A model for the development of elementary and secondary instructional materials covering the broad range of intellectual skills is presented. The document is a result of a search to identify and evaluate existing instructional materials, classification schemes, models, hierarchies, and taxonomies of cognition. It is presented in four sections. Section I examines models of cognitive processes such as Bloom's Taxonomy of the Cognitive Domain, Dewey's Stages in Problem Solving, Gagne's Conditions of Learning, and Guilford's Structure of the Intellect Model. No single model was found to be ideally suited to the curriculum developer. Section II focuses on 36 sources of curriculum theory organized to literature dealing with general cognitive processes; early childhood, science, and social studies instruction; and specialized skills. The third section presents a taxonomy of cognitive skills. Sixty-three skill-based instructional materials are sorted into the components of the Higher-Order Cognitive Skills Taxonomy. The materials are further divided into three levels: preschool to second grade, third and fourth grade, and fifth grade and beyond. The final section provides bibliographical citations for documents referred to in the report. (Author/KC)
VARIEITIIES OF COGNITIVE SKILLS:
TAXONOMIES AND MODELS OF THE INTELLECT

by

John W. Thomas

August, 1972
Abstract

The Higher-Order Cognitive component (HOC) is one of three curriculum development efforts within the Humanizing Learning Program. One mission of the HOC component has been to investigate the domain of cognition in order to discover or develop a taxonomy of cognitive skills which is at once sufficient to describe the varieties of skill instruction previously undertaken and fertile enough to serve as a basis for the development of innovative materials dealing with cognitive skills. To this end, a search was conducted to identify and evaluate existing instructional materials, classification schemes, models, hierarchies and taxonomies of cognition. Analysis and synthesis of this literature resulted in a review of popular classification schemes and available curriculum materials and the development of what seemed to be a comprehensive and viable taxonomy—a working model for the development of instructional materials covering the broad range of intellectual skills.
# TABLE OF CONTENTS

## MODELS OF COGNITIVE PROCESSES
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Each of the over half dozen types of models discussed, such as:
- Bloom's Taxonomy of the Cognitive Domain,
- Dewey's Stages in Problem-Solving,
- Gagne's Conditions of Learning,
- Guilford's Structure of Intellect Model,

has a special use but no single model was found to be ideally suited to meet the needs of the curriculum builder.

## CURRICULUM MODELS
---
Over three dozen sources of curriculum theory organized according to literature dealing with:
- Cognitive Processes—General,
- Early Childhood Instruction,
- Science Instruction,
- Social Studies Instruction and
- Specialized Skills

and the content sorted into the six general areas of the Cognitive Taxonomy presented in this document.

## A TAXONOMY OF COGNITIVE SKILLS:
The Application of the Higher-Order Cognitive Taxonomy to Realia
---
Sixty-three skill-based instructional materials designed for the elementary school sorted into the components of the Higher-Order Cognitive Skills Taxonomy and further subdivided by level:
- Preschool to second grade,
- Third and fourth grades,
- Fifth grade and beyond.

Many portions of the Higher-Order Cognitive Taxonomy are sparsely represented by available curriculum materials, few of the available materials are skill-oriented and fewer, if any, are sequenced across all grades.

## BIBLIOGRAPHY
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Provides citations, with a few exceptions, only to those documents actually referred to in the paper. Other bibliographies listing curriculum theory literature and instructional materials appear on pages 18 and 47.
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Varieties of Cognitive Skills

A conceptual framework is a necessary starting point for a curriculum development effort. This paper documents the construction of a framework designed to guide the development of a kindergarten through eighth-grade curriculum focusing on the training of intellectual skills and problem solving. In order to develop a model or taxonomy of cognition that could be used for both descriptive and prescriptive purposes, a search and analysis of educational and psychological literature was undertaken which resulted in a review of the variety of models used to classify cognitive processes, skills, abilities and stages; the development of a tentative taxonomy which was used to organize the cognitive goals of diverse curriculum development projects; and the application and enlargement of this taxonomy through an analysis of the objectives and activities that make up a variety of skill-based instructional programs.

MODELS OF COGNITIVE PROCESSES

Cognitive and experimental psychologists are typically reticent about publishing theories and models of human intellectual behavior. They believe, with good reason, that the scope and variability of intellectual processes cannot be adequately accounted for by any small set of psychological constructs. Historically, attempts at defining such a global theory have met with some disdain and with impossible verification difficulties. The models of the intellect that are to be found in the literature tend to be constructed for specific psychometric, educational or clinical purposes. Consequently, despite apparent similarities or contradictions, these models cannot be considered to be theoretical alternatives. Rather these models or schemes of intelligence, cognitive processes, or problem-solving stages must be treated as heuristic devices with which the psychologist, clinician or educator seeks to organize research findings or further his own research ends.

It is interesting to note that lately there has been a renewed interest on the part of psychologists, and especially educators, in models of intellectual processes. Two trends in psychology have contributed substantially to this phenomenon. Schoolmen and parents have become increasingly critical of the use and misuse of intelligence tests in the schools. For whatever reasons, IQ test scores and resultant differential practices based upon these scores tend to favor the advantaged, English speaking white population. Educators and
School psychologists have begun to look for alternative means of describing academic competence and potential, thus, new models of intelligence are in demand. A related trend began in the early 1960's and centered around research in creativity. Submerged for fifty years, the creative process, or the creative potential, has recently become a legitimate and popular field of inquiry. One of the early results of this type of research was a widely disseminated criticism of the established models of intelligence and academic achievement. It was argued that creative or divergent thinking ability plays an important role in academic achievement, in peer group adjustment, and in the production of innovative ideas in all aspects of life, yet, the creative process has traditionally been ignored as a dimension of intelligence and neglected as an objective of instruction.

A Psychometric Model: Guilford's "structure of the intellect" model has furthered the cause of both of these trends. The model has provided an empirical referent for criticisms of existing IQ measures and has been used by educators, especially, to champion the creative processes against the convergent thinking processes allegedly tapped by intelligence and achievement measures. The model is a psychometric one. Intercorrelations between performance data on a variety of ability tests were manipulated through statistical techniques such that factors were caused to emerge. These factors appeared to be along
three major dimensions. Guilford and his associates then introduced additional ability tests into the analysis in the attempt to define pure measures of independent factors which could be arranged along the intersections of the three dimensions of intelligence.

Operations, according to Guilford, are the intellectual processes—what the individual does with information that comes to his senses. An individual stores and retrieves information, or engages in the process of memory; he comprehends or understands sense data, or cognizes; he generates information in response to determining conditions, or engages in convergent thinking; he generates information under conditions where originality and quality of ideas is stressed, divergent thinking; or he makes judgments about information relative to established criteria, or evaluates. Each of these operations may be performed relative to four different contents or modes of representing information. And the products of operations upon the content may take six different forms dependent upon the way the individual is processing the information. Of the 120 separate abilities described by the model, something in excess of 80 have been defined operationally to date.

Psychologists tend not to be ambivalent about this model. They are either unalterably opposed to it in all of its ramifications, or they believe that it offers valuable implications usually beyond those of Guilford. Without attempting to review the voluminous literature for and against Guilford's research, suffice it to say that the adherents of the model stress its utility for defining educational objectives and its critics stress its tenuous predictive validity. Attempts have been made to devise instructional objectives directly from the cells of the model (Karnes, 1970; Meeker, 1969) while other psychologists have altered the model to fit their own instructional interests, e.g., Williams (1970).

Without a doubt, the most pervading aspect of the model is that it includes a dichotomy of sorts between convergent and divergent production; between creativity and the more constrained, typical academic thinking activities. A number of investigations into creativity followed Guilford's (1959) presentation of the model (Getzels and Jackson, 1962; Torrance, 1965; Wallach and Kogan, 1965; Yamamoto, 1964). Substantial evidence was compiled in support of the claim that divergent thinking ability was related to academic success. In addition, support was amassed for the separate dimensionality of creativity and intelligence.

The creativity (divergent thinking) vs. intelligence (convergent thinking) controversy may serve to illustrate the utility of Guilford's model for education. Criticisms of its validity and its predictive significance notwithstanding, the model should serve to promote more varied and multidimensional conceptions of educational objectives.

A Task Analysis Model: Classification of cognitive processes can have another kind of empirical base, task analysis. Psychologists using this technique are interested in defining the total number of discrete performances necessary to carry out a particular task or set of tasks. Gagne's learning model, as well as the majority of problem-solving models, stems from
task analysis and research into the qualitatively different sorts of performances that serve as prerequisites for complex tasks.

