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To test the hypothesis that if given a curriculum designed to develop cognitive functioning and taught by strategies designed to develop cognitive skills, students would then master more sophisticated symbolic thought earlier and more systematically than could be expected if this development had been left to the accidents of experience or if school experien"e had been guided by less appropriate teaching strategies, a pretest-posttest control group design was used in addition to analysis of classroom interaction. Upper elementary school students were matched on mental and chronological age and IQ. The control group had the usual social studies curriculum and their teachers did not receive training during the study. The three experimental groups were composed of (1) students with one or more years of exposure to the Contra Costa Social Studies Curriculum and teachers who received special training in teaching cognitive skills, (2) students new to this curriculum and teachers who received special training during the study, and (3) students new to this curriculum and teachers not specially trained in teaching cognitive skills. Generally, results confirmed the hypothesis, but they were not consistent. Limitations were an unbalanced sample and difficulty in clearly identifying the more complex teaching and thinking patterns. (Included are a 54-item bibliography and some tests and materials used.) (SG)

TEACHING STRATEGIES AND COGNITIVE FUNCTIONING

IN ELEMENTARY SCHOOL CHILDREN

Cooperative Research Project No. 2404

Hilda Taba

SAN FRANCISCO STATE COLLEGE
February, 1966

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ERRATA

Cover	Line 5	Insert the words "Project Director."
Frontispiece	Line 5	Insert the words "Project Director."
vii	Line 24 Line 25	Change the number "166" to "167." Change the number "167" to "166."
p. 58	Line 14	Insert the reference "p. 43" at the end of the line.
p. 64	Line 9	Delete quotation marks.
p. 66	Line 11 Line 16	Change the number "880" to "780." Change the word "seven" to "six."
p. 71	Line 3	Change the words "next two discussions" to "second discussion."
p. 148	Footnote	Delete
p. 150	Line 10	Insert "G" after the word "Appendix."
p. 154	Line 5 Line 7 Line 8 Line 11 Line 15 Line 29	Insert "1" after the code "CG 4XPzT." Insert "/" after the word "business." Insert "/" after the word "think?" Insert "/" after the word "beef," Insert "/" after the word "jobs." Insert "/" after the word "poor."
p. 169	Within the figure change heading "E4" to "C." Figure caption Insert: "Figure 9 Percentages of Substantive Thought Units."	
p. 170	Within the figure	Change heading "E4" to "C."
p. 202	Within the figure	In each case change the heading "TG" to "CG."
p. 204	Within the figure	In each case change the heading "TG" to "CG."

PREFACE

The study described in this report is a sequel to Thinking in Element..y School Children (Taba, Levine, Elzey, 1964). Both appraised within a normal classroom setting certain ideas about the development of thinking under laboratory conditions and examined the effects of planned teaching strategies on the development of children's thought.

The study, Thinking in Elementary School Children, established the main rationale for conceptualizing the processes of thinking and the chief strategies for teaching thinking. It established the concept of cognitive tasks as a central focus for organizing and integrating the cognitive skills and for developmental teaching strategies.

The current report restates with certain important extensions and modifications the rationale first outlined in the previous one. A new test in the social science area, the Application of Principles Test, has been added and modifications made in the two major tools from the previous study, the Social Studies Inference Test, and the coding system for classroom transactions. Further, models of teaching strategies and other relevant findings from the first study were used as training materials in the current one. The current study has extended and specified teaching strategies.

Both studies were based on an assumption about teaching cognitive skills – namely that appropriate teaching strategies can lead students to master the abstract and symbolic forms of thought much earlier and more systematically than could be expected if this development were left solely to the accidents of experience or to less appropriate strategies. Complementary to this assumption was a strong suspicion that, provided they have access to the intellectual skills with which to master the information they encounter, children can learn more and on a more mature intellectual level than they now do.

It was recognized, of course, that cognitive development was only one of many targets of the instructional process and that in actual learning there must be several lines of growth in knowledge, in attitudes, and in skills, which intertwine with growth in cognitive processes.

The question of how to introduce the elementary school children to the key concepts and ideas of social studies is a central issue in any reappraisal of social studies curriculum and teaching. The chief problem is to design teaching strategies which offer children opportunities to manipulate these concepts and ideas without forcing on them a mode of thinking that is alien to them.

In spite of recent emphasis on cognitive processes, the gap between what is known about the nature and the development of thinking and what is translated into instructional practices is still enormously wide. Too little is known about the dynamics of the processes in the formation of concepts and generalizations or about the use of these concepts and generalizations in creating new knowledge. Still less is known about the particular teaching strategies that induce students to engage in the symbolic and the abstract thought.

Those who have studied the development of thought, and particularly Piaget and his followers, have suggested that there is a sequence in the development of abstract and symbolically mediated thought. This sequence proceeds from the early perceptually bound responses to an increased use of abstract conceptual schemes and logical operations. The question this study set out to answer was how instructional strategies and the curriculum might accelerate this development.

The chief task of the study was to translate theoretical precepts into appropriate teaching strategies, to train teachers in these strategies and then to examine their impact on the development of children's thinking.

Although the control group design was used to sharpen the analysis of the impact of the specific teaching strategies, the reader is cautioned to regard the findings as exploratory and descriptive. The tools for analyzing the complex relationship between teaching strategies and thinking are as yet imperfect. Further, any research in a normal classroom setting is beset by more variables than it is possible to consider, let alone control.

Because of the time gap between the completion of the field study and final report, the list of the staff contributors is long. Some contributors took part in the original field study and some worked on the final data analysis and reporting. Sam Levine and Freeman Elzey were entirely responsible for the work on the two criterion tests reported in Chapter VI. Enoch Sawin had similar responsibility for the work on the nonverbal testing device in that he adapted an Edex teaching system for testing purposes reported in Chapter VII.

Mary Durkin had the chief responsibility for organizing the training of teachers and for the taping of classroom dialogues. The scoring was done by four staff members: James Hills, Freeman Elzey, Leon Paulson, and Hilda Taba. Norman Wallen, Shu-Kie Ho, and William Crawford collaborated on the final analysis and reporting on the data from tapescripts (Chapters IX and X).

The research staff is indebted to the teachers from Berkeley Unified School District, Brentwood Union School District, Jefferson Elementary School District, Mt. Diablo

Unified School District, Richmond Unified School District, and San Ramon Valley Unified School District, who participated in the study and generously opened their classrooms to testing and taping. The research staff is also deeply indebted to the administrations of these school systems for providing a cooperative setting for the study.

Special appreciation is due to Virginia Palmer who edited the manuscript and organized the coding manual and to Lynn Vogel who spent many exhausting hours in typing the manuscript.

Hilda Taba
San Francisco, 1967

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CHAPTER I

THE NATURE OF THOUGHT

Studies of Thinking

A canvass of recent research reveals several approaches to the study of cognition in general, and of thought in particular. While numerous studies are concerned with the processes and strategies of thought, each seems to use a different frame of reference and is based on different assumptions. In addition to the lack of a clear-cut theoretical framework differentiating the elements from the dynamics of thought processes, confusion also prevails about the roles of the psychological and the logical aspects of thought. Peel (1960, p. 89) suggested that thought can be studied both as a psychological phenomenon and as a logical system: "If the psychology of thought is concerned with how people think, the logical thought can be considered as a model of actual thought." For example, concept formation involves certain psychological processes, such as discriminating the elements or properties of objects or events; these discriminations can also be assessed on the bases of logical form, relevance, level of abstraction, and appropriateness to the logical Gestalt of the task of producing or discovering a concept.

Both the psychological processes of the learners and the logical properties of the products are important in studying learning processes and in assessing the effectiveness of teaching strategies. Smith (1950) has pointed out the deficiency in a concept of teaching caused by the failure of the psychologically-oriented analysis of thinking to consider the logical operations that individuals must, and do, perform on the content. For example, the usual classroom treatment of problem-solving fails to consider the logical validity of the resulting product: the steps of problem-solving are followed with little regard for the quality of the product. Thus the process of fact-finding may end in irrelevant, inadequate, or poorly interpreted data especially since students often select problems to study which are not worth studying.

As Dienes (1959, p.10) suggested, there may also be an inherent relationship between a process and a content:

> Apart from differences in individual emphasis . . . we must consider the possibility that there are ways which are objectively better or more efficient for acquiring a given concept . . . because of the inherent nature of the concepts in question. It has, in fact, been shown that certain concepts are just not amenable to learning by certain forms of mental organization . . .

One variable in determining the match between the thought processes and their products may be found in the hierarchical nature of these products. Concepts, generalizations, and judgments, as products of thought, are of different levels of abstraction and complexity. It is conceivable, depending on the level of abstractness and complexity of the concepts and ideas, that there are different strategies of concept attainment or methods of forming generalizations.

Styles of Thought

Most of the studies reviewed are concerned with styles of thinking and with individual differences within these styles. Presumably, individuals have a predilection toward one or another way of selecting what they respond to in the environment and of organizing and processing their knowledge and perceptions. This predilection, or characteristic set, is the individual's cognitive style. The genesis of these styles is still obscure although it is frequently assumed that they relate to personality factors.

These styles may be concerned with ways of representing reality or ways of labeling what one represents. For example, Bruner (1963) is interested in the nature of the representations of the world and how these representations change with growth. He defines concept formation essentially as the building of a system of representing the world (Bruner, 1964) and considers the evolution of this system of representation the key to cognitive development. He distinguishes three types of representation:

1. Enactive representation, in which past events and irregularities of the environment are represented through appropriate motor responses, such as navigating around familiar obstacles, bicycling, tying shoes, etc.;
2. Iconic representation, which summarizes the environment in images that "stand for" the environment and which organize its spatial, temporal, and qualitative aspects. In iconic representation, the pictures "stand for" an event or an object, such as a picture of a house for the actual one;
3. Symbolic systems, which represent reality still more arbitrarily and distantly than does iconic representation. The word "house" does not even "stand for" the house the way a picture does, nor does it point out the referent. The symbolic system is more flexible precisely because it is so distantly related to reality. Words can

be combined in more ways than can pictures or acts.

Bruner's concept of the evolution of steps in representation is similar to Piaget's stages of thought: each preceding stage is a prerequisite for the next one. An individual does not move to the next step until he has "overpracticed" or "overlearned" the preceding one. He also suggests that the transition from iconic to symbolic representation is the most crucial step during the elementary school years because it is here that the greatest complex of problems occurs.

Vygotsky (1962) described three sequences of conceptual groupings, each of which uses a different psychological perspective and a different kind of logic:

1. Heaps, i.e., grouping disparate objects in unorganized congeries put together in an arbitrary way simply because the child has decided to put them together this way.
2. Complexes, or groupings in which individual objects are united by subjective impressions and bonds which actually exist between the objects. Complexes group features that are not uniform. This type of grouping occurs according to a rule which does not apply in all cases. The bond in a complex is concrete and factual rather than abstract. Any factually present connection may lead to the inclusion of an element in a complex such as grouping some things together because of color and others because of shape. The complexes may be composed by association, contrast, or a functional experiential relationship such as grouping words and

events together by the sequence in which they happen or, for example, joining cement, cement mixer, and patio, because all three are involved in the same operation.

3. Scientific class concepts proper, which are sophisticated groupings arranged according to a system of super- and sub-ordination. To form the concepts on which classification depends, it is necessary to abstract or single out elements and to view them apart from the matrix of concrete experiences in which they are imbedded. Such a concept embodied in a word is a generalization, although in the process of forming a concept it is equally important to separate and unite, to analyze and to synthesize.

Vygotsky makes a special point about distinguishing the scientific concepts from what he calls pseudo-concepts. Pseudo-concepts are not developed spontaneously by the child. Rather, the lines along which they develop are predetermined by the meaning of a given word that exists in the language of adults. This type of concept is common among school children who learn vocabulary by imitation or definition (Vygotsky, 1962, Ch. 5). Pseudo-concepts often mislead teachers and researchers because the superficial similarity of the pseudo-concept and of the real concept makes it difficult to distinguish them. Vygotsky considers this difficulty a major obstacle to the analysis of thought.*

* Holt, John, Review of Toward a Theory of Instruction by Jerome Bruner, New York Book Review, VI, 6, (April 14,1966). Holt points to a similar phenomenon when he suggests that, in his experiments, Piaget's questions may actually elicit a problem in the child's mind that differs from the one the question implies. For example, the use of the word "longer" may mean, to the child, "the one that sticks out the most."

Kagan, Moss and Sigel (1960) distinguish three kinds of labeling behavior:
1. descriptive labeling, which depends on the manifest physical attributes of the objects, e.g., identifying a group of men in uniform as "all soldiers";
2. relational-contextual labeling, which describes a functional interdependence between objects, e.g., grouping a boy with a man carrying a cane and wearing blasses by saying, "The boy is helping the blind man across the street"; and
3. categorical-inferential labeling in which an object or event is subsumed under a group label that is representative of a total class, e.g., grouping together all objects which are tools under that heading.

Other students of thinking are concerned with styles of thought processes or strategies. Some of these investigators have studied cognitive style as a function of the individual's inclination to take intellectual risks. Maslow (1956, pp. 37-38) juxtaposed defense and growth. Shaftel (1959) referred to autocentric and allocentric styles of thought. Witkin (1962) distinguished field-dependent and field-independent styles of thought. Getzels and Jackson (1962) differentiated between high IQ and high-creative individuals. Bartlett (1958) and Rokeach (1960) spoke of the closed and open systems of thought. The closed system is characterized by uniformity of process and in the order of steps. Once a certain amount of evidence has become available, sooner or later the thinker is compelled to take a particular route. In contrast, the open system of thought sustains variety in process and order of steps and thus permits a variety of conclusions.

This classification is very similar to the convergent and divergent styles of thought described by Guilford in his model for the structure of intellect (Guilford, 1960). Convergent thinking is a mode that is directed toward finding a correct or a right answer by a predetermined method. Divergent thinking is oriented toward the novel and the unusual in the method and in the ensuing thought. Gallagher (1965a, pp. 7 - 8) selected Guilford's structure of the intellect as a model because it was a comprehensive description of cognitive processes and therefore amenable to the formulation of testable hypotheses upon which a picture of complex thought development and operations could eventually be built. Gallagher studied the verbal interaction in ten classes of academically talented students in junior and senior high schools in five consecutive class sessions in English, Science, and Social Studies. The tapescripts of the verbal interaction were analyzed according to the categories developed by Guilford as follows: 1. cognitive-memory, or simple recall of contents; 2. convergent thinking, or analysis of given or recalled data by responding in a tightly structured framework which leads to one expected end result; 3. divergent thinking, or an intellectual operation in which the individual is free to generate ideas within a data-poor situation or to take a new direction or new perspective on a given topic; 4. evaluative thinking, dealing with judgments, values, or choices.

Gallagher found that cognitive-memory was the most prevalent in most groups, followed in frequency by convergent thinking. Only a small per cent of the verbal transactions represented divergent or evaluative thinking. He also found that the character of student behavior was largely directed by the teacher, i.e., student responses were directly related to the style of teacher questioning. Because the behavior of the same teachers varied from class to class, Gallagher suggested that factors, such as subject matter content or the composition of the class, may also have influenced the nature of classroom transactions. The characteristic which students exhibited uniformly, despite variety in their teachers, content, and classroom interaction, was their degree of expressiveness, i.e., students who were highly expressive in divergent thinking were also high in other categories. There were no striking differences in the performance of the divergent- and convergent-thinking students. Those performing well on the one did equally well on the other. IQ scores did not seem to be a significant variable.

An interesting distinction between analytical and constructive modes of thinking is made by Dienes (1959, p.10). He wrote:

> We know . . . that some people must formulate their concepts very explicitly and exactly before they can use them, while others can think in terms of the same concepts with equal efficiency but only with a small amount of such explicit formulation. Or, again, some people, as Bartlett points out, tend to think in broad concepts, in terms of the internal relationships of the constituent concepts, while yet others build up their concepts following some intuitively realized requirements or standards. For the former, it is more the detail and its intricacies; for the latter, the overall picture that counts. These might be called the analytical and the constructive aspects respectively.

Peel (1960, pp. 16-18) described four styles of thinking: thematic, explanatory, productive and integrative. Thematic thinking, e.g., the pattern employed in creative writing, is relatively free. However, the associations are controlled, directed, or unified by the theme and present a consistent whole. In explanatory thinking, the direction employed in describing and explaining events must conform to the practical criterion which controls the sequence of associations. Explanatory thought provides a jumping-off point for a control over, and manipulation of, the environment. When we are able to explain an event, it is at least theoretically possible to control it. Productive thinking is employed when an individual is called upon to apply knowledge or to make use of knowledge to explain new situations. This type of thought goes beyond explanation. It modifies the original situation so that the original problem is removed. These three types of thought, according to Peel, account for most of the thought required of students in school. The fourth, integrative thinking, is seen only tentatively among the most able of the students. It:

> . . . reveals itself in the innovation of new theories and systems of thought which embrace a wide range of apparently dissimilar phenomena. This type of thought may be nothing more than finely discriminative and majestically comprehensive variations of the first three kinds of thinking. (p. 17)

While these studies of styles of thinking are highly suggestive and provocative, it is difficult to translate their results into educational strategy. Further, the diverse terminology used to describe essentially similar styles makes it difficult to consolidate the concepts into a single comprehensive system.

A more serious difficulty in application of the research on styles of thought lies in the fact that the styles of thought do not represent discernible processes or skills that can be used to construct teaching strategies. As general qualities of thought, these styles are not directly learnable or teachable because they describe qualities or characteristics which transcend the several categories of specific thought processes, such as forming concepts, generalizing and inferring from data, and applying principles to explain, predict, or hypothesize.

The Strategies of Thought

Only a few studies are concerned with strategies of thought, and still fewer deal with the complex interactions of these strategies in a classroom.

Bruner and his associates (1956), for example, have examined the strategies of concept attainment under simplified and rigidly controlled laboratory conditions. These conditions are not analogous to the complex classroom conditions which involve processes other than concept formation as well as developmental changes in the processes and concept formation.

The classic attempt to study strategies of problem solving was made by Duncker (1945). He presented problems to a subject and then asked him to think aloud while he was solving them. Duncker distinguished two methods of problem solving: organic and mechanical. The organic problem solver first rephrased the problem according to his insight into its structure gained from his background and experience. He suggested a partial solution, then rephrased the problem and proceeded in this manner until he reached an effective restatement or discovered that his "solution" was not a real one, whereupon he might attack the problem differently. In contrast, the "mechanical" problem solver applied his knowledge to a poorly analyzed problem and, when this method failed, resorted to haphazard trial and error.

Duncker described the conditions necessary to arrive at an organic solution: it is important to understand the essential structure of the problem, to distinguish the essential from the irrelevant conditions, to decide how to vary the appropriate elements meaningfully, to analyze the situation in terms of the goal, to determine what stands between the goal and its realization, and to analyze the available materials in order to know what can be used. The direction that the process of solving the problem takes depends on the relief map (or the cognitive map) of the problem and the movability and variability of its elements. Duncker also suggested that, although knowledge and habit play a role in problem solving, thought process is the most influential factor in creating "looseness" or flexibility.

Wheeler (1958) pointed out another phenomenon in problem solving, namely, that individuals may suffer from functional fixedness wherein they become so set in their perception of objects or relationships between their elements that they are incapable of new responses. This rigidity makes it impossible to restructure the problem and to reorganize the materials of thought.

Wertheimer (1945) analyzed a similar strategy of problem solving under the name of productive thinking. He observed elementary school children solving geometry problems (such as finding the area of a parallelogram) and examined their approaches to these tasks. He, too, postulated that the root of all productive thinking is in the discovery of the fundamental structural properties of the problem, the ability to see relationships between the different elements of the structure and to organize the "field" of the problem so that sensible thought may be applied to it. Wertheimer maintained that problem-solving processes prepare the student to use, as vehicles for further thought, the generalizations he has already acquired. To do this, students must acquire the necessary perspective on the problem in order to select and assemble, from previous experiences, the generalizations and facts that apply sensibly and significantly. Sensible application of previous knowledge requires a reasonable restructuring of the problem so that it can be seen in a new perspective.

Wertheimer distinguished between prescriptive and productive learning and teaching. Prescriptive teaching provides the student with those things which he should discover for himself. This teaching produces non-adaptive learning because it does not lead the student to a rational understanding of his learning task. The learner can only perceive each new learning task as similar to the one he has mastered before and is therefore predisposed to apply mental operations used previously in the current situation. Prescriptive teaching therefore reduces the possibility of creative thinking and inhibits the transfer of learning. The difference between prescriptive and productive learning and teaching lies in the delicate balance between what is given the student and the cognitive operations he is asked to perform on it.

More recently, Suchman (1962, pp. 29-42) has experimented with another strategy: the method of generating autonomous inquiry in children of elementary school age. He began by showing children some motion picture demonstrations of problem episodes in physics. Each of these problem episodes illustrated certain key principles or causal relationships. These episodes were designed to baffle children and to create a cognitive dissonance, thereby producing a set for search and inquiry. The students were then asked to explain the phenomena. They could begin the inquiry by asking questions but were required to phrase their questions so that they could be answered "yes" or "no." Thus, if they learned to ask productive questions and to structure their probes, they could acquire information but could not "brain-pick."

Training in inquiry process followed a sequence which began with the showing of the episode followed by its analysis to verify the available facts. These facts were then examined for their relevance. The final step was an explanation of the observed phenomena by discovery of the principles and relationships which govern the changes shown in the film. Suchman called this "the induction of relational constructs." The individual was then forced to use his existing conceptual systems in order to hypothesize and test the existence of causal relationships.

Suchman's study of inquiry training involved analysis of the elements of thought and the strategy of inquiry. He postulated that the cycle of operations in autonomous inquiry involves four tvpes of action: searching, processing, discovery, and verification. Each action in turn involves certain more specific processes. For example, data processing consists of analysis, breaking down complexes into their component parts; comparison, bringing together comparable elements to discern differences and similarities; isolation, a selective separation of, and attention to, small groups of variables; and repetition, repeated juxtaposition of elements of data to decrease the probability of unrecognized elements.

One of the common features of these studies of strategies of thought is the postulate that there is a generic method of inquiry and/or problem solving which is relatively independent of the specific content. The relative roles of the generic method of inquiry and mastery of appropriate information have been debated for a long time and continue to be studied and debated. Obviously, thought cannot proceed from a knowledge vacuum. However, if the method by which needed information is acquired induces a restrictive set that prevents the restructuring of the problem, it can limit productive thought and autonomy of inquiry. Often emphasis on acquisition of meaningful knowledge is regarded as an efficient alternative to discovering the structure of the problem and the principle for solving it, but that does not resolve the difficulty because it is difficult to define meaningfulness without reference to the context in which the knowledge is used (Taba, 1963).

It must also be remembered that there is a relationship between the level of abstraction on which the problem solver can operate and what aspects of the structure of the problem he can perceive. Higher levels of abstraction permit greater control and larger scope of representation and therefore offer possibilities for devising a simple structure to solve a problem. The greater the range of elements that can be considered as incidents of the general case, the more encompassing the solution. Conversely, a lower level of abstraction tends to produce more scattered organizational patterns in problem solving, a more complex structure of the problem, and a design for solution that encompasses fewer elements.

The studies of strategies of thought described above also assume that the fundamental intellectual activity is that of discovering the structure of the problem, the main principle, and the crucial causal relationships between the events. This discovery process is seen as a possible means for developing autonomous thinking and encouraging transfer of method and of knowledge.

These studies all suggest, or actually propose, a new teaching strategy and a new role for the teacher. This role is that of stimulating cognitive processes. Thus, the first requirement for this strategy is that teachers themselves have a cognitive map of the concepts and mental operations involved in the various learning tasks in order to be able to diagnose the type and the level of thought processes children bring to the tasks. Further, they must employ methods which maximize the autonomy of thought and follow a valid psychological sequence for attaining it. Although the two goals are not mutually exclusive, for optimum teaching they must distinguish the methods suitable to generate creative and productive thinking from those suitable for holding facts efficiently. As Peel pointed out, "We need a balance between over-information and freedom, a point between lack of information and the fettering of imagination by too much of it " (1960, p. 171).

The Development of Thought

Most notable among the studies of the development of thought is that of Piaget and the so-called Geneva School. Their studies have pursued the development of thought as mental activity or as a problem-solving and information-processing capacity.

