1975a, 1975b, 1977) and Lockhead (1976) have individually been active in the field of teaching

thinking, and though this joint venture as yet has no empirical support, it promises to be a system very adaptable to the needs of the classroom.

To add to the programs reviewed above, there are many programs written and funded by local educational agencies such as school districts and state boards of education. An example of such a program is an effort funded by the Ohio Department of Education and is known locally as QUEST (Questions to Upgrade and Encourage Student Thinking) (Hughes, 1981, p. 49). This program is based on the work of Ehrenberg and Ehrenberg (1978).

Level 3: Systematic Contextualization. Hunt (1961) has contributed a definition of intelligence which serves as a bridge between the second and third levels of curricular purpose:

> Intelligence...would appear to be a matter of the number of strategies for processing information that have been differentiated and have achieved the mobility which permits them to be available in a variety of situations (p. 354).

"Strategies for processing information" suggests the unique characteristic of the third and most comprehensive category of curriculum. Content (Level 1) is the object of mental manipulation by specific skills (Level 2) which are themselves systematically patterned (Level 3) through the maximum variety of contexts and possibilities. Said another way, content, e.g., the facts to be learned in a

social studies unit, is the data which is organized and structured by specific skills (e.g., skills of abstraction which assign meaning to the content: sort, sequence, classify, categorize, taxonomize; use of analogies; syllogisms and other forms of logic; problem solving patterns and sequences, et.), which skills are patterned and given purpose by some deliberately chosen goal or purpose (e.g., to learn that the United States is the true champion of democracy and human rights, as is their world responsibility). It is clear to see in this example that the lower levels are given meaning by the ones above them. For example, a social studies unit in a communist-bloc country may focus on the same content, but result in a very different learning experience and conclusions due to the fact that the determining factor is the third level, and the unit would be guided by a very different goal and purpose.

The goal of this third level of curricular purpose may be stated, itselve in levels, as follows: The purpose of instruction is to

1) accumulate content

2) arranged in meaningful patterns and relationships through use of various skills of thinking and abstraction, with the

3) integrative realization that what is learned is deliberately selected from competing alternatives for consciously considered reasons and purposes;

that within each lesson, unit, text, or discipline the

1) content was selected from among competing alternatives,

2) the methods of representing and thinking about that content was selected from among competing alternatives, and that

3) thinking within that or any other discipline becomes more powerful and learning more complete to the extent that the competing alternatives of both (numbers 1 and 2 above) and the reasons for selection from among them become consciously recognized and deliberately chosen by the learner.

A goal of such an instructional style is to enable students to deliberately and consciously recognize that

1) there is no meaning outside of context,

2) that for any word, fact, or idea there are competing alternative contexts for meaning, and

3) that selection of a context by which to assign meaning is guided by a value, purpose, or goal, be it stated or unstated, conscious or unconscious.

Such processes as those described above are brought about not only by separate training in the skills

of intelligence and thinking (Level 2), but most effectively by changing instructional methods commonly utilized within the various content areas (e.g., reading, math, social studies, the physical sciences, etc.), so that those skills are taught as the natural structure and methods of examination which give meaning to that content (Level 3).

John Dewey (1934, Chapter 3) gave early voice to the idea of leveling in his delineation of the three types or levels of experience: the immediate, or direct in experience; the mediate, or placing of experience into a meaningful context; and the valued mediate, or use of some purpose or value to explain the selection of the particular context from among alternatives and give it its ultimate worth.

Alfred North Whitehead (1929) refers to the same variations in experience, and added an educational oblivation:

> In training a child to activity of thought, above all things we must be aware of what I will call "inert ideas"--that is to say, ideas that are merely received into the mind without being utilized, or tested, or thrown into fresh combinations (p. 1).

Jerome Bruner (1960, 1966) has long been an advocate of the importance of giving students an understanding of the structure of subject matter. His pioneer work in helping focus curricular purpose on ideas,

concepts, and structural knowledge has been of major importance. He was perhaps first to help establish a center for cognitive studies, of which there are now many. The Center of Cognitive Studies was organized at Harvard University in 1960. It would be difficult to overstate the importance of his contributions.

Eisner (1979) speaks of "the desirability for children to have opportunities to create and play with patterns that enable them to appreciate the structure of ideas and to enjoy the process through which those structures are formed" (p. 271. Italics mine).

Ansebel (1968, especially pp. 133-160; also reviewed in Joyce and Weil, 1980, Chapter 5) advocates the use of "advance organizers" to aid in the learning process. These advance organizers provide the structure and categories of what is to be learned before the material is presented. Such a procedure provides the framework and contexts in advance, giving learners some place to "put" (to significate) what they are presented, allowing them to proceed from the familiar to the unfamiliar with greater power.

Schmeck (1981) refers to "elaborative processes" when discussing the necessity of establishing a relationship between the student and the information:

> In general, it's important to have the student realize that a fact doesn't exist in isolation but is always related to other information. Furthermore, the student must learn there are alternative ways of expressing any unit of information ; its importance is in its meaning, and similar meanings can be symbolized in different people (p. 385).

It is precisely this link between the learner and the information which must not be left to chance in educational planning. Only through the deliberate development and use of this link, this "synthetic a priori" (Decker and Saunders, 1976), can we begin to increase the usefulness of each experience in the student's world, both in and out of the school environment be increased.

Saunders (1969) has developed such a system for processing information, which is, according to the model proposed in Chapter 2, a third level method for increasing students' intelligence. Among alternatives, it provides the most comprehensive structure for the systematic and exhaustive examination of any idea or problem.

## Conclusion

In consideration of a curricular effort to teach the "Intelligencing" process, isolated content (Level 1) or independent skills of thinking (Level 2) already exist, however, unrelated, unorganized and non-deliberate. Without the structure for systematic application, however,

they do not bring about the purposeful creation of meaningful and easily retrievable arrangements of information in the learner's world. Used alone, these processes simply perpetuate "the subjections of the pupil to the disembodied verbalization of the culture" (Smith, Goodman, and Meredith, 1976, p. 85).

An intentionally used framework to serve as a guide for creating materials and teaching strategies which effectively teach students to inform experiences, contextualize content, and utilize thinking skills in a deliberate manner is the pressing need in curriculum reform today. Such a framework may take the form, as suggested by this study, of a model which would guide any teacher, in any content area, in the development of materials and especially strategies designed to increase intelligence. Rather than taking shape as a new subject, teaching for thinking needs to be done as a natural part of any content area--the part which contextualizes, significates, and organizes for future reference that concent for the learner--and goes on to share the generic processes for doing the same for any purpose. Such is the theoretical model described in Chapter 2 herein. Examples of the application to classroom instruction appear in Chapter 4.

# CHAPTER 4

## SUBSTANTIVE APPLICATION OF THE MODEL: CURRICULAR MODIFICATION

The purpose of this chapter is to illustrate through example how the model for teaching to increase intelligence, presented in Chapter 2, may be used to generate teaching strategies and materials and to adapt existing lessons from textbooks and other sources.