Gagne's model is a classification of the variety of learning paradigms. For Gagne, learning a simple stimulus-response chain is not only easier than learning to solve a problem, but also the conditions under which the learning occurs, the nature of the response, and the internal conditions of the learner are necessarily different in each case. The following summary is from Gagne (1970, p.334):

**SUMMARY OF ESSENTIAL CONDITIONS APPROPRIATE FOR EACH TYPE OF LEARNING**

<table>
<thead>
<tr>
<th>Learning Type</th>
<th>Prerequisite Capability</th>
<th>External Conditions of Learning</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ss-R Connection</td>
<td>Apprehension of stimulus</td>
<td>Presentation of stimulus so that desired response will be contiguous in time and supply contingent reinforcement.</td>
</tr>
<tr>
<td>Motor Chain</td>
<td>Individual connections</td>
<td>A sequence of external cues, stimulating a sequence of specific responses contiguous in time; repetition for selection of correct response-produced stimuli.</td>
</tr>
<tr>
<td>Verbal Chain</td>
<td>Individual connections including &quot;coding&quot; links</td>
<td>A sequence of external verbal cues, stimulating a sequence of verbal responses contiguous in time; repetition may be necessary to reduce interference.</td>
</tr>
<tr>
<td>Discrimination</td>
<td>Apprehension of stimulus</td>
<td>Practice providing contrast of correct and incorrect stimuli; or, practice providing progressive reduction in stimulus differences.</td>
</tr>
<tr>
<td>Concrete Concept</td>
<td>Discriminations</td>
<td>Responding to a variety of stimuli differing in appearance, belonging to a single class.</td>
</tr>
<tr>
<td>Rule, including Defined Concepts</td>
<td>Concepts</td>
<td>External cues, usually verbal, stimulate the formation of component concepts contiguous in a proper sequence; application is made in specific examples.</td>
</tr>
<tr>
<td>Higher-Order Rule-Problem Solving</td>
<td>Rules</td>
<td>Self-arousal and selection of previously learned rules to achieve a novel combination.</td>
</tr>
</tbody>
</table>

In contrast to Guilford's model, problem-solving models, and information-processing models, Gagne's cumulative learning model deals with thought processes through the specification of the characteristic performances by which the processes are expressed and
the particular external and internal conditions prerequisite for the emergence of these processes. The conditions of learning are further elaborated through a specification of the events and procedures of instruction (Gagne, 1970). Gagne’s model is not, however, a model of thinking. It’s value lies in its utility for deriving instructional objectives, designing curricula to meet the objectives and designing the process of instruction and evaluation. If one’s interest is in developing a problem-solving curriculum, the model would not describe the variety of problem types or problem-solving processes and strategies. However, the model could contribute to the design of each portion of the curriculum insofar as it specifies the kind of prerequisite learnings necessary and the instructional conditions which would maximize transfer to the criterion tasks.

A Taxonomy Of Cognitive Objectives: Another model based upon task analysis is Bloom’s “taxonomy of educational objectives” of the cognitive domain (1956). Rather than being a classification of the variety of learning paradigms, it is a taxonomy of the variety of educational objectives. Consequently, it spans learning tasks and the more abstract goals of instruction that have to do with thinking about the content of learning tasks. Bloom’s cognitive taxonomy is as follows:

### Bloom’s Taxonomy of the Cognitive Domain

<table>
<thead>
<tr>
<th>Level</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Knowledge</td>
<td>Classifications—categories, Sequences—series, Specific facts, Terminology, Recall of information</td>
</tr>
<tr>
<td>Comprehension</td>
<td>Extrapolation, Interpretation, Translation</td>
</tr>
<tr>
<td>Application</td>
<td>Particular and concrete Situations</td>
</tr>
<tr>
<td>Analysis</td>
<td>Organizational principles, Relationships, Elements</td>
</tr>
<tr>
<td>Synthesis</td>
<td>Derivation of abstract relations, Production of plan-pattern, Production of uniqueness</td>
</tr>
<tr>
<td>Evaluation</td>
<td>Judgment by internal criteria, Judgment by external evidence</td>
</tr>
<tr>
<td>-</td>
<td></td>
</tr>
</tbody>
</table>
Bloom's model is a descriptive one. Whatever hierarchical qualities are attributed to it by Bloom and others are logical and not psychological. In contrast to Guilford's model, Bloom's taxonomy is sufficiently general to create difficulties in interpretation, yet it has proven to be quite useful as a classroom observation or evaluation scale and as a guide in using inquiry or discovery methods. The taxonomy does share one thing in common with Guilford's model. It is best used by a curriculum planner as a reference rather than as a framework for the derivation of objectives. Deriving (as opposed to specifying) objectives from a descriptive model of educational practices or from a model of testable human abilities is, in reality, tantamount to perpetuating an existing state of affairs.

A Developmental Model: Cognitive developmental research can hardly be ignored in any discussion of models of thought processes. Piaget's analysis of the development of hypothetico-deductive or formal reasoning has introduced many constructs into the psychologists repertoire. More importantly, Piaget has been influential in the growth of a new breed of psychologists interested in human thought processes, intelligence and problem solving. The unique aspect of this approach to cognition is the belief that complex intellectual behavior is best understood and defined via an analysis of the developmental sequence through which it emerges. For Piaget, the child progresses through an invariant sequence of qualitative changes in his cognitive structure. These changes are observable through an analysis of the logical explanations the child volunteers relative to a variety of external events. The characteristics listed on the chart below, which elsewhere are considered to be cognitive skills, problem-solving processes, human abilities, etc., are, for Piaget, attributes to cognitive adaptation — of the successful attainment of stages of intellectual development. The following chart is taken from an article by Williams (1969):

**Piaget's Stage Theory of Intellectual Development**

<table>
<thead>
<tr>
<th>Stage</th>
<th>Characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Sensory-Motor Stage</strong></td>
<td>Mute — no use of verbal symbols&lt;br&gt; Learns to perceive — discriminate and identify objects</td>
</tr>
<tr>
<td><strong>Pre-Operational Stage</strong></td>
<td>Symbols and representations&lt;br&gt; Acts on perceptive impulses&lt;br&gt; Self-centered&lt;br&gt; Static-irreversible thinking</td>
</tr>
<tr>
<td><strong>Concrete Operations Stage</strong></td>
<td>Analyzing&lt;br&gt; Conscious of dynamic variables&lt;br&gt; Measures&lt;br&gt; Classifies things in groups or series</td>
</tr>
<tr>
<td><strong>Formal Operations Stage</strong></td>
<td>Abstract-conceptual thinking&lt;br&gt; Reasoning generalized&lt;br&gt; Evaluation&lt;br&gt; Hypothesizing&lt;br&gt; Imagining&lt;br&gt; Synthesizing</td>
</tr>
</tbody>
</table>

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**Notes:**
- ERIC (Educational Resource Information Center) reference included.
Similarities and differences between Piaget's and psychometricians' conceptions of intelligence have been competently discussed by Elkind (1969). Likewise, a comparison between Piaget's views on the development of intellectual skills relative to the views of learning psychologists is treated by Gagne (1968), Kohlberg (1968), and Rohwer (1970). Despite the fact that Piaget's writings are not notable for their pedagogical prescriptions, it is fair to say that any attempt to define teachable cognitive skills for an elementary school curriculum must consider the qualitative differences in intellectual competence exhibited by children of different ages. And insofar as these deficiencies represent stages of development and are not amenable to instruction, the curriculum planner must be quite cautious in planning instruction which matches the cognitive structure and learning readiness of the child.

Problem-Solving Models: One of the oldest conceptions of the nature of thought is concerned with the logical stages or distinct steps involved in a complex thinking act, usually problem-solving. Dewey's five steps have been both expanded and reduced yet their appropriateness as a model has not lost favor since 1910. The original steps and their revised equivalents are taken from Getzels (1964) and Dewey (1933) respectively:

1. a felt difficulty (recognize problem)
2. location and definition (analyze problem)
3. suggestion of a possible solution (generate solution)
4. development by reasoning of the bearings of the suggestion (test consequences)
5. further observation and experiment leading to its acceptance or rejection (judge selected solutions)

Samples of other stage conceptions of the thinking process are listed on the following page.
## Stages in the Problem Solving Process