The work of Piaget (1953; 1957; Piaget, Inhelder and Szeminska, 1960; Hunt, 1961, Chs. 5 - 9) describes certain developmental sequences in the formulation of thought from the first sensory-motor reactions to the development of reflective thought. The behavior of the human organism starts with the organization of sensory-motor reactions and becomes more intelligent as coordination of reactions becomes progressively more interrelated and complex. Thinking becomes possible after language, and with it a new mental organization, develops.

Of singular importance is the central postulate of Piaget that the progressive maturation of mental operations occurs according to a lawful sequence. Four main stages can be differentiated in this sequence. The first is the sensory-motor stage (from birth up to age 2) in which the coordination of the various senses is accomplished and a relationship is established between perception and action. Piaget postulated that motor action is the source from which all mental operations that an individual acquires emerge. During this period, the separate sensory impressions evolve into the perception of objects and events with multiple properties. The second pre-operational stage (2 - 7 years of age) is the period of acquiring a language which permits the child to interact with the world symbolically instead of directly through motor action. The child is still ego-centric, although he gradually learns to see spatial and temporal relations that are independent of himself. The third stage, that of concrete operations or operational thought (7 - 11 years of age) is characterized by a developing dependence on perceptions and by a growing capacity to reason. Although the child's reasoning is still on a concrete level only, he can classify, compose series, and count but largely by manipulating objects and by a method of trial and error.

The fourth and final stage is of conceptual or reflective thought (11 - 16 years of age). During this stage, an individual acquires the capacity to deal with abstract propositions, symbolic relationships, and hypothetical possibilities. Conscious manipulation of concepts replaces the intuitive grasp of abstract relationships. A consciousness of form is acquired, e.g., at this stage an individual can deal with the form of an argument while ignoring its empirical content.

Such a concept implies that development takes place through a hierarchical organization of the information-processing strategies and the symbolic representation of experience. At each succeeding stage the cognitive operations and structures become more abstract and complex. In addition, the sequence of development is lawful in the sense that the mental structures developed at any one stage are a prerequisite to success in the subsequent one and are incorporated into it. For example, the mastery of concrete operations is psychologically and logically necessary to activate formal operations. At each stage, new competencies are developed which extend the individual's grasp and control of the world and his freedom beyond immediate stimulus (Flavell, 1963, p. 20). Furthermore, this continuous creation of increasingly complex structures of mental organization (or schemata) is the product of interaction between the organism and the demands of its environment. Thus cognitive operations can be viewed as products of the individual's active effort to cope with his environment and are therefore active processes which are not controlled fully by either environmental stimulation or passive conditioning.

This interaction between an individual and his environment, and especially the progressive complexity in the form that it takes, involves a dual mechanism consisting of two complementary processes: assimilation and accommodation. Assimilation means that the individual "in any cognitive encounter with the environment" organizes the objects and events into his existing cognitive structure and invests them with the meaning dictated by the system. He perceives each new phenomenon in terms of an existing conceptual framework and new phenomena have meaning only to the extent that they can be fitted into patterns of concepts and relationships that exist in his mind. Experience is molded into the existing system of concepts and their relationships.

In contrast, accommodation is a process of adaptation to the "variegated demands of the environment." This process occurs when the new experience does not fit the particular conceptual schema of the individual. He must therefore rebuild, extend, or otherwise alter his schema to meet the demands of a new reality. For example, a child's concept of measurement may be that of measuring with a yard-stick. When faced with something that cannot be measured with a yardstick, such as the volume of water in a jar, the child must extend his concept of measuring to include different means. Eventually, he must evolve the abstract idea of measurement and distinguish it from any and all specific means of measuring. Such reorganization takes place only as the learner is induced to cope with phenomena that do not fit his current schemata.

In Piaget's theory, the rotation of assimilation and accommodation constitutes the dynamics of change and growth of thought. It represents the coordination of thought patterns to one another and to external reality. Both are present in every cognitive act, of any type or at any developmental level. However, their relationship changes drastically both within and between the developmental stages, and these alterations depend upon the kind of intellectual functioning that takes place (Flavell, pp. 44-52, 58). For a child in school, that intellectual functioning will largely depend on the nature of the teaching which he encounters.

CHAPTER II

THE NATURE OF TEACHING

Teaching is much more complex than is generally assumed. The usual paradigm of teaching is a mixture of sets of scattered ideas and conceptual models and of simplistic assumptions. Neither a comprehensive theory of teaching nor a set of satisfactory conceptual models is available to describe individual teaching acts or teaching strategies and their effect on learning.

Assumptions about Teaching

Several assumptions prevail about the nature and function of teaching. Among the simplest and most obstinately held has been the idea that the chief, if not the only, function of teaching is to impart knowledge, i.e., to explain and tell. According to this assumption, effectiveness of teaching bears a direct relationship to teachers' knowledge of content areas. Evidence of this idea can be found in the practically self-teaching and presumably "teacher-safe" curriculum packages and in the emphasis on training teachers in the content background as the chief way of ensuring excellence of teaching and learning. While improvement and updating of the content of curriculum and of the content background of teachers no doubt improves teaching, it also involves the danger of a uniform curriculum uniformly and unimaginatively taught to all varieties of students and under all varieties of conditions.

Another widely accepted but equally inadequate assumption about teaching is that it consists of mastering certain special "methods," such as "methods for teaching history." Often the idea of method is narrowed still further, such as to a chronological or a topical "method" of teaching history. Acrimonious debates about the method of teaching reading consist largely of putting one method against another as the only right method of teaching a subject, such as reading. This assumption is the base of the prevailing scheme of separate methods courses in teacher training. This assumption takes for granted that there is one right method of teaching anything and that that method is equally effective in the hands of all teachers for all kinds of students and under a variety of learning conditions (Medley and Mitzel, 1963, pp. 85-88). However, the chief weakness of teaching modeled on this assumption is that it would be determined solely by the unique characteristics of subjects and not also by the requirements of general educational objectives, such as the development of thinking and certain values.

Still another assumption is that good teachers are born, not made. Those operating on this assumption regard teaching as a sort of mystical art, the secrets of which a few "good" teachers grasp intuitively. Such an assumption denies the possibility that teaching involves techniques and skills that can be learned by a great range of individuals, provided we can identify those techniques and skills and help teachers to master them.

Perhaps the most basic recent criticism leveled against approaching teaching as a theoretical construct is that the concepts of methods have been inferred too directly from the various partial and inconsistent learning theories, each of which postulates a different basic mechanism of learning, such as conditioning, identification, and the organization of perception and cognition. Each of these leads to a different teaching model. The first suggests that teaching is conditioning of responses by controlling the stimuli; the second, by providing models; the third, by arranging stimulus conditions to induce reorganization of perception and cognition. The confusion is further compounded by the fact that many learning theories are derived from laboratory studies, often of lower animals, in which learning occurs in tightly controlled environments that have little or no resemblance to a classroom. Page (1962, pp. 74-75) suggests that there has been a gross misapplication of behavioral sciences, especially psychological theories, and has called attention to the "verbal magic" in which both psychologists and educators engage in translating laboratory findings into educational theory. He defines "verbal magic" as a process of over-generalizing laboratory findings, such as generalizing from the reactions of hooded white rats to electric shock, to the reactions of organisms in general, and then applying the generalization to human learning in a classroom. The resulting inference would be that, since hooded white rats learn less well from punishments than from rewards, the same can be said for organisms in general or third graders in particular.

Another difficulty in analyzing teaching is caused by lack of adequate differentiation among types of learning: among learning facts, developing skills, learning to think, and acquiring attitudes. Without such differentiation it is difficult to match teaching strategies to particular types of learning. Often, therefore, principles of learning relevant to one type of learning are applied indiscriminately to all types with understandably unsatisfactory results.

Past studies of teaching which have concentrated largely on the relationship of teacher characteristics to teaching effectiveness have been rather fruitless. Getzels and Jackson conclude that, despite the importance of the problem and a half-century of prodigious effort, very little is known about the relationship between teacher personality and teacher effectiveness:

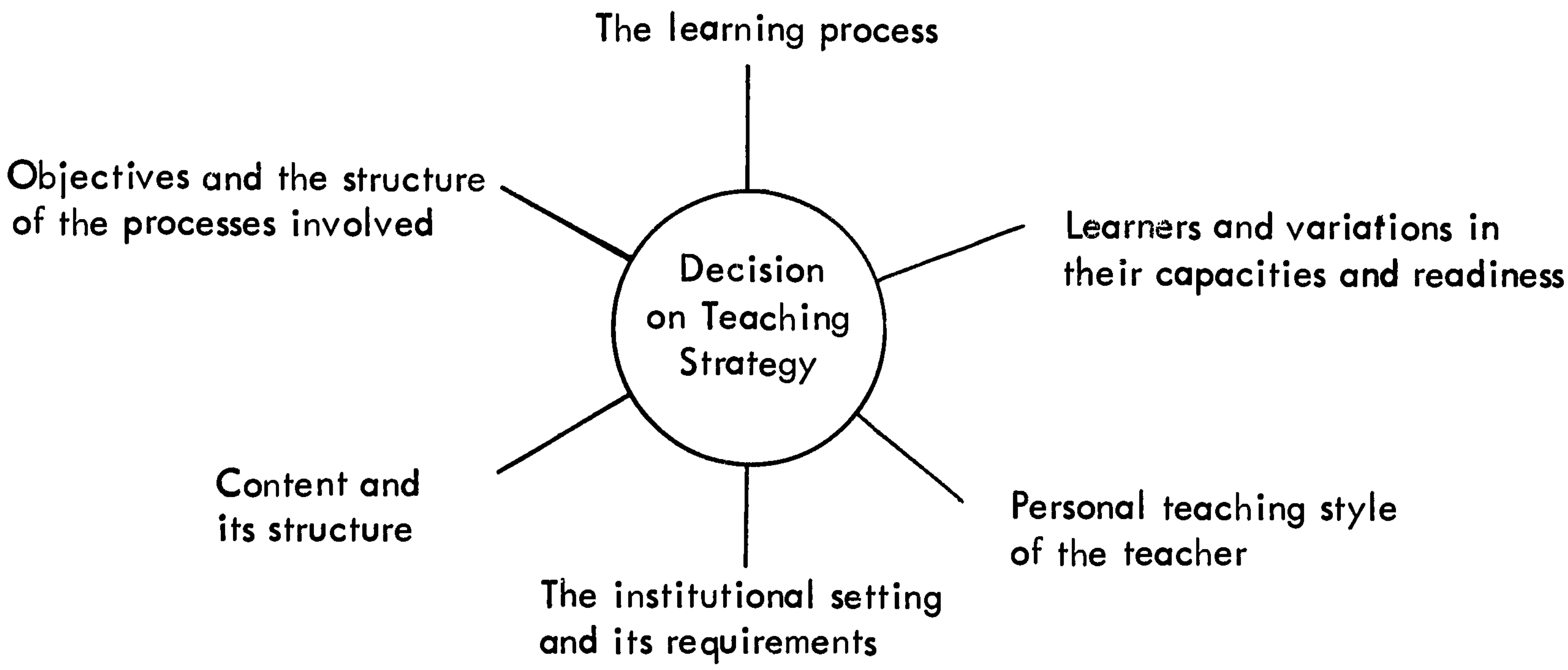
> The regrettable fact is that many of the studies so far have not produced significant results. Many others have produced only pedestrian findings. For example, it is said after the usual inventory

> tabulations, that good teachers are friendly, cheerful, sympathetic, and morally virtuous rather than cruel, depressed, unsympathetic and morally depraved. But when this has been said, not very much that is especially useful has been revealed. For what conceivable human interaction - and teaching implies first and foremost a human interaction - is not better if the people involved are friendly, cheerful, sympathetic, and virtuous rather than the opposite? (Getzels and Jackson, 1963, p. 574)

The Nature of Teaching

Teaching is one of the most complex human activities. Even simple decisions, such as what questions to ask a third grader, require considering and integrating a multitude of factors as shown in the chart below (Taba and Hills, 1965, p.48):

Considerations in Making Decisions about Teaching



Decisions regarding teaching strategies are affected first by the nature of the content taught and by one's view of that content. To the extent that there are differences in the structures of the various disciplines , there must also be variations in the strategies of teaching them.

In addition, if teaching is addressed to multiple behavioral objectives, the behaviors implied by these objectives must be differentiated and appropriate strategies differentiated and planned. For example, attitudes cannot be "taught" in the same sense one teaches geographic principles nor yet map-reading skills.

Further criteria for formulation of teaching strategies are supplied by knowledge about the learning process qua process. What do principles such as generalizing in an inductive sequence, such as focusing on manageable targets and such as pacing the learning appropriately, imply in deciding what questions to ask third graders about community organization, or what research assignment in history to give fifth graders? A particularly important principle for those concerned with autonomous learning is that of involving students actively in the business of their own learning.

Still more criteria and modifications are dictated by differences among learners' abilities, cultural backgrounds, and maturity levels. Such differences require the teacher to determine ways of motivating students, or the optimum size of the steps in a sequence of learning tasks. The latter is especially important when the tasks involve conceptualization, abstraction, and other forms of thinking.

Finally, there are the considerations of whether certain teaching techniques harmonize with the teacher's personal style of teaching and with the requirements and limitations of the institutional and community setting. Even techniques that are generally the best can be unproductive if they do not fit into a given style of teaching or are inappropriate to a given school setting.

Generally, however, the above diagram suggests that teaching is a way of synthesizing into one sequence two aspects of a logical model: the structure of the content and the behaviors to be attained by the students. Too often, in current considerations of teaching, these factors are separated.

Studies of Teaching

Recently, the previously mentioned limitations of directly modeling teaching from results of laboratory studies and of inferring teaching effectiveness from the personality characteristics of teachers, or from a general list of a priori competencies, have begun to be recognized, and a number of studies have been conducted of normal class situations. The model for assessing teaching effectiveness is also moving toward evaluating the effects of interaction between teacher and students.

In these studies of teaching the description of teaching acts and of teaching strategies has become one of the chief tools for securing data. However, the acts selected to be described differ, as do the systems of description, both apparently as functions of what the researcher considers important in teaching. The studies of teaching tend to differ, therefore, in several important respects.

One difference lies in the range of teaching behavior observed. Whereas one set of observations may be concerned with the logic of teaching, others may focus on classroom climate, on critical thinking, or on communication patterns.

A second source of variation is the setting and the population that is being studied. For example, certain studies observe classes while they are studying a specific subject, while others cut across subject areas. Some investigators are interested in observing teaching of gifted children; others study under-achievers. Some concentrate on high school classrooms only and others investigate elementary school classrooms.

A third difference is the observational procedure itself. In one study observations may be recorded in the classroom during the lesson while in others the analysis of teaching is made indirectly by examining tape recordings, kinescopes or tapescripts. As a rule, the observational procedures used tend to be a function of the kinds of behavior under study. For example, analysis of many dimensions of a particular unit of behavior precludes the direct coding of immediate observation as the sole method of coding and requires the availability of a permanent record (Kliebard, 1966, p.47).

Finally, the studies differ according to whether they focus on teacher or on student behavior or on both simultaneously.

In one of his earlier statements, Smith (1950, pp. 229-41) maintained that, in order to develop an adequate theory of didactics, one must first describe the behavior of the teachers. The tactics of teaching could be described later. Smith believes that such a description should cut through the verbality which now obstructs intensive analysis of teaching behavior.

Because studies of teaching show progression in methodology of recording as well as in types of behavior analyzed, the major prototypes are presented in a semi-chronological sequence.

One of the earliest studies by Marie Hughes (1959) analyzed teaching acts. Her study examined the effects of control and freedom in the classroom. Among the categories describing teacher acts were the following:

1. Controlling, acts which tell children what to do, how to go about it, and who should do what;

2. Facilitating, acts such as those which check, demonstrate, and clarify;

3. Content development, acts such as those which elaborate the structure of the problem under consideration, or build data for generalizing;

4. Personally responsive acts, and

5. Positively and negatively affective acts.

Hughes inferred certain qualities of teaching and a certain impact upon what the students learn from frequencies in the categories of teaching acts. For example, a large percentage of controlling acts by the teacher is considered indicative of a tendency to limit students' intellectual activity to memory and recall. A large percentage of acts designated as content development is considered to imply that mental processes other than recall are being developed.

Flanders (1963; 1966) is interested in somewhat similar categories of behavior and their effects on the classroom climate and goals. He uses ten categories to describe the behavior of teachers and students. Seven of these ten describe teacher behavior: accepting feelings, praising and encouraging, using ideas of students, asking questions, lecturing, giving directions, criticizing, justifying authority. The first four represent indirect teacher influence and the last three direct influence. Flanders' thesis is that indirect influence expands the freedom of action for the student and makes him less dependent upon the teacher while the direct influence has the opposite effect. By combining these behaviors in interaction matrices, Flanders plots the concentration of direct and indirect influence and , from the ratio of the two, infers the impact of teaching acts on students (1962a, pp. 50-62). Both of these studies catalogued teacher behavior while observing in the classroom.

Smith (1962) made the transition to the use of tapescripts as a method of recording classroom transactions. His first study was mainly concerned with teaching acts apart from their effect on learning. He classified teaching acts according to certain categories of operation: logical ones, such as defining, classifying, comparing, contrasting, evaluating, or others, such as directing and admonishing. His second study (1964) is devoted to establishing a framework for studying teaching strategies.

In the latter, "ventures" and "moves" constitute the basic elements for describing various teaching strategies. The venture is defined as a "segment of discourse consisting of a set of utterances dealing with a single topic and having a single over-arching content objective." Usually five or six such self-contained units of discourse may be found in a lesson. This definition of ventures as self-contained units assures that the teaching strategies will not be fragmented as they would be if time units were used. But such large units also constitute a source of unreliability in identification. Nine types of ventures were identified according to their cognitive import, central meaning, or theme:

1. Causal ventures dealing with cause-and-effect relationships;
2. Conceptual ventures, or the over-arching criteria for determining what is a member of a class and what is not;
3. Evaluative ventures, namely, the rating of an action, object, or event as to its goodness, correctness or worth;
4. Informatory ventures, or clarifications and amplifications of specified topics;
5. Interpretive ventures, namely, those dealing with the meaning of words or symbols;

6. Procedural ventures, attempts to disclose a sequence of actions by which an end may be achieved;
7. Reason ventures, attempts to reveal the reasons for action, decision, policy or practice;
8. Rule ventures, namely, the conventional ways of doing things or analytical relationships which may be used to guide action, and
9. System ventures, that concentrate on functional relations of the parts of a mechanism that produce a given end.

The move is a verbal maneuver that relates the terms set forth in a proposition to events or things. Moves are multiple. For conceptual ventures alone, eighteen types of moves are identified. Moves and ventures, combined in certain ways, make up strategies which consist entirely of abstract moves or which combine abstract moves with "instancing" moves. Smith and his associates identified two basic dimensions of strategy, namely, the treatment dimension or that of structuring the information, and the control dimension or the devices that the teacher uses to guide and to control the students' operations on the content.

Arno Bellack (1963) and his associates perceive teaching as a form of rule-governed game. Their study is essentially a description of the roles that the teacher and students play when engaged in the game of teaching and learning. The game is verbal and it is assumed that the principal function of language is to communicate meaning. Therefore, the analysis of language in the classroom offers the most promising way of studying the communication of meaning.

In the game of teaching, Bellack distinguishes four basic verbal maneuvers which constitute the first dimension of meaning:

1. Structuring, the function of which is to focus attention on the subject matter or a classroom procedure in launching interaction;

2. Soliciting, designed to elicit a verbal response, to encourage the persons addressed to attempt something, or to elicit a physical response;

3. Responding which is reciprocally related to soliciting ; and

4. Reacting, occasioned by structuring, soliciting, or responding functions.

These latter moves serve to shape or mold classroom discussions by accepting, rejecting, modifying or expanding what has been said.

The content of what is said is subdivided into two categories: 1. substantive meanings, such as international trade, and 2. instructional meanings, such as managerial statements and those concerned with assignments and procedures.

Bellack's findings (1965) are as follows:

1. The chief cycle consisted of teacher soliciting → student responding → teacher reacting; this cycle made up more than three quarters of all verbal moves made.

2. Teachers were verbally more active than students. Teachers structured the lesson, solicited responses from pupils, reacted to pupils' responses and, to some extent, summarized the discourse. The pupils responded primarily to teachers' solicitations; they did not overtly evaluate teacher statements; they evaluated the responses of other pupils only at the infrequent times when the teacher asked them to.

3. In most classes, structuring accounted for about 10% of lines spoken. Soliciting, responding, and reacting each accounted for 20% to 30% of the lines. Summarizing was rather infrequent.

4. Regarding content, instructional meanings accounted for 25% of the discourse and approximately 75% of the discourse was specifically concerned with substantive meanings. The largest proportion of these utterances consisted of stating facts or explaining while, in contrast, analytic and evaluative meanings accounted for only a small portion of the total discourse in any class.

5. The most frequent activities were teachers' statements about procedures, assignments, and other instructional matters.

6. Teachers' behavior was characterized by a relatively stable emotional style.

The study described in this report as well as the study that preceded it (Taba, Levine and Elzey, 1964) differs from those described above in several respects:

1. This study was conducted in an experimental setting rather than a naturalistic one. This experimental setting included a newly organized curriculum plus training the teachers to develop cognitive processes in the students. (Note that Bellack did include some training).

2. The study focused on a single target - the development of cognitive processes.

3. The study attempted simultaneously to analyze, in terms of cognitive processes, two poles of interaction: teacher behavior and the quality of student responses.

4. The study attempted to identify both the functions (in terms of behaviors sought) of the individual teacher acts and of the combinations of these acts

defined as strategies, namely, the sequences, clusters, pacing, and flow.

5. The study attempted to examine a series of dependent variables. For instance, it examined the relationship of the target objective – the levels of cognitive process – to social sciences content achievement, to intelligence, to economic status, and to reading and language ability.

Perhaps the chief distinction between the studies described above and the current study is that they generally analyzed spontaneous teaching behavior of teachers who were not specially trained to promote the behavior being studied in the students. In this study, it was assumed that the teacher had certain techniques made available through training. The emphasis was on how the teacher managed these techniques and how he combined them into a personal style of teaching.

CHAPTER III

BASIC PREMISES AND POSTULATES

Before studying a phenomenon, one has to determine what major concepts describe it, which variables to examine, what units to use in examining them, and what type of expression of behavior to use as an index.

This study deals with two phenomena: thinking and teaching. Therefore it involves two sets of concepts: those pertaining to thinking and those pertaining to teaching.

As the preceding chapters demonstrated, there is as yet no single coherent theory of the nature of thought. Each study is predicated on a different set of premises about the nature of thought, uses a different breakdown of the phenomena of thought, follows different hypotheses, and concerns itself with different facets or aspects of the total process.

The study described here has its own set of premises and its own unique way of breaking apart the phenomenon designated as thinking. Some of these postulates were developed in a preceding study (Taba, Levine and Elzey, 1964). Others emerged from empirical analysis of classroom learning processes conducted in connection with the development of the experimental social studies curriculum that provided the setting for the study.

The Theoretical Postulates about Thinking as an Educational Objective

Several theoretical assumptions about thinking governed the study. Perhaps the most important one is that thinking can be learned and that it can therefore be taught. The very fact that thinking has figured as an educational objective and the frequency with which its central importance in the educational enterprise has been invoked presumes that the capacity to think can be systematically fostered.

Recent projects in curriculum innovation in social studies as well as in other subjects have renewed this central emphasis on cognitive functioning. In part, this emphasis is the necessary corollary to the stress on students "penetrating the structure" of the disciplines they study.* It is impossible for the student to "penetrate the structure of the subject" without performing the intellectual operations that yield insight into the basic concepts of that subject or without himself discovering at least some of the general principles that constitute the essence of that subject. Yet this objective, by and large, has remained a pious hope because a variety of factors have prevented the development of a well thought out strategy of teaching thinking.

One serious obstacle to helping students become autonomous and productive thinkers has been the hazy concept of the nature of thinking. Thinking has been treated as a global process which seemingly encompasses anything that goes on in the head, from day-dreaming to constructing a concept of relativity. Consequently, unresolved distinctions between the various types of thinking led to defects. As yet, there is no adequate taxonomy of cognitive skills that compose the complex phenomenon called thinking. Even the more serious educational thinkers fail to distinguish the strategies of thinking, such as problem-solving, from the basic cognitive processes and skills, such as generalizing, differentiating, and forming concepts.