Without returning completely to the philosophical issues raised earlier (Chapter 2), it bears restatement at this point that for the raising of intelligence or any other issue, especially in the behavioral sciences, there does not exist a model which is "right." A model is merely the best explanation its creator can construct of a particular phenomenon, written so as to be open to systematic examination and application. Its "rightness" or "correctness" can be judged only by the extent to which it can be operationally observed fulfilling the purpose of its creation, consistent with its internal definitions and categories. Since the definitions and categories of a model implicitly dictate the parameters of what will be observed, models have the effect of

becoming a form of self-fulfilling prophecy. A true model, then, actually generates the proof of its own "correctness."

Such an ostensively dangerous phenomenon becomes a concern only when the model in question is accepted as being the "correct" explanation of whatever it describes. To use a biblical analogy, a model must never be accepted as "gospel," but rather, the gospel according to its very human author, and thus subject to error and improvement. A model can only be refined and improved if an attitude of tentative and qualified acceptance prevails throughout.

Another important reminder bears restatement here. The model offered here is not a model of intelligence, but a model to guide teachers in structuring learning activities that focus on sharpening skills of intelligence. It is not presented as a simple solution to a complex problem. It is not a step-by-step, color-by-number recipe for teaching intelligence, nor can it be used in such a simplistic manner. It is intended, rather, as a framework around which to build and from which to draw principles and ideas to formulate instructional strategies and materials.

This is not to say that the model could not be used to guide the construction of "how to" manuals, with specific

suggestions and guidelines for teaching in different content areas as well as in the "content-less" realm of thinking itself. Manuals such as these are perhaps a logical next step. They do not, however, fit within the scope of this paper, and more importantly, are not necessary for the model to be immediately useful. With but a small investment of time to

3) understand the concept, reality, and need for improving thinking and raising intelligence,

2) acquire insight into the purposes, implications, and possibilities of the structure and categories of the model, and

1) a little practice,

(leveled as per the leveling concept utilized in the model) any concerned teacher can begin using instructional styles and materials which fulfill the purpose of the model.

It will be helpful, now, to restate the model, and provide some reminders and further clarifications with regard to the levels and columns.

## The Columns

For the purposes of instruction, intelligence may be considered as using:

Skills of Abstraction

In a Systematic Fashion

For A Specified Purpose

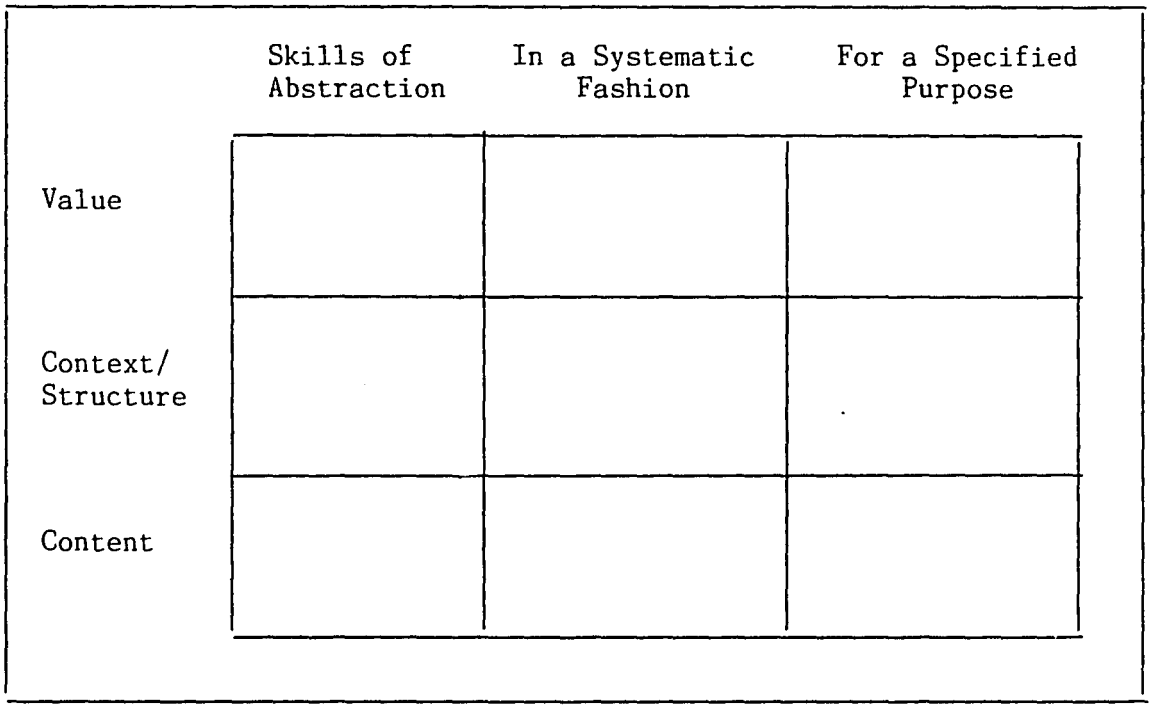


Figure 6. A model for teaching skills of intelligence.

Another perspective of the columns may be that the model should guide teachers in helping students to

| | | |
|---|---|---|
| Consciously use specific skills | In deliberate, patterned ways | To accomplish specified ends. |

The previously used analogy to carpentry...

| | | |
|---|---|---|
| Tools--hammer, nails, saw, etc.-- (are of no value used randomly or in an unskilled hand) | Used correctly, systematically, and skillfully | Can build what you determine in advance--a woodshed instead of a doghouse, for example. |

In other words instruction should help students learn to

| | | |
|---|---|---|
| Consciously construct relationships (abstract) between data | With which to buttress the use of relational, patterned thinking | In order to realize their deliberately selected ends--to avoid "walking backward into the future. |

## The Levels

The concept of leveling as utilized by this model carries great power in its usefulness in restructuring the thought process. Its use alone, without even the addition of the columns, would cause distinct improvement

in pedagogical practice. Briefly, the concept of leveling, as discussed in Chapter 2, is that any idea can effectively be examined through a structure of three levels:

Level 1. Content--at this level any group of data, content, idea, is without shareable meaning. It is barren without the clarity of definition provided by considering and examining the various contexts and/or competing alternatives which could give specific meaning to that data, content, or idea. Only when that is done, which is a level 2 task, can it assume true meaning.

Level 2. Context and Structure--at this level the data, content, or idea is considered in a specific context selected from among competing alternatives. The structure of that context is important and considered. For example, consider the statement, "Reading instruction in the primary grades is the most important part of the curriculum." Such a statement is usually accepted at Level 1 because most people take for granted what is implied, and agree. However, a Level 2 response would include, for example, an inquiry as to what the competing alternatives of "reading instruction" are, and whether the speaker refers to intensive phonics, an eclectric approach, or a holistic-type approach? Exactly what

other curricular purposes are you considering when you rank reading as first? What about grooming a solid sense of self-worth? What about developing a love for learning first and foremost? These are context and structure concerns which force one to consider more than the unquestioned "face value" of a statement or idea.