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<th>BINET (1909)</th>
<th>BUHL</th>
<th>CRUTCHFIELD</th>
<th>DEWEY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Direction</td>
<td>Recognition</td>
<td>Problem formulation</td>
<td>Difficulty felt</td>
</tr>
<tr>
<td>Comprehension</td>
<td>Definition</td>
<td>Information processing</td>
<td>Difficulty located</td>
</tr>
<tr>
<td>Invention</td>
<td>Preparation</td>
<td>Idea generation</td>
<td>Possible solutions</td>
</tr>
<tr>
<td>Criticism</td>
<td>Analysis</td>
<td>Idea evaluation</td>
<td>Suggested</td>
</tr>
<tr>
<td></td>
<td>Synthesis</td>
<td></td>
<td>Consequences considered</td>
</tr>
<tr>
<td></td>
<td>Evaluation</td>
<td></td>
<td>Solution accepted</td>
</tr>
<tr>
<td></td>
<td>Presentation</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>EMERY</th>
<th>GORDON</th>
<th>GREGORY</th>
<th>KAUFMAN</th>
</tr>
</thead>
<tbody>
<tr>
<td>List deviations</td>
<td>Problem as given</td>
<td>Decide on objective</td>
<td>Identify problem</td>
</tr>
<tr>
<td>Set priorities</td>
<td>Make strange familiar</td>
<td>Analyze problem</td>
<td>from needs</td>
</tr>
<tr>
<td>Define deviation</td>
<td>Problem as understood</td>
<td>Gather data</td>
<td>Determine solutions, requirements, and alternatives</td>
</tr>
<tr>
<td>Identify differences</td>
<td>Operational mechanisms</td>
<td>Organize data</td>
<td>Select solution</td>
</tr>
<tr>
<td>List changes</td>
<td>Make familiar strange</td>
<td>Induction</td>
<td>strategy from alternatives</td>
</tr>
<tr>
<td>Dev. up possible</td>
<td>Psychological states</td>
<td>Planning</td>
<td>Implement solution</td>
</tr>
<tr>
<td>cause</td>
<td>States integrated</td>
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<td>strategy</td>
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<tr>
<td>Test possible cause</td>
<td>w/problem</td>
<td>Activate plans</td>
<td>Determine performance</td>
</tr>
<tr>
<td>Operating test</td>
<td>Viewpoint</td>
<td>Evaluate</td>
<td>strategy</td>
</tr>
<tr>
<td>on cause</td>
<td>Solution or research target</td>
<td></td>
<td>Revise as necessary</td>
</tr>
<tr>
<td>Design corrective alternative</td>
<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>KEPNER/TREGOE</th>
<th>LAIRD/GROTE</th>
<th>MILES</th>
<th>OSBORNE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Recognize problems</td>
<td>Recognize and identify problem</td>
<td>Orientation</td>
<td>Orientation</td>
</tr>
<tr>
<td>Separate and set priorities</td>
<td>Gather information to solve problem</td>
<td>Information</td>
<td>Analysis</td>
</tr>
<tr>
<td>Specify deviation</td>
<td>Determine cause of problem</td>
<td>Speculation</td>
<td>Preparation</td>
</tr>
<tr>
<td>Determine distinctions</td>
<td>Generate possible solutions</td>
<td>Analysis</td>
<td>Hypothesis</td>
</tr>
<tr>
<td>Find relevant change</td>
<td>Select solution to do best job</td>
<td>Program planning</td>
<td>Incubation</td>
</tr>
<tr>
<td>Develop possible cause</td>
<td>Put solution into practice</td>
<td>Program execution</td>
<td>Synthesis</td>
</tr>
<tr>
<td>Test for cause</td>
<td></td>
<td>Status summary and conclusion</td>
<td>Verification</td>
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<tr>
<td>Establish objectives</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Classify objectives</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Develop alternatives</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Evaluate alternatives</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Choose best one</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Assess adverse consequences</td>
<td></td>
<td></td>
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<tr>
<td>Control effects in final decision</td>
<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>PARNES</th>
<th>POLYA</th>
<th>ROSSMAN</th>
<th>SHULMAN (1966)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fact finding</td>
<td>Understanding the problem</td>
<td>Need observed</td>
<td>Problem sensitivity</td>
</tr>
<tr>
<td>Problem finding</td>
<td>Devising a plan to solve the problem</td>
<td>Problem formulated</td>
<td>Problem formulation</td>
</tr>
<tr>
<td>Idea finding</td>
<td>Carrying out the plan</td>
<td>Available information surveyed</td>
<td>Search behavior</td>
</tr>
<tr>
<td>Solution finding</td>
<td>Looking back</td>
<td>Solutions formulated</td>
<td>Resolution</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Solutions examined</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>New ideas formulated</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>TORRANCE (1962)</th>
<th>UPTON/SAMSON</th>
</tr>
</thead>
<tbody>
<tr>
<td>Observation</td>
<td>Tentative statement of problem</td>
</tr>
<tr>
<td>Definition</td>
<td>Multiple definition of key terms</td>
</tr>
<tr>
<td>Preparation</td>
<td>Working definition or restatement of problem</td>
</tr>
<tr>
<td>Analysis</td>
<td>Working classification</td>
</tr>
<tr>
<td>Ideation</td>
<td>Classification of collected specimens</td>
</tr>
<tr>
<td>Incubation</td>
<td>Analysis of planned structure</td>
</tr>
<tr>
<td>Synthesis</td>
<td>Analysis of planned operation</td>
</tr>
<tr>
<td>Evaluation</td>
<td>Analysis of past/existing operation</td>
</tr>
<tr>
<td>Development</td>
<td>Induction</td>
</tr>
<tr>
<td></td>
<td>Deduction</td>
</tr>
<tr>
<td></td>
<td>Planned execution</td>
</tr>
<tr>
<td></td>
<td>Planned evaluation</td>
</tr>
<tr>
<td></td>
<td>Execution</td>
</tr>
<tr>
<td></td>
<td>Evaluation</td>
</tr>
</tbody>
</table>
Varieties of Problem-Solving Paradigms: These models of problem-solving processes or stages seem at once to be highly similar in nature and at the same time to be arbitrary relative to the choice of words and the number of steps included. Undoubtedly, this ambiguity arises from the tremendous variance that exists in the types and complexity of problematic situations. Keisler (1969) identifies 13 dimensions upon which problem-solving events may vary:

1. variables dealt with
2. the extent to which the problem must be defined
3. the extent to which the environment supplies cues
4. the extent to which incentives are external or internal
5. the extent to which the problem has rules or a standard method
6. the extent to which responses are required for the solution
7. the extent to which the problem demands convergence vs. divergence
8. the extent to which the outcome is the learning of a principle or a procedure
9. the extent to which the learning of the solution is going to generalize
10. the educational importance of the problem or the extent to which this learning facilitates learning to solve more advanced problems
11. the extent to which the learner has mastered prerequisites
12. the extent to which the learner has mastered prerequisite procedures or strategies for this type of problem
13. the extent to which the learner has acquired broad patterns of behavior conducive to this type of problem

Getzels (1964) lists eight different types of problems which vary according to whether the problem is presented or remains to be discovered, whether a standard method exists for dealing with it, whether this method is known by the problem solver and whether the method is known by others. Similarly, Bruner (1970) makes the distinction between problem solving and problem finding, pointing out that, in life, problems are seldom presented fully defined, hence the processes and skills involved in finding and defining problems may be more important for educational purposes than the processes of problem solving.

It is possible, of course, to pursue each one of Keisler’s 13 variables and arbitrarily present a dichotomy characterizing two distinct types of problems. One of the most important variables for instruction in problem solving has to do with Keisler’s fifth point, whether or not a problem has a well-defined method for its solution. Black (1946) makes the distinction between “rule-constituted” acts and “rule-governed” acts, where the former include instrumental acts towards some solution or goal which are constrained, determined or at least defined by rules that specify contingencies and consequences. The latter class of actions is one whereby rules afford a certain amount of guidance for the achievement of a solution, but a wide latitude exists in methods and outcomes that satisfy the problem. Solving a quadratic equation problem is a rule-constituted act whereas solving architectural
design problems is a rule-governed act. Olton and Crutchfield (1969) expand this distinction to include the difference between having students rediscover the known (e.g., arithmetic problems, workbook exercises, science experiments) and having them work "in an organized, planned manner on problems that seem to resist solution, formulating and evaluating new possibilities, and developing a sensitivity to odd or unusual circumstances that may lead to a discovery or fresh insight."

The scope of this distinction can be widened even further to include open-ended problems which do not demand organized, planned study, but rather imaginative expression or insight. The problems used by Torrance (1967), for example, in his tests and his curriculum materials on creativity are almost rule free with respect to the limitations placed upon the student's responses. They are problems designed not to be instructive so much as to be facilitating of original or divergent expression.

Without belaboring the point any further, it might be instructive to present additional problem-solving classifications which are attempts at defining qualitatively different classes of problematic situations or processes that refer to these classes:

**TYPES OF PROBLEM-SOLVING PARADIGMS**

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<thead>
<tr>
<th><strong>Parnes (1967)</strong></th>
<th><strong>Berman (1967)</strong></th>
<th><strong>Bruner (1962)</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>producing and developing</td>
<td>dealing with the known</td>
<td>acquisition</td>
</tr>
<tr>
<td>evaluating and verifying</td>
<td>reaching beyond the known</td>
<td>transformation</td>
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<tr>
<td>defining problems</td>
<td>judging, rating and evaluating</td>
<td>evaluation</td>
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</table>

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<thead>
<tr>
<th><strong>Selye (1964)</strong></th>
<th><strong>Osborn (1963)</strong></th>
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<tbody>
<tr>
<td>true (a search for)</td>
<td>fact finding</td>
</tr>
<tr>
<td>surprising</td>
<td>idea finding</td>
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<tr>
<td>generalizable</td>
<td>solution finding</td>
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Information Processing Models: The schemes outlined above are of the sort found in educational literature. Research literature on problem solving contains many additional constructs, dimensions and classification schemes relative to thought processes. (See, for example, Davis, 1966; Kleinmuntz, 1966.) One other approach to problem-solving processes information-processing modes— is worthy of mention here. In an attempt to simulate the operation of the human mind by studying and adapting the computer, psychologists have promised both a fuller understanding of the human brain and a more efficient means of
teaching problem solving. Selected examples of information-processing models are the following:

"Schematic representation of a general operational model of information processing with four functional stages of cognitive processes." (Fletcher, 1969)

The TOTE Unit (Miller, Galanter and Pribram, 1960)

More elaborate information-processing schemes have been prepared by Newell and Simon (1961), Gregory (1967), Guilford (1967) and Reitman (1970). Keisler (1968) suggests that curriculum development is underway to translate the information-processing framework into problem-solving strategies for school children.
CURRICULUM MODELS

Literature dealing with curriculum theory, including teacher's guides to instructional material, provides another source of taxonomies of cognitive processes. Thirty-nine taxonomies found through a search of curriculum literature, despite some degree of redundancy, were sufficiently varied in both purpose and abstractness to necessitate the development of a superordinate classification scheme.

The classification scheme below, entitled the Higher-Order Cognitive Taxonomy, was used to sort the cognitive processes emphasized by curriculum specialists.