Implementation of thinking as an educational objective has been handicapped also by a widely accepted assumption that a person cannot think reflectively while

* "Report on Project Social Studies." <u>Social Education, 29</u>, No. 4, April, 1965, p. 206 ff.

acquiring facts, but must spend a lengthy period of time acquiring them before he can think. Teaching that rests on this assumption stresses factual coverage and burdens the memory with unorganized and therefore rather perishable information. Within the teaching of the social sciences, this assumption is manifested, first, in overdescriptiveness; second, in dealing with highly obsolescent facts and concepts; third, in burdening the students' memory with aggregates of information for which they have no organizing conceptual schemata.

An equally inhibiting factor is the assumption that thought is an automatic by-product of assimilating the end products of someone else's disciplined thought or studying certain subjects which are assumed to bestow this power independent of how they are learned or taught. Memorizing geometric theorems or the steps in mathematical processes is assumed to be inherently better training in thinking than memorizing cake recipes although both may be learned in the same manner and call for the same mental processes - rote memory (Taba, Levine and Elzey, 1964).

The third deterrent to realistic implementation of thinking as an objective has been the assumption that thinking is dependent solely on ability as expressed by IQ scores: high IQ individuals can think and low IQ individuals cannot. Hence, training or assistance can add very little. Recent studies of the structure of intelligence and of thought processes have demonstrated the unsoundness of this assumption.

The study described here sought a more balanced framework and rested on the following postulates about thinking:

1. Thinking was perceived as something which can be taught, provided that the specific processes and skills composing it are identified and, among those, the skills and processes that can be enhanced by systematic assistance are distinguished. It was further assumed that this systematic assistance required both a curriculum and teaching strategies designed for this purpose. Under these conditions, an acceleration of cognitive performance would be open to all students including those who are now considered incapable of higher mental activity because of low IQs.

2. Thinking was perceived as an active transaction between the individual and the data in the program.

This means that, in the classroom setting, the materials of instruction become available to an individual mainly through his performing certain cognitive operations upon them: organizing facts into conceptual systems, relating points in data to each other and generalizing upon these relationships, making inferences and using known facts and generalizations to hypothesize, predict, and explain unfamiliar phenomena. From this, it follows that the conceptual schema and the mental operations which an individual acquires cannot be taught in the sense of being "given" by a teacher or of being acquired by absorbing someone else's thought products. The teacher can only assist the processes of internalization and conceptualization by stimulating the students to perform the requisite processes while offering progressively less and less direct support from the external stimuli.

How individuals think, then, depends largely on the "thinking experiences" they have had and on the degree of autonomy they have acquired in performing a variety of cognitive operations.

3. The processes of thought evolve by lawful sequence. This idea of sequence is similar to that of Piaget described in Chapter I, except that it is used not only to explain a development across age levels but also the steps in learning to cope with specific cognitive tasks, such as that of generalizing from discrete facts or classifying and grouping objects and events. Each successive step in the mastery of these tasks is dependent on the mastery of a preceding step; these steps, therefore, cannot be taken in reverse. This concept of lawful sequences requires teaching strategies that observe these sequences. For example, a sequential questioning strategy needs to be formulated in the order of the psychological steps that are required to develop generalizations.

Further, the development of thought, understood in this way, is not linear in the sense of simply adding increments but represents qualitative transformations in which the organizing schema as well as the modes of operations are altered. For example, identification and enumeration of specific points viewed in a film differ qualitatively from explaining these events and making inferences from the observed events. Each of those activities requires a different mental operation and the transition from one to the other represents a qualitative transformation rather than simply a quantitative increase.

4. The prime dynamic of growth in cognitive performance involves a dual set of adaptations that function outwardly as coping and inwardly as organization. This set of adaptations consists of two complementary processes: assimilation and accommodation, as set forth in Chapter I. In the classroom, these processes appear as alternate activities of intake of information and organization of that information in a new system. A special case of the same dual process is the use of discrepant or

inconsistent information to generate new perspectives and to enlarge the existing conceptual schema in order to accommodate a larger set of facts.

5. Thought can be studied as both a psychological phenomenon and a logical system. The psychological aspect is concerned with mental processes. The logical aspect is concerned with the nature of conclusions reached by applying different maxims (Hawthorne and Weiss, 1924). While the processes of thought are psychological and hence subject to psychological analysis, the product and the content of thought must be assessed by logical criteria and evaluated by the rules of logic. For example, while concept formation involves certain psychological processes such as discriminating the elements or properties of objects or events, the kinds of discrimination that are made can be assessed in terms of their logical relevance, validity, level of abstraction, and appropriateness to logical dimensions of the task, of which the concept formation is a part.

Literature on thinking often confuses the logical systems, the rules about classification and the classification of products of thought, with the psychological phenomena such as the processes of forming concepts or generalizations. This confusion, in turn, has produced confusion in applying what is known about thinking to educational programs. This issue is important because it determines the conception about the role of curriculum and instruction as means by which we equip human beings for growth and cognitive functioning.

The Concept of Cognitive Tasks To implement the above postulates, the concept of cognitive tasks was devised which permits both an identification of the clusters of learnable and teachable skills and the application of a lawful sequence to the acquisition of these skills. Thus, it combines the merits of allowing examination of dynamic wholes with those of analyzing specific operations within these wholes.

This study focuses on three cognitive tasks: 1. concept formation; 2. generalizing and inferring through interpretation of raw data; 3. the application of known principles and facts to explain and predict new phenomena. (Note that these tasks do not necessarily encompass all processes of thought. They exclude, for example, critical and evaluative thinking per se). In each of these tasks a distinction was made between two sets of operations: the overt activities in which the individuals engage and the covert mental operations that are required in order to perform the overt activities. The covert operations determine the sequence of the overt activities because they represent the sequential skills that are necessary at each step.

Task 1: Concept Formation. In order to organize aggregates of information, individuals must engage in three types of activities, each of which is the prerequisite for the next one. He must, first, <u>enumerate</u> or <u>list</u> the items of information. He must then group those items according to some basis of similarity. Finally, he needs to develop categories and labels for these groups and subsume the items in groups under appropriate labels.

Certain covert processes underlie these steps in overt activities. In order to <u>enumerate</u>, an individual must differentiate one item from another, such as differentiating the materials of which houses are built from other things also associated with building houses, such as tools and processes. This differentiating involves analyzing the global wholes and breaking them into specific elements with specific properties.

The second step, that of grouping, calls for abstracting certain common characteristics in an array of dissimilar objects or events. These common characteristics become the basis for grouping the objects or events together, e.g., grouping hospitals, doctors and medicine together as something to do with health care. Naturally, the same objects and events may be grouped in several different ways. For example, hospitals, x-rays, and surgical equipment can be grouped together as health facilities, types of services, or as indices of standards of living, depending on the purpose of the grouping. As was pointed out in Chapter I, children form groups on several different bases. They may group by functional relations (grouping together Father and Mother because they live together), proximity (grouping together tables and chairs because they are near each other), grouping together items that are part of the same activity such as cement, cement mixer and patio because the first two are items needed in building the last.

Categorizing, combined with subsuming, calls for an awareness of a hierarchical system of super- and sub-ordination in which items of lower order of generality are subsumed under items of a higher order of generality. Only as individuals are able to see that objects and events can be arranged in hierarchical systems of super- and sub-ordination can one say that they have acquired a scientific class system of categorization and conceptual organization.

In the following chart, dealing with Task 1, the first two columns show the sequence of relationships between the overt and covert processes (Taba and Hills, 1965, p. 85):

Cognitive Task 1: Concept Formation

Overt Activity	Covert Mental Operation	Eliciting Questions
1. Enumeration and listing	Differentiation	What did you see? hear? note?
2. Grouping	Identifying common properties, abstracting	What belongs together? On what criterion?
3. Labeling, categorizing	Determining the hierarchical order of items. Super- and sub-ordination	What would you call these groups? What belongs under what?

These steps are sequential because the differentiation involved in listings must be mastered before it is possible to identify common properties and group them. Similarly, the ability to identify common properties of objects and events and to form groups according to common properties is a prerequisite to determining the classes to which they belong and categorizing them.

Task 2: Inferring and Generalizing. Generalizing and inferring from data takes place when students are required to cope with raw data, such as when they must see and interpret a film or compare the tools and techniques for producing goods from differing technologies. Essentially, this cognitive task consists of evolving generalizations and principles from processing concrete data. Several sub-processes are involved. The first, and simplest, is that of identifying specific points in a mass of data, such as identifying from a film the tools used in agricultural processes or, after a period of research and reading, selecting the relevant points regarding education in Latin America. This process is somewhat analogous to the listing or enumeration preceding grouping in the first task.

The second process is to explain specific items of information or events, e.g., explaining why ocean currents affect temperature or why Mexico employs the "each one teach one" system to wipe out illiteracy. This process involves relating the points in information to each other to detect causal relations and to establish relationships.

The third operation is that of forming inferences that go beyond that which is directly given. For example, after comparing data on population composition in certain Latin American countries and relating these to data on standards of living there, a student infers that countries with predominantly white populations tend to have a higher standard of living.

The chart below depicts the overt activities, the covert mental operations and the sequence of the eliciting questions for the process of generalization (Taba and Hills, 1965, p. 94):

Cognitive Task 2: Inferring and Generalizing

Overt Activity	Covert Mental Operations	Eliciting Questions
1. Identifying points	1. Differentiating, distinguishing relevant information from irrelevant	1. What did you note? see? find?
2. Explaining identified items of information	2. Relating points to each other; establishing cause and effect relationships	2. Why did so-and-so happen? Why is so-and-so true?
3. Making inferences or generalizations	3. Going beyond what is given; finding implications, extrapolating	3. What does this mean? What would you conclude? What generalizations can you make?

Task 3: Application of Principles. The essence of this task is using information already possessed to explain something new, to predict consequences of events, or to hypothesize about causes and effects. For example, if one knows what a desert is, the way of life a desert permits and how water affects agricultural production, one can predict what might happen to the desert way of life if water became available. This process is the reverse of the one involved in interpretation. While interpreting and generalizing from raw data is an inductive process, applying known facts and generalizations is a deductive process.

Three distinct steps are involved in this task also. The first step is that of predicting or hypothesizing. This involves the covert processes of analyzing the problem and of recalling and retrieving knowledge relevant to the problem. The second step consists of explaining or supporting the predictions or hypothesis by identifying the causal links that lead from the described condition or problem to the hypothesis or prediction. The third step is that of verifying the explanation, prediction or hypothesis by checking its probability and universality. This involves logical reasoning; for example, the use of logical inferences to determine the necessary and sufficient conditions for the probability of a given prediction.

The processes involved in applying principles can be represented schematically as follows (Taba and Hills, 1965, p. 102):

Cognitive Task 3: Application of Principles

Overt Activity	Covert Mental Operation	Eliciting Questions
1. Predicting consequences, explaining unfamiliar phenomena, hypothesizing	1. Analyzing the nature and the dimensions of the problem or condition	1. What would happen if . . . ?
2. Explaining and supporting the predictions and hypotheses	2. Determining the causal links leading to a prediction or hypothesis	2. Why do you think this would happen?
3. Verifying the predictions and hypotheses	3. Using logical reasoning to determine the necessary conditions and the degree of universality of the prediction or hypothesis	3. What would it take for so-and-so to be true? Would it be true in all cases? At what times? Etc.

It must be remembered that both the processes and the content with which they deal - the concepts, references, generalizations and predictions - are hierarchical. Both can be on different levels of generality, complexity and abstraction. The progress of students can therefore be of two orders: an advance in the complexity and abstractness in the cognitive processes or in the content to which these processes are applied.

Finally, it must be understood that the successive steps in the processes of each task are qualitative transformations of thought processes. Grouping a list of specific items is not simply an addition to listing but rather a qualitative transformation of the listing. Inferring is not simply an extension of identifying points and explaining but a transformation of the identified points and explanations into a new organization called a generalization. For example, the point identified 'living in mud houses' and an explanation 'lack of other materials' combine with an identified point 'a diet primarily of corn' and its result 'deficiency diseases' and are translated into generalizations regarding poverty and primitiveness.

The Theoretical Postulates About Teaching

A series of theoretical postulates also governs the analysis of teaching:

1. Not all teaching results in learning. It is important to distinguish between productive teaching strategies that lead to learning and those that do not. Only if the specific function of each teaching act is considered can we be sure that it is productive.

2. Teaching is a vastly complicated process requiring an infinite number of decisions, each of which must, in turn, meet many criteria.

3. Development of an adequate theory of teaching entails a detailed analysis of teaching acts and strategies with reference to each of four major areas of educational objectives: acquisition of knowledge, development of cognitive skills, mastery of a variety of academic and group skills, and the development of attitudes and feelings. Reaching each of these objectives requires slightly different learning strategies and therefore teaching strategies unique to the objective. Productive teaching, in effect, involves developing strategies which are focused sharply on a specific target while at the same time integrating these specific strategies into an overall strategy that accommodates the generic requirements of multiple objectives.

A crucial factor in developing student skillfulness in the three cognitive tasks is the proper strategy of question-asking on the teacher's part. First, this strategy involves asking open-ended questions and thus providing the opportunity for responding on different levels of abstraction, sophistication and depth, as well as expressing different perspectives. Secondly, it involves a strategy of matching the pace of the questions to the students' capacity for mastering the skills at each step, for example, permitting the students to absorb sufficient descriptive information before asking them to explain an item. The features of such teaching strategies for each cognitive task are shown in the third column of the charts presented on pp. 39, 40, and 42. Each sequence of questions follows the developmental sequence of acquiring the skills and models necessary for the cognitive task. For example, the sequence of the steps in concept formation dictates the sequence of questions to be asked.

In order to accommodate the principle of pacing, each question is pursued long enough to permit a considerable number of students to respond.

Such pacing could be depicted graphically as follows:

	Student No. 1	Student No. 2	Student No. 3
1. What?	⟶	⟶	⟶
2. Why?	⟶	⟶	⟶
3. What does it mean?		⟶	⟶

Such a strategy permits the accumulation of a variety of responses which represent a variety of levels of abstraction and models of conceptualization, assuring that all students have an appropriate, recognizable model of each step, to which they can relate. This procedure also increases the involvement of all students in all steps of thinking and assures that the majority have a chance to practice all the skills required by the three steps (Taba and Hills, 1965, pp. 112-113).

4. While each teaching act serves a specific function, such as focusing on the task or eliciting transformations of thought from one level to another, the impact of teaching does not lie only in the frequency of single acts. It also lies in the ways in which these acts are combined into sequences and patterns. Thus, it is

especially important to experiment with these patterns and to study their cumulative effect on thinking.

5. Because the content organization sets limits both on the kind of learning and on the teaching strategies that are possible, in order to successfully teach thinking the curriculum content must be specifically organized for the same purpose.

6. The basic theoretical postulates regarding thinking must be consistently expressed in the theoretical postulates about teaching strategies. For example, if thought is considered an active process, heuristic questioning becomes an important element of teaching strategy. If the development of thought is considered to take place in a lawful sequence, teaching strategies must exemplify and implement such a sequence. If thinking in the classroom is regarded as a social process, then facilitating participation becomes part of teaching strategies.

7. Teaching strategies are compounded of two distinct modes, the generic and the unique. The generic could be described as the technique of teaching and the second as personal judgment, or the art of teaching. The major aspects of the generic or the technical can be described and models created for them. As such, in a way prescribed as models, they can be taught to teachers and planned in advance.

In contrast, the particular and unique aspects of teaching depend on judgment and cannot be prescribed or learned in the same way as generic technique is learned. They depend on personal judgments made in the light of feedback from students; therefore, they differ from one class to another and require a semi-intuitive and instantaneous evaluation of what students say or do. While the ability to listen to students and to evaluate what they say or do can be increased by training, the actual steps and techniques remain unpredictable and a matter of invention according to the students' responses to generic strategies. Thus, it is necessary to train teachers not just in pedagogical techniques but also in the rationale for these techniques, in learning theory, and in the capacity for diagnosis. For example, teachers need to understand the nature of the cognitive tasks and the sequences of data processing they involve,in order to invent questions and other strategies to fill in between the three generic questions.

8. No matter how narrow the specific target of teaching under study, it would be impossible to focus on it without considering a series of other functions simultaneously. The requirements of the logic of the task are not the only ones used to determine the total teaching strategy. Because teaching and learning occur in group situations, a host of managerial functions are needed. The teacher must do certain things to keep order in a discussion. He must keep a balance between disorder and control which is so great that it stifles expressions. He must not let the aggressive or the abler students absorb all of the social space or opportunities for self-expression but must watch for opportunities to enlarge student participation. In order to establish an effective climate in a classroom, the teacher must manage students' ego needs and be alert to the variety in the nature and degree of these needs.

CHAPTER IV

THE SETTING OF THE STUDY

Anterior to all questions of why, how, and on whom a program produced its effects is a question of understanding what it was that really produced the effects. The ingredients of the program should be made explicit. Otherwise, it may turn out that it was, in actuality, program B and not program A "that produced the effects." (Hyman, Wright and Hopkins, 1962, pp. 74 - 75).

The program which was the setting for the study described here had three main components, the combination of which was thought to produce optimal conditions for training students in the use of cognitive processes: 1. the curriculum; 2. the types of learning experiences provided, and 3. the teaching strategies for development of training teachers in the use of these strategies. Each was experimental in nature.

Without a theoretical understanding of the structure of the curriculum, its implementation tends to be mechanical and adaptations to the needs of a particular class group may be inconsistent with the basic aims of the program.

Two elements of the curriculum were examined: 1. the multiple objectives, and 2. the selection and organization of content. Each element was discussed by indicating the method of making decisions about it and by examing the role it plays in the total program.

The Curriculum: The Structure of Content

The social studies curriculum had several unique features. First, its content was based on a concept of the structure of knowledge which differentiated three levels of knowledge, each of which served a different function in instruction and learning: 1. the basic concepts; 2. the basic generalizations, and 3. specific samples of areas of content and specific descriptive information concerning these areas (Taba, 1962).

The basic concepts were seen essentially as high level abstractions expressed in verbal cues and labels, e.g., interdependence, cultural change and causality. These concepts encompass and organize large amounts of specific information and present models of relationships. For example, the concept of causality expresses a model of a certain type of relationship. It does not represent a continuity of events.

These basic concepts were also treated hierarchically in the sense that they represented ascending levels of abstraction, complexity and generality. It was understood that, being hierarchical, they could be learned only through exploring graduated concrete instances, each of which revealed a different aspect of the concept. Consequently, on each grade level return engagements were made to the same basic concept in a different context, at a different level of depth, abstraction and sophistication. In this sense, the basic concepts represented threads that ran through the curriculum on several grade levels. Some especially significant and abstract concepts merited return engagements throughout the entire span of the six-year program. This hierarchical treatment of concepts permitted a cumulative and longitudinal development, but the possibility was also open for different individuals in the same grade to be on a different rung of the conceptual ladder while being engaged with the same content.

Significant generalizations and principles - the main ideas - drawn from several social science disciplines represented the second level of knowledge. Along with the concepts, these generalizations represented durable knowledge, the "fundamentals" in any discipline,and therefore the basic knowledge to be learned by all students even though at different depths and levels of sophistication. These generalizations served several functions in planning curriculum and learning. Together with the basic concepts, they gave meaning to the descriptive facts. This meaning-giving is a necessary ingredient of productive learning because, according to many researchers and scientists, there are no "stubborn, irreducible facts" lying outside a context or a conceptual model (Turhayne, 1962).

The basic ideas also supplied the criteria of relevance for selecting specific content and learning experiences and thus helped to solve the problem of having to cover too much. These ideas determined how far to go into what, and thus delimited the coverage. Furthermore, by serving as centers of organizing the content, these main ideas determined which dimensions of topics to cover and how to interpret the descriptive facts. The most significant and powerful generalizations were those which were broad enough to provide the basis for integrating materials from several social science disciplines.

Finally, there were the specific facts and cases used to develop the basic ideas, to clarify them, to make the appropriate distinctions, to contrast and to compare. This specific information was sampled rather than covered. Since a variety of specific material could be equally well used to evolve the same general ideas and concepts, it was possible to sample different specifics according to differences in interests, abilities, and motivation patterns of students. In other words, a conscious effort was made to limit the coverage of specific content to a manageable amount in order to provide time for depth study and for learning the important cognitive skills.

To make this reduced sampling of specific content an effective tool for developing significant ideas, a special effort was made to select it in such a way that, for each idea, at least two contrasting examples of concrete content were available (Taba, 1962, Ch. 12).

Multiple Objectives

Another distinguishing feature of the curriculum was that it was addressed to achieving simultaneously multiple objectives, of which the basic knowledge of the three different levels described above was only one. Three other areas of behavioral or process objectives were stressed. The most important of these was development of thinking or the cognitive operations involved in information processing as described in Chapter III. This concept of cognitive operations was a necessary corollary to the concept of the nature of knowledge described above. A student cannot penetrate the structure of the subject without performing the intellectual operations which yield insights into basic concepts and without himself generating inferences and generalizations from the data.

Attitudes, feelings,and sensitivities always involved in social studies formed another area of objectives. This curriculum stressed extending sensitivity to cultural differences and to the dignity and worth of all people, and involved development of: 1. the capacity to identify with people in different cultures, preventing or overcoming stereotypes that hinder real understanding of, and respect for, other ways of life; 2. the self-security that permits one to be comfortable in differing with others; 3. the open-mindedness that examines the opinions and ways of other people with reasonable consideration and objectivity; 4. the acceptance of changes and the ability to adjust to new ways and events; 5. the tolerance of uncertainty and ambiguity without anxiety, and 6. responsiveness to democratic human values.

Academic skills constituted the third area. This included the ability to read and interpret maps, to construct time lines, and to use multiple references. Research skills were also emphasized, such as selective reading, asking relevant questions, organizing information around study questions, and developing reasonable hypotheses. Such skills as the ability to participate productively in discussions, to develop ideas through interaction with others, and to plan cooperatively, were among the group work skills that were stressed.

This differentiation of the four areas of objectives - knowledge, thinking, attitudes and skills - was necessary because it was assumed that each required a slightly different learning strategy and hence a different teaching strategy as well. There is a difference in the mental processes required to learn to think and those involved in learning facts. For example, one can learn the date of the discovery of America simply by being told and remembering it. To learn to make inferences from data takes long, active practice. The ways in which attitudes are acquired and changed differ from the ways that are appropriate for learning a skill. Attitudes and feelings are changed either by being exposed to, and examining, experience or by reading material that has an emotional impact (Taba, 1962, Ch. 14).

This emphasis on multiple objectives introduced new criteria for planning curriculum and instruction. It seemed necessary to develop not only the content outline but also a detailed sequence for the learning experiences in order that both the objectives of knowledge and the behavioral objectives could be implemented with proper attention to their scope, sequence and incremental development. In practice, this meant, for example, that thinking was treated not only as a direct target of certain types of teaching strategies but also that the basic cognitive skills were stressed in each new unit in an increasingly complex context and on an increasingly demanding level of performance.

Learning Experiences

Because it was assumed that the nature of learning experiences and their sequence played a crucial role in implementing all behavioral objectives, they were spelled out in much more detail than is customary and were organized in sequential order. Each learning experience was designed to serve a justifiable and identifiable function and to provide for multiple learning. This type of sequential specification of learning activities seemed necessary to assure that learning experiences adequate to implement all four types of objectives were available. Learning experiences were also organized sequentially so that each preceding one developed a basis for performance required in the subsequent one and each subsequent one built on a previous one. For example, the dual function of learning both the content and the ways of processing this content required that, as each student went through the curriculum, he would be able to deal with the new and more complex content and, at the same time, extend his capacity to think: to make finer distinctions and more adequate references, to produce more productive generalizations and hypotheses and to apply his knowledge to a greater range of new phenomena.

This continuity was especially important in developing thinking because it is not learned instantaneously. It takes time and gradual nurturing, beginning with simple operations upon fairly concrete and familiar content and ending with formal operations on abstract content.

In addition to the principles of curriculum organization, the emphasis on the dual nature of learning - the learning of content and the learning of such behaviors as thinking, attitudes and skills - required a new perspective on teaching strategies. Teaching strategies, in effect, had to combine the multiple requirements of multiple objectives into one cumulative stream of learning activities in which each specific learning experience performed more than one function and thereby served more than one objective. The major sequences of learning experiences were outlined in the guides because it was recognized that planning these multi-purpose sequences called for more time and more knowledge than an individual teacher could supply, especially while teaching. However, the specific implementation of the sequences remained for teachers to plan.

Other aspects of curriculum organization introduced other requirements for teaching strategies. The fact that specific content consisted of samples of contrasting instances of the idea or of the concept required a strategy of contrasting and comparing them by encouraging a systematic generalizing about similarities and differences among diverse sets of cases and events (See Taba and Hills, 1965, pp. 63-66).