Level 3. Purpose, Goals, or Value Framework--at this level one must look to what purpose, value, or goal dictated or informed the selection of the particular context adopted, the unique alternative selected, in Level 2. If we mean an intensive phonics program, is it because we believe that children learn best when we decide what is best for them, cut it into little pieces, and spoonfeed them? Is it the conscious and deliberate choice of a philosophic realist who sees the behavioristic approach as "best" for the purposes of the school? Do we choose phonics because it is the only approach we really can understand and are comfortable with? Have we chosen phonics because our brother-in-law is the sales representative for the reading program? The point is, there is a reason we selected from among competing alternatives the context which gave meaning to the content. The purpose of the third level is to make examination and choice of that informing purpose conscious and deliberate.

An instructional device used for aiding students to understand and use the concept of leveling is included as Figure 7. It is a simple format designed to elicit appropriate responses from students for each level.

## The Model

With the categories and structure as outlined in Chapter 2, and reviewed briefly above, the cells can be used to "hold" key words and ideas which suggest specific activities to the user. Since the model is a framework, we can begin to "fill in the blanks" with suggested ways to accomplish the purposes of the specific columns, levels, and cells (see Figure 8).

The remainder of this chapter is a collection of examples of the model applied to instruction. Most examples will be couched in specific content areas, and will be so labeled. Some of those will be "teacher made" lessons, while others will be adapted to lessons found in specific texts. The majority of teachers are not given, complete freedom of instruction within a particular content area--e.g., reading, math, social studies. Most are required to follow district-prescribed texts, with the flexibility to use "teacher-made" materials and lessons within the parameters of that text. Both types of examples are, therefore, included.

PERSPECTIVE:PURPOSE

3 For the purpose of _____

_____

What is _____

_____

In terms of _____

_____

As opposed to _____?

CONTEXT:ALTERNATIVES

2 What is _____

_____

In terms of _____

_____

As opposed to _____

_____?

CONTENT:DESCRIPTION

1. What is _____

_____?

T. F. Saunders
University of Arizona
Think Tanks for teachers
Summer 1983

Figure 7. A format for eliciting leveled responses.

| | Skills of Abstraction | In a Systematic Fashion | For a Specified Purpose |
|---|---|---|---|
| Value/Purpose | Analogies | The "Cube of Inquiry" (Saunders, 1969)<br><br>Contextual/Relational thinking style (Retroductive) | The assignment: Considering an issue according to a deliberate choice based on a value, goal, or purpose; student's own value or purpose dictates nature or direction of assignment, as well as its perspective |
| Context/Structure | Building vocabulary by generic category<br><br>Spatial relations<br><br>Examining structure and alternatives<br><br>Logical Fallacies<br><br>Venn Diagrams | "Looping" methods of problem solving.<br><br>The scientific method<br><br>Categorical/inferential thinking style (Lateral) | The assignment: An exploration of alternatives and/or structure of an issue; considering an issue according to some designated criteria or context; |
| Content | Similarities:<br><br>Taxonomize<br><br>Categorize<br><br>Classify<br><br>Sequence<br><br>Sort | Step by step, lineal problem solving strategies.<br><br>Descriptive/Analytic thinking style (Lineal) | The assignment: A specific task; accumulation of straight content; rote learning |

Figure 8. Key words within model structure.

The example lesson plans are structured as follows:

Subject--identifies the content area within which the lesson occurs, e.g., history or math. The "subject" may also be a specific skill of abstraction, thinking pattern, etc. and therefore not fit neatly into a traditional content area. However, the major purpose of any lesson generated by this model is not the transmission of selected content within a particular universe of discourse, but deliberate exercise of a skill of intelligence. The "content" of the lesson is learned, and learned more powerfully, in the context of a specific skill of intelligence as identified by the model.

Model--the specific parts of the model addressed by the lesson. A lesson may address as little as one cell, as much as the whole model, or more often, one complete level or column. When less than one complete level or column is utilized, it must be done with an eye to the future introduction of all the cells in that column or level. The more levels and columns used, the more powerful the lesson becomes in terms of the complexity of the processes of abstraction deliberately utilized by the learner. Another concern regarding the component parts of the model is that teachers may make

improper assumptions about certain parts of the model. For example, assuming that a second grade class is too young to learn to level, or, on the other hand that an adult class already understands analogies or the structure of a certain universe of discourse may both be erroneous.

Remarks--A brief explanation of what the lesson is intended to accomplish, and how that will be done in terms of the model; a general explanation of the purpose and expected outcomes of the lesson.

Lesson Plan--The specific strategy is described.

An integral part of the model, the third column, suggests that all intelligence is exercised for a specific purpose. If utilized, this implies that students will be doing something as a result of the lesson. Whatever is done is the object of evaluation. The effectiveness of the lesson, either collectively or individually, is evaluated by analyzing the students' work (oral or written) to find evidence of deliberate and systematic use of the skill(s) of abstraction and/or the pattern of its application as specified in the lesson plan. Evaluation of these kinds of products of instruction--processes as well as content--is yet

in its infancy. Traditional survey tests so widely used--SAT, CAT, etc.--do very little, if any, to explicitly measure progress in this area.

## Sample Lesson Plans

Subject: Social Studies - History

Model: Levels; thought styles applied to a specific assignment.

Remarks: As always, the levels and their use should be referred to by the teacher explicitly--that is, the teacher should continually point out what sort of criteria determine a Level 1, 2, or 3 consideration of an issue or problem. In this example, the subject is United States History, and the specific content is the Civil War. Rather than giving the usual "cause, course and consequences" assignment, a teacher could do the following, which would result in just as much (or more) content being learned, with the added strength of instruction in thought styles and their deliberate use.

Lesson Plan: An actual--say the Second Battle of Bull Run--or contrived battle is set up for the students. The assignment is to describe the concerns and method of carrying the responsibilities of each of three people:

Level 3--President of the United States

Job: Win the war.

Thought style best suited to task: Contextual-relational. Concerns: What is the general purpose of the battle in the overall scope of the war? How will this battle affect other present or future battles? Is the potential loss of life worth what will be won in a victory--or a defeat. Is there another way to accomplish our purposes besides this particular battle? Besides this war?

Retroductive Thinking

Level 2--Gield General in Command

Job: Win the battle.

Thought style best suited to task: Categorical-inferential. Concerns: To win this battle, what are the alternatives possible to me? Draw up several alternative battle plans and discuss their relative merits. All efforts are centered on gaining the victory within certain given parameters.

Lateral Thinking

Level 3-Sargeant

Job: Take and maintain a specified position position by carrying out orders as precisely as given.

Lineal Thinking

Thought style best suited to task: descriptive-analytic. Concerns: Carrying out orders. Maintaining safety of self and those he leads into battle within the parameters of orders. Questioning orders may lead to own death or court martial.

The purpose of the assignment, again, is to help students be able to recognize and use the three different thought styles, and to gain some feeling for the perspective each brings into a given situation.