The Higher-Order Cognitive Taxonomy:

1. Learning-to-Learn Processes
2. Communication Processes
3. Classifying and Comparing Processes
4. Synthesizing and Producing Processes
5. Judging and Evaluating Processes
6. Value Analysis and Decision-making Processes
# Taxonomies of the Cognitive Domain

## Classes of Higher Order Cognitive Processes

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<tr>
<th>Classes of Higher Order Cognitive Processes</th>
<th>I. Cognitive Processes — General</th>
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<td><strong>I. Learning to Learn Processes</strong></td>
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<td>Understanding</td>
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**II. Communication Processes**

- Abstracting
- Translation
- Transformation
- Equal Decoding

**III. Classifying and Comparing Processes**

- Classifying
- Comparing
- Convergent Thinking
- Divergent Thinking

**IV. Synthesizing and Producing Processes**

- Synthesizing
- Producing
- Convergent Thinking
- Divergent Thinking

**V. Judging and Evaluating Processes**

- Evaluating
- Convergent Thinking
- Divergent Thinking

**VI. Value Analysis and Decision Making Processes**

- Value Analysis
- Decision Making
## Taxonomies of the Cognitive Domain

### I. Learning to Learn Processes

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<tr>
<th>Process</th>
<th>Subprocesses</th>
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<tbody>
<tr>
<td>Physical Knowledge</td>
<td>* Learning to Learn Strategies</td>
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<tr>
<td>* Language for Thinking</td>
<td>* Learning to Communicate</td>
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### II. Communication Processes

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<th>Subprocesses</th>
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<tr>
<td>Logical Knowledge</td>
<td>* Logical Classification</td>
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<td>* Logical Linguistics</td>
<td>* Logical Relationships</td>
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### III. Classifying and Comparing Processes

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<td>Logical Thinking</td>
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<td>* Logical Learning</td>
<td>* Logical Evaluating</td>
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### IV. Synthesizing and Producing Processes

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<td>* Logical Interrogation</td>
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<td>* Logical Integrating</td>
<td>* Logical Constructing</td>
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### V. Judging and Evaluating Processes

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<td>* Logical Deduction</td>
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<td>* Logical Induction</td>
<td>* Logical Abstraction</td>
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### VI. Value Analysis and Decision Making Processes

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<th>Process</th>
<th>Subprocesses</th>
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<tr>
<td>Logical Analyzing</td>
<td>* Logical Knowledge</td>
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<td>* Logical Decision Making</td>
<td>* Logical Action</td>
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## II. Early Childhood Instruction

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<tr>
<td>Logical Learning</td>
<td>* Logical Cognition</td>
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<tr>
<td>* Logical Communication</td>
<td>* Logical Language</td>
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### Reference

### Taxonomies of the Cognitive Domain

**VALUE ANALYSIS AND DECISION MAKING PROCESSES**

- Conceptual Analysis
- Problem Solving
- Decision Making

**SYNTHESIZING AND PRODUCING PROCESSES**

- Comprehension
- Conceptualization
- Synthesis

**CLASSIFYING AND COMPARING PROCESSES**

- Perception
- Classification
- Comparison

**COMMUNICATION PROCESSES**

- Understanding
- Communication

**LEARNING TO LEARN PROCESSES**

- Reflection
- Planning
- Adaptation

**CLASSES OF HIGHER ORDER COGNITIVE PROCESSES**

- Analysis
- Synthesis
- Evaluation

**III. Schematic Instruction**

- Knowledge
- Understanding
- Application
- Analysis
- Synthesis
- Evaluation

*References for Taxonomies*

## Taxonomies of the Cognitive Domain

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**V. Specialized Skills**

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TAXONOMIES OF THE COGNITIVE DOMAIN

I. Cognitive Processes -- General


II. Early Childhood Instruction


III. Science Instruction


IV. Social Studies Instruction


V. Specialized Skills


A TAXONOMY OF COGNITIVE SKILLS:
The Application Of The Higher-Order Cognitive Taxonomy To Realia.

Operating with an expanded taxonomy derived from the models collected in the search of curriculum theory literature, a selection of innovative skill-based instructional material was analyzed with the goal of expanding and refining the HOC taxonomy. It was hoped that by identifying what is taught across a variety of materials and by classifying these objectives and activities according to an exhaustive taxonomy of cognitive processes and skills, it would be possible to identify the skill areas that are untreated by current materials.

The analysis that follows is a classification of cognitive activities and objectives of sixty-three innovative instructional programs. The programs were sorted according to the following taxonomy:

HIGHER ORDER COGNITIVE SKILLS TAXONOMY

I. Learning to Learn Skills
   - Attending and Orienting
   - Decoding
   - Memorizing
   - Studying

II. Communication Skills
   - Observing
   - Describing
   - Explaining
   - Discussing

III. Classifying and Comparing Skills
   - Differentiating and Grouping
   - Classifying
   - Ordering
   - Comparing
   - Using Numbers

IV. Synthesizing and Producing Skills
   - Inventing
   - Associating
   - Elaborating
   - Generating Implications
   - Planning
   - Solving Problems Using Strategies

V. Skills of Judging and Inferring
   - Coding
   - Judging
   - Inferring
   - Testing

VI. Skills of Value Analysis and Decision Making
   - Valuing
   - Evaluating
   - Deciding
At this stage, it should be useful to identify the constraints that went into the analysis:

1. Only currently available elementary school curriculum materials were selected.

2. The program had to be oriented towards cognitive or intellectual skills or "process education."

3. The material had to be accompanied by instructional objectives (in a few cases, the objectives were provided by some independent source).

With these constraints, science, math, English and social studies materials were included only if their major emphasis was on teaching the skills of research and problem solving in those areas. Curriculum materials dealing strictly with knowledge or concepts, and organized in that manner, were excluded from the analysis.

Sixty-three educational programs were selected for inclusion in the analysis. Nineteen were early childhood curricula, four of which were programs oriented towards some specific skill area. Seven were science curricula; six were social studies curricula; one was a math program and one other was a science and math program. The remainder were innovative skill-oriented programs that could not be classified under traditional subject matter headings. In addition to the sixty-three programs, four documents which offered a glossary of objectives and activities were included in that they were designed to instruct teachers in building a skill-based curriculum.

This analysis provides documentation of curricular needs, exposes the lack of sequenced, hierarchical, skill-based curricula and invites comparisons between instructional programs within and across grade levels. Despite its value as a guide for the developer of innovative curriculum, the following ambiguities and discrepancies should be pointed out:

1. The ideal analysis would have consisted of a separate taxonomy of cognitive skills for each grade level; however, this was found to be an impossible task. Some materials were recommended for a specific age group while some contained recommendations for a sequence of instruction over a range of ages. The more common case, however, was that the materials were recommended for an age range, e.g., early childhood.

2. The ideal result of this analysis would be a continuum of cognitive skills. That is, instead of three taxonomies (classifications), the taxonomies would be integrated such that hierarchies would emerge within and across specific skill clusters. Instruction in memory skills would proceed from simple prerequisite skills to complex, more differentiated skills. Skills taught in isolation in early grades, e.g., listening skills, would be taught in conjunction with other skill areas in the later
grades, e.g., listening skills with critical thinking skills. Again, this kind of organization could be imposed upon the analysis only with great risk to its validity. Only a few of the instructional programs were based upon a hierarchical model of instruction.

3. Some skill areas are not represented. Insofar as the working definition of “higher-order cognitive skill” necessitates that the objective under analysis require some transformation or translation of input, traditional reading, penmanship and grammar programs were not included in the analysis. Critical reading skills, reading and composition skills and semantic analysis skills were, however, included.

4. Subject matter areas tend to be represented to the extent that skill-based performance objectives were included with the materials. As expected, science programs were found to contain performance objectives more often than other programs. A high percentage of mathematics curricula were also found to contain performance objectives; however, because the Higher-Order Cognitive package staff had made the decision to restrict the analysis to mathematics problem-solving programs, only two math projects were included.

5. The sorting process, which involved six components or classes of cognitive processes and twenty-six processes or skill clusters, became a bit unwieldy at times causing some very arbitrary classifications. For example, science units which involve the coordination of skills in making operational definitions, controlling variables and generating hypotheses were classified solely under the Component V subset of “Testing.” A great variety of critical thinking skills were classified under “Judging,” but the distinction between “Judging” in Component V and the subset of “Listening skills requiring responses” under Component I was difficult to preserve. Map and globe skills were classified under Component I, II, or IV depending upon the emphasis of the unit. In summary, our classification scheme turned out to be quite useful, albeit imperfect.

The analysis allowed a number of interesting implications and conclusions:

1. A number of skill-oriented programs are offered for the early childhood grades. There seems to be more attention paid to providing for the facilitation of a broad set of skills in these years than in any others. In addition, there is a heavy emphasis on learning-to-learn skills in the early years.

2. There is a paucity of good skill-based instructional material available for the middle elementary grades (3-4) in all areas save creative expression.

3. While there are many programs which purport to deal with problem solving, very few of them are skill-oriented and fewer still contain skill-based objectives in creative problem solving or critical thinking.
4. Although a number of experimental programs can be found which attempt to teach affective expression, there are almost no programs which are oriented towards teaching skills of value analysis and decision making.