In an effort to have the learning experiences become instrumental in creating autonomy in thinking, each was designed to activate students on behalf of their own learning. Each learning experience was also open-ended in that it permitted heterogeneity of responses and levels of activity according to students' ability, experience and background, allowing responses on different levels of abstraction, sophistication and depth. This same requirement of permitting heterogeneous responses would apply to teacher-prepared matters such as specific assignments and questions. The principle of active learning calls for heavy emphasis on question-asking instead of answer-giving.

For example, the strategies described in connection with the three cognitive tasks (see charts, Ch. III) consisted of asking a series of analytical questions, each designed to elicit a certain type of overt activity. These questions followed a sequence that was consistent with the developmental sequence of learning the skills involved in these tasks. The sequence of questions in the task of concept formation, for example, was as follows: first, "What did you see, remember, note?", to elicit a listing of facts noted or remembered; secondly, "Do you see some things that belong together?", to elicit the activity of grouping; third, "How would you call these items?" and "What goes under what?", to induce labeling and subsuming. The principle of sequential learning called for pacing these questions in a manner calculated to elicit the transformation of these modes of thinking at points at which the majority of students had mastered the previous processes.

The reverse was true of the strategy for developing a method of inquiry. Here, the students rather than the teachers were the questioners.

Finally, a variety of means of learning were employed varying from the use of multiple references to analysis, observation, interviewing, and analyzing stories.

Teacher Training

Teacher training to assure a competent implementation of the curriculum was needed for several reasons.

A group of twenty-four teachers was involved in the study. Of these, twelve were in charge of the experimental groups in which one experimental variable was trained teachers. Therefore, only these twelve teachers received specific training.

These teachers needed a thorough understanding of the rationale of the curriculum and a preparation for developing the teaching strategies required by this curriculum pattern. Since the development of thinking was the special object of study, it was also necessary to induct the teachers into specific strategies for the three cognitive tasks which served as a special focus of the study.

The training program, therefore, emphasized three major areas as follows:

1. The analysis of the rationale and the structure of the curriculum.
2. The nature and the function of learning experiences.
3. Teaching strategies for the development of the skills involved in the three cognitive tasks.

The Rationale and the Structure of the Curriculum. The purpose of the discussions of the rationale and the structure of the curriculum was to enable these teachers to use the curriculum guide with insight, to make the necessary adjustments in the specific content samples and learning experiences, and to create the necessary teaching strategies consistent with the chief intent of the curriculum. This included understanding the rationale for the fourfold classification of the objectives and the implications of this differentiation for conducting classroom learning experiences. Especially important was understanding the fact that these objectives represented a basis for selecting and organizing both the content and the learning experiences as well as their elaboration and development in the classroom. Development of a teacher's ability to see the psychological and logical connections between specific learning and teaching acts and objectives is often overlooked, with the result that introduction of new objectives does not materially alter teaching behavior. Of special importance was the understanding of the complexity of teaching strategies introduced by simultaneous pursuit of multiple objectives. While the very fact that these teachers had volunteered for this study implied that they probably did not accept the simplistic assumptions about teaching described in Chapter III, they did have many teaching habits which corresponded to those following from these assumptions and, of course, lacked many skills needed to implement the new rationale.

It was hoped, furthermore, that these teachers would become competent enough to invent, specifically, new strategies with which to pursue the cognitive tasks.

As far as organization of content was concerned, the chief purpose was to make clear how the three levels of content functioned in curriculum pattern and in instruction: what the roles of concepts, ideas, and specific information were and what treatment each required; how to sample specific information and use it so that it could serve as working material for the development of basic ideas; how to use both the concepts and the basic ideas as criteria for establishing the relevant dimensions to cover in each topic for selecting and interpreting the specific data.

Since the teachers in the experiment were expected to make adaptations in the specific implementation of the generic curriculum outline, they needed to understand what degree of freedom for adaptation and modification each of these levels of content afforded and how to go about making the appropriate alterations. The basic concepts offered the least freedom for modification by an individual teacher because they thread through the entire program. The adaptation of these concepts by an individual teacher is usually limited to manipulating at the level of abstraction at which they are learned.

In altering the basic ideas, greater freedom is possible because the basic ideas refer to grade level topics that are in the control of individual teachers. Each teacher can omit some, substitute others for those in the units or add new ones, provided they can marshal the specific data needed to develop them.

The specific facts and concrete content samples represent the most flexible and adaptable level of knowledge. Since a great variety of specific cases and information can be used to develop the same idea, teachers can, and should, substitute new content samples to meet the needs and motivation patterns of their particular students, provided that these substitutions are equally appropriate to developing the basic ideas, represent important contrasts, and can be studied in depth.

The fundamental point here regarding the nature of learning experiences was not only to understand that all learning experiences must serve identifiable functions and that nothing should happen in a classroom that could not be justified in terms of an objective, but also to acquire the skill of identifying these functions and relating the function to an appropriate teaching strategy. Without this skill and understanding, teachers could mismanage the learning experiences suggested in curriculum outlines. They are also in a poor position to develop specific teaching and learning strategies that could not be spelled out in curriculum guides because these strategies depend on the nature of student feedback and cannot be prescribed in advance.

Some practice was provided in identifying the functions described above and the ways of having a learning experience serve multiple objectives, such as combining the acquisition of information with the ways of processing that information, were especially explored. Special attention was also given to implementing the sequential nature of the development of thought in more specific ways than was suggested in curriculum outlines. For example, the teachers built question sequences for a discussion of a film or for a particular comparison.

Further, emphasis was needed on the necessity of rotating various activities: intake of new information; interpretation, reformulation, or application of information; activities designed for cognitive understanding; activities extending feelings and values; analysis; synthesis; inductive development of generalizations; and opportunities to apply generalizations.

This analysis of the general rationale for selecting and organizing learning experiences was followed by a closer study of the ways to adapt learning activities to the particular levels of maturity and ability of the students. Ways were worked out for setting multiple levels of expectations for such tasks as composing time lines, developing classification schemes, interpreting maps, and for arranging these experiences in ascending orders of precision and complexity according to the demands of the task and the amount of the students' previous experience. Special sessions were devoted to the strategy of conducting open-ended discussions and formulating open-ended analytical questions as set forth in Chapter III, Item 3.

Although the general principles involved in these strategies are not new, applying them concretely is often difficult. For example, in handling samples of content, the chief training problem was to counteract the prevailing concept of "coverage." Teachers habituated to covering descriptive information had to overcome guilt feelings about omitting certain portions of the content. The idea of sampling, in itself, is not too easy to grasp nor is it easy to develop the skill and insight needed for creating alternative samples of content when the ones in the curriculum outlines are inappropriate for one reason or another.

Integrating material from disciplines that were not part of the teachers' own backgrounds, such as anthropology, caused some difficulty. Although relatively little was done formally to provide that background, these teachers did a great deal of reading to familiarize themselves with it.

All of the above strategies require continual diagnosis - a method of inferring students' ability to think from what they write or say in discussions, a method of determining the amount of information they can cope with at any given time, a method of deciding what the bite-size steps are in pacing the learning of new skills, etc. Although this is difficult to do under any circumstances, instruction that is focused on multiple objectives makes the task even more difficult, for then diagnosis must be multiple also, involving diagnosis of the increments in the maturity of content, thought processes, skills, and attitudes.

Finally, these experimental teachers needed to learn new skills to extend the variety of means of learning, such as conducting open-ended discussions, guiding a socratic dialogue, helping students in interpreting original data, etc.

Training in Strategies for Cognitive Skills

Since cognitive performance was the central focus for the study and the independent variable in its design, special attention was given to elaborating the structure of the three cognitive tasks and to the teaching strategies appropriate for helping students cope with these tasks. Teachers were given a total of ten days' training. Five full days were spent in a workshop before school opened, and the balance was spent in half-day sessions through the year.

The work on each cognitive task proceeded in at least two or three steps. First came the analysis of the structure of the task which included the differentiation of the overt activities, of the covert mental processes, the generic questions for eliciting them, and the charting of the progressive generic steps in the learning process. This analysis was followed by a study of models of effective strategies, and of common errors in these strategies. Next, the teachers scored a sample tapescript of a class session, distinguishing the functions of teacher acts and the levels of thought expressed by students. Finally, each teacher examined his own tapescript. This procedure was designed to develop skill in devising appropriate sub-strategies according to the emerging student responses to the generic questions.

These training sessions also served to help teachers develop two sets of cognitive maps necessary to adequately conduct classroom discussions: one map of content, the other of the nature of thought processes. The cognitive map of the content of thought is necessary for guiding thought in relevant directions by, for instance, distinguishing significant from trivial or irrelevant inferences. Such a map is especially needed to guide the hypothesizing and predicting in Task 3 where questions such as "What would happen in a desert if it should have all the water it needed?" are discussed. Since this task stimulates a high degree of divergence and since these predictions and their support do not occur in an orderly sequence, it is difficult for the teacher to diagnose the meaning of a particular response or to distinguish random guessing from hypothesizing without a cognitive map of relevant dimensions of the problem. Since the central task is a double one - to protect creativity and autonomy of thinking simultaneously with the logic of the content - it taxes the teacher's sensitivity to the utmost. The adequacy of the teacher's cognitive map is especially critical when dealing with high levels of abstraction. Analyzing the cognitive maps of the thought processes helped also to differentiate what types of cognitive operations to expect of certain maturity levels. For example, since the styles for grouping and labeling vary according to maturity and age, a functional classification such as grouping peaches and ice-cream together because they are eaten together may be appropriate for a second-grader. A third-grader might be expected to group the same items by class categories, such as food. On a higher level of skill and maturity, students may be able to manage classifying by multiple bases.

The tasks and the strategies described above required acquiring a new curriculum rationale, acquiring a new perspective on teaching, and mastering new skills. Since it was impossible to accommodate all that in the total ten days of training, it was necessary to identify the crucial objectives of the training. Two criteria guided the selection: what was most fundamental, and what was most difficult to learn. For example, it took special emphasis to establish a clear relationship between the objectives and the content on one hand, and the learning experiences on the other.

Teachers who were used to "covering ground" had to be made to feel at ease omitting certain portions of content which were usually covered, and spending time on the slow build-up of mental operations that emphasis on thinking requires. Perhaps the greatest shift in ingrained habits was in the necessity of "waiting out the students" - waiting for them to come up with a generalization or a basis of categorization rather than supplying it when they hesitated. Teachers found it difficult to accept the slowness of the process of developing ideas inductively in comparison to expository teaching of the same ideas. A teacher who is anxious about the final product finds such preparatory activity as the listing of specific points, before launching into explanation and interpretation, a sheer waste of time because the content produced does not warrant the time and effort. At such points the temptation to supply what is needed - a generalization, a basis for grouping, or a condition for prediction - is great. As long as teachers' expectations are focused on the final "product" instead of the evolving processes, the pacing required to develop the appropriate skills inductively seems intolerably slow, if not unproductive.

Practice was also needed in avoiding channeling thought in the direction of a particular single end point. For example, teachers needed to be freed of the tendency to teach, when grouping and classifying, a particular classification that seems desirable to them and thereby teaching the scheme of classification rather than the processes of classifying. Further, the habit of seeking the "right" answers created a tendency to close the search when a few students came up with a "right" generalization without realizing that the rest of the class also needed to practice generalizing. In this connection, a special problem was to sensitize teachers to student use of verbal symbols that have no meaning for them, especially abstract terms such as "climate," "weather," "monopoly," and "middle class," without knowing what phenomena these terms describe or how they are related. Seemingly the brighter the students, the greater the danger that they use meaningless verbalism so convincingly that they fool a teacher into believing that their thinking is more advanced than it is.

A revision was needed also in the concept of the role that specific information plays in the development of thinking. The traditional emphasis on acquiring information leads to overvaluing it. Out of preference and long habit, teachers tend to elaborate descriptive information at the expense of processing data, an imbalance that gets in the way of acquiring cognitive skills. For such teachers, it is difficult to see that an over-elaboration of detailed information at certain points in instruction may actually be detrimental to thinking because its abundance tends to blur the relationships and block its proper processing. This eagerness to extend specific information is especially difficult to change because teachers are conditioned to considering themselves as conveyors of information and as answer-givers. They therefore cherish an abundance of information regardless of its relevance to the focal concern or its contribution to thought.

Training was needed, also, in ways of organizing a class for productive group work and in pacing the work of groups. These matters are crucial if the work of these groups is to eventuate, not in a series of reports, but in discussions in which material pertaining to the same question, such as agricultural technology, but secured from different sources, such as references on Argentina and on Bolivia, is to be compared.

There is no point in pretending that ten days of training is sufficient to master all these complexities. The chief purpose of these training sessions was to introduce teachers into ways of <u>learning to learn</u> from continued practice because these concepts and skills take both time and practice to become adequate. Because some of these teaching strategies require radical changes in ingrained personal dispositions and habits, and in the entire perspective on teaching, the full results of training could not be expected right after training was completed, but only a year or two later. However, it was evident that even ten days can make an immediate impact on the methods of teaching, provided that such training fulfills at least three conditions:

1. Gives a reasonable theoretical foundation for the strategy in terms that teachers can understand.

2. Provides models.

3. Gives opportunities to mobilize self-learning by providing feedback on their own attempts at these strategies.

CHAPTER V

THE OBJECTIVES AND DESIGN OF THE STUDY

This chapter will discuss the major objectives of the study, the general design, the ways in which the design of the study implemented these objectives, the chief hypotheses, the problems that attended this design, and some of the important assumptions connected with each of the above.

The Major Objectives

The central objective of the study was to examine the development of thinking processes under "optimal conditions defined as follows: 1) a curriculum designed to emphasize inductive development of basic ideas and to provide systematic opportunities to practice the skills involved in the three cognitive tasks described in Chapter III; 2) the use of teaching strategies explicitly focused on the mastery of cognitive skills; and 3) adequate time in training for the students to undergo a developmental sequence.

Another objective was to create instruments appropriate for studying the complex phenomena of thinking as they occur in the classroom and to examine the relationship of the teaching strategies used to the levels of thinking. This included the necessity for developing at least a tentative taxonomy of teaching strategies that would extend the taxonomies produced to date by studies of teaching, including the study that preceded this one (Taba, Levine and Elzey, 1964).

The Experimental Design

The theoretical postulates regarding the nature of thought and of teaching required a study design that permitted collection of data on the differential effects of each of the above factors. Consequently, the following experimental design was established to study the development of thinking:

Group E1 Experimental Group E1 was to be composed of students who had had one or more years of exposure to the Contra Costa County Social Studies Curriculum, and whose teachers received special training.

Group E2 Experimental Group E2 was composed of students who were newly introduced to the Contra Costa curriculum and whose teachers would receive special training during the study.

Group E3 Experimental Group E3 was composed of students who were newly introduced to the Contra Costa curriculum and whose teachers were not trained during the study.

Group C Control Group C was to be composed of students exposed to their usual social studies curriculum and whose teachers were not involved in training during the study.

It was hypothesized that groups with a greater length of exposure to the curriculum and with trained teachers would manifest higher levels of thought. It was further hypothesized that the combination of these conditions would produce higher levels of thought at an earlier age than has been found in developmental studies of children with no special training, and that this acceleration and increment in cognitive functioning would not be limited to students with high ability as measured by intelligence tests. These hypotheses were based on the assumption that systematic opportunities to develop and practice the necessary cognitive skills according to lawful sequences in educational experiences will accelerate the maturation of these skills as compared to maturation subject only to accumulation of accidental experiences with these processes and skills.

Specifically, these hypotheses were as follows:

Hypothesis 1: The predicted rank order of gains in interpreting data and making inferences from social studies data is as follows: $E1 > E2 > E3 > C$.

Hypothesis 2: The predicted rank order of gain in application of social studies principles is as follows: E1>E2>E3>C.

Hypothesis 3: The predicted rank order of the level of thought processes based on an analysis of classroom discussions is as follows: E1>E2>E3>C.

Hypothesis 4: There will be no difference among the change scores of the four groups on a usual social studies achievement (STEP) test.

The Sample

To create a sample, two classes each at the fourth, fifth, and sixth grade levels were selected for the one control and three experimental conditions, providing a total of twenty-four classes and 880 students.

The sample was limited to the upper elementary grades because the previous study revealed that the less mature students had difficulty in understanding and marking the paper and pencil tests used as criterion measures. The students were fairly evenly distributed by grade levels and experimental conditions. The study sample was drawn from twenty schools and seven school districts in the San Francisco Bay area.

The peculiar requirement of the study, i.e., studying the effects of trained teachers teaching an experimental curriculum, created special problems for composing the four groups required by the design of the study.

It was first necessary to select teachers for the E1 and E2 groups who had the following qualifications:

1. A principal who was willing to release the teacher for at least ten half-days to participate in training, and to provide data on his students' achievement, IQ, and socio-economic status.

2. Willingness on the part of the teachers to follow the curriculum guide and to make the adaptations necessary to accommodate the needs of their own class.

3. Willingness to attend a week-long workshop in August and ten half-day training sessions during the year.

4. Willingness to have four class discussions tape-recorded.

The teachers were contacted by the field coordinators of the project on the advice of their administrators and supervisors. Then, from among those willing to participate, teachers were selected who were interested in studying the rationale, and who seemed to have motivation to improve their teaching together with sufficient competence and flexibility to acquire new teaching strategies during a relatively short training period.

This selection procedure yielded a group of teachers who were heterogeneous in almost every respect - age, length of experience, amount of training, and content background. The group was highly motivated and energetic in developing new teaching strategies for the teaching of thinking.

Selection of the E1 group presented a special problem. At each grade level only a limited number of classes was available in which the majority of the students had been exposed to the Contra Costa County Social Studies Curriculum during the previous year. Therefore, the initial step in the selection of a sample was to obtain teachers and classes for the E1 group. Teachers had to be found who met the criteria and who would be teaching children with previous experience in this curriculum. Thus, the characteristics of the sample in this group determined the characteristics to be obtained in the samples of the other three groups. This manner of selection inevitably introduced certain imbalances in sample characteristics.

An additional difficulty in the composition of the E1 group appeared after the study had started. Because of the high mobility of students in California, it is difficult to promote classes intact. Despite promises to the contrary by the principals, the students who had had the Contra Costa curriculum were not promoted as a group to teachers selected for the E1 group. Thus, the pure E1 group did not materialize as planned. When the fall testing started, it developed that only two classes in the E1 group contained a majority of students in the second year of exposure to this curriculum. This reduced the total population of the E1 group to two fourth-grade partial classes, that is, to 44 students.

In general, certain problems attend the study of any phenomenon as complex as classroom learning. Because many variables are operating, it is difficult to control the various effects on the particular variables being studied. The direct approach to this problem is to control all relevant variables not directly involved in the program. This is clearly impossible in a study conducted in a naturalistic classroom setting.

Another approach is to randomize the influence of these factors. However, the necessity for matching the characteristics of the E1 group, combined with the fact that classes - rather than individual students - were the natural units of study, made it impossible to obtain a completely random sample. The only practical approach was to match the groups as well as possible on the basis of available measures.

To select comparable classes for the E2, E3, and C groups, the mean IQ and mean grade-placement scores on reading and language were obtained for each class in the E1 group. Then, from among those recommended for participation in the study, teachers whose classes were as similar as possible to the classes in the E1 group were selected. Although the match was not perfect, this method provided some degree of control for initial comparability of the classes. It was possible to obtain similar distributions on intelligence, achievement, and socio-economic status in each of the four groups, (E1, E2, E3 and C), but not necessarily in each class. Therefore, these groups are comparable with respect to the above variables but individual classes within groups are not. Some classes rated high in IQ and achievement, while others rated low. The number of classes with high mean achievement, intelligence, and socio-economic status exceeded the number of classes low in these characteristics.

In addition, teachers' styles and competencies varied so that there were differences in the effect of training: some teachers not only mastered the generic techniques well but invented additional ones, while others followed what they were taught.

An additional problem must be noted in the use of the control group. In any classroom experiment, the control group is presumably not exposed to experimental conditions, but is exposed to an undescribed curriculum and teaching strategies which presumably differ from those to which the experimental groups are exposed. Since the guides for the experimental curriculum and the description of teaching strategies were in the public domain and accessible to anyone who wanted to buy them, contamination was a special problem with the control group in this study. It is possible that the curriculum guides and some knowledge of the teaching strategies had been available to a couple of teachers in the control group.

The Criterion Measures

Two sets of instruments were available to secure data on certain fundamental aspects of thought processes and to accommodate the dynamics of complex thought as it occurs in the classroom. Both had been developed in the previous study and were revised for use in this study. There were two paper and pencil tests, the Social Studies Inference Test (SSIT) and the Application of Principles Test (APT). The other instrument was a system of coding verbal interaction in the classroom.

Paper and Pencil Tests. The two tests developed in the previous study, the Social Studies Inference Test (SSIT) and the Application of Principles Test (APT) (See Appendices A and B), were redeveloped for this study and were administered by a member of the research staff at the initiation and the conclusion of the one-year study period. These two tests were administered on separate days and within the same week. In order to remove the possibility of the teacher's knowledge of the test affecting his selection of social studies content, he was not present during the initial administration of these tests. Also, a standardized social studies achievement test (Sequential Test of Educational Progress: Social Studies, (STEP)) was administered by the teachers both at the initiation and at the conclusion of the study.

Since it was clearly impossible to construct several forms of the same test for the pre- and posttesting, interpretation of the results must include consideration of the effect that pretesting may have had on learning.

Recording and Analysis of Classroom Interaction. Analysis of classroom interaction was the chief source of data on the dynamics of thought and the relationship of teaching strategies to it. Four classroom discussions at different points in the school year, each of about an hour's length, were tape-recorded in each of the twenty-four classrooms. These discussions were focused on the three cognitive tasks: 1) concept formation, involving grouping and classification; 2) inferring and generalizing from data; and 3) application of principles. Limited time and finances precluded a pre- and posttaping of each task.

Because the curriculum outline projected a detailed sequence of learning experiences incorporating the cognitive tasks, it was possible to tape each discussion at a point when it came naturally in the sequence of learning experiences. The first discussion, (Cognitive Task 1), was taped during the very first class session devoted to social studies during the first week of the school year. The next two discussions, (Cognitive Task 2), was on interpreting a film, "Forgotten Village," which was shown to all classes in order to get from all of them one set of responses to a common content stimulus. The third discussion, (also Cognitive Task 2), was one in which the class compared and contrasted data which individual and committee research had produced and attempted to generalize from their findings. In the fourth and final discussion, (Cognitive Task 3), taped late in the school year, students applied previously learned knowledge to described hypothetical conditions in order to predict consequences. Thus the discussions were recorded over a span of one school year.

This necessity of recording the three cognitive tasks at different points in the year's curriculum sequence was disadvantageous in that the results from each task not only reflected task differences but also reflected increasing experience with the cognitive skills. For example, since the Task 1 discussion involving grouping and classification was recorded during the first social studies class, the teachers had barely been introduced to the technique of conducting such discussions, and the students were using skills and thought processes developed under other conditions. In contrast, the Task 3 discussion involving application of principles came at the end of the school year and presumably reflected experience gained during the entire year in handling these thought processes. Although it was thus impossible to secure comparative growth data on skills entailed in each cognitive task, the short duration of the study provided no other alternative. However, because each discussion was taped at the same point in the sequence of learning experiences for each class, it is possible to compare classes and groups of classes on the same discussion.

Interpretation of the results must consider the further fact that teachers were being trained at the same time that their techniques were being recorded. Thus, they were learning and practicing their skills as the study went on; (See the discussion of teacher training in Chapter IV). The ideal method would have been to train teachers during one year, and to give them time to internalize the skills by delaying recording a discussion until the following year.

A multi-dimensional coding scheme, based on the one in the preceding study, was used to analyze the transcribed classroom discussion. This new scheme, which will be set forth in Chapter VIII, was designed to:

1. Code teacher behavior in terms of its pedagogical functions visavis the development of cognitive processes of the students, describing both the individual acts and relevant patterns of acts or strategies;
2. Categorize students' responses in a matter that: a) described the nature of the cognitive operations; b) yielded a direct measure of the quality or level of these operations; and c) described the degree of the complexity and abstractness.
3. Assess the nature of the interaction between these.

While it is not easy to analyze the data produced by such a scheme on a precise quantitative basis, especially since the very model for such an analysis had to be created, a number of considerations had suggested the necessity for it.