A variation on this assignment would be to ask students to write possible consequences of a Field General who plans and carries out the battle using a retroductive thought style, as opposed to the same situation with a Field General using a lateral thought style, as opposed to the same situation with a Field General using a lineal thought style. What would some of the likely differences be in how the battle was planned and carried out? How would the consequences likely differ with each of the three thought styles? Most importantly, why? That is, how does a particular thought style influence the course of decision making, etc.

Subject: Elementary Social Studies

Model: Leveling, with a focus on the relationship between levels 2 and 3.

Remarks: A "universe of discourse analysis" provides structural strength to the learning experience, reminicient, perhaps, of the "advance organizers of Ausebel (1968). Purposes of such a lesson include, 1) examining and making explicit the structure and organization of the text (in this example the McGraw-Hill Our Nation, Our World Social Studies program for Grade 5 [Vuicich, 1983]), 2) comparing that structure to the structure of the universe of discourse which it supposedly represents (identifying discrepancies and unaccounted for areas), and 3) discussing what values and/or purposes held by those who produced the text dictated the subjective selections of content and emphasis.

Lesson Plan: The following material is taken from the introductory pages of the above-cited social studies text. As those introductory pages are not numbered in any way, they are not cited herein.

"The primary objective of McGraw-Hill's new social studies program, OUR NATION, OUR WORLD, is to develop effective, participating, responsible citizens of the United States."

The structure of the text is outlined as follows: Objectives are grouped into two categories--Knowledge and Skills. In the category of Knowledge there are listed five areas, and in the category of Skills there are listed four areas. The following is an outline of these areas, along with the number of objectives in each and a measure of the emphasis given each one.

| Objectives | Number of Objectives | Number of Pages In the Outline |
|---|---|---|
| KNOWLEDGE | | |
| History | 6 | 1 |
| Geography | 7 | 1 |
| Other Social Sciences | 3 | 1/3 |
| Citizenship | 4 | 1/3 |
| Economics | 4 | 1/3 |
| | 23 TOTAL | 3 TOTAL |
| SKILLS | | |
| Map and Globs Skills | 8 | 1 |
| Social Skills | 4 | 1/4 |
| Thinking Skills | 3 | 1/4 |
| Study Skills | 8 | 1/2 |
| | 23 TOTAL | 2 TOTAL |

The above information is read as follows: Of a total of 24 Knowledge objectives, six are in the area of History, and their relative emphasis is one third of the total Knowledge emphasis. Of all the Skills, those of Map and Globe skills are considered as important as all

the others combined. For the purposes of comparison, the Social Science universe of discourse may be considered to have within it at least the following disciplines, with the following traditional definition:

Social Science--those studies of past, present, and future individual and group behavior, including (in no particular order)

1) History
2) Anthropology
3) Archaeology
4) Political Science
5) Law
6) Psychology
7) Sociology
8) Communications
9) Economics
10) Futuristics
11) Values
12) Others

Example questions for discussion:

1. What is the difference between "Knowledge" and "Skills?" Can you suggest another structure, e.g., Things you should KNOW, and Things you should know how to DO? (Level 2)

2. There is one complete page of references to History, and one complete page of references to Geography, and only 1/3 of a page of references to Other Social Sciences (except economics, which merited a separate objective). Why do you suppose there is such a seeming lopsided emphasis on one or two of the many social sciences? (Level 3)

3. Evaluate the stated primary objective. What values caused its selection? Is it nationalistic? What about the importance of world citizenship? What other primary objectives could a social studies program such as this emphasize? (Levels 2 and 3)

4. What is the difference between a Study Kill and a Thinking Skill? Are these (and some of the other) categories mutually exclusive? (Level 2)

5. To what extent do you think these categories were developed as an afterthought when the program was already written, rather than as the informing agent of its construction? (Level 3)

6. Compare this text to the text we used last year (or whenever--you may need to supply another for comparison). In what ways are they alike and different in their stated goals and objectives and methods of presentation? (Level 2)

7. Which studies within the social science seem to have been slighted or completely ignored. Why do you think this is so?

Note: Questions and answers should be <u>explicitly</u> related to levels.

Subject: Spelling

Model: Similarities--Categorization at each level.

Remarks: A purpose of any skill of abstraction is to create relationships between words or ideas. This very simple categorization activity requires students to categorize according to common, traditional criteria as well as their own constructed criteria. Such an activity is more easily accomplished with a list of nouns to begin with, but can be done with any list of spelling words found in a text. Most teachers are required to use a designated spelling text, in which the words are almost always grouped by phonetic (e.g., short "a" words) or structural (e.g., compound words) criteria. To add power to such a lesson, students may be asked to:

Level 3: Choose five words from the list that sound "bad" to you. For each tell why that is or could be so.

Choose five words from the list that sound "good" to you. For each tell what that is or could be so.

Create categories of your own with stated criteria for membership and divide the words in the listen to those categories.

From the list of words, construct five pairs of words and tell how each pair are alike--that is, what do they have in common, or what are they both a case of, etc.

Level 2: Divide the words into three groups: 1) animal, 2) vegetable, and 3) mineral.

Divide the words into two groups: 1) part, and 2) whole.

Divide the words into groups according to the parts of speech: 1) nouns, 2) verbs, 3) adjectives, 4) adverbs, etc. Which words could fit into more than one category?

Level 1: Divide the words into three groups according to the first vowel sound in the word: 1) short vowel sound, 2) long vowel sound, and 3) other.

There really are endless varieties, both traditional and student-made, of ways to categorize and group words. The more often done, the more skillful students will become.

Subject: Spelling: Vocabulary development

Model: Hierarchical structure--Column 1, Level 2

Remarks: An alternative to the traditional spelling list is having students generate, perhaps with a lot of teacher help at first, a list of words related in some way other than in their phonetic or structural

likenesses. An excellent substitute is to develop vocabulary by subject rather than structure. This is done most often in the traditional content areas, such as science and social studies. For example, students are given a list of words about atoms and molecules to memorize.

Lesson Plan:

1. Given a list of content- or subject-related words, students would be asked to begin exploring relationships between the words. For example, a list of words in a primary grade unit on animals may be as follows:

| | | |
|---|---|---|
| lion | shark | tiger |
| elephant | giraffe | snake |
| bear | dog | zebra |
| alligator | lizard | cow |
| chicken | eagle | robin |
| horse | | |

The teacher could then lead a discussion about what some of these animals have in common, leading to the students' considering the animals in terms of several different criteria, such as:

a) domesticated and non-domesticated

b) animals that produce by-products used by man

c) warm blooded and cold blooded

d) animals that find food in the water

e) felines, reptiles, etc.

There are many, many possibilities, and again, practice expands horizons. The more often such exercises are

done in class, the more sophisticated witll the students become in their ability to construct and use categories.