5. Perhaps the most important finding is that with one, perhaps two, exceptions, no curricula exist which include a continuum of skill instruction across grades. The great majority of the programs included in this analysis are either for one grade level, or, if they include material for more than one level, no attention is paid to devising learning hierarchies. One of the exceptions, Science: A Process Approach, is built upon a hierarchical model of instruction within and across grade levels. Students learn simple observation skills, classification skills, etc., in the early grades and then learn more complex skills in these areas in later grades. In addition, as you go up in grade level, these skills begin to build upon one another such that in the later grades, fifth and sixth, more complex skills made up of an integration of prerequisite skills become the center of attention.

This analysis engendered a variety of impressions concerning available curriculum materials. For someone interested in developing materials with the idea of fostering cognitive skills in elementary school students, grades 3-6 offer an almost untapped area. Yet some excellent guidelines are offered by such exemplary programs as Science: A Process Approach; Man: A Course of Study; Science Curriculum Improvement Study; SRA Basic Skill Series; The Productive Thinking Program; and Social Science Laboratory Units. The vast majority of curriculum material for the elementary grades is concerned exclusively with what might be termed, instrumental skills of reading, writing and arithmetic. More recently, this basic skill core has been expanded to include skills of scientific inquiry.

Among the skill areas identified by the Higher-Order Cognitive component as receiving less than adequate emphasis by existing programs are the:

1. learning-to-learn skills of using mnemonic strategies for memorizing and learning and using problem-solving strategies for inquiry
2. communication skills of reporting descriptions and explanations and conducting discussions
3. analytic skills of using strategies, diagrams and classification schemes to solve problems
4. production skills of planning
5. creative problem-solving skills, especially generating implications
6. critical-thinking skills of coding, assessing statements, inferring and testing
7. skills of decision making.
What is needed, of course, is to determine a way to:

1. generate operational definitions for these skills and for their relevant subskills
2. determine the optimum level at which these skills need to be introduced into the curriculum
3. determine the optimum sequence for training these skills
4. generate vehicles or topics for illustrating and practicing these skills
5. determine methods for evaluating the effects of instruction in these skills.

To this end, the Higher-Order Cognitive component of the Humanizing Learning Program of Research for Better School has initiated plans for development of a wide range of curriculum materials. A preliminary set of materials designed to teach the skills of Component V, critical thinking and problem-solving skills, is currently under development.

The instructional materials analysis which follows is divided into three grade-level sections: preschool to second grade, grades 3 and 4, and grade 5 and beyond. Within each group, the skills taught by the reported materials have been assigned to the appropriate sections of the HOC taxonomy. Therefore, all analyzed materials which teach a corresponding HOC taxonomy skill are grouped together as, for example, the six programs which teach the skill of “decoding” on the preschool to second grade level. One program may be catalogued on several different pages under different HOC categories, for example program (14), the Early Learning Curriculum teaches HOC skills of “decoding,” “describing objects and systems,” and “planning,” among others. The numbers appearing in parentheses on the chart are keyed to a list of curriculum materials which appears after the charts.
I. LEARNING TO LEARN SKILLS

A. Attending and Orienting
1. Following Directions
   - giving directions, focusing attention (14)
   - interpreting directions for mood, humor (29/17)
   - impulse control, competition, social skills (14)
   - names and responses to locomotor movements (4)
   - echolocates, repeats sentences (4)

B. Decoding
1. Auditory Decoding
   a. Auditory Discrimination
   - matching instruments that sound alike, generating rhymes
   - echoing stressed words (4)
   - pitch, intensity, types of duration, direction, distance (14/13/37/14)
   - matching objects that sound alike, generating rhymes

2. Visual Decoding
   a. Visual Discrimination
   - shape, color, size, position orientation (14/61/61)
   - naming objects, pictures (4)
   - design matching (61)
   - recognition of representations, recognition of symbols (13/11/36)
   - figure-ground, perceptual constancy, position in space
   - perception of spatial relations, terms for (19/61/128)
   - uses words, foreground and background (4)
   - identifies whether form will fit in mold, in complex diagram (3)

   b. Spatial Relations
   - cross modal discrimination (14)

   c. Visual Comprehension
   - labelling objects, pictures, finding hidden figures
   - discriminate parts from the whole, labelling details (33)
   - labelling sequence, figure completion, identifying shapes (13)
   - associating names to pictures, inferring sequence, consequences (61/21/3)
   - figural memory (37)

   d. Visual Memory
   - labelling pictures, recalling pictures, reproducing sequence, name missing parts, events (14/33)

   e. Auditory Memory
   - memorizing poems, rhymes, songs, word series, addition, recalling details from a story, digit span, associative recall (14/33/28)
   - reading (14)

   f. Memory Span
   - coding skills (14)

   g. Mnemonics
   - strategies for memorizing rhymes, serial ordering, clustering pegs (14)

C. Memorizing
1. Visual Memory
   a. Labelling
   - labelling pictures, recalling pictures, reproducing sequence, name missing parts, events (14/33)

   b. Memorization
   - figural memory (37)

   c. Auditory Memory
   - memorizing poems, rhymes, songs, word series, addition, recalling details from a story, digit span, associative recall (14/33/28)

   d. Memory Span
   - coding skills (14)

   e. Mnemonics
   - strategies for memorizing rhymes, serial ordering, clustering pegs (14)

D. Studying
1. Comprehension Skills
   a. Language Mediators
   - formulating questions, asking appropriate sources, rejecting irrelevant information, reading (14)
   - sequence events in stories (1)
   - differentiating fact from fiction, recognizing dialect, criticizing stories, listening for details, main ideas (16)
   - cartoon appreciation, map reading (7)
   - critical discrimination skills, meaning of common symbols (5)

   b. Listening Skills
   - using library, skills of interviewing (15)
   - making a collage, oral report (5)
   - reports (5)

   c. Information Interpretation

2. Production Skills
   a. Information Locating
   - asking questions, making inferences, summarizing (15)

   b. Information Organizing
   - using library, skills of interviewing (15)

   c. Communication Skills
I. LEARNING TO LEARN SKILLS

Level: Third and Fourth Grades

A. Attending and Orienting

B. Decoding

1. Visual Comprehension
   a. Interpreting Pictorial Material

C. Memorizing

D. Studying

1. Listening Skills
   a. Language Skills
   b. Listening Comprehension

2. Information Locating
   a. Reference and Library Skills

3. Information Interpretation
   a. Using Maps and Globes
   b. Using Chronological Concepts

4. Information Organizing
   a. Classifying or Sequencing Information
   b. Outlining and Notetaking

interpreting pictorial material

identifying sequence, details (iv) main ideas in stories,
generating plot titles, inferring conclusions, relationships,
recognize unsupported ideas, emotionalism (l)(51)

knowledge of library (i)

rules for use of scales, symbols, finding distances,
inferring from maps, cardinal directions, compases,
parallels and meridians, map projections (iv) determining
directions, locating places, composing maps (31)

using the calendar, time system (31)

paper writing techniques (31) cataloging, sequencing
pictures and information (60)

notetaking skills, keeping a notebook, techniques of
outlining - articles, speeches, movies (iv)(51)(60)

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I. LEARNING TO LEARN SKILLS

A. Attending and Orienting

B. Decoding
1. Visual Decoding
   a. Interpreting Pictorial Material
   b. Interpreting Cartoons

C. Memorizing

D. Studying
1. Listening Skills
   a. Listening Comprehension
   b. Critical Listening Skills
2. Information Locating
   a. Reference and Library Skills
3. Information Interpreting
   a. Interpreting Charts and Graphs
   b. Using Maps and Globes
   c. Strategies for Studying
4. Information Organizing
   a. Outlining and Notetaking
   b. Summarizing and Reporting

Level: Fifth Grade and Beyond
II. COMMUNICATION SKILLS

Level: Preschool to Second Grade

A. Observing

1. Skills of Reporting (concepts & vocabulary)
   a. Object Properties
      - color, shape, texture, etc.
      - temperature, sound, odor, type
      - drawing shapes, using formboard
      - solids, liquids, plant parts
      - names shapes and functions of objects
      - by color, by touch, by shape, by arbitrary property
   b. Systems and Physical Phenomena
      - temperature, sound, weather, magnets, plant growth
      - flashlights, magnets, seeds, color mixing
   c. Behavior
      - animal motion, responses

2. Process of (visual decoding):
   a. Relationships and Relativity
      - relative sizes, cues, relational prepositions
      - patterns, symmetry, angles, shadows, distance
      - position and perception, bias, meaning and observing
      - discrimination between observation and assumption
   b. Strategies for Data Gathering
      - experiments with changing properties
      - posing questions, problem finding
      - identifying objects in an array
      - questionable, ranking, search, strategies for missing objects
   c. Reporting Sensations
      - using several senses

B. Describing

1. Describing Properties
   a. Shapes and Patterns
   b. Objects and Systems

2. Using Space/Time Relations
   a. Location and Position
   b. Temporal Relations, Events

3. Describing Affect
   a. Sensations
   b. Emotions

C. Explaining

1. Describing Sequence and Causation
   a. Systems
   b. Events
II. COMMUNICATION SKILLS (continued) Level: Preschool to Second Grade

2. Using Causal Terms
   a. Skills of Predicting
   b. Simple Experimentation

D. Discussing
1. Reporting, Summarizing and Persuading
2. Skills of Group Discussions and Debates

anticipates dangers (29) predicts occurrences, demonstrates predictions (57) predicts results of growth, decay, manufacture, waste (13)
describes simple experiments, describes interaction, hypotheses (47) physical and interpersonal outcome hypotheses (13)
persuades someone to do something, proves a point, provides examples, provides clarification, gives reasons for statements (14)
translates, defines words to peers, gives directions, shows operation to others (29) summarizes events, reading, operation (51/3)
takes part in group discussion, role play, silent discussion (29)
II. COMMUNICATION SKILLS  Level: Third and Fourth Grades