It was our hypothesis that under the twin impact of curriculum and teaching strategies designed for an explicit emphasis on cognitive learning, students would master formal operations of thought at an earlier age than is suggested by studies conducted with untrained children. This focus set several criteria for the method of recording and of analyzing classroom interaction.

The concept of teaching and learning as a dynamic transaction between teachers and students required that the code permit an assessment of the impact of teaching acts on the nature of thinking expressed by students. It was therefore necessary that the coding scheme describe the teacher acts and the sequences and patterns of these acts in light of the pedagogical functions they served and, at the same time, permit an assessment of these functions in terms of their impact on student thinking. The theoretical ideas about the nature of the development of thought dictated still other criteria. For example, the concept of a cycle of assimilation and accommodation in thinking called for a scheme which expressed a difference between teacher acts which encourage extension of thought on the same level (assimilation) and those that call for transformation of thought from level to level (accommodation). The activity principle of the development of thinking required a differentiation between teaching acts that control and those that open up thought.

In order to assess growth, provisions were needed in the coding and the analysis of data for assessing levels of thought both within and across the three cognitive tasks. Since the cognitive tasks themselves represented an ascending hierarchy of complexity and difficulty, some means had to be found to describe the quality of thought across these tasks that reflected this hierarchy and reflected transitions from one level to another. In addition, each cognitive task involved certain unique processes and sequences, something like its own logic of operations and sequences, important enough to be reflected in the coding scheme. For this reason, it was decided to treat each cognitive task as a separate entity in coding and to deal with the problem of change across cognitive tasks by designing an appropriate method of analyzing the data. (See Chapter IX).

The concept of teaching as a set of complex strategies required that the coding scheme be able to reflect not only the frequencies of the types of teacher acts, but also their combinations, sequences, and patterns. Because it only measured the frequency of certain teacher acts, the code used in the previous study was not sufficient to describe the effect of teaching on thought development. It was evident that the timing and duration of these acts, as combined in a teaching strategy, was the chief determinant in the total effect on thought. (See Chapter X). The scheme needed refinement to yield data not only on the frequency of teaching acts, but also on the patterning of these acts. In order to assess the effect of the teaching, it seemed necessary to identify the modules or small cycles of strategies and then to describe the ways in which the teachers combined these modules. For instance, if a teacher summarizes inferences produced up to a certain point, and then seeks inferences on a higher level, the act has a different effect than does seeking higher level inferences without such a summary.

It seemed obvious that such a three-dimensional analysis would not permit a very refined differentiation within each category of coding, without making the coding task overly difficult. It was also possible that an overly large number of code distinctions would not permit generalized findings.

In the process of experimentation with, and revision of, the coding scheme, several categories of analysis were tried and discarded. Among these was an attempt to differentiate between different forms of expression, such as questions and statements, and an attempt to identify the nature of errors and fallacies of thought, such as appeal to authority, overcautiousness, irrelevance.

Because the study was designed to differentiate the comparative effects of several variables – the training of teachers, the curriculum, and the degree of experience students had with the curriculum under trained teachers – it was impossible to control all factors sufficiently. Also, since testing and training were contiguous, it seemed that the study would still retain an exploratory character and could not be viewed as an experimental study in the strict sense of that term.

The sensitivity and stability of the instruments is always a problem in studying complex phenomena of learning and change. The measurement of change requires instruments which are more sensitive than is necessary for the measurement of a static condition. All criterion measures (the Social Studies Inference Test, the Application of Principles Test, and the system of coding classroom interaction) had certain deficiencies in this respect.

Procedures for Securing Auxiliary Data

The data on chronological age, intelligence test scores, reading and language achievement test scores, and socio-economic status, were supplied by teachers in the fall of 1964.

Different tests of mental ability had been used in the participating schools. Among the intelligence tests were the following: Lorge-Thorndike Intelligence Test, Kuhlman-Anderson Intelligence Test, California Test of Mental Maturity, Henman-Nelson Tests of Mental Ability, Otis Group Intelligence Scale, and Wecksler Intelligence Scale for Children. Because it was not possible to administer additional mental ability tests, it was necessary to do all group matching on the basis of scores from these different instruments. An additional complication was that some of the tests had been administered at different times. Because students were matched on chronological age and mental age as well as IQ, it was necessary to extrapolate to obtain estimates of current mental ages, although the investigators were aware of the problems and errors that this method of extrapolation introduced. IQ was assumed to be constant; current chronological ages were obtained, and estimates of current mental age were obtained by applying the standard IQ equation for mental age.

The achievement tests used were: Stanford Achievement Tests, California Achievement Tests and Iowa Test of Basic Skills. Some of these scores were not current and raw scores were not available. Therefore it was necessary to use grade placement scores and extrapolate some of them to obtain estimates of current levels of performance. To do this, the interval (in months used to compute grade placements) between time of testing and time of matching was added to each student's score. For example, if a student's grade placement score was 4.8 and six months had elapsed since time of testing, his extrapolated score would be 5.4 (4.8 + 0.6 = 5.4).

To determine the socio-economic status, the nature of the job of the major wage earner in the family was used as the index. Information on these jobs was compiled by teachers from entry cards and supplemented, when necessary, by interviews with students. This information was then judged on the revised Warner scale,* a point rating scale developed in Chicago and grouped into three major class categories of social status for reporting as shown in Table 1 (1 - 2 = upper, 3 = middle, and 4 - 5 = lower).

The Characteristics of the Sample

Table 1 shows the initial data on which the experimental and control groups were matched. The number of students in each group is substantially larger than shown in later tables because of student attrition due to absences and transfers which occurred between initial and final testing. When interpreting the data in Table 1, one should bear in mind the problems in data collection and extrapolation previously described.

* Reported in Research Memorandum, Report No. 3, on the Chicago Tribune Sample Census. February, 1956.

For those reasons no tests of statistical significance were performed, and all matching was done by inspection.

Intelligence. - The groups themselves were very similar on the basis of average IQ, but classes within groups were divergent. The greatest difference occurred in group E3, where the mean IQ for the fifth grade was substantially higher than for the sixth grade. These classes were also substantially different from the fifth and sixth grade classes in other groups. The mean of the control group (C) was slightly lower than the means for other groups.

Reading and language achievement. - As would be expected, the mean scores on these two measures paralleled each other and, for practical purposes, they can be considered together. The mean score for the control group (C) was lower than for any of the experimental groups, which were similar to each other. As with intelligence, the fifth grade in group E3 had a higher mean score than the sixth grade.

Socio-economic status. - The highest proportion of students from high socio-economic families occurred in group E2. The lowest proportion of students from high socio-economic families occurred in the control group. The proportions of students from middle socio-economic families were about equal in all four groups. Even wider variations in socio-economic distribution were encountered between different classes. For example, only 2% of the students in the sixth grade, in group E3, came from high socio-economic families, but 74% of the students in the sixth grade of group E2 came from such families.

These data indicate the extent to which the groups, and especially classes within groups, differed on the variables shown in Table 1. However the group differences, except for socio-economic status, are not great enough to cause concern and the pattern of differences was the same for all variables.

Table 1

Means and Standard Deviations for Student Characteristics for the Four Groups by Grade Level

Group	Grade	N	CA X	CA SD	IQ X	IQ SD	READ* X	READ* SD	LANG** X	LANG** SD	SOCIO-ECON*** 1-2	SOCIO-ECON*** 3	SOCIO-ECON*** 4-5
E1	4	65	112.5	4.6	112.8	14.3	5.8	1.5	6.0	1.6	26%	20%	53%
	5	67	124.8	3.9	113.9	14.1	6.6	1.7	6.7	1.8	24%	27%	47%
	6	63	137.1	5.4	117.3	15.0	6.9	2.1	6.9	2.3	32%	26%	40%
	T	195	124.7	11.0	114.6	14.6	6.4	1.8	6.5	1.9	28%	25%	48%
E2	4	66	110.3	14.4	112.2	12.4	4.9	1.4	4.2	1.2	25%	30%	43%
	5	62	122.5	5.5	115.5	13.7	6.4	1.7	7.2	1.9	53%	25%	19%
	6	64	132.1	5.5	118.2	12.6	7.6	1.5	7.8	1.8	74%	18%	6%
	T	190	121.5	13.1	115.4	13.1	6.3	1.9	6.4	2.3	51%	25%	24%
E3	4	71	111.3	5.0	119.9	15.6	5.1	1.0	4.7	0.9	50%	18%	30%
	5	69	125.5	4.2	120.1	11.2	7.3	1.3	7.4	1.3	33%	34%	30%
	6	69	141.3	6.6	98.0	12.8	5.8	1.6	5.7	1.4	2%	18%	78%
	T	206	125.7	13.3	112.5	16.8	6.2	1.6	6.0	1.7	30%	24%	48%
C	4	69	112.8	5.2	112.2	13.0	4.2	1.2	4.2	1.2	18%	32%	48%
	5	62	125.0	5.0	103.1	19.1	4.7	1.6	4.9	1.6	6%	20%	72%
	6	61	136.1	5.4	107.6	15.1	6.4	1.4	7.0	1.5	20%	18%	60%
	T	189	124.0	10.9	107.8	16.3	5.0	1.7	5.3	1.9	15%	24%	60%

* Number of students at grade level.

** The reading and language grade placement scores were obtained as of the end of the preceding school year or for the beginning of the current year. Means and standard deviations represent achievement level in school years and months, e.g., 6.7 = 6 years and 7 months.

*** Socio-economic data is presented in percentage of students falling into each category, as determined by the revised Warner Scale. Category 1-2 indicates high, 3 middle, and 4-5 low socio-economic status.

All other data given in means and standard deviations.

Table 2 shows the initial data on the Social Studies Inference Test (SSIT), the Application of Principles Test (APT), and the Sequential Tests of Educational Progress: Social Studies, (STEP). Some of the group and class means were significantly different from each other. These differences are not enumerated separately because the final analyses to determine effects of the curriculum were performed by analysis of covariance. In the final analysis, each pretest score was used as the covariate for the corresponding posttest analysis. These will be discussed in a later section.

Table 2

Means and Standard Deviations for PreTest Scores on SSIT, APT, and STEP Tests

			SSIT										APT							STEP		
			I		D		C		OG		I + D			G		E		IR		Social Studies		
Group	Grade	N	$\overline{X}$	SD	$\overline{X}$	SD	$\overline{X}$	SD	$\overline{X}$	SD	$\overline{X}$	SD	N	$\overline{X}$	SD	$\overline{X}$	SD	$\overline{X}$	SD	N	$\overline{X}$	SD
E1	4	61	12.7	3.9	6.9	2.8	8.7	3.8	6.9	2.3	18.67	5.77	61	23.5	4.0	7.4	1.8	6.4	2.2	62	46.0	15.2
	5	63	13.0	3.6	7.7	2.4	9.9	3.6	5.6	2.5	20.75	4.90	62	25.1	4.8	7.1	2.2	5.8	2.0	64	63.4	19.0
	6	61	14.1	3.8	8.9	2.3	9.9	3.4	5.1	2.5	23.28	4.93	57	28.0	4.5	5.8	2.3	5.4	2.0	62	68.2	22.2
	T	185	13.2	3.8	7.9	2.6	9.5	3.6	5.9	2.6	20.90	5.54	180	25.5	4.8	6.8	2.2	5.9	2.1	188	59.2	21.3
E2	4	64	12.1	3.3	6.7	2.6	9.9	3.4	5.7	2.6	18.83	5.15	61	23.6	5.2	7.4	2.0	6.3	2.2	64	53.2	15.6
	5	59	15.4	3.7	8.6	2.4	8.6	3.7	5.2	2.5	23.97	5.17	59	29.7	8.3	7.1	9.2	6.2	8.6	57	72.4	20.7
	6	64	16.2	3.8	10.5	2.1	8.8	3.6	4.5	2.2	26.72	4.88	62	30.5	4.9	5.0	2.1	4.5	1.9	65	92.7	20.2
	T	187	14.6	4.0	8.6	2.9	9.1	3.6	5.1	2.5	23.15	6.05	182	27.9	7.0	6.5	5.6	5.7	5.2	186	72.9	25.0
E3	4	56	13.1	3.7	7.9	2.7	9.8	4.0	5.6	2.1	20.96	5.48	69	25.6	4.3	7.0	1.9	5.6	2.2	71	56.8	17.6
	5	68	13.6	3.2	8.8	2.2	9.7	4.3	5.5	2.2	22.44	4.35	67	27.9	4.5	5.9	2.2	5.7	1.9	69	74.9	22.7
	6	69	13.6	3.2	8.1	2.5	8.9	3.8	5.9	2.2	21.68	4.86	64	24.7	5.3	6.9	2.2	6.2	2.2	68	66.0	21.0
	T	193	13.5	3.4	8.3	2.4	9.4	4.1	5.7	2.2	21.74	4.92	200	26.1	4.9	6.6	2.2	5.8	2.1	208	65.8	21.8
C	4	66	11.2	3.8	6.4	2.4	11.5	4.5	5.9	2.1	17.59	5.11	66	22.6	3.5	7.4	2.5	7.2	1.9	67	48.7	13.3
	5	60	11.0	3.6	6.8	2.4	11.3	4.5	5.8	2.5	17.77	5.25	60	23.9	4.7	6.8	2.4	6.7	1.8	60	49.4	15.0
	6	61	13.1	3.6	7.8	2.2	10.8	3.9	5.2	1.9	20.79	5.10	62	26.8	4.7	6.3	2.1	5.7	1.8	64	69.9	22.8
	T	187	11.7	3.8	7.0	2.4	11.2	4.3	5.7	2.2	18.71	5.36	188	24.4	4.7	6.8	2.4	6.5	1.9	191	56.0	20.1

Note. - Abbreviations are as follows:
I = Inference. D = Discrimination. C = Caution. OG = OverGeneralization.
I + D = Sum of Inference + Discrimination. G = Generalization. E = Error. IR = Irrelevant.

CHAPTER VI

CRITERION TESTS OF THINKING PROCESSES *

This chapter presents the rationale, development, and properties of the Social Studies Inference Test (see Appendix A) and the Application of Principles Test (see Appendix B). These tests relate to two major objectives of the curriculum, the ability to interpret data and apply principles to new phenomena. Because of the limited manner in which responses can be obtained from young children in a group situation, it was necessary to construct both tests so that the students selected their responses from a list of predetermined alternatives. The tests of the hypotheses relevant to the SSIT, the APT, and the STEP Social Studies Test, are also reported in this chapter.

The Social Studies Inference Test

The Social Studies Inference Test, hereafter referred to as SSIT, is designed to measure several aspects of the processes involved in drawing inferences from data which are unfamiliar to the students. The test yields scores on the following:

1. The ability to discriminate between the various items given in the test problem;
2. The ability to draw inferences or "to go beyond that which is given;"
3. The ability to recognize the limits of the data and to refrain from overgeneralizing or, conversely, from being over-cautious; and
4. The tendency to make errors which represent contradictions to that provided or suggested by the data.

This test assesses the student's ability to interpret what is given in a situation and to make judgments regarding the validity of inferences from these data. The

* This chapter represents the work of Samuel Levine and Freeman F. Elzey.

student is presented with a story describing a situation in which certain behaviors or events are interrelated. Following the story, a number of alternative inferences are presented which vary in their degree of plausibility or the probability of occurrence. The inferences are the test items and are predicted on generalizations around which the situations are written. In effect, the descriptive stories contain information that permits the child to select "valid" inferences if he knows or understands the basic generalization of which the data are specific instances.

The SSIT provides an indirect test of the individual's ability to generalize. For example, having formed the generalization that occupations follow family lines in non-literate societies, the student should be able to make inferences about all males in a particular family or predict the occupation of unborn males of a particular family. Schematically, the model for the SSIT is as follows:

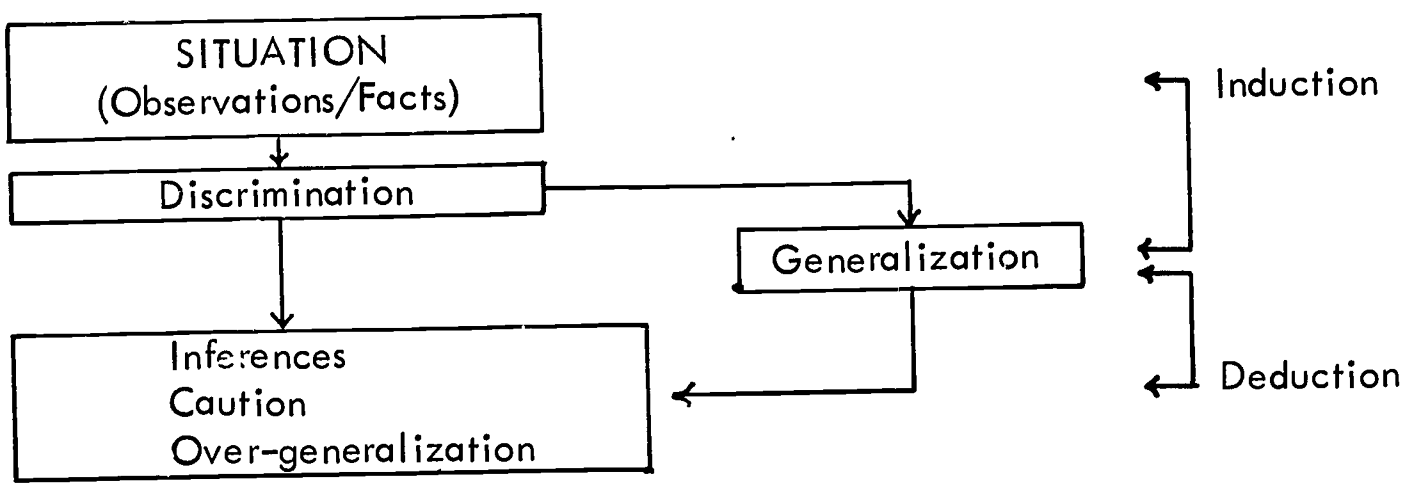


Figure 1 Model for Social Studies Inference Test (SSIT)

The Substantive Nature of The Test. The SSIT is designed to yield four scores: Discrimination (D), Inference (I), Caution (C), and Over-generalization (OG).* It consists of 13 situations with a total of 59 items: 15 Discrimination items, 17 Over-generalization items, and 27 items scored as either Inference or Caution, depending upon the response to the item. Furthermore, two of the Over-generalization items can also be scored as Caution, so the OG and C scores are not independent. The student responds to the items by indicating whether he believes a statement to be probably true, probably false, or that the data are equivocal and there is no way of determining whether the statement is likely to be true or false. Thus, the student has the choice of responding to each statement by marking it as Probably True, (PT) Probably False, (PF) or Can't Tell (CT).

In order to make a correct inference, the child must discriminate the particulars in a given situation and, by the process of abstraction, inductively arrive at the concepts and generalizations around which the situations are written. He must also be able to relate points from his previous knowledge and make appropriate comparisons either in the form of extrapolation or interpolation. Finally, he needs to make judgments about the limits of data.

Discrimination Score. The Discrimination items are designed to assess the student's ability to distinguish one event or object from another. In this test, discrimination includes the recognition of facts and ideas presented in a situation. This process is akin to distinguishing between relevant and irrelevant data, relevance always being determined within the context of a given situation. For example, the

* Some aspects of interpretation of data included in these tests are similar to those included in the Eight-Year Study and reported in Smith and Tyler (1942).

age of the child in a situation may or may not be relevant depending on whether age is related to concepts critical to making particular inferences. In a society where reading and writing are not stressed, the fact that the child is beyond "school age" has little bearing on concepts dealing with literacy. However, in a society where the individual's competence is primarily expressed in symbolic form, concepts dealing with literacy are central to judging competency. In such a society, the individual interpreting data will look for criteria relevant to literacy, age being one of these. Discrimination thus aids in the process of abstraction, the latter being critical to generalization. Once the individual has abstracted the essentials of the situation, he can then interrelate the conceprs so formed, and use them to arrive at generalizations.

It would be expected that individuals who are good data discriminators, in the sense just discussed, would be better at judging the plausibility of an inference than poor data discriminators. Further, the individual who is a good data discriminator would be less likely to be overcautious in making inferences than the poor data discriminator. That is, there would be a negative relationship between the Discrimination test scores and the Over-caution test scores.

Because the Discrimination items are designed to assess the child's ability to determine what is presented in the situation, his score for a particular item should indicate whether he can accurately assess what is given in the situation. These items are not measures of recall. They require some interpretation, although they are not classified as inferences. The Discrimination items restate what is given rather than go beyond what is given in the situation. The student responds to each item by choosing either <u>Probably True</u>, <u>Probably False</u>, or <u>Can't Tell</u>. For each item, only one of these choices is correct, the other two being considered as errors. The Discrimination score is the sum of correct responses for these items.

Inference Score. The Inference items are designed to measure the student's ability to make inferences from data, including the logical operations of interpolating, extrapolating, predicting, hypothesizing, and explaining. In interpreting data the student is required to make inferences with respect to:a) how he or another individual is likely to behave under given circumstances; b) whether an event will or will not occur; and c) whether an event is responsible for the occurrence of another event. For a given inference, only one of the alternatives Probably True, Probably False, or Can't Tell is correct. The Inference score is derived by summing the correct alternatives for inference items.

Caution Score. Where the nature of the data is such that the most plausible answer is either Probably True or Probably False and the subject selects Can't Tell, he is considered overcautious. The probabilistic nature of any inference permits the student to select Can't Tell. However, many of the items are of such a nature that an inference from the data can be defended either on deductive grounds or as a reasonable extrapolation from the data. Caution appears to be related to an individual's personalistic style of approaching data. It represents a tendency to avoid taking a risk. A student who can discriminate fairly well may be overcautious if he has learned this style or is afraid of going beyond that which is given.

Over-Generalization Score. The most prevelant types of generalizations in the social sciences are over-inclusion and stereotyping. Stereotyping is usually involved when people or some aspect of human behavior is the referrent. Vinacke(1949, p. 265)states that stereotyping occurs when there is "a tendency to attribute generalized and simplified characteristics to a group of people in the form of verbal label." McDonald (1959, p. 157) points out that "Stereotypes are developed because the individual does not think critically, does not observe, does not analyze." That is, the individual has formed concepts based on inadequate experience and, therefore, categorizes indiscriminately.

The individual who over-generalizes uses little empirical data and arrives at conclusions with minimal evidence. He may do so for two kinds of reasons: a) his prior sets tend to dominate the data; therefore, he would be a poor data discriminator; or b) he may be an individual who discriminates well, but has a set to go beyond the data.

Example of a Test Situation. An example of one situation in the SSIT, and the kind of test scores that are derived, is presented below:

> Pambo is twelve years old. There are no schools where Pambo lives. He does not read or write. He fishes with his father every day. Pambo is learning to cut bark from trees in order to make a canoe. His father teaches him many things and is proud of how well Pambo can do them.
>
> Tom is also twelve years old. He works hard at school and gets good grades. When he comes home from school he reads his books so that he will learn things that will help him.

The basic generalization around which the Pambo and Tom situation is written is: Many activities of primitive people are carried on through the family and/or tribe, whereas modern communities provide for these activities through organized institutions. From this, it is possible to make deductions about family structure, how learning occurs (actual versus vicarious experiences), and occupational choice.

Item 17. Tom is smarter than Pambo

This item is designed to determine whether the child will accept the over-generalization. If he indicates that the inference is probably true, it seems clear that he does not recognize that, in some cultures, reading and writing are not essential and hence not valued. The student has not formed an adequate concept of the diversity of cultural demand in regard to the kind of competence required. If the child over-generalizes about all cultures or societies having schools that stress reading and writing, he will also stereotype all people who cannot read and write as stupid. His thinking may be characterized as follows:

Premise: All children after a certain age go to school.

Premise: Smart people can read and write.

Premise: Most children who go to school learn to read and write.

Conclusion: If a child does not know how to read and write and is of school age, he must be stupid (intellectually dull).

Item 18. Pambo's father can read and write.

Considering the fact that there are no schools in this society and that his child cannot read and write, the most likely inference is that the father, too, cannot read and write. The manner in which the father pursues his occupation and the things he teaches his son could all point to this society as primitive. If the child selects Probably False, his response is accurate and he obtains one point on Inference; if he selects Can't Tell, his response is considered cautious and he obtains one point on Caution.

Item 22. Tom reads every day because he is behind in his school work.

This item contradicts the data which indicates that Tom gets good grades.