2. A second alternative to traditional spelling and vocabulary methods is to begin with a single term and build categories, alternatives and example cases of each around it. For example, using the same subject, we can take the word "tiger" and in a kindergarten class the ensuing discussion may proceed something like this:

| Teacher | Student(s) |
| --- | --- |
| "What is a tiger?" | "An animal." |
| "Can you name another animal like a tiger?" | "How about a lion?"<br>"A panther!" |
| How is a lion (or panther) like a tiger?" | "They're both mean!"<br>"They both eat other animals |
| That's right! To live they need to eat other animals. If you kill to stay alive, do you think it would help to be mean? | "Yes!" |
| Do you know what we call animals that must eat meat to stay alive? Carnivores--they are carnivorous. So what kind of an animal is a tiger? | "A carnivore?" |
| That's right! How else are a lion and a tiger and a panter alike? | "Well, they all have pretty fur." |
| "Good. Now, do you think all animals with pretty fur eat other animals to stay alive?" | "Heck, no!" |

| | |
|---|---|
| Who can think of one that doesn't?" | "How about a chipmunk?" |
| "Okay, good. So not all fur-bearing animals are carnivorous. How else are a lion and tiger and panther alike?" | "I know! They all four legs." |

...and so on. Following such a plan, the teacher could lead students through an entire hierarchical structure of a universe of discourse, for the previous example as follows:

| Categories | Equivalent Category |
|---|---|
| Biology (Life) | Geology |
| Animal Life | Plant Life |
| Mammals | Reptiles |
| Quadraped (Four-legged) | Biped (Two-legged) |
| Carnivorous (Meat-eaters) | Herbivorous (Plant eater) |
| Fur-bearing | Hair-bearing |
| Felines | Reptiles |
| Nondomesticated | Domesticated |
| Tiger | Lion, Panter |

The left column is arranged in ascendingly genetic order, while the right column helps firm up the definition or criteria of the corresponding category in the left column by naming an equivalent category.

Using strategies such as these, a fun lesson about "the many varieties of animals in our world"

evolves into a powerful structural lesson. What students add to the content learned is 1) a hierarchical framework in which to "house" or with which to give meaning to the content, and 2) a conscious use of criteria with which to build the categories in the hierarchy. These are powerful and necessary preparatory skills for utilizing and understanding the purposes of Level 2 thinking and its many applications.

Subject: Math; Generic thinking structure and process.

Model: Level 2 skill of abstraction.

Remarks: Simple, constant use of Venn diagrams throughout the year, in math (as in this example) or any other subject, builds studen's ability to construct relationships. Hierarchical as well as inductive reasoning skills are strengthened. Students begin to see the relational nature of meaning, and how context determines that meaning. Students begin to develop the important ability to visualize a spatial arrangement of information, and to construct and use frameworks for arranging larger amounts of data.

Lesson Plan: Very simple examples in math are as follows:

1. Instead of:

ALGORITHMS
Addition
Subtraction
Multiplication
Division

We have:

Algorithms

\+ - + -

2. To clearly define a square you must go through the following:

| Figure | Criteria |
|---|---|
| geometric shape | Any two dimensional shape formed by a closed line |
| polygon | formed by straight lines |
| quadrilateral | formed by four straight lines |
| parallelogram | opposite sides are equal in length |
| rectangle | all angles are 90° |
| square | all four sides are equal in length |

The chart is read with any figure formed by adhering to all criteria to the side and above it, so that each figure is a special case of the one above it.

Such a lesson and concept can be portrayed with more power using Venn diagrams, not in replacement of the verbal definitions, but to add to the strength of their internal arrangement in the learner's mind.

Subject: United States History

Model: Third level--analogies

Remarks: Use of analogies is dependent on the extent to which the teacher shores up the experience by explaining the types of analogies--that is, shares the rules by which the relationships work. Before, or along with, use of analogies in a specific content area, students should be taught in the mechanics of analogies, regardless of content. That is, students should first and most importantly be instructed in the type of relationship rather than the content area used in the relationship, as explained further in the next lesson plan.

Lesson Plan: In this particular lesson, students are asked to construct analogies between the Revolutionary War and the Civil War as a review activity. Working in groups, pairs, or individually as the situation dictates, students are assigned specific topics from which to construct the analogy.

Group 1--People. Examples...

WASHINGTON: GRANT:: :LINCOLN (LAURENS)

WASHINGTON: CORNWALLIS::GRANT: (LEE)

H. B. STOWE: UNCLE TOM'S CABIN:: THOMAS PAINE: (COMMON SENSE)

Group 2--Places. Examples...

PHILADELPHIA : LONDON :: WASHINGTON, D.C.:
(RICHMOND, VA.)

LEXINGTON: FORT SUMPTER:: YORKTOWN:
(APPOMATTOX)

Group 3--Issues. Examples...

CIVIL WAR: EMANCIPATION :: REVOLUTIONARY WAR:
(DEC. OF INDEP.)

BOSTON TEA PARTY: TAXES :: : SLAVERY
(HARPER'S FERRY)

After the analogies are compiled (in which case the review has already taken place!) they may be shared in any number of ways with the rest of the students in the class.

Subject: General thinking skills, any subject.

Model: Analogies; analogies by levels.

Remarks: Use of analogies represents a third level skill of abstraction according to the model, due to the number and sophistication of relationships that must be understood and used. Analogies themselves, however, can be leveled according to the content of the relationship utilized. Though the criteria for membership from one level to the next may be somewhat arbitrary, the model fulfills its purpose by suggesting the type of content and relationship appropriate at each of the three levels.

Most importantly, the model has the effect of forcing one to construct relationships not otherwise obvious or evident.

There are many different types of analogies. Sternberg (1974, pp. 12-15), in the Barron's How to Prepare for the Miller Analogies Test outlines "fourteen specific categories which are organized into seven general groups."

Each of these types of analogies can be leveled, thus extending the quality of the relationship. For example, Sternberg's sixth category is "superordination," which are relationships in which the first of the pair is a category in which the second of the pair is a member: Magazine is to Time as Newspaper is to The Washington Post, written in traditional analogy form as Magazine: Time :: Newspaper : The Washington Post. We may level this category by using criteria which each level suggests: Level 1, content; Level 2, structure or context; Level 3, value, purpose, or goal. An example of such a leveling is as follows:

Level 1-Content.

NOUN : TRAIN :: VERB : RAMBLE

Level 2-Structure or context.

EDUCATOR : DEWEY :: PHILOSOPHER : PEIRCE

In this analogy, the context of education causes

one to think of in a slightly different way than if we put him on the other side of the analogy as the philosopher, which we could have done. The point being that the context determined the meaning, and the analogy is proper as it stands, though it could be changed and still be correct.

Level 3-Value, purpose, or goal.

GREAT MEN: JOHN F. KENNEDY :: IMPORTANT INVENTIONS : TELEVISION

Although spelled out here, rather than in the traditional form of having one of the four parts missing and being required to supply it from one of several alternatives, the relationships still maintain the superordination style, but that relationship rides totally on the reader's definition of greatness and importance. In some people's opinion, the television is one of the least important (in fact, damaging) inventions ever, and for others, John F. Kennedy may not be their idea of a great man. The point is, of course, that the relationship rides on personal values and purposes.

The leveled examples of a superordination-type analogy above illustrate how an ostensive Level 2 analogy--Level 2 because it's relationship rides on category

membership, which is structure--can be subjected to the leveling criteria in the model and hence made more powerful in terms of the relationship used and the consequent instructional value.