A. Observing
1. Skills of Reporting (concepts & vocabulary)
   a. Systems and Physical Phenomena
   b. Behavior
2. Process of (visual decoding):
   a. Relationships and Relativity
   b. Reporting Sensations

B. Describing
1. Describing Properties
   a. Parts and Wholes
2. Using Space/Time Relationships
   a. Position and Motion
   b. Temporal Relations, Events

C. Explaining
1. Describing Sequence and Causation
   a. Systems
   b. Events
2. Using Causal Terms
   a. Making Logical Explanations

D. Discussing
1. Reporting and Summarizing
2. Skills of Group Discussions and Debates
### II. COMMUNICATION SKILLS

**Level:** Fifth Grade and Beyond

#### A. Observing

1. Reporting on Observations
   - cartoon analysis, inferring, recognizing implications (iii)
   - discriminating observation reports from assumptions (60)
2. Conducting Observational Studies
   - collecting behavior specimens, demonstrate ways of making valid observations, discriminating between observations, inferences and value judgments, producing behavior specimens (49)

#### B. Describing

1. Skills of Composition Writing
   - making efficient descriptions, aesthetic, definitive descriptions (58)
2. Map Reading Skills
   - describing land routes, describing flights (45)

#### C. Explaining

1. Using Different Types of Explanation
   - giving opinions, indicating a procedure, using definitions, making evaluations, drawing conclusions, drawing comparisons, making descriptions (58) identifying circular causations (49)
2. Inquiry Skills
   - generate circular causation, resolution of, analyze behavior specimens, demonstrate causation in behavior, use inquiry techniques to discover causes for social problem (24)

#### D. Discussing

1. Summarizing
   - current events summary, decision tree (5)
2. Skills of Group Discussions
   - skills of being participant, leader, knowledge of 8 flaws in discussion (58)
III. CLASSIFYING AND COMPARING SKILLS

A. Differentiating and Grouping

1. Broad Conceptual Categories
   - grouping based upon themes: foods, pets, animals, play things, clothing [11][38][137] grouping objects in 2 different ways, picture sorting [3]

2. Relational or Functional Properties
   - grouping objects with the same function, attributes parts [15][13][29][13][38][137] grouping by use, by position, matching [11]

3. Descriptive or Perceptual Qualities
   - figure sorting task [3][29] size, shape, color [38] texture [3]

4. Alphabet or Vocabulary Groupings
   - sorting cards by numerals, letters, symbols [3] sorting alphabet sounds, word functions, endings [36]

B. Classifying

1. Multiple Classification and Matrices
   - logical classification, develop a concept deductively, modifies concept with new information [29] one dimensional sorting with or without noisy attributes, 2 and 3 dimensional sorting, matrices, hierarchical sorting, using disjunctive classes, describing a classification system [14] concept of set and grouping [34] multiple classification [26] refining a classification, comparing to written classification, outline form, classification for pictures [44][28][13]

2. Using Classification Skills

C. Ordering

1. Seriation and Geometric Skills

2. Time Order, Sequencing Skills

D. Comparing

1. Equivalence, Conservation, Class Inclusion
   - evaluating one to one correspondence, food/people [3] conservation of amount [34] demonstrates one to one correspondence, cardinal value, equal units, reversibility conserves equality [29] class inclusion problem, problem solving with categorical exclusion [8] matching, to sample with or without noisy attribute, oddity problem using examples [14]

2. Discriminating and Defining
   - identifying similar designs, symbols, letters, rhymes vs non-rhymes, generating synonyms and antonyms [3] compares conceptual and functional properties: animals, geography, cooking utensils, binary comparisons, same order different position, size, up or down, in or out [11][12][12][12][12] finding and generating similarities and differences, train and airplane [60] for a series of pictures, for time periods, products, stories [5]

3. Measuring
   - using appropriate size words [46] weight [3] compares sizes with big, little, quantities with number, qualities with texture [38] direct comparison, mediated comparison with standard objects, with marks, with standard units [14] comparing lengths, volumes, linear with metric units, using a balance, ordering, figures by area, comparing forces with springs, using scales, temperature, volumes [46] non-numerical measuring, with reference units, comparing changes, experimentation [34] comparing length plants, ordering lengths, dividing length into segments, measuring length, comparing, ordering, dividing area, weight and volume [42][36][13][14]
II. CLASSIFYING AND COMPARING SKILLS (continued) Level: Preschool to Second Grade

E. Using Numbers

1. Counting Skills

   - using sets, numerals, order, number line, using 0-99, addition of positive integers, multiplication (48) counting, recognizing and writing to 20, discriminating, odd and even counting up from x to y (36) sets operations, equations, fractions (14) addition, subtraction, multiplication, division, fractions (34)

2. Problem-Solving Skills

   - using a tally chart to identify number of instances of an event (4) ordering properties, comparing volume with numerals, tally marks to represent objects in a set (34) one-to-one correspondence (34) scaling and representation, construction of a scaled model (34)
III. CLASSIFYING AND COMPARING SKILLS

A. Differentiating and Grouping
   1. Learning Classifications

B. Classifying
   1. Qualifying (language skills)
   2. Generating Classification Scheme
   3. Classifying as Problem Solving

C. Ordering
   1. Time Order, Sequencing Skills

D. Comparing
   1. Discriminating and Defining
   2. Measuring

E. Using Numbers
   1. Counting Skills
   2. Problem Solving Skills

Level: Third and Fourth Grades

grouping words, attributes, objects, sentences, e.g., by function (58) identifying, e.g., direction, chronology, membership, synonym, predication, comparison, seriation, order, sequence in a communication (58) defining meaning by context, differentiating meaning by order, pattern, correspondence, context, modifying words (58)
animals according to commercial use, governments, rules of phonics (5) materials (48)(34) natural systems (34) types of measurement (5) geography (5) numbers, fractions, decimals (5)
inventing means of classifying shapes, objects (9) using who, what, where, when in reading (5) self-generating categories for literature analysis, defending classification schemes (50) multiple classifications (53)
using a classification scheme as a research tool (47) using inquiry techniques to classify unknown objects (24) classification games (15)
ordering attributes on perceptual characteristics or complexity, on chronology, on direction, generating narration (58)

describing similarities and differences, e.g., birds, butterflies, qualifying comparisons when data is not valid (60) fictional characters, seasons, countries, plants, animals, appliances (5) comparing on stated criteria (5) breaking down assumptions in comparing things with the same name (21)
recognize perceptual illusions, increase measuring efficiency (21) measuring angles, units of force (46)
multiplication, numbers and their properties (34) decimals, large numbers (46) using computers, graphs, making changes (34)
III. CLASSIFYING AND COMPARING SKILLS

A. Differentiating and Grouping
   1. Qualifying (language skill)

B. Classifying
   2. Using Classification Schemes

C. Ordering
   1. Problem Solving as Ordering
   2. Using Diagrams for Logical Thinking

D. Comparing
   1. Discriminating and Defining
   2. Measuring with Charts, Graphs and Maps

E. Using Numbers
IV. SYNTHESIZING AND PRODUCING SKILLS

A. Inventing

1. Designs and Graphics
   - Constructing two different shapes by adding lines to given shapes, producing two objects from combination of given figures, arrange geometric shapes to make two faces, invent meaning for scribble drawing by illustration (3) generate an idea for an alternative to an umbrella (3) generating ideas to make the classroom better (3)

2. Ideational Fluency
   - Ideational fluency (3) participate in a simple brainstorming session (3)(7)(12)(20) ways of using large pile of stones (3) new uses for objects (29)(14) possible function for mystery objects (14) generate substitutions for functional objects (3) problem finding (36) generating objects for categories (33)

3. Strategies for Idea Generation and Inquiry

B. Associating

1. Associational Fluency
   - Associational fluency (3) teaching strategies (35) tell two ways to play with ball, three properties of three things, generate synonyms, antonym, free associate to the color red, tell ways two objects are alike, two pictures, two meanings for a word, two homonyms, two figures, generates things that come in pairs (3)(33) would you rather be an x or a y (21) identifying opposites in pictures, expressions (3)(33)

2. Analogical Reasoning
   - Identify completions of figurative analogies (3)(14)(44) picture word analogies, word-word analogies (44) complete a semantic relationship in a matrix, pictured relationship, generate missing picture (3) complete remote associates, generate word that stand for two things (3) simile generation (4)

3. Reasoning by Association

C. Elaborating

1. Creative Expression, Fluency and Originality
   - Creative expression, fluency and originality (35) answering creative questions (3)(14)(21) story titles drama (20) picture description, story creation, riddles, story endings, making a diary, games, e.g., object description by giving clues (3)(21) rearranging words to make sense, generate names for a drawing, breaking concepts when a house is not a home, simile completion (3)

2. Dramatic Expression and Humor
   - Dramatic expression and humor (35) produces a joke overstatement, incongruity (29) role playing, rhyme recitations, dramatic stories (33) pantomime, motor responses to pictures, acting out descriptions (19) generating a story appropriate to a musical piece (4)