The item is a restatement of what is given in the situation and is therefore a discrimination item. If the child selects either Probably True or Can't Tell, his response is considered as an error. If he responds by marking Probably False, he is given one point on Discrimination.

Test Development Procedures. An earlier version of the SSIT was used in a previous study conducted by the principal investigator (Taba, Levine and Elzey, 1964). A summary of the item sampling and pretest procedures follows.

To develop the test items, a number of situations or stories were written around a sample of generalizations for each grade level from four through six. The situations and inferences (test items) were reviewed by subject matter supervisors of grade levels in which the generalizations were taught, as well as by members of the faculty of San Francisco State College who train teachers in social studies. This procedure aided in clarifying the stories, provided a check on vocabulary level and the adequacy of the story to elicit the required generalizations. Inferences were reviewed in order to determine the justification for scoring a response as either Inference, Discrimination, Caution, or Over-generalization. Inferences that could not be defended in terms of the rationale of the particular score to which it would contribute were eliminated. The situations and test items were then pre-tested both in group testing and in individual testing.

The situation was administered to a group of older subjects who had completed the grades to which the generalizations apply. This procedure was helpful in identifying ambiguous, irrelevant, and overly difficult items.

At various stages in the initial development of the test, individual children were asked to respond to the situations. They read the situations out loud and judged each inference as Probably True, Probably False, or Can't Tell. They were then asked to give a reason for the answer they selected. This entire procedure was tape recorded and provided a check on readability, vocabulary level, and whether children provided appropriate generalizations for explaining their choices. The children selected for this procedure were of both sexes and at various levels of intelligence. Test situations and items were re-written, deleted, or new ones added as suggested by the results of this procedure. Based upon an item analysis of the earlier version of the SSIT, new situations and items were written and pretested as indicated above.

Test Properties. This section reports the SSIT reliability and stability coefficients, the correlations between student characteristics and achievement and SSIT scores, and the intercorrelations between the various components of the SSIT.

Reliability. Table 3 reports the pre- and posttest odd-even correlation coefficients for the combined samples for each of the components of the present SSIT and the previous form of SSIT. The coefficients are moderately high and are of approximately the same magnitude for the pre- and posttest scores.

An effort was made to get more breadth in the situations included in the form of the SSIT used for this study than in the form used in the previous study. This effort led to a test that was less internally consistent than the previous form of the test.

Stability Coefficients. The stability coefficients between pre- and posttest scores for the SSIT are reported in Table 4. The time period between pre- and posttesting was approximately nine months. These coefficients are relatively low as compared with the STEP Social Studies Test for which the pre-post coefficient was .74. The correlations were of approximately the same magnitude for each component and each of the experimental and the control groups. The low stability coefficients

Table 3

Odd-Even Reliability Coefficients* for
Pre- and Posttest of Present SSIT and for
Previous SSIT

	Present SSIT		Previous SSIT
	Pretest (N=752)	Posttest (N=752)	Pretest (N=398)
I	.61	.68	.85
D	.58	.69	.72
OG	.45	.54	.73

* Pearson Product-moment correlations corrected by Spearman - Brown Prophecy Formula

might be explained on either of two grounds: 1) there was considerable shifting within the groups due to the influences of the curriculum; and 2) there was considerable shifting within the groups due to the relatively high error of measurement of the tests. The second explanation is the more likely because the reliability indices of each test were low and the means for pre- and posttesting were not significantly different from each other. The means and correlation coefficients showed as much shift for the control as for the experimental groups.

Relationship Between Student Characteristics and SSIT. The pre- and posttest correlations between initial scores on Chronological Age, (CA), Mental Age, (MA), Intelligence Quotient, (IQ), and Socio-Economic Status (S-E) are reported for each

Table 4

Pre- and Posttest Correlations
(Stability Coefficients) for SSIT for each study group

Group	N	I	D	G
E1	115	.38	.50	.34
E2	102	.51	.43	.43
E3	119	.39	.44	.33
C	96	.39	.29	.21

Note. - Abbreviations for scores are as follows:
I = Inference
D = Discrimination
OG = Overgeneralization

study group in Table 5. Because none of the correlations between these variables and change scores on SSIT differ from zero, they are not reported. However, the correlations with MA, IQ, and CA are reported for SSIT pretest scores because, in some groups, the IQ did not increase regularly with an increase in CA. Under these conditions, it is reasonable to expect that either CA or MA, but not both, will be more highly correlated with the criterion.

In general, the correlations between these variables and the SSIT are low, even though many are statistically significant from zero. The differences in magnitude of the pre- and posttest correlations with student characteristics are not statistically significant.

The relatively low correlations between CA and the components of SSIT were unexpected. It had been hypothesized that the ability to discriminate, to infer, and to generalize would increase with age, apart from increments due to the introduction of the Contra Costa County Social Studies Curriculum. This effect is probably due to the fact that, in some classes (particularly in the E3 group), the mental ages did not increase proportionately with chronological age. This suggests that the ability to use complex intellectual processes may not necessarily develop at later chronological ages without special training, regardless of relative mental ability.

Correlations between Achievement Tests and SSIT. The pre- and posttest correlations between the SSIT scores and reading, language, and the STEP Social Studies Test scores for each study group are reported in Table 6. The correlations for Inference and Discrimination of the SSIT are positive. However, the correlations between the achievement test scores and Over-generalization are negative. The correlations for Inference are somewhat lower than for the Discrimination component and are stable from pre- to posttest.

The correlations between the achievement test scores and change scores on the components of SSIT did not differ from zero. This probably can be explained by the fact that the amount of change for the groups included in the study was rather small. The same pattern occurred for (APT) test. Additional discussion of this effect can be found in the section on this test.

Intercorrelations Between SSIT Components for Pre- and Posttest Separately. The intercorrelations between the components of SSIT for the pre- and posttests are presented in Table 7. The intercorrelations at each of these time points were approximately of the same magnitude and in the predicted direction. That is, individuals who tend to be high on Discrimination also tend to be high on Inference and low on

Table 5

Correlations Between Student Characteristics And Pre- And Posttest Scores on SSIT[1]

		Pre Test				Post Test		
Group		N	I	D	OG	I	D	OG
CA	E1	115	.12	.15	-.25	.17	.09	-.05
	E2	102	.33	.40	-.02	.42	.48	-.06
	E3	119	.00	.02	.12	-.15	-.04	.09
	C	96	.16	.32	-.12	.32	.25	-.15
MA	E1	115	.29	.35	-.22	.25	.36	-.26
	E2	102	.30	.44	-.22	.39	.42	-.29
	E3	119	.26	.47	-.32	.23	.42	-.29
	C	96	.30	.43	-.01	.39	.39	-.22
IQ	E1	115	.26	.31	-.07	.18	.36	-.27
	E2	102	.24	.38	-.23	.30	.40	-.21
	E3	119	.21	.36	.34	.30	.37	-.30
	C	96	.22	.25	.10	.17	.25	-.13
S-E[2]	E1	115	-.16	-.17	-.03	-.06	-.14	.21
	E2	102	-.28	-.30	.13	-.33	-.34	.26
	E3	119	-.12	-.11	.33	-.26	-.21	.19
	C	96	.20	-.24	.04	.06	-.14	-.01

[1] Note. - Abbreviations for scores on the Social Studies Inference Test are as follows: I = Inference, D = Discrimination, OG = Overgeneralization.

[2] Lower Socio-Economic groups are assigned scores with higher numeric values.

Table 6

Correlations Between Achievement Tests
And SSIT
For Pre- And Posttest Scores

	Group	PreTest				PostTest		
		N	I	D	OG	I	D	OG
READ	E1	115	.37	.50	-.21	.26	.44	-.15
	E2	102	.42	.51	-.22	.43	.46	-.28
	E3	119	.26	.53	-.29	.24	.39	-.17
	C	96	.34	.50	-.08	.41	.44	-.19
LANG	E1	115	.28	.44	-.16	.21	.44	-.18
	E2	102	.57	.49	-.10	.42	.42	-.34
	E3	119	.15	.43	-.26	.11	.34	-.13
	C	96	.28	.46	-.04	.33	.45	-.24
STEP	E1	115	.37	.52	-.29	.30	.44	-.23
	E2	102	.49	.57	-.23	.46	.49	-.32
	E3	119	.28	.54	-.34	.26	.56	-.25
	C	96	.35	.43	-.03	.45	.54	-.20

Note. - Abbreviations for scores on Social Studies Inference Test are as follows:
I = Inference
D = Discrimination
OG = Overgeneralization

Overgeneralization. The difference between Discrimination and Overgeneralization is the most distinct because all these coefficients are negative, six are statistically significant beyond the .01 level, and two are significant beyond the .05 level.

In spite of low stability coefficients, the relationships between the components were not statistically different between pre- and posttesting.

Table 7

Intercorrelations Between the Components of SSIT
For Pre- And Posttest Scores

	Pre-SSIT				Post-SSIT		
Group	N	I-D	I-OG	D-OG	I-D	I-OG	D-OG
E1	115	.34	.18	-.23	.25	.13	-.27
E2	102	.50	.20	-.52	.55	.08	-.32
E3	119	.43	.05	-.32	.37	.21	-.30
C	96	.49	.31	-.32	.53	.02	-.19

Note. - Abbreviations for scores on Social Studies Inference Test are as follows:
I = Inference
D = Discrimination
OG = Overgeneralization

Application of Principles Test

In the Application of Principles Test, (APT), as in the SSIT, the student is given a situation in the form of a short paragraph which contains data relevant to social studies. These situations relate to the concepts and generalizations included in the curriculum for grade levels four, five, and six. If the student has learned these concepts and generalizations, he should be able to recognize which of them apply to the situation, even though the situation itself is new to him. Applying a generalization to a situation in this instance is tantamount to selecting the generalization which best explains the occurrences or event in the situation.

Substantive Nature of the Test. Operationally, after the situation is read to the student by the examiner, he is then read four generalizations. These generalizations have been written so that each situation has a correct generalization at a low order of abstraction or explanation, a correct generalization at a high order of abstraction, a correct generalization that is irrelevant to the situation and therefore not explanatory, and a relevant but incorrect generalization. The student is requested to select the two generalizations that he thinks best explains the events in the situation. He is asked to blacken the space on a Mark Sense card labeled "1st choice" for the best explanation and then blacken the space labeled "2nd choice" for the next best explanation.

The score obtained from the APT is a Generalization Score based on the number and order of correct generalizations selected. For each situation, the possible scores range from zero to three. Points are assigned as follows:

3 points: Selection of the high order correct generalization as 1st choice and selection of the low order correct generalization as 2nd choice

2 points: Selection of the low order correct generalization as 1st choice and selection of the high order correct generalization as 2nd choice, or selection of high order correct generalization as 1st choice and selection of either the incorrect or irrelevant generalization as 2nd choice

1 point: Selection of either the incorrect or irrelevant generalization as 1st choice and selection of either the low or high order correct generalization as 2nd choice, or selection of the low order correct generalization as 1st choice and selection

of either the incorrect or irrelevant generalization as 2nd choice

<u>No points:</u> Selection of the incorrect and/or irrelevant generalizations as the 1st and 2nd choices, regardless of order of selection.

The APT contains 7 situations and 8 items to which the child must make 16 responses. Based on the scoring scheme presented above, the range of possible scores is from 0 to 48 points.

<u>Example of a Test Situation</u>. An example of one situation in the APT and the basis for scoring the child's responses is presented below *:

Pambo And Tom

Pambo is twelve years old. There are no schools where Pambo loves. He does not read and write. He fishes with his father every day. Pambo is learning to make canoes from tree bark. His father teaches him many things and is proud of how well Pambo can do them.

Tom is also twelve years old. He works hard at school and gets good grades. When he comes home from school he reads his books so that he will learn things that will help him.

One day Pambo and his family moved to the city where Tom lives. Pambo and Tom became good friends.

5. Tom helps Pambo learn to read but Pambo does not teach Tom how to build canoes

A. because certain things that are important in some cultures are not important in others.

B. because people of modern cultures tend to teach the people of primitive cultures instead of learning from them.

C. because a newcomer to a culture has difficulty in learning the ways of that culture.

D. because people who come from primitive cultures are not as smart as people living in modern cultures.

* This particular situation is identical to the one included in the SSIT, except that in the APT Pambo moves to the city where Tom lives. It is this latter point that is used as the basis for leading into the generalizations. Not all of the APT situations were developed from SSIT situations.

In this example, response A is scored as the higher order generalization, response B is scored as the lower order generalization, response C is scored as an irrelevant generalization, and response D is scored as an incorrect generalization. That is, D is considered incorrect because "smartness" is determined within the context of specific cultural requirements. It would certainly be an overgeneralization to infer anything about the intelligence of people living in "modern" and "primitive" cultures from the data. C is irrelevant, not because it may lack intrinsic validity but because it does not adequately explain the relative status of Tom and Pambo. B is explanatory insofar as the immediate situation is concerned but is more restricted in its generality than A.

Test Development Procedures. In addition to the items having substantive characteristics specified previously, items were selected according to whether or not they differentiated between fourth and sixth graders on the pretest. This was done to insure that the test would show increases over time. Furthermore, only items that elicited a relatively high frequency of responses to all alternatives were chosen. Items that did not meet these criteria were either discarded or rewritten. The final form of the test was checked by six faculty members, each of whom made independent judgments as to whether an item alternative was a generalization of low or high order, irrelevant, or incorrect.

Test Properties. This section reports the APT reliability and stability coefficients and the correlations between student characteristics, achievement, and the APT Generalization Score.

Reliability. Table 8 reports the pre- and posttest odd-even reliability coefficients for the combined samples for the APT Generalization Score. These coefficients are moderately high and the increase from the pre- to posttest was not statistically significant. It may be that this increase was due to a test-retest effect. These coefficients are approximately of the same magnitude as those for the components of the SSIT.

Table 8

Odd-Even Reliability Coefficients* for the APT

Generalization Score

PreTest (N=716)	PostTest (N=727)
.60	.73

* Pearson Product-moment correlations corrected by Spearman-Brown Prophecy Formula.

Stability Coefficients. The stability coefficients reported in Table 9 are between the pre- and posttest APT Generalization Scores. The time period between the pre- and posttest was approximately nine months. These coefficients are relatively low. Although they are somewhat higher than for the components of the SSIT, the differences are not significant. The coefficients are of approximately the same magnitude for the experimental and the control groups.

Relationship Between Student Characteristics and APT. The pre- and posttest correlations between the APT pre- and posttest scores and CA, MA, IQ, and S-E status are reported for each group in Table 10. The differences in the magnitude of the pre- and posttest correlations with student characteristics are not statistically significant. The relationships between APT and CA, MA, IQ, and S-E status were very similar to those for SSIT. These were discussed earlier and the SSIT discussion is relevant for these data also.

The relatively low correlations with CA indicate that the test items were not as differentiating for these groups as had been the case in the field test prior to the initiation of the study.

Table 9

Pre- and PostTest Correlations (Stability Coefficients) for the APT Generalization Score for Each Study Group

	Generalization	
Group	N	r
E1	115	.50
E2	102	.54
E3	119	.43
C	96	.53

Correlations Between Achievement Tests and APT. The correlations between the APT and the initial scores on reading, language and the STEP Social Studies Test are reported in Table 11. The correlations between the achievement test scores and the pre- and posttest APT scores were not statistically significant. These correlations are of the magnitude usually found between achievement test scores and tests of mental ability.

The correlations between these achievement test scores and APT Generalization change scores did not differ from zero. Considering this and the fact that the mean pre- and posttest APT scores were not significantly different, it can be concluded that the few changes which did occur were probably random variations and not due to the effect of the curriculum. The differences in means are discussed in a later section.

Table 10

Correlations Between Student Characteristics And Pre- And PostTest Scores And The APT Generalization Score

	Group	N	PreTest	PostTest
CA	E1	115	.27	.12
	E2	102	.25	.29
	E3	119	-.26	-.09
	C	96	.28	.27
MA	E1	115	.46	.51
	E2	102	.45	.58
	E3	19	.53	.51
	C	96	.37	.58
IQ	E1	115	.36	.54
	E2	102	.36	.51
	E3	119	.58	.46
	C	96	.21	.45
S-E*	E1	115	-.18	-.35
	E2	102	-.32	-.33
	E3	119	-.40	-.19
	C	96	-.06	-.02

* Lower socio-economic groups are assigned scores with higher numeric values.

Table 11

Correlations Between Initial Reading, Language, And Social Studies Test Scores And The APT Generalization Score

Test	Group	N	PreTest	PostTest
Reading	E1	115	.50	.55
	E2	102	.48	.69
	E3	119	.62	.44
	C	96	.54	.66
Language	E1	115	.33	.50
	E2	102	.53	.65
	E3	119	.48	.33
	C	96	.59	.63
Social Studies	E1	115	.46	.56
	E2	102	.59	.69
	E3	119	.65	.50
	C	96	.56	.58

Relationship between SSIT and APT

The relationship between the revised SSIT and the APT is shown diagrammatically below. In both tests, a situation (interrelated events or observations) is presented to the child. In the revised tests, most situations are different for each of the tests. However, this need is not necessary. In the SSIT, the child evaluates the validity

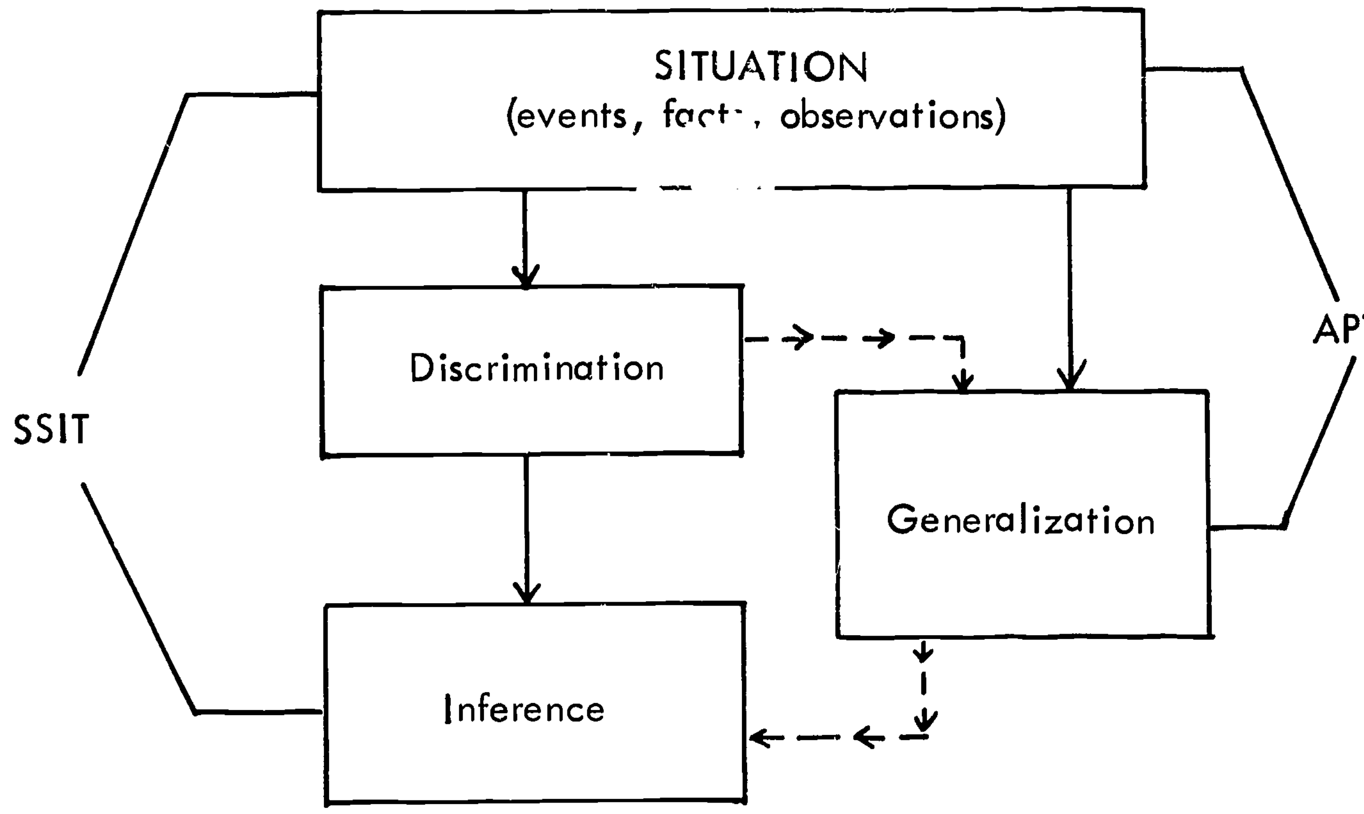


Figure 2 Conceptual Relationship between SSIT and APT

of discrimination and inference statements. It is presumed that the child will bring to bear some previously learned generalization in judging the inference type statements, hence the dotted line to the box labeled "generalization." In the APT the child selects the generalization(s) that best explain the occurrences in the situation.

It can be seen that the ability to recognize applicable generalizations is central to both tests. Based on the interrelations, as conceptualized for the purposes of test development, there should be a positive correlation among the three cognitive processes measured by the SSIT and the APT.

The intercorrelations between the scores of the SSIT and APT were as predicted. The Inference and the Discrimination scores were positively correlated with the Generalization score of APT. These correlations held for all of the study groups and for pre-pre as well as pre-post test correlations. The results are presented in Table 12.

Table 12

SSIT And APT Intertest Correlations

		Pre SSIT - Pre APT			Pre SSIT - Post APT			Pre APT - Post SSIT		
Group	N	I-G	D-G	OG-G	I-G	D-G	OG-G	I-G	D-G	OG-G
E1	115	.23	.33	-.22	.35	.39	-.28	.22	.28	-.14
E2	102	.43	.41	-.19	.47	.40	-.15	.36	.32	-.29
E3	119	.12	.42	-.38	.26	.51	-.15	.27	.34	-.23
C	96	.21	.29	-.10	.28	.35	.05	.25	.33	-.16

Note. - Abbreviations for scores on the Social Studies Inference Test and Application of Principles Test are as follows:

I = Inference (SSIT)
D = Discrimination (SSIT)
OG = Overgeneralization (SSIT)
G = Generalization (APT)

Hypothesis 1. The first hypothesis was: "The magnitude of changes in achievement on the Social Studies Inference Test will be in the following rank order: E1>E2>E3>C."

The SSIT was designed to assess the three aspects of cognitive functioning defined as Discrimination, Inference, and Overgeneralization. Statistical tests of the hypothesis were conducted for each subtest separately. The results of these analyses are shown in Tables 13 and 14 and are discussed in the following paragraphs.

Discrimination. The difference in Discrimination posttest means was statistically significant at the .05 level when pretest sco' ,s were used as a covariate. The rank order of means was E3>E1>E2>C, which was different from that predicted in the hypothesis. The difference in magnitude between the lowest mean (C) and the highest mean (E3) was less than one raw score point.

Inference. The difference in Inference posttest means was statistically significant at the .01 level when pretest scores were used as a covariate. The rank order of means was E3>E2>C>E1, which was different from that predicted in the hypothesis. The difference between the lowest mean (E1) and the highest mean (E3) was approximately one raw score point.

Table 13

Analysis of Covariance

	SSIT PostTest			APT PostTest	STEP PostTest
	Discrimination	Inference	Overgeneralization	Generalization	Social Studies
F	3.52	7.56	3.92	5.13	2.84
$d.f._b$	3	3	3	3	3
$d.f._w$	626	626	611	640	676
p	$<.05$	$<.01$	$<.01$	$<.01$	$<.05$

Overgeneralization. The difference in Overgeneralization posttest means was statistically significant at the .01 level when pretest scores were used as a covariate. The rank order of means was E3>E1>E2>C. This order was different from the hypothesized order but the same as the order for the Discrimination means. The difference between the lowest mean (C) and the highest mean (E3) was less than one raw score point.

Table 14

Adjusted PostTest Means

	Tests				
	SSIT			APT	STEP
Group	Discrimination	Inference	Overgeneralization	Generalization	Social Studies
E1	8.95	13.71	4.81	28.85	78.32
E2	8.71	14.39	4.68	30.54	79.38
E3	9.07	14.69	5.41	29.42	81.95
C	8.22	13.80	4.87	28.61	79.01

Hypothesis 2. The second hypothesis was: "The magnitude of the changes in achievement on the Application of Principles Test will be in the following order: E1>E2>E3>C."