Subject: Language; Social Studies - Current Events

Model: Level 2 and Column 3

Remarks: As is true with most strategies presented herein, this concept can be applied in many subjects. Explicit examination and use of logical fallicies can be carried out especially easily in the context of writing and analyzing editorials and controversial issues in the newspaper. Such controversies also exist in debates over certain issues in United States history. A particularly fruitful field is a heated political arena, such as a presidential debate.

Lesson Plan: The purpose of this lesson is to teach students to consciously utilize logical fallicies in writing political speeches for actual or contrived political candidates.

Schulman's Love is a Fallacy provides an entertaining, cleverly written way for teachers and older students to learn a number of logical fallacies. The following is a summary of those logical fallacies, along with the names and some examples Schulman uses.

Dicto Simpliciter--An argument based on an unqualified generalization. Exercise is good, therefore, everyone should exercise. Everyone should not exercise--for example, those who have health problems which exercise would exacerbate.

Hasty Generalization--An argument based on too few instances to support the conclusion. "I don't speak French, you don't speak French, Petey doesn't speak French. Therefore, no one at the University of Minnesota speaks French."

Post Hoc--Assuming a cause and effect relationship which does not exist. Let's not invite Bill on our picnic, because everytime we do it rains. The implied relationship, of course, that Bill causes the rain.

Contradictory Premises--An argument in which the opposing premises contradict each other. If God can do anything, He can make a stone so heavy He can't lift it.

Ad Misericordiam--Evading an issue with a statement of personal hardship or misery. "And what are your qualifications for the job?" "My wife has terminal cancer which has caused our family a great deal of financial hardship and emotional suffering. This job would really help us out a lot."

False Analogy--Assuming a similar relationship to an example. If doctors use x-rays to guide them in surgery, then students should be able to use their notes during tests. Of course, the relationship between x-rays and surgery is not analogous to the relationship between notes and tests.

Hypothesis Contrary to Fact--Drawing conclusions from an untrue hypothesis. If Madame Curie hadn't left a photographic plate in a drawer with a chunk of pitchblende we would not have x-rays today. False, of course, since someone else could have discovered the process later some other way, or invented it under completely different circumstances. You can't make something "true" from something that is not.

Poisoning the Well--Discrediting an entire argument (usually an opponent's) with a statement such as "My opponent is a liar," or "Come on. Tell it like it is!"

After discussing one or more of the fallacies, students are asked to select a position on an issue, or a candidate in a political race, and write articles and/or speeches which explicitly use the logical fallacy. The assignment must include an explicit explanation of where and which logical fallacies are incorporated.

Another excellent source for these kind of exercises is the analysis and/or creation of advertising slogans and scripts.

Subject: Reading, Comprehension

Model: Leveling; Thought Styles

Remarks: This lesson is an application of thought styles and leveling in general to the analysis of stories and other literature by the class. This, along with the next lesson plan, was developed in a Think Tank for Teachers conducted by T. F. Saunders during the summer of 1983, in collaboration with Brad Ferguson and Steve Frame, and is included here with the permission of both.

Lesson Plan: Thought Stylization Through Children's Literature. The purpose of this strategy is to introduce to preschool through intermediate grade students the three thought styles, and to provide an instructional format where students may practice formulating questions from each of the three styles of thought.

The instructional setting is that of a structured discussion about a piece of literature, which has either been read aloud by the teacher or read individually by the students. The methodology suggested here is only a framework, which should be altered and adapted as necessary to allow for classroom differences such as: group or individual instruction, age and/or maturity, reading ability, availability of multiple copies of the text, and the multitude of other variables which make each classroom unique.

Methodology

1. Explain to the students that, after hearing or reading the piece of literature, they will be asked to ask the teacher questions about it. Whenever possible, each student should have a copy of the story or poem or whatever is being discussed.

2. Presentation of the piece of literature may be through any of the following receptive modes: read aloud by the teacher, read aloud by the student(s). or read silently by the student(s).

3. After the reading, the student and teacher alternately ask each other questions about the piece. The teacher should ask questions from all three levels. It is to be expected that students are likely to ask the level of questions they think the teacher wants. Prior experience, therefore, may restrict students' ability or inclination to ask certain levels of questions. This should change when they find out what your expectations are.

4. The teacher may, at this point, evaluate student questions in terms of the thinking style criteria to determine the level of thought style most often employed by the student(s).

5. After a few minutes of questioning, the teacher should stop the process and point out the

qualitative difference between the student questions and the teacher questions. This serves as the launching point for instruction in the three levels of thought style.

6. The teacher should provide clear instruction in the three thought styles (or levels of question), including providing students the criteria for evaluation of the same.

7. In subsequent readings, each questioner, teacher and student, must state

1) the question,

2) the thought style (or level of question) it is, and

3) why, because of what specific criteria, the question belongs at that level.

8. Repeated use of the exercise enables students to continually improve their ability to identify and use each thought style (or level of question) through sheer practice and feedback, as well as modeling from the teacher and other students.

It is suggested that the following sheet (Figure 9) may be used for initial instruction in the thought styles, for diagnosis of the same, and also to give to students to help them formulate their questions as they learn.

| LEVEL III - RETRODUCTIVE THINKING or Reading behind the lines. |
|---|
| Questions that show the student has stepped outside the author.<br>For example, questions that<br>1) acknowledge personal values inform any and all interpretations of the piece or any of its parts, or<br>2) question the author's choice of options in conceptualizing and/or writing the piece. |
| |
| LEVEL II - LATERAL THINKING or Reading between the lines. |
| Questions designed to elicit an interpretive response.<br>For example, this level question typically explores things such as<br>1) the author's intended message,<br>2) the "moral" of the story,<br>3) "What can we learn from this story?"<br>4) "What does this mean to you?" or<br>5) "What would you do if you were . . . (a character in the story)?" |
| |
| LEVEL I - LINEAL THINKING or Reading on the lines. |
| Questions designed to elicit literal recall.<br>For example, answers to this level question are typically<br>1) traceable to the literal story-line of the text, and are, consequently answerable as<br>2) correct or incorrect. |

Figure 9. Thought style criteria for questions.

Subject: Any; General Thinking Skills

Model: Column 1, All Levels; Leveling

Remarks: This activity provides the format for learners to practice and improve their ability "go generic" through categorization tasks.

Memory, a card-matching "Concentration"-type game can be used as a stimulating vehicle for teaching pre-school through elementary age children to formulate and name generic categories. Through evaluating student responses in terms of the level criteria suggested on the following page, the teacher may also gain some insight into the thought style most often utilized by the student.

After initial instruction in how to play, it is intended that students play the game without teacher direction or participation--perhaps as a "filler" for those who finish work early, etc. The teacher may, of course, play with the students occasionally, or do what seems best to increase students' ability to "go generic."

The game contains two sets of cards with simple pictures on each card. Each set is divided into nine general categories of six cards each:

1) birds
2) children
3) flowers

4) fruits

5) insects

6) mammals

7) solid-colored (different colors) geometric shapes

8) toys

9) two-color squares containing different patterns

Note: The teacher is by no means restricted or limited to the cards in the Memory game. Other sets of cards and objects could also be used effectively.