D. Generating Implications

1. Generating Causes and Consequences
   - Predicting difficulties, dangers in using materials (14) generating consequences for physical structures, blocks (4) identifies problem displayed by pictures, generates conclusion (4) consequences for social situations, changes (3) stating actions occurring before a given picture (3) guessing causes, consequences (what would happen if (21)

2. Imagining Future Events and Role Playing
   - Imaging future events and role playing (36)(35) what if you were a... problems (60)(23) e.g., lost in a strange city (6) reporting imagery (33) discussion of future events, imagining future events (82)(37) just suppose (21)
IV. SYNTHESIZING AND PRODUCING SKILLS (continued) Level: Preschool to Second Grade

E. Planning
   1. Structures and Designs
direct copying, one, two, three dimensional patterns, copying
   involving translation, extending resource patterns (14)
   planning a block structure, map, floor plan, structure from
   a map (28) paths through mazes (3) building houses (2)
   plan trips and parties, reviewing alternatives, school
   activities, story telling (6) using imagery in planning,
   maps, itineraries (28) group work to solve class
   problems: assign roles, etc. (3)

   2. Activities and Operations

F. Solving Problems Using Strategies
   1. Generating Alternative Solutions
   steps in problem solving: definition, characteristics of a
   solution, alternatives, evaluating guesses (381)
   information locating strategies used in problem solving,
   collecting evidence (u) generating possible solutions to
   problems (e.g., what shall class project be) (280)
   beginning probability, predicting outcomes, if it were true,
   what would happen (41) surveying opinion, using graphs
   (86) simple physical experiments with predictions (3)
   (48) transferring from previous problem solving activity to
   new one: student predicts outcomes under changing
   conditions (u)
   2. Formulating Hypotheses and Predicting
   Outcomes
IV. SYNTHESIZING AND PRODUCING SKILLS

Level: Third and Fourth Grades

A. Inventing
   1. Designs and Graphics
   2. Ideational Fluency

B. Associating
   1. Associational Fluency

C. Elaborating
   1. Creative Expression, Fluency and Originality

D. Generating Implications
   1. Generating Cause and Consequences

E. Planning
   1. Structures and Designs
   a. Map Making
   2. Projects and Projections

F. Solving Problems Using Strategies
   1. Social Science Investigations
   2. Experimental Design
IV. SYNTHESIZING AND PRODUCING SKILLS

Level: Fifth Grade and Beyond

A. Inventing

1. Strategies for Ideational Fluency
   - using direct analogies, functional analogies, identifying new ways to look at problems (52)
   - identifying sequence of the inventing process (52)
   - introduction to brainstorming, role playing, collages (20/135)

2. Ideation Strategies for Creative Problem Solving
   - extended effort principle, free association, synectic techniques, analogy, brainstorming, part changing method, checkerboard, borrowing, Osborne checklist, morphological analysis used in problem solving (59/143) attitudes of creative problem solving (43) exercises in insightful thinking, sequential thinking, strategic thinking (18)

B. Associating

1. Associational Fluency
   - associational fluency (35) making bizarre comparisons: how is a chair like a boy (62) comparisons in science (52)
   - describing similarities, explaining relationships (21)

C. Elaborating

1. Creative Expression, Fluency and Originality
   - creative expression, fluency and originality (35) story completion exercises (59) creative responses to recorded material (51) describing what sounds suggest, images to sounds (22) plot titles, describe original movie plot, sentence writing using given words, cartoon completions (23)

D. Generating Implications

E. Planning

1. Projects and Projections
   - reviewing alternatives relative to school, home activities, making diagrams and maps to display alternatives (5) making a model of community, making a collage, group planning of class projects (39)
   - planning a class trip, selecting panels for class discussions, making time budgets (5)

F. Solving Problems Using Strategies

1. Heuristic Strategies
   - skills of problem recognition, formulation, information organizing, idea generation and hypothesis testing, strategies of plausability, persistence, set changing, idea checking (43/30)

2. Research Tools and Strategies
   - historical research, graphing trends, descriptive research: mean, mode, median, standard deviation, tally marks, research design, tables (54) diaries, bar graphs, pie charts, maps (45) maps, collages, classifications, interviews, questionnaires, charts of geographical composition, bar graph of occupations, pie charts ethnic composition for study of cities (38)
V. JUDGING AND EVALUATING SKILLS

A. Coding

1. Using Evaluative Words
   - Using and responding to "yes" statements, using polar opposites, relational propositions, using negative instances and positive instances, simple if-then deductions (4)
   - Identifying errors in use of all, everybody (5) defining terms (4)

B. Judging

1. Assessing Statements Using Logical Criteria
   - Generating true and false statements, criteria for judging (3)
   - Assessing the news, TV propaganda (5) supporting statements with evidence (50) examining claims by checking evidence, discovering fallacies in advertising (60)

2. Evaluating According to Pragmatic Criteria
   - Assessing statements with evidence (50) examining claims by checking evidence, discovering fallacies in advertising (60)
      a. Looking for Assumptions
         - Questioning validity of information sources (5)
         - Distinction between describing observations and what is assumed, distinction between assumptions, guesses and fact (60) reading stories, separating fact from fiction, determining conditions that could make something true.
      b. Judging Solutions
         - Recognizing the correct pattern, detecting errors of sequence, errors of causal reasoning (3)
         - Evaluating advertising characteristics of a good ad, tallying types of ads relative to given criteria, evaluation of visual appeals (41) judging speeches by length, voice, content, form of presentation, judging pictures relative to appropriateness to some criteria (5) given pictures, records, oral information if statements are true or false (50) evaluating items that don't belong, e.g., in pictures, evaluate appropriateness of tools for functions, choose objects that best fit descriptive criteria, selecting pictures that are most suitable to criteria (3)

C. Inferring

1. About Objects
   - Inferring the contents of a package from size and shape (4)
   - Inferring from pictures by using clues, inferring from maps (2) mystery boxes (48) differentiating between similar things through inference (48) the characteristics of packaged articles (46)

2. About Events
   - Inferring about human growth (2) inferring events from pictures, form and context from reading, from reading and pictures, doing crossword puzzles (44) inferring sequences from 2 or 3 related events, inferring what could have happened before, judging what will happen next from pictures (11)

D. Testing

1. Inference and Hypotheses
   - Trying out inferences, or problem solutions on a range of related problems, trying out solutions on an original problem (14) testing hypotheses about plants and earth science (5)
V. JUDGING AND EVALUATING SKILLS

A. Coding
1. Interpreting Word Usage
   - interpreting mood, dangerous words, imagery, distortion phrases, loaded words, advertisements, vivid words (iv)

B. Judging
1. Assessing Statements Using Logical Criteria
   - discriminating between opinion and fact (5) judging the reliability of statements (21) distinguishing fact from fiction (4) criticizing superstitions, errors in observation (21) analyzing thought habits (5) using like-dislike statements to discriminate relevant from irrelevant facts (60)

   a. Looking for Assumptions
   - learner should give evidence to support his claims or recognize the assumptions made (60) recognizing assumptions in a story (5)

   b. Evaluating According to Pragmatic Criteria
   - evaluating reasons for different room arrangements (5) deciding on purchases, recognizing the more important criteria (21) compare prices of products, name brands with others, evaluate effect of stamps, categorize appeals (41)

C. Inferring
1. Physical Systems
   - observations and inferences (46) tracks and traces, displacement of water, loss of water by plants, electrical circuits, shape of cut things (46)

2. Events
   - determining if the date of an experience supports a particular interpretation (60) recognizing the difference between an implication and an inference, especially in literature where reader draws inferences from implications (5) (21) inferring, generalizing from evidence (21)

D. Testing
1. Inferences and Hypotheses
   - testing inferences about climate, doing research to test inferences (5) the nature of proof, backing up inferences with evidence (21) applying problem-solving and central thinking skills to social issues (7)

2. Testing Using Experimental Methods
   a. Formulating Hypotheses
   - electric circuits, analysis of mixtures, cells and living things (42)

   b. Defining Operationally
   - rolling cylinders, movement of liquids, mold, loss of moisture (46)

   c. Controlling Variables
   - guinea pigs, analysis of mixtures, precision in measurement, interpretation of field of vision (46)

   d. Interpreting Data

Level: Third and Fourth Grades
V. JUDGING AND EVALUATING SKILLS

Level: Fifth Grade and Beyond

A. Coding

1. Words
   - identifying words used to judge, imply, qualify (60)
   - multiple definition (65)
   - recognizing words used to influence impact of words (63)
   - distinguishing between denotation and connotation, recognizing power of words (55)

2. Symbols and Abstractions
   - recognizing symbols, discriminating between the symbol and the thing (63)
   - identifying levels of abstraction, use of classification for meaning (55)

B. Judging

1. Critical Reading Skills
   - distinguishing fact from opinion (51)
   - describing authors purpose, point of view, research evidence, make judgments on validity of author's statement (51)
   - recognizing differences in purpose of different papers, magazines (51)
   - recognizing agreement and disagreement between two sources, decide which is more acceptable, examine reasons for contradiction, examine for consistency, freedom from bias, recognize propaganda (51)