Only one score, Generalization, was derived from the APT. The difference in means was statistically significant at the .01 level. The rank order of means was E2>E3>E1>C, which was different from that predicted in the hypothesis. The difference between the lowest mean (C) and the highest mean (E2) was approximately two raw score points. These results are presented in Tables 13 and 14.

Hypothesis 3. The third hypothesis was: "There will be no difference in the magnitude of the change scores among the four groups on the STEP Social Studies Test."

The difference in means was statistically significant at the .05 level. The rank order of means was E3>E2>C>E1. The difference between the lowest mean (E1) and the highest mean (E3) was approximately four raw score points. These results are presented in Tables 13 and 14.

Discussion of Tests of Hypotheses. The predicted order of mean scores was not found in any of the analyses. The means for the experimental groups were higher than that of the control group on Discrimination, Overgeneralization, and Generalization. The mean Inference score for the control group (C) was higher than that for the E1 group. The largest difference in any comparison was approximately two raw score points. Even though these small differences were statistically significant, they are not educationally significant. A mean difference of two or less raw score points on a short test designed to measure specific intellectual processes probably does not indicate that differential learning occurred between the several groups. Furthermore, because the tests had low indexes of reliability, one would expect to find differences from pre- to posttesting and from group to group. Even though analysis of covariance was used to correct for pretest differences, it does not correct for internal unreliability of the measures themselves.

The largest mean difference in STEP scores was only about four raw score points. This result, although statistically significant, is not educationally significant. It follows therefore that effective social studies content achievement as measured by the STEP Social Studies Test was not different between groups. This indicates that at least as much information processing occurs in the Contra Costa County Social Studies Curriculum as in a traditional curriculum structure. It should be noted here that the original hypothesis concerning relationships between STEP scores was that the scores would be approximately ($\approx$) equal.

CHAPTER VII

EXPERIMENTATION WITH THE NON-WRITTEN TESTING DEVICE: APPLICATION OF THE EDEX TEACHING SYSTEM AS A TESTING DEVICE*

Because the paper-and-pencil tests of thinking involved too many reading difficulties to be valid, an Edex Teaching ** system was purchased. With this system, it is possible to present stimulus material in visual and/or spoken form so that it is not necessary to rely on students' reading ability. The equipment is especially suitable for the following purposes:

1. For presenting the test situations and obtaining student reactions in non-written form.
2. For obtaining samples of students' thinking (in conjunction with group interview techniques) as a source of item alternatives and structures for test development.
3. For exploring of students' thinking processes through recording of continuing feedback on their reactions during the presentation of stimulus material.

This exploration was undertaken for several purposes: first, to determine whether it is possible to present the complex pencil-and-paper tests on making inferences and applying principles in social sciences in a slightly modified form by auditory and visual means; second, to provide preliminary data towards testing

* This chapter represents the work of E. I. Sawin.

** The Edex equipment used in the study included the following components: (1) tape recorder unit for voice commentary and control signals for activation of projection equipment, (2) a programming unit for preparing the tapes that control the operation of the projectors and the printer, (3) forty individual student response stations (each with four select-buttons A, B, C, and D, (4) meters to indicate the proportion of students responding A, B, C, or D, (5) a counter for each of the forty response stations which shows a cumulative score on each student, and (6) a printer for recording the responses of a maximum of 20 students each time the printer is activated.

thinking of primary students and of students with reading difficulties; third, since the designs used represent only two of the possible formats, an additional purpose was to ascertain the suitability of these formats for the primary grades.

Two programs were designed, based on the two instruments developed for the current study, one using an exercise from the Social Studies Inference Test and the other a series of exercises from the Application of Principles Test. (See Ch. VI and Appendices A and B).

The Program for the Social Studies Inference Test : "Tom and Pambo" Exercise

The first program presented cumulative pieces of information to the students. Two questions were implicit in the design of the program: 1. Will the student be able to make the appropriate inference after sufficient information is provided? 2. If so, at what point does he consider the information sufficient?

In each of the ten segments in the program, new information was added to that which the student had previously received. Each segment also contained a stated inference, "Tom is smarter than Pambo," to which the student responded with Probably true, Probably false, or Can't tell.* Reviews of previously given information were presented periodically in the program in order to make it unnecessary for the student to rely on his ability to memorize the items of information.

The ten items, in the order of their presentation, are as follows:

1. This is a story about two boys. Both are twelve years old. One is named Tom. The other is named Pambo.
2. Tom and Pambo wear different kinds of clothes.
3. Tom lives in a city in the United States. Pambo lives in a jungle in South America.

* A complete transcript of the voice commentary of the program is provided in Appendix C . This includes the directions for working the response buttons.

4. Tom goes to school every day. Pambo goes fishing with his father every day.

5. Tom knows how to read. Pambo does not know how to read.

6. After school, Tom does his homework. After fishing, Pambo helps his father build canoes.

7. For most jobs where Tom lives, people have to know how to read and write. For most jobs where Pambo lives, people have to know how to fish and build canoes.

8. Tom is usually behind in his schoolwork. Pambo has built the best canoe of any of the boys where he lives.

9. Tom needs a great deal of help on his schoolwork from his teacher. Pambo helps some of the other boys who have trouble learning to build canoes.

10. The teacher told Tom's mother that he was a poor student. The chief told Pambo's father that Pambo would someday become a leader of the tribe.

After each of the above items of information, the student was asked to press the A button if he thought the statement, "Tom is smarter than Pambo," was Probably true; the B button, if he thought it was Probably false, and the C button if he thought the best answer was Can't tell. The printer component recorded each student's response.

The program was applied without interruption to groups of students varying in size from approximately ten - thirty. Since the printer is limited to a maximum of twenty response stations, in groups over twenty a few students' responses could not be recorded. In those instances, extra students were randomly assigned "dummy" response stations that were not connected to the Edex console. Students were not told that any stations were "dummies" nor did the researcher know which students had them.

After the program had been presented and a printed record of each response obtained, a discussion was held with the students on the reasons for their responses. A method of stimulated recall, re-presenting the slides, was employed. Students were asked after each slide if they could remember how they responded at that point and if they could remember the reasons they used for deciding on their answers. Each possible answer regarding each item of information was discussed, one at a time, with each group.

For example, after the first item , which names the boys Tom and Pambo and gives their ages as twelve, the students were asked, "How many answered A,(Probably true) to the statement, 'Tom is smarter than Pambo' ?" Those who did were asked to give the reasons for their answers. The same procedure was used for answer B (Probably false). In the case of C (Can't tell), the students were also often asked what additional information they would need in order to give another answer. The discussion of reasons, which was tape-recorded, took approximately 30 - 40 minutes for each group.

In a group discussion of this sort, some of the reasons given may have been influenced by what other students had said previously. An attempt was made, therefore, to minimize this type of distortion by urging students to give their own reasons, regardless of what others had said. Partial success is indicated by the fact that the answers given were quite divergent, and sometimes conflicting.

The Sample

The total sample consisted of 69 students from schools in the San Francisco Bay area. Twenty-eight were third graders who had received instruction based on the curriculum used in this study. The balance were fifth graders who had not been taught according to the curriculum. Because of administrative difficulties, no attempt was made to obtain a random sample. (Unfortunately, for one group, the data on reasons for answers was lost because the tape recorder failed).

Analysis of Results

Scoring. One part of the analysis was to apply a scoring scheme to provide a basis for item analysis. The scoring was in terms of total number of correct responses. The correct answer for the first seven items was assumed to be Can't tell and for the last three, Probably false.

The mean score for all groups combined was 4.33, and the standard deviation was 1.67. Since the response to each item was based on all of the information presented for previous items as well as on the new information, determination of the reliability of the scores was problematical. The split-half method seemed the best one available. The computed value of the odd-even split-half reliability was .519 after application of the Spearman-Brown correction.

Item Analysis. An item analysis was made of the ten items using scores indicating total number correct as the criterion. The group was divided into high, middle, and low thirds according to the scores. Difficulty level was determined by the proportions of students answering each item correctly. A discrimination index was obtained by subtracting the number of students in the low group answering the item correctly from the number of students in the high group answering it correctly, then dividing by the number of students in the high group. Totals were obtained for the number of A, B, C and Omit responses on each item. The results of the item analysis are shown in Table 15.

Table 15

Item Analysis Results
(N=69)

Item Number	Responses				Discrimination Index
	A Probably true	B Probably false	C Can't tell	Omit	
	%	%	%	%	
1	3	0	97*	0	.09
2	14	10	71*	4	.39
3	45	10	43*	1	.17
4	72	10	14*	3	.30
5	61	12	22*	6	.30
6	72	6	17*	4	.26
7	35	10	35*	20	.61
8	12	38*	43	7	.61
9	10	42*	36	12	.57
10	14	54*	29	3	.39

* Correct response used in computing scores

One especially interesting result shown in Table 15 is that the Probably true choice was a very powerful distractor in Items 3 - 7, for which the keyed response is C, Can't tell. The most plausible explanation for this trend is that many students consider people in the United States to be generally smarter than people who live in jungles. Strong support for this interpretation was also found in the reasons given by students for their answers.

Table 15 shows that, except for Items 1 and 2, the items were rather difficult. The fact that the percentage of students correctly answering Items 4, 5, and 6 was below chance expectation (33%) indicates that wrong responses probably were based on misinformation rather than on guesses.

It is also of interest to note that, except for Items 1 and 3, the discrimination indices are high and all are positive. This means that there is a rather high degree of agreement between individual items and the total score, when number correct is the basis for scoring.

Analysis by Patterns of Response. While the above scores indicate the extent of agreement of each student's responses with the correct responses, very few students used response patterns closely following that of the correct responses. No student received a perfect score, and only two students scored eight out of ten.

However, the correct response sequence represents only one possible pattern of responding. It was believed, therefore, that merely analyzing the responses in terms of agreement with the correct responses might result in masking some of the more important aspects of student response patterns. Because many other response patterns are possible, it was necessary to know how many recognizably different response patterns there were and which pattern was used most frequently.

A crude form of pattern analysis was used to identify clusters of students with very similar response patterns. The first step in the application of this technique was to obtain 69 scores for each student by using each student's response pattern as a scoring key. The result was a 69x69 matrix which indicated the number of identical responses for all possible pairs of students. For example, the entry in row 15, column 20, was a score which revealed the number of items for which student No. 15 and student No. 20 gave identical responses. By counting the number of high scores in the various columns, it was possible to determine the extent of agreement in the response patterns of all students. The process of identifying clusters of students was similar to that typically used in analyzing student preferences in preparing a sociogram. The results of this analysis are shown in Appendix F .

The most common pattern of responses was a Can't tell answer for Items 1 and 2, followed by Probably true answers for Items 3 - 7, followed by Probably false responses to Items 8 - 10. (All A (Probably true) responses in the pattern are incorrect). The dominance of this pattern indicates once again that some students have misconceptions about the mental capacities of people in jungle societies as compared to those in the United States. It is encouraging to note, however, that even though many students using this pattern had initially chosen a Probably true response, they were able to switch over to a Probably false response starting with Item 8, when information was supplied about Tom's not doing well in school.

Another pattern was characterized by overcaution. Students gave Can't tell responses at the beginning of the program followed by one or two Probably true responses with a return to Can't tell for the remaining items. The responses of 18 students did not appear to fit any of the patterns shown by other students. A complete listing of all student responses, grouped according to pattern, is provided in Appendix F.

Content Analysis of Reasons for Responses. Groups of students were asked to give the reasons for their selection of each response to every item. The interviews were tape recorded and a content analysis of the responses was later made. The following paragraphs contain an abstract of this analysis based on a division of the Edex program into: 1. the first seven items, and 2. the last three items.

This division of responses corresponds to the pattern used in the scoring key, i.e., C, Can't tell for the first seven items and B, Probably false for the last three items. The first seven items represent stages when sufficient information for making valid inferences regarding the mental ability of Tom and Pambo was not available, while the last three items represent stages when it was. Both sections contain only representative samples of the student responses.

Items One Through Seven. Reasons for Probably true response to first seven items. These responses indicated that the students formed their conclusions before adequate information was available:

> Pambo is such a strange sounding name for an American, so I thought he would be born in another country, and Tom might be smarter.
>
> Because Pambo lived in the jungle. They don't have many good schools there, or good teachers.
>
> Pambo just learns how to fish and build canoes. Tom learns reading and arithmetic, so he is smarter.
>
> When you fish and things like that, you don't get much education like when you go to school.
>
> Pambo did not learn to read, had no education, so could not get a job - could only get a job making canoes.
>
> If you can read, you can learn about people in other lands. If you can't read, you can only learn about what is around you.
>
> Pambo is just building. Tom goes to school.
>
> Fishing was just for food. They don't have to worry about a job.
>
> They don't have to worry about taxes or bills or anything. They can live on fish and plants.

People in the United States are smarter than people in jungles.

Tom learns more things. Pambo learns only two things - how to fish and build canoes.

Reasons for Probably false response to first seven items. These responses also indicated that the students formed their conclusions before adequate information was available:

Couldn't tell what kind of clothes they wore.

They probably have some kind of sign language to learn in the jungle.

If Pambo did a good job of building the canoes, he was pretty smart.

Maybe Tom could read, but it didn't say how he could spell.

The responses in this category are generally illogical and suggest that some students did not really grasp the meaning of the problem. Only 8% of the students chose Probably false at this point. The third example in this list is of particular interest. It suggests that the students who gave it may have grasped the basic logic of the problem, but responded prematurely because actual information about Pambo's skill in canoe building had not yet been presented.

Reasons for Can't tell response to first seven items. These responses indicated that the students perceived that inadequate information was available on which to form a conclusion:

It only says there are two twelve year old boys. That is not enough.

You need to know if Tom went to school and if Pambo went to school.

Need to know if Pambo learned anything by way of work.

Pambo could have gotten his name by being born in another country, then moved here and become smart.

The name does not tell much.

Have to know more about the clothes.

Can't tell how smart by kind of clothes.

You could wear just a bath towel, but that wouldn't make you dumb.

Need to know where they lived. Maybe they do smarter things in some countries than in other countries.

Tom went to school, but Pambo could learn things in the jungle that Tom couldn't.

People in the jungle just live in their natural way. You can't tell how smart they are by the way they live.

You can learn just as much in the jungle as in the city.

If you go fishing, you kind of learn because you learn about nature.

Each would need to know the kinds of things they have where they live.

If Pambo came to America, he could learn - he'd get smarter than Tom.

If they changed places, Tom would learn their ways and Pambo would learn ours. It would be about even.

It didn't say if Pambo could read or not.

It doesn't say how well Tom is doing. He might be getting F's. It doesn't say how good Pambo is at fishing and building canoes.

Pambo would have to learn how to build canoes. Tom would have to learn things too, but maybe Pambo's things would be harder.

Pambo is smarter where he lives. Tom is smarter where he lives.

In some ways it would be the same, because they would both have to learn something.

Items Eight Through Ten. Reasons for Probably true response to last three items:

Tom knows how to read and write and can get a better job. Pambo can only make canoes and can't get as good a job

Tom knows how to read and write, but probably only a little at a time if he needs help from his teacher. Pambo just helps other boys who are learning how to make canoes. Boys who are learning how to make canoes probably earn enough to make a good living. Tom can't because he is still learning - but little by little.

Tom still knows how to read. Pambo would just lead his people. While he is doing that, Tom could be earning money for his family.

Reasons for Probably false response to last three items:

Pambo would catch on to new things quickly if he came to the United States. Tom would not catch on so quickly in South America.

Pambo was real good at canoes. Tom was dumb in his country.

If Tom was behind in his schoolwork and Pambo built the best canoe, it probably means Pambo is smarter than Tom.

Tom is behind in his schoolwork. Pambo helps the boys. Tom can't because he's behind.

First Tom was a little bit smarter than Pambo, but now Pambo knows how to make canoes and Tom is back in his work.

Pambo was like a teacher to some of the kids.

Because Tom needs help, Pambo doesn't. He helps others. He's probably smarter where he lives.

If Pambo is to become a leader of the tribe, that's like a teacher.

Tom should have been a better student than what his teacher told his mother.

Tom was a poor student, and if you are going to be a leader of the tribe you have to be smart.

Reasons for Can't tell response to last three items:

Pambo did well, but Tom had to learn harder stuff.

Tom might be behind in his schoolwork, but Pambo just builds canoes. In a way Tom is smarter. At least he knows a little history, language, arithmetic, etc.

If Tom went to South America, he wouldn't need as much help. He'd already know how to fish.

The content analysis showed no consistent differences between the reasons given by third graders and those given by fifth graders. This may be because the number of observations recorded in each group was too small to reveal differences.

A combined analysis of the A, B, C responses and the reasons given for the responses reveal a clear problem regarding how some students defined the word "smarter." For many students, smartness appears to mean the extent of one's knowledge or education. In several cases this concept of smartness was linked to the ability to get a good job. The other definition used extensively by students was the same one used by makers of the program, i.e., that smartness pertains to the rapidity with which a person can learn. This definition also included the difficulty level of the things a person is able to learn. The same problem of definition involving the word "smarter" probably exists in connection with Item 17 (Section 2) of the Social Studies Inference Test.

It is apparent that many students failed to respond correctly, not because they were unable to make the correct inference, but because they were using a definition of the word "smarter" other than that of the persons who prepared the program. One way in which this problem might be corrected is to provide additional items at the beginning of the program which present the desired definition to the students. The students would then be tested on their understanding of this concept before the remainder of the program was presented.

This type of content analysis provides concrete illustrations of the way children respond to certain stimulus material, and is an excellent source of possible choices to be included in extensions of the present program. While the students' reasons represent a source of ideas for alternatives to use in further refinement of the Social Studies

Inference Test, some of them may also suggest formats for items in other tests.

The Program on the Application of Principles Test

The Purposes of the Program. Another Edex program was prepared in order to: 1. obtain samples of children's thinking in response to the stimulus material presented in the present version of the Application of Principles Test which could then suggest item alternatives and models for additional items; 2. obtain information relevant to delineating the intellectual processes measured by the Application of Principles Test.

The Nature of the Program. (A complete copy of the voice commentary of the second program is provided in Appendix D). The program began with a practice exercise, following which a situation description from the Application of Principles Test was presented. Three questions were presented on each situation description, designed to elicit the kinds of responses represented by item alternatives of the Application of Principles Test. That is, the questions were phrased so that the reasons children would be likely to supply in the group interviews would be similar to the item alternatives on the written test. The situation descriptions and the questions for each were as follows:

> It was recess time. It was Billy's turn, so the teacher let him take the ball to the playground. The class had only one ball to play with that day. After Billy played with the ball for a while, some of the other children asked if they could play with it, but Billy did not want to give it up.
>
> 1. (Practice item). Do you think Billy did the right thing?
>   A. (No). Billy should have let the other children use the ball.
>   B. (Yes). Billy was right in keeping the ball for himself.
>   C. (Can't tell). Need to know more about it.
>
> Farmer Jim lived a long time ago. He raised food for his family, chopped trees to build his own farmhouse, and had his own horse to pull his plow. He

rode his horse to town once a month to get supplies.

Farmer Tom, who has a farm today, hired carpenters to build his farmhouse. He has a machine to cut wheat which he sells to other people who make flour. He owns a truck which he drives to town every week.

2. Did Farmer Jim's neighbors build their own houses, too?
   A. Yes.
   B. No.
   C. Can't tell. Need to know more about it.

3. Which farmer went to town more often?
   A. Farmer Jim, who lived long ago.
   B. Farmer Tom, who has a farm today.
   C. Can't tell. Need to know more about it.

4. Who did more of the repair work himself on the farm machinery?
   A. Farmer Jim, who lived long ago.
   B. Farmer Tom, who has a farm today.
   C. Can't tell. Need to know more about it.

This story is about Mr. Jones. Mr. Jones and his family had always lived in a small town in the United States. Mr. Jones was a very good blacksmith and he made the best horseshoes in town. When the automobile was invented, there were not as many people riding horses as there used to be. Mr. Jones and his family moved to a big city to look for a job.

5. Was moving to the city a wise choice for Mr. Jones?
   A. Yes.
   B. No.
   C. Can't tell. Need to know more about it.

6. Will Mr. Jones have a hard time finding a job in the city?
   A. Yes.
   B. No.
   C. Can't tell. Need to know more about it.

7. Will Mr. Jones and his family be happy right after they move to the city?
   A. Yes.
   B. No.
   C. Can't tell. Need to know more about it.

The situation descriptions were presented through display of projected slides accompanied by a recorded voice commentary. As each new item of information was voiced, a black and white line drawing presenting the same information was flashed on the screen. The pictures for each situation were cumulative, i.e., the first picture stayed on the screen while the second was presented, and they remained on the screen while the third was presented, etc. All pictures for a situation remained visible until all questions pertaining to it had been presented. (Copies of the pictures are included in Appendix E).

The above method of presentation was used to avoid relying entirely on verbal communication of the stimulus material.

The questions themselves were presented visually by means of a second (manually operated) slide projector at the same time that they were presented aurally by the tape recording. After each question, student responses were automatically recorded.

When the voice commentary asked for a discussion of the reasons for student responses, immediately after each set of responses was printed, the researcher intervened and conducted a group interview. Thus, the group discussions of reasons progressed along with the program in contrast to the method of stimulated recall used with the "Tom and Pambo" program, in which the discussions were held <u>after</u> the program.

How the Second Program was Applied

The program described above was administered to several groups of students ranging in size from about ten to thirty. The group interviews were informal and students were encouraged to express their own reasons regardless of what they believed others might think. Students who answered <u>C, Can't tell</u> were encouraged to indicate the additional kinds of information they would like to have in order to give another answer.

With one third, and one fifth, grade group, time permitted an additional stage. The purpose of this additional step was to obtain information about whether or not some students used particular reasons and how many students used each reason. The interviewer took notes on the kinds of reasons cited by the students during the group interviews. At the completion of the program, the reasons were repeated one at a time by the interviewer and students were asked to indicate their way of thinking by pressing the A button if they were thinking along the lines indicated by the stated reason and the D button if they were thinking in some other way. Tabulations of responses were obtained for five reasons supplied by one group and six reasons supplied by another.

The Sample. The sample consisted of 39 fifth grade, 25 fourth grade, and 27 third grade students in three San Francisco Bay Area schools. Random sampling techniques were not feasible and the classes were not of equal size. Group interviews on reasons for answers were conducted with the total 91 students, but because the Edex printer is limited to 20 responses, a record was obtained on the A, B, and C responses for only 71 students. The third grade students had received instruction based on the curriculum used in this study, while the fourth and fifth graders had not.

Analysis of Results. Response frequencies for the items are shown in Table 16.

No further analysis of the response data was made because the main purpose of the second Edex program was to perform content analyses of reasons given by students for their responses.

Table 16

Item Analysis of Second Program
(N=71)

Item Number	Responses A %	B %	C %	Omit %
1	86	0	1	13
2	24	28	48	0
3	8	82	10	0
4	23	54	23	1
5	76	14	7	3
6	38	18	42	1
7	23	27	46	4

A content analysis was made of reasons obtained through group interviews for each response for every item. Because the detailed listing of results of these analyses is rather lengthy, only a representative sample of reasons for responses to selected items is given.

Reasons given for Yes response to Item 2:

In those days they didn't have carpenters that came around to build houses for farmers.

They didn't have the stuff (to build with) that we have nowadays.

Wouldn't have money to hire other people.

There was no one around except other neighbors, and they had their farms to take care of.

He lived long ago. They didn't have machines to build houses with in those days.

Reasons given for Can't tell responses to Item 2:

It said how many days a week Farmer Tom and Farmer Jim went, but how would you know for sure?

A horse can travel - though a truck faster - and Farmer Jim could still decide to go.

When Tom went to town he could get enough supplies for a whole month.

Maybe both the old-time farmer and the modern farmer would grow their own food.

Farmer Tom can carry more things, but Farmer Jim doesn't need as much.

Reasons given for Yes response to Item 5:

When they invented cars his work went out of business, because they didn't use horses as much.

There are more opportunities in the city, and more jobs and better houses.

When the automobile was invented, there were still horses in the city, because the cars scared people. He could move to the city and open a blacksmith shop there.

If he stayed in the small town, he could look for another job, but he probably would have to learn more about it. If he went to the big city, a lot of jobs there don't need the knowledge - where you learn at the job.

The cars would scare the horses.

They weren't going to get any more horses, and he himself has a car.

On the farm you'd have to do a lot more work than in the city.

If he moved to the city he could make more money for his family.

If he goes to the city, he could work on cars.