Lesson Plan: Players take turns selecting a set of six cards and arranging them any way he/she wishes, so that the arrangement reflects predetermined generic categories or informing hypotheses selected by the student. When you teach students how to play, your choice of words is critical. Avoid, in your instructions, using such words as line-up, categorize, etc., as they may influence what the child does or thinks should be done with the cards.

The second or next player, or the rest of the group as a whole, must name the generic category(s) used by the person who arranged the cards. Perhaps the player who guesses could be the next to arrange the cards. For example, if the player selects the six cards which each picture a different bird, he/she may arrange them in any number of ways. Some possibilities are:

1) color--browns, greens, reds, yellows, earth tones, non-earth tones
2) shape or size--large species, small species
3) physical features--tufts, no tufts long or short tail feathers
4) habitat--tropical, cooler climate, tree nesters, rock nesters
5) use by humans--domesticated, non-domesticated used for food by humans, not used for food
6) feeding habits--nocturnal, daytime by preferred diet
7) by direction facing on card
8) by ability to "parrot" human speech
9) by those who are symbols for commercial enterprises and those who are not (NBC Peacock, Cardinal baseball team, etc)
10) sequenced from smallest to largest
11) etc. ad nauseum

These are only examples of what may be done. Students will think of many others. The game can and will become increasingly complicated and sophisticated. As the students' skills improve, they may begin drawing their set of cards from any number of the nine groups (e.g., two birds, two shapes, two toys, and two children) and arranging them in novel and unusual ways. Outside

the nine "natural" categories found in the cards, there is no reason to limit the number of cards used to six.

The general goal of the game is to get students to use increasingly abstract criteria for arranging the cards into specific categories, sequences, etc. The following is a general set of criteria which approximate an abstraction continuum more than levels, but for some unknown reason, we felt it was incumbent upon us to put them into three levels (or you-know-who...).

Level I. Arranged according to the content of the card, e.g., color, shape, physical characteristics, etc.

Level II. Arranged according to relationships not pictured on the cards, e.g., habitat, eating habits, etc.

Level III. The actual content or objects pictured on the cards are not considered in their usual contexts, e.g., the cards may be used for unusual purposes such as building three-dimensional figures, letters of the alphabet, geometric designs, etc.

## The Teacher's Aide: A Verbal Format

As a final addition to this chapter, it would perhaps be helpful to the practicing teacher to have a verbal format to make it easier to begin to use the model. In preparing a lesson, the teacher may find the following sequence of questions and instructions useful:

1. Identify as precisely as possible the content to be learned in the lesson or unit. It will help to list it in outline form.

2. For each major area of content or data to be remembered, identify the categories of which they are a member, and into which they can be broken.

3. Determine which skill(s) of abstraction you will use to construct and strengthen relationships between the content. In other words, how may the content be sorted, sequenced, categorized, etc? What analogies may be constructed using the content along with previous related content?

4. Deliberately level the content to be learned. Consciously level the abstractions used in instruction.

5. How may the object of this lesson be perceived differently from different points of view? What choice was it, and what was their purpose?

6. Can the lesson be adapted to demonstrate differences according to thought style?

7. Is there a problem-solving strategy that would aid in learning the content? Does the strategy allow for relational thought?

8. Does the assignment I am giving allow for alternatives, both within the subject matter and for the needs and beliefs of my students? How can I best force students to recognize these alternatives?

9. Does the assignment press students to consciously recognize the values and purposes of those involved with this lesson? Those persons involved include any persons who may be the object of what is to be learned, textbook writers, the teacher, and most importantly, their own--does the lesson force students to bring their values to bear on the lesson in a deliberate way?

# CHAPTER 5

## EPILOGUE: THE CHALLENGE

> We always live at the time we live and not at some other time, and only by extracting at each present time the full meaning of each present experience are we prepared for doing the same thing in the future. This is the only preparation which in the long run amounts to anything (Dewey, 1938, p. 49, Italics mine).

In an age when the body of technological knowledge and sheer amount of information continues to grow almost exponentially, it becomes increasingly compelling that educators seriously reexamine the basic assumptions and goals upon which the existing curricular framework of our schools is founded. The very logic of curricular structure remaining static and unchanged while passing through, and indeed, participating in the most extensive technological upheaval in history is disconcerting at best. To those who rest complacently on the notion that change is nothing new is recommended a thoughtful reading of the first chapter of Teaching as a Subversive Activity (Postman and Weingartner, 1969). Its authors suggest the metaphor of a clock face to illustrate dramatically the reality of the "knowledge explosion." Each minute being

50 years, the entire clock represents the last 3,000 years of human history. The point is made that there were almost no significant technological advancements until about nine minutes ago.

> About three minutes ago, the telegraph, photograph, and locomotive arrived. Two minutes ago: the telephone, rotary press, motion pictures, automobile, airplane and radio. One minute ago, the talking picture. Television has appeared in the last ten seconds, the computer in the last five, and communications satellites in the last second.... In other words, change isn't new; what is new is the degree of change. As our clock-face metaphor was intended to suggest, about three minutes ago there developed a qualitative difference in the character of change. Change changed. (pp. 10-11. Italics mine.)

This swiftness of change, which continues at an even faster rate today, carries with it the necessity for educational change. Alfred North Whitehead (1933), in a statement of an almost prophetic nature for its time, stated that the traditions, both educational and otherwise, which served society for so long (with questionable success), are no longer reasonable in this age of change:

> The whole of this tradition is warped by the vicious assumption that each generation will substantially live amid the conditions governing the lives of its fathers and will transmit those to mould with equal force the lives of its children. We are living in the first period of human history for which this assumption is false. (In Postman and Weingartner, 1969, p. 11. Italics in original.)

This is definitely more true today than when first written.

Hunt (1961) coupled a recognition of the nature of this change with an understanding of its educational implications--the purposeful development of intelligence:

> ...[O]urs is a technological culture of increasing complexity. Its development continually demands an ever larger proportion of the population with intellectual capacity at the higher levels. It calls for intellectual giants to solve the problems that become increasingly complex. The fact that it is reasonable to hope to find ways of raising the level of intellectual capacity in a majority of the population makes it a challenge to do the necessary research (p. 363. Italics mine).

Serious consideration of these issues must suggest even to the most conservative of educational planners the necessity of looking beyond the traditional content-centered curriculum to instructional strategies and materials designed to increase students' ability to use consistent, purposeful, and efficient thought processes--to increase intelligence. Allowing even for the unfortunate but typical 25- to 75-year "lag-time" between educational research and its consequent application in the schools (Bigge and Hunt, 1958, p. 254), it is time to begin.

## The Problems

Such a beginning, despite its seemingly obvious desirability, harbors many implicit and explicit problems

for school administrators, curriculum designers and supervisors, and those responsible for the formulation of educational policy. Recognizing that educators have total control over nothing for which they bear responsibility, implications and problems of a systematic curricular effort to increase intelligence are discussed beginning with those over which educators have the greatest immediate ability to impact.