2. Assessing Statements Using Logical Criteria
   - problem recognition, defining issues, recognizing assumptions, suggesting solutions, identify relevant sources, identify degree of authority, pick out relevant data, distinguishing fact and opinion, use statistics, charts, graphs, recognizes bias and propaganda, spots ambiguity (51)
   - performing in a panel discussion, examining source material, supporting judgments and rationalization (51)
   - oral speaking, challenging assumptions, pick out assumptions on TV news, political speeches (51)
   - distinguishing fact, opinion, judgment, inference and evaluate each, distinguish sound opinion and those based on fallacies, misleading comparisons, distinguish between reasoned and emotional appeals (51)
   - comparing information on a topic to discover agreement or disagreement, making generalizations, (51)
   - identifying value judgments (49)

C. Inferring

1. Events and People

D. Testing

1. Formulating Hypotheses
   - testers and non-tasters, effect of temperature on reaction time (46)

2. Defining operationally

3. Controlling Variables

4. Interpreting Data
   - magnetic fields analysis of mixtures, chance, contour maps (46)
   - testing inferences (40)
   - gathering, organizing data, isolations, variables, relationships between variables, hypothesis testing (24)
   - interpreting research graphs and charts (5)
   - controlling and experimenting recognizing and defining problems, relevant information, hypothesis testing, forming conclusions, recognizing assumptions (12)
   - distinguishing verifiable and unverifiable data, determine recency and adequacy of data, detects errors in data, arranges and presents data, recognize when data is inadequate, reformulates (4)
VI. VALUE CLARIFICATION AND DECISION-MAKING SKILLS

Level: Preschool to Second Grade

A. Valuing
   1. Reporting Feelings
      Identify things one likes, dislikes, likes about others, dislikes, anticipates future satisfaction (30) relates class things to home things (30) child uses words angry, mad, happy, sad; child describes a feeling response to role being played, uses words afraid, scared (4) identifying facial expressions, their appropriateness (3) choosing an angry response from others, anticipates what he would do in a particular social situation (3)

B. Evaluating
   1. Beginning Value Analysis
      Views situation in another's perspective (29) child describes what his mother would like, not like, classify the helper vs. the helped in situations, identifying action or series in ambiguous pictures (3) verbalize all people's desire to be loved, evaluate the correct behavior toward shy children, by selecting appropriate pictures, will identify how he thinks a child in a picture feels and identify two ways by which he knows when his friend is happy, two occasions when he made someone happy, someone sad (3)

C. Deciding
   State problem clearly, list obstacles that stand in the way of solving problem, list best assets in your favor that will help you, generate possible solutions (17) describing a group problem shown in a picture and generates solutions (4) describes, economic, political, social problems (6) given a situation, the learner must look at his own feelings, beliefs, attitudes, thoughts and then decide what he values - decide course of action that fits with his values (60)
VI. VALUE CLARIFICATION AND DECISION-MAKING SKILLS

Level: Third and Fourth Grades

A. Valuing
   1. Reporting Feelings

B. Evaluating

C. Deciding

Reporting emotional reactions to problems, hypothetical situations (21) matching pictures to emotions, role playing, generating ways to make people friendlier to you (9)

decision making exercises relative to the making of America, the metropolitan community, agriculture, industry and the Indian subcontinent (6)
VI. VALUE CLARIFICATION AND DECISION-MAKING SKILLS

Level: Fifth Grade and Beyond

A. Valuing

1. Value (attitude) Clarification
   - creative exercises: how would you like to be a camera, what does no fence feel like, freedom (52) describe how it would feel to be Claude Brown, Helen Keller (32)
   - value clarification techniques: ranking, continuum, public interview, whipping (20) number of ways to answer who am I question, senses and sensations, blocks to our sensing, ambiguity and symbols, either-or, self-deception techniques, advertising ploys (32)

2. Achievement Training
   - recognizing achievement, searching for causes, recognizing resources, setting goals, trying best method, checking, being ready to change (56) plan experiences for satisfaction, ways of reducing stress (56)

B. Evaluating

1. Behavior
   - examples of how experience influences behavior, make as similar, different, describe similar behavior with similar causes, different behavior, how people react to stress (56) dynamics of group process, roles of members, characteristics of leader (49) process of development, intelligence, language (49) friendly, unfriendly behavior, loyalty (49)
   - identify feelings with respect to people who are different, concepts of discrimination, stereotype (49) heredity and environment, conformity of group to norms (49) relative values, questions of values and attitudes (50) values differ, values originate outside ourselves, values influenced by people, by environment (10)

2. Strategies for Value Analysis
   - data collecting of change in values and interests over growth, individual differences, sex, age (49) tools for studying value change in a group context (49)

C. Deciding

1. Ethical Decision Making
   - steps of inferring motivation from behavior, effects of decisions on others, evaluating information carefully, recognize self-deception, ordering values, identify source of values and evaluating them, accepting consequences (10)

2. Personal Decision Making
   - demonstrate importance of, identify five kinds of personal influence in decision making, demonstrate influence that affects children's decision making, identify categories of types of decision making, compare two individuals in decision making, two groups, steps of decision-making process (49)
SELECTED HIGHER ORDER COGNITIVE INSTRUCTIONAL MATERIALS

1. ACADEMIC PRESCHOOL, THE (BEREITER-ENGEIMANN LANGUAGE TRAINING PROJECT)

2. ADVENTURES IN DISCOVERY

3. AMELIORATIVE CURRICULUM, THE

4. CHILD (Coordinated Helps in Language Development)

5. CHILDREN’S THINKING—HEATHCOTE SCHOOL

6. CONCEPTS AND INQUIRY

7. CONCEPTUAL SKILLS PROGRAM

8. COPING CURRICULUM, THE

9. CREATIVE THINKING KITS: A PROGRAM FOR MIDDLE GRADES

10. DECISION MAKING

11. DEVELOPING COGNITIVE SKILLS IN YOUNG LEARNERS
12. DIRECT TEACHING OF CRITICAL THINKING IN GRADES FOUR THROUGH SIX


13. EARLY CHILDHOOD DISCOVERY MATERIALS


14. EARLY LEARNING CURRICULUM, AN


15. ELEMENTARY SCIENCE STUDY


16. EXEMPLARY UNIT ON INFERENCE EVALUATION, AN


17. FAMILY LIVING SERIES: ABOUT YOU


19. FIVE-DAY COURSE IN THINKING, THE


19. FROSTIG PROGRAM FOR THE DEVELOPMENT OF VISUAL PERCEPTION, THE


20. HUMAN DEVELOPMENT LAB


21. IDEABOOKS


22. IMAGI/CRAFT SERIES

23. IMPROVEMENT OF PROBLEM SOLVING PROCESSES

24. INQUIRY DEVELOPMENT PROGRAM

25. INQUIRY, DISCOVERY AND INVENTION

26. INQUISITIVE GAMES: EXPLORING NUMBER AND SPACE

27. LEARNING READINESS SYSTEM

28. LEARNING TO THINK SERIES

29. LET’S LOOK AT CHILDREN

30. MAN: A COURSE OF STUDY

31. MAN AND COMMUNITIES PROGRAM

32. MAN THE MEANING MAKER

33. MILWAUKEE SPEECH AND LANGUAGE PROGRAM
34. MINNEMAST PROJECT


35. NATIONAL SCHOOLS PROJECT


36. OPEN COURT KINDERGARTEN PROGRAM


37. PEABODY LANGUAGE DEVELOPMENT KITS


38. PERRY PRESCHOOL PROJECT


39. PLANNING FOR CHANGE


40. PROBLEM SOLVING IN MATHEMATICS


41. PROBLEM SOLVING IN SOCIAL STUDIES: A MODEL LESSON


42. PROCESS/CONCEPT SCIENCE SERIES


43. PRODUCTIVE THINKING PROGRAM


44. READING-THINKING SKILLS

45. SCHOLASTIC STUDY SKILLS BOOKS


46. SCIENCE—A PROCESS APPROACH


47. SCIENCE CURRICULUM IMPROVEMENT STUDY (SCIS)


48. SENSE AND TELL


49. SOCIAL SCIENCE LABORATORY UNITS


50. SRA BASIC SKILLS SERIES


51. SRA LISTENING SKILLS PROGRAM


52. SYNECTICS EDUCATION SYSTEMS


53. **TABA SOCIAL STUDIES CURRICULUM, THE**


54. **TEACHING GIFTED ELEMENTARY PUPILS HOW TO DO RESEARCH**


55. **TEACHING PACKET ON CRITICAL THINKING, A**


56. **TEACHING PROGRAM IN HUMAN BEHAVIOR AND MENTAL HEALTH, A**


57. **TEACHING SCIENTIFIC THEORY TO FIRST GRADE PUPILS**


58. **THINKING AND WRITING: AN INDUCTIVE PROGRAM IN COMPOSITION**


59. **THINKING CREATIVELY: A GUIDE TO TRAINING IMAGINATION**


60. **THINKING SKILLS DEVELOPMENT PROGRAM**


61. **TRY: EXPERIENCES FOR YOUNG CHILDREN**


62. **TUTORIAL LANGUAGE PROGRAM TO DEVELOP ABSTRACT THINKING IN SOCIA LLY DISADVANTAGED SCHOOL CHILDREN**


63. **UNDERSTANDING LANGUAGE SKILLS**

TEACHING STRATEGIES DOCUMENTS


Keislar, Evan R. *Teaching Children to Discover: A Problem of Goal Definition.* Inglewood, Calif.: Southwest Regional Laboratory for Educational Research and Development, 1968.


Meeker, Mary N. *The Structure of Intellect: Its Interpretation and Uses.* Columbus, Ohio: Charles E. Merrill, 1969.