Perhaps the most critical problem which may impede the incorporation of this effort into the schools is the recurrent crusade for "back-to-basics." As aptly stated by J. Merrill Hansen, "Ironically, the unsteady pendulum of instructional practice has gone from simplistic inquiry and mindless content to the total aberration of basics at any price and at the expense of thinking skills" (1982, p. 60). It is a crisis-level problem in education today. The public's demand for "accountability" has somehow spilled over to a presumed ability to prescribe educational remediation to the problem they perceive: teach only the basics, the traditional 3R's with a little physical science thrown in. A recent ASCD publication describes the counter-productive nature of this prescription:

> Problem solving, higher-order cognitive skills, intelligence--whatever it's called, thinking is in big trouble in the American classroom. Study after study reports a dismaying inability, particularly among high school students, to translate what they know into systematic ways of viewing and coping with practical problems. Educators say without a major effort to teach students how to apply what they've learned, millions may find themselves unprepared for the increasingly complex and technological future that lies ahead (1980, p. 1).

The title of this article, Basics Movement in Hindering Problem-Solving: Intelligence Can Be Taught, adequately states the concern.

Perhaps the most simple yet powerfully convincing reason why just more intensive "basics" is not what students need in the schools is illustrated in the following:

> The "basic skills" needed to function successfully in our...society extend somewhat beyond the 3R's. What separates the corporate executive from his secretary is more than just spelling proficiency. The difference between a shop owner and his clerk is not just facility with figures. And the community college student and the Ivy League scholare are likely to be distinguished from each other in many ways, and not just in reading ability (Donmoyer, 1979, p. 238).

The current fervor to "restore" quality to American schools must not be taken as a mandate for a greater emphasis on the accumulation of inert and soon-to-be-outdated content. When knowledge of certain content becomes the standard against which students are judged, what remains with a student when school days are over and

school learning is forgotten will be seriously inadequate as a preparation for success in life.

A brief exploration of certain ideas of John Dewey will help to illustrate. Dewey (1909, p. 24) warned of the effects of such schooling when he observed that "[t]he strong learn to glory, not in their strength, but in the fact that theyare stronger." Dewey suggested, rather, that "[t]he aim of education should be to teach the child to think, not what to think" (Dewey, quoted in Kerber (1968), p. 11). Such an aim, as stated in the opening quote of this chapter, demands that the child be taught to make the most of present experience. To do so would constitute the best guarantee of the quality of future experience.

The Growth Principle of John Dewey is an excellent vehicle for carrying this thought. Generally stated, this principle holds that in any situation one should choose the option which most effectively expands and refines the qualitative options for himself and those whom his behavior affects. Continuous growth, then, is the obejct of education. For Dewey, the vehicle for examining and discussing growth is the experience. In Education and Experience (Chapter 3) he elucidates the Growth Principle by suggesting that an experience may be:

1) educative, if it increases the learner's opportunity for greater experience, and his/her ability to learn from them;
2) non-educative, if it does not affect either; and
3) mis-educative, if it damages the learners' ability to have and learn from future experiences.

In Moral Principles of Education Dewey (1909) suggests, as a corollary to the Growth Principle, that any idea or experience may be considered:

1) moral, if it results in better actions or behavior than would otherwise have been the case;
2) non-moral, if it has no effect on behavior, and
3) immoral, if it results in worse conduct than would otherwise have been the case.

An important educational implication of this is that it is the present--how skillfully we learn to consider and act on our own present experiences--that must be the focus of education, not storing up information for later use.

A closely related issue which will become a problem to the extent that thinking skills are focused upon in education is testing. How will student progress be measured? What will the criteria for success be? How will scores on existing tests of achievement and intelligence be affected and interpreted. Each of these issues will require careful attention.

A major task confronting those promoting a concerted effort to teach students to think more powerfully is teacher education, both preservice and inservice. Inservice efforts are being met with great enthusiasm by teachers (see, for example, Hughes, 1981). However, the insignificant percentage of teachers who actually change teaching practices as a result of inservice (15% as reported by David Berliner in a personal conversation) dictates that more effective methods of inservice training be developed and used. Teacher training programs must also begin to focus more time and effort on preparing prospective teachers to teach thinking skills.

Another issue which needs to be monitored carefully is the effects of such training efforts on students in the "normal" range of ability. Until recently, research and instructional strategies have focused on two sub-populations of children; socio-economically disadvantaged preschoolers, and those categorized as educable mentally retarded. Such efforts were considered to be compensating for a depressed ealry learning environment (preschoolers) or for learning disabilities. Although several programs (reviewed in Chapter 3) have been used with "normal" students, such efforts are in their infancy, and must be monitored to begin to crystallize

what may be expected from populations of learners with no ostensible "catching up" to do.

A major concern over which educators have limited control is the need for the re-education of various segments of the population, both in and out of education, regarding the aims of education. School administrators, school board members, state legislators who expect to see content-centered education must be educated to understand the need for a curriculum whose primary purpose is to raise intelligence through teaching skills of thinking, and that such efforts should increase the learning of content.

Closely related to societal re-education is a final concern over which educators have the least control: the home environment. Santayana (in Kerber, 1968) said, "a child educated only at school is an uneducated child." And so the problem faced by all who would educate children surfaces again: public education is only one of many factors which together educate the child. This is precisely why, in several of the studies reviewed in Chapter 3, researchers have tried to influence parenting behaviors as well as child behaviors. Many have suggested introduction of preschool education on a widespread basis, (Pines, 1979). Saunders (1969) suggests "abstraction training" for all preschool age children.

## Raising Intelligence in the Public Schools: The Flight of the Phoenix?

Educational planners appear to be at the crossroads with regard to the teaching of skills that will raise intelligence. Can the teaching of intelligence move from the realm of mythology, knowing that to do so invites the hard work and problems of mortality? Or, do we doom the Phoenix to succumb once more in the funeral pyre of complacency and indecision, to rise again in a wiser age--as it surely will.

The body of supporting research exists, with its long list of successes. IQ's have been raised. Perhaps even more critical than the research to the success of such an effort, interest and recognition of need for such an effort now exist in greater proportion among educators than ever before.

Building on informed, comprehensive definitions of intelligence and their consequent models for implementation, educators can channel their efforts to the pedagogical implications that those definitions and models demand. Whether this is done will determine the eventual fate of the Phoenix--not to mention the fate of a new generation of thinkers.

Will it be another end of the final beginning?

## The Promise

A reflection of one singularly skillful thinker, Albert Einstein, conveys an appropriate concluding feeling:

> When I have no special problem to occupy my mind, I love to reconstruct proofs of mathematical and physical theorems that have long been known to me. There is no goal in this, merely an opportunity to indulge in the pleasant occupation of thinking...(In Dukas and Hoffman, 1979, p. 13).

Public education is not likely, nor need it expect, to produce on a regular basis large numbers of "Einstein-level" thinkers in our public schools. It is not, however, a worthy goal to strive to develop a generation of "einstein-type" thinkers who have discovered and can utilzie "the pleasant occupation of thinking" with skill and purpose?

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