The results of the additional step in inquiry conducted with two of the groups were not very useful. In the fifth grade group nearly all students pressed the A button, indicating that they were thinking in the way indicated for each of the items. Many students in the third grade apparently did not understand the procedure, as suggested by the fact that they pressed buttons other than A or D. In addition, the technique is limited because taking notes during the group interview lengthens it and decisions about which reasons to re-state must be made hastily. Shortage of time made it difficult to apply the second stage technique at the end of the class period.

The content analyses provided little information about the aspects of thinking that are assessed by the Application of Principles Test. The multiple-choice structure of APT items was not represented in the Edex program because the program was directed toward eliciting free responses from which other multiple-choice alternatives might be constructed.

The results did show that the students gave a rather wide variety of reasons for most of the items. That suggests that different thought sequences may be stimulated by the stems of multiple-choice questions, and that the variety of items for each situation in the present test is too limited. If additional items are developed, it may be possible to assess a wider variety of thought sequences associated with each of the present item stems.

Observations.

Although the general format of the Tom and Pambo program seems to be effective, the program needs revision to include standardized definitions of the words used. Additional items may have to be constructed in order to improve the reliability of the results. In addition to the reliability of scores derived from the number of correct answers, reliability estimates should be obtained on the consistency with which the program will identify students whose thinking is characterized by the various patterns shown in Appendix F .

Additional groups of items should be prepared using a format similar to that of the Tom and Pambo program to yield a diagnostic profile representing a larger range of thinking processes. Different versions of the same programs probably will be needed for different grade levels.

Results obtained with such programs should be studied in relationship to student characteristics, such as mental ability, school achievement, interests, and cultural background. Such studies should be based on samples that are more representative of school populations in general than are the ones used here.

Other formats should be developed and tested for the Edex system in order to determine which ones furnish the most valid and reliable data relative to children's thinking processes.

It would be useful to conduct individual as well as group interviews to permit identification of the sequential development of each child's thinking rather than relying only on samples of reasons given by different individuals.

The paper-and-pencil Application of Principles Test should be revised, using the results of content analyses obtained with the second Edex program.

The feedback feature of the system might be used to study the degree of similarity among children's thinking processes in group discussions. While other sections of this report present analyses of the levels and categories of student comments in class discussion, the extent to which silent members of the class were thinking in the same way could not be determined. Thus, it might be possible to determine the levels of thinking for the entire class, rather than for the responding student alone. Controls would be needed to minimize the biases introduced by the questioning technique itself.

The Edex system could also be used for in-service education or teacher orientation in the application of particular teaching strategies, the use and interpretation of techniques of evaluation, and the proper use of instructional materials.

Conclusions.

Results of the study described in this chapter indicate that the Social Studies Inference Test and the Application of Principles Test can be presented in a similar form by means of Edex equipment. The programs ran smoothly; students understood the instructions and the problem situations presented. They found it easy to use the response stations to indicate their answers.

Results also indicated that the Edex equipment can be used effectively in developing tests for primary students. It was apparent that combinations of aural, pictorial and printed presentation of test contents reduced complications stemming from low levels of reading skills on the part of younger students.

The basic design of the formats was found to be satisfactory, but minor changes are needed in the programs to improve reliability and to eliminate uncertainty regarding certain definitions.

Other significant findings were as follows:

1. The pattern analysis technique used shows promise as a means of analyzing and displaying assessments of thinking processes in a form similar to that of a sociogram. Thus, if a teacher is shown the results in this form, he can see not only what putterns of thinking exist in the group but also the identity of the students using each pattern.

2. The analysis of both the tabulable responses and the group interviews showed that the reasoning of many of the students was greatly influenced by ethnocentrism. They appear to believe that people in the United States are smarter than people who live in jungles. This finding was so conspicuous as to indicate that the Tom and Pambo program could be

adapted to serve as the basis of a scale on ethnocentrism.

3. There were numerous indications from various parts of the data that some students at grade levels 3 - 5 are inclined to form conclusions before adequate information was available. Other students, however, showed considerable sophistication in recognizing when the available information was inadequate to answer a question.

4. The reasoning of some students seemed illogical, or based on false premises, or perhaps on a misunderstanding of the problem.

5. The large number of statements in the children's own words provide examples of concepts they use and provide clues to their chains of logic as well as possible alternatives for test items. Thus, the results of the group intervi[illegible] are a rich source of material for further development of Edex programs and of written tests.

CHAPTER VIII

CLASSROOM INTERACTION: TAPING AND CODING

As discussed in Chapter V, one of the chief sources of data for this study was analysis of classroom interactions obtained from scripts of classroom discussions and coded with a multi-dimensional coding scheme. This chapter contains a discussion of the method of recording classroom interactions, the procedures used to code them, and the details of the coding scheme.

Technique for Gathering Classroom Discussion Data

In order to taperecord classroom discussions under realistic conditions, all discussions were conducted by the teachers and were held in the classroom during the time usually allotted for social studies work. On the date on which the particular task occurred in the learning sequence, a member of the research staff recorded the discussion. He placed himself and the tape recorder unobtrusively in the classroom to minimize distraction. In order to identify specific children's voices on the tape recording, the observer obtained a seating chart and, as each child spoke, he wrote the child's name and a key word of what was said. The observer also recorded non-aural activities and matter, e.g., pointing to a place on a map or writing on the chalkboard. In verbatim transcripts of the tape recordings each child's statement was identified by the child's name and the research code number. The observer then compared the tape recording with the transcript before the latter was coded.

Scheduling the Tapings

It will be recalled that the first tape involved Cognitive Task 1, the second and third tapes involved Cognitive Task 2, and the fourth involved Cognitive Task 3.

The first recordings (which indicate the opening dates of various school systems) were made between September 3 and 22, 1964. Since the film used in the second discussion, "Forgotten Village," described a rural Mexican village, interpretation of the film called for an analysis of culture. Therefore it was desirable to tape the discussion after each class had participated in learning experiences that prepared them for that task. The second recording spanned the time from December 8, 1964 to February 17, 1965, the third discussion from March 2 to May 7, 1965, and the fourth from May 14 to June 9, 1965.

The differences in the times of recording are less important than it might appear, because in each grade the recordings were made at the same point in the unit sequence. The time differences reflected only the rate at which each class was moving through the sequence and not a difference in accumulated experience with cognitive skills.

Focusing the Cognitive Tasks

The nature of the cognitive tasks was common to all grade levels. Subject matter differed from grade to grade and the initial focusing questions reflected these differences. On each grade level, however, the focusing questions were the same. In experimental groups E1 and E2, the specific follow-up questions which developed the sequential steps in the task were jointly formulated by the teachers. Although these questions were planned according to the principles discussed in Chapter III, p. 43 ff., it must be remembered that each teacher also had to formulate specific questions based on actual student responses.

Cognitive Task 1: Concept Formation (Tape 1)

This task coincided with what is called an Opener in the curriculum guide, and took place in the first social studies session. The focusing questions were:

Fourth Grade: Tell me everything you know about California. This could be from a long time ago to right now. Anything and everything you happen to know about California.

Fifth Grade: What do you know about the people who came to the United States of America, (all the kinds of people who came here).

Sixth Grade: If you go to Latin America (South America, below the border), what differences would you expect to find?

Cognitive Task 2: Inferring and Generalizing (Tape 2 and Tape 3)

Because, in the second series of recordings, all classes were to discuss the same film, a common focusing question was used:

All Grades: What did you see in the film?

In the third series of recordings, the discussions were based on research that members of the class had already performed as part of their studies. Therefore the focusing questions reflected the subject matter of each grade level. The focusing questions were:

Fourth Grade: Compare and contrast the way of life of the Mission and the Rancho days.

Fifth Grade: Compare and contrast the problems of the colonists and the problems of the pioneers.

Sixth Grade: Compare and contrast life in the Latin American countries.

Cognitive Task 3: Application of Principles (Tape 4)

In this fourth discussion, as in the third discussion, the questions reflect the grade level content. Note that this task calls for divergent thinking. The focusing questions were:

Fourth Grade: Let's look today at one of these maps, that show pretty well the desert area of California. We know about the climate and what it's like in the desert. We know that there are not too many people living out here in the desert. It would be lonely and hot. I wonder what would happen if someone was in that area, shall we say prospecting, looking over the soil and the area and he discovered under the ground a deposit of oil in this lonely place on the desert where there is no living soul, so to speak, except the desert animals, and he reported that he discovered this vast supply of oil. What would happen in that area of California?

Fifth Grade: Today we are going to discuss a make-believe situation. Let's pretend that somebody from our country suddenly discovered a great big island right off the coast of California. And on this island there were some native people who were not very civilized, but they farmed a little. Then this person suddenly let the news out that there was gold on this island. What do you think would happen there?

Sixth Grade: At present, 80% of the exports of Argentina is beef. Let us suppose that Argentina cannot sell any of its beef anywhere. What would happen in Argentina?

The Coding Unit

One of the problems in analyzing classroom transactions for the purpose of describing thought processes is to devise a unit of analysis which can be coded accurately and which is coherent within itself.

Coding by time units generally leads to high inter-rater reliability. However, this method does not always result in meaningful units of thought. For this reason, the time unit was discarded in favor of a "thought unit" so that the contextual meaning of the statements could be preserved. A "thought unit" was defined as a remark or series of remarks which expressed a more or less complete idea, served a specified function, and could be classified by a level of thought. It is therefore possible for a single word, a sentence fragment, a complete sentence, or an entire paragraph, to be designated as a thought unit. This definition, which produced units of an uneven length to code, made it more difficult to establish reliability.

In scoring thought units, each coder separated thought units by slash marks on the transcript and the code was written in the margin.

a. Sharon   Another thing - - - well, education helps us/because well, if - - - like if a one-product country goes/well, it just is not good anymore/ then well, if you didn't have education,/you could not communicate with other countries./

b. T   Is it important to communicate?/ *

The Coding Scheme

Verbal transactions were scored by three different sets of codes in order to describe simultaneously the teaching-learning acts and the levels of student thinking. These three were: identification of source, pedagogical function, and thought level. The codes for identification of source and for pedagogical functions remained the same across cognitive tasks and tapes. The thought level codes were distinct for each task. However, the higher numbers generally indicate the higher level or more complex thought processes. The hierarchical levels refer to the sequential order of specific cognitive operations because in mastering the process, the preceding and lower level is prerequisite to performance on the next (see Chapter I). Thus, the coding scheme at once represents the developmental sequence of steps for each cognitive task and the level of difficulty. In addition, distinctions were made between the remarks that were irrelevant and those that were relevant to the focus of the task (see p. 149).

Identification of Source

This code indicates whether the source of the thought unit originated with a teacher or a student, and whether the speaker is giving or seeking information. The code symbols are:

* - In the examples taken from the tapescripts, "T" signifies teacher, " ---" signifies a pause in speech; and ". . ." signifies omission of remarks.

CG - Child Gives.

a. Harold: You can't buy firecrackers here. CG

CS - Child Seeks.

a. Joan: Where can you buy them? CS

TG - Teacher Gives.

a. T: It's against the law to sell them. TG

TS - Teacher Seeks.

a. T: Where do we see lots of firecrackers? TS

Pedagogical Functions

The pedagogical functions indicate the effect of a remark or a question. When applied to remarks or questions by teachers these codes were used to describe teaching acts which affected the subsequent thought of children. Of course, the responses of children can serve similar functions, though in these particular discussions this usage occurred infrequently. Two large groups of pedagogical functions were distinguished: managerial and thought related or substantive.

Managerial. Thought units in this category are questions or statements made by the teacher or the students which are unrelated to the logic of the content or to the level of thought. They are psychological or managerial in their function and are accompanied by identification codes but not by thought level codes.

A - Agreement or Approval. A thought unit that states or seeks agreement with, or approval of, the content of a previously given thought unit.

a. Claire I think so, too. CG A

b. T That's a good point, Joan. TG A

D – Disagreement or Disapproval. Such a thought unit states or seeks disagreement with, or disapproval of, the content of a previously given thought unit.

a.	Carol	i don't agree with Jane.	CG D
b.	T	That's not quite accurate, Betty.	TG D

CM – Classroom Management. These thought units are statements which the teacher uses to establish discipline, restore order to the classroom, or control an individual. Its use is restricted to remarks by the teacher.

a.	T	Put your hands down for a minute.	TG CM
b.	T	We'll have to take our turns and wait for the other person to finish.	TG CM

DM – Discussion Management. This code is used whenever a child or the teacher makes a statement which concerns the management of the discussion. The first kind of statement coded DM is sheer management, e.g., "You'll have your turn later." The second kind of statement coded DM is management that provides clarification and perspective for the discussion, thus providing the setting for new thought, e.g., "So far we have discussed this, this, and this . . ."

a.	John	Getting back to what Betty Jo said about taxes . . .	CG DM
b.	T	We have quite a long list here now. I think that's enough.	TG DM

c. T All right. Your idea is similar to the one that the people would move on to another place. TG DM

Thought Related or Substantive. The second group of pedagogical functions is related to generating thought, but not directly to a given thought level. These codes accompany identification and thought level codes.

R - Reiteration. These are statements by the teacher or a child that restate what already has been said. Reiteration by the teacher may be a habitual expression or may be used to insure that the entire class hears a remark. It may also be part of certain teaching strategies (see Chapter X).

a.	Carol	California is a state.	CG __*
	T	All right, California is a state.	TG __R
b.	T	What did you say?	TS __R
	John	I said they came to California in wagons.	CG __R

R+ - The sole difference between R (Reiteration) and R+ is that R+ refers to thought units other than the immediately preceding one. Pages of dialogue may occur between the original statement and the thought unit coded R+. This code appears in the systems for Cognitive Tasks 2 and 3.

X - Extension. These are remarks which develop thought on the same level, or questions which seek further ideas or clarification of the preceding idea. It may also be used to designate continuity of the same idea across several thought levels.

* - Indicates omission of accompanying code.

a. (Carol There's a place in California called Death Valley).

John It's the hottest spot. It goes up to 128°./ CG __X

b. (Fred Scientists think that there will be more people in Los Angeles than in New York.)

T When? TS __X

Fred 1970. CG __X

c. Bruce If Argentina couldn't export any of its meat or hides,/ then they probably wouldn't keep on CG 1
bringing up more herds./ They would cut down CG 4X P__
so they could use some of the land for wheat./ CG 4X P__
Then they could just use the surplus cattle for themselves./ CG 4X R

C - Control. These are statements in which the teacher controls thought by performing what the students should do for themselves, such as giving a generalization in a discussion focused on forming generalizations, giving information when assembling information is the focus, or classifying when the discussion is focused on the process of classifying. In addition, some statements are coded C when a teacher cues the question so that the students are pinned down to a limited realm of thought. In other cases, however, a Control functions to enlarge what the student has said.

a. T All right. 'Lots of playgrounds' goes with 'many state parks.' TG __C

b. (Glenn The places that Argentina sells it to would be minus a lot of meat).

T (How do you want it?) Receivers of the exports minus meat? TG __C

RC – Reiteration Control. This code was used when the teacher reworded a child's contribution and altered it in a controlling way, e.g., by including data not previously mentioned, broadening the application, or narrowing the focus.

a. (John They came to make houses and stay here.)

T They came to settle, didn't they? TG __ RC

b. (Carol They have different customs.)

T Okay. A different way of life. TG __ RC

Sp – Specification. This code applies when the speaker is seeking or giving specific instances of a general statement. It seldom appears at the higher thought levels.

a. (John We saw how she was trying to cure the boy.)

T Whom are you referring to now? TS Sp __

John Twini. CG __ Sp

Thought Level Codes

The third set of codes designates thought levels of thought units. There are separate systems for coding thought levels for each cognitive task that designate the hierarchical steps within the tasks.

Cognitive Task 1: Concept Formation. The level of operation of the thought unit was identified by two-digit Arabic numbers. The numbers 10-13 indicated enumeration; 20-23 indicated grouping; 30-33 indicated labeling (categorizing) and subsuming on a single basis; and numbers 40-43 indicated recognition that an item can be classified in more than one category, or categorizing and subsuming on multiple bases. These categories were used to classify both child and teacher responses. They are accompanied by identification of source codes and also can be accompanied by the thought related substantive codes of the pedagogical functions.

Within each set of ten, the units have the following meaning:

0 - Incorrect information in thought unit;

1 - Correct response without elaboration;

2 - Correct response accompanied by some clarifying or amplifying statement;

3 - Correct response which includes a reason or explanation.

It was found that many times teachers asked questions which focused on enumeration, grouping, or categorizing and subsuming, rather than specific levels within those steps. In such cases, teacher questions were coded by Roman numerals.

I Enumeration

TS I - Teacher seeks enumeration.

a. T Are there any other differences that you might observe in South America? TS I

10 - Incorrect enumeration of specifics.

a. Cathy The Pilgrims came to California. CG 10

11 - Correct enumeration of specifics.

a. Anne A long time ago there was an earthquake in California. CG 11

12 - Correct enumeration of specifics with clarification, amplification, and/or giving comparative data without making an inference.

a. John They (Latin Americans) don't have all the modern things that we have, like stores. CG 12

13 - Correct enumeration with reason or explanation.

a. Laura They smoothed down the Dam Road a little so they could put stores and a road there. CG 13

II Grouping

TS II - Teacher seeks grouping.

a. T . . . Does anyone else see any other items here which would come under another group? TS II

20 - Incorrect grouping. No examples.

21 - Correct grouping.

a. Harry I think that people and children should go with Pilgrims and Indians. CG 21

22 - Correct grouping with clarification, amplification, and/or giving comparative data without making an inference.

a. Mary Those things are both about buildings. CG 22

23 - Correct grouping with reason or explanation.

a. Harry 'People and children' goes with 'Pilgrims and Indians' because they're all people. CG 23

III Labeling (Categorizing) and Subsuming on a Single Basis or on a Multiple Basis

TS III - Teacher seeks categorization (labels for groups).

a. T Can anyone give a name to this group that has: lack of firearms, police department, uniforms for policemen, policemen , and government? TS III

30 - Incorrect subsuming.

a. John 'Chinese' would go under 'Explorers of the West.' CG 30

31 - Correct subsuming.

a. Eddie 'Trains' go under 'transportation.' CG 31

32 - Correct subsuming with clarification, amplification, and/or giving comparative data without making an inference.

a. Tom 'Physical features' means the way the land is shaped. High mountains are physical features. CG 32

33 - Correct subsuming with reason or explanation.

a. Greg I think 'language' goes under 'people' because people have language and people have communication. CG 33

40 - Incorrect categorizing of a single item in more than one category. No examples.

41 - Correct categorizing of a single item in more than one category.

a. Cathy 'Church' can go under 'architecture' and it can go under 'religion', both. CG 41

42 - Correct categorizing of a single item on multiple bases, with amplification, and/or giving comparative data. No examples.

43 - Correct categorizing of a single item on multiple bases, with reason or explanation.

a. John If you put 'lower standard of living' under 'government,' then you have to put 'not as rich as US' under 'government' also because not just US could go under 'lower standard of living.' CG 43

Cognitive Task 2: Inferring and Generalizing. As in Cognitive Task 1, the level of operation of the thought unit was identified by Arabic numbers which could accompany the thought related substantive pedagogical functions. Units bearing thought level codes may be given or sought by either a child or teacher. In the coding scheme for Cognitive Task 2 single digit numbers were used.

Again, Roman numerals were used when teacher questions were addressed to general steps within the task rather than to specific levels.

I Identifying Points, Giving Information

TS I - Teacher seeks information, without specifying the level.

a. T What did you see in this film? TS I

b. T All right, what differences did you notice? TS I

0 - Incorrect information in the thought unit.

a. Peter They found the Northwest passage in California. CG 0

b. (T What do you notice about the directions that both the colonists and the pioneers went in?)

Dorothy They went in opposite directions. CG 0

1 - Giving specific units of data.

a. John The lady was trying to cure by the egg. CG 1

b. Carol Sometimes the wagons got stuck in the snow and people got killed. CG 1

2 - Relating, comparing, contrasting units of data.

a. Mary In the West Indies they speak French, and in Brazil they speak Portugese, and in the rest of the countries they speak Spanish. CG 2

b. John Well, the pioneers weren't traveling on the ocean, like the colonists, they were traveling on just land. CG 2

II Explaining

TS II - Teacher seeks explanation (without specifying whether factual or inferential.

a. T Why would she think like that? TS II

b. T Why do they have to use tractors? TS II

3 - Providing a factual explanation.

a. Patty (Life was harder on the missions than on the Ranchos) because on the ranchos they had experienced Indians to help them. CG 3

b. Babs (The children washed at school) because they don't have time to go home after they work in the corn fields. CG 3

5 - Providing an inferential explanation.

a. Tom (I'd rather have been with the colonists) because if I was a pioneer I'd have to walk all those miles and I don't think my feet would ever feel the same. CG 5

b. Karl (The colonists had more security) because they were more in bunches than the pioneers were. CG 5

III Making Inferences, Generalizing

TS III - Teacher seeks inference, generalization, or principle without specifying a particular level.

a. T In what way would their lives be affected? TS III

b. T What made you think that the woman believed so strongly in the witch doctor? TS III

4 - Giving inference from units of data.

a. John (When you're traveling right in the middle of the Atlantic Ocean), it's pretty much the same all the way along. CG 4

b. Frances I don't see how that wise woman could predict what the baby was going to be. CG 4

6 - Giving an inference that is a generalization upon generalizations, drawing analogies.

a. Harry (Some people say that a long time ago Africa was hooked on to South America. There's a possibility that people moved from Africa to South America) and they just followed their customs ever since. CG 6

b. Bob The witch doctors are trying to do with wands and cracked eggs what our medical doctors do with needles. CG 6

7 - Giving the logical relationship between inferences.

a. Ben If you can't educate enough people to teach, then you don't have enough teachers. CG 7

b. Linda If we bought the island, we could make it into a naval base and use it to protect us against the Communists right across the ocean. CG 7

Cognitive Task 3: Application of Principles. The coding of this task required a slightly different pattern from the two described above. This task also is composed of three steps: I Predicting; II Explaining and supporting the predictions; and III Verifying the predictions by logical inference. It is more difficult, however, to assign a hierarchical order to those steps than to the steps of the previous tasks, so qualitative, non-hierarchical letter codes were created to distinguish the major steps of the task. These codes accompanied the number codes which describe the levels of thinking as in Cognitive Task 2. *

I Predicting. A thought unit coded "P" answers the question, "What would happen if such-and-such happens." Since predictions are always inferential, the "P" is always accompanied by one of the number codes indicating an inference, depending on whether it is a simple inference (4), or a compound inference (6).

a. Steve They would have to switch to raising wheat. CG 4P__

b. John The people who don't leave will be poor/ CG 4P__
so they're going to fall down. CG 4P__

c. Carrie Their standard of living would go down. CG 6P__

d. Tom . . . so the government would get poorer and poorer. CG 6P__

Cp - Changing the given parameters or giving hypothetical and/or irrelevant parameters. By this it is meant that the speaker introduces a condition that is at variance with those involved in the problem, is not clearly inferred from data given, or is not defended logically. (See p. 134 for

* Level 7 was combined with Level 6 in Cognitive Task 3, because it appeared so infrequently as an independent statement and because the whole task was in the "if - then" form.

original questions and conditions). Like facts, these conditions operate on thought levels 1, 2, and 3.

a. Jane (Fifth grade)

Maybe he was a scientist/ and he wanted to go over and see what the wildlife was like	CG 1 Cp
on this island./	CG 1 Cp

b. John (Fourth grade)

There might not be any city there at all./	CG 1 Cp

P_2 - Prediction generated by a change of parameters. The sole difference between a P and a P_2 is that the latter rests on an added condition (Cp) which was simply introduced and accepted by the participants in the discussion.

a. Fred (Fourth grade)

Some oil company might come in and buy the land/ and then they wouldn't allow the	CG 1 Cp
city to be built./ They would just build oil	CG 4X P_2__
wells./	CG 4X P_2__

Causality codes. Causality codes distinguished predictions according to whether they dealt with an immediate or a long range consequence of the focus event given in the question or whether they were unrelated to it. Causality codes were assigned to all 4P's and $4P_2$'s, but not to 6P's. (See Appendix G for further exploration of the underlying rationale).

4Py - Immediate effect of the focus event.

a. Sharon (Fourth grade)

A lot of people would come to get the oil.	CG 4Py__

b. Chuck (Fifth grade)

They'd probably find a new food element on the island.	CG 4Py__

c. Sherry (Sixth grade)

The country that used to buy Argentina's meat wouldn't have any.	CG 4Py__

4Pz - Long-range consequence of focus event.

a. Harry (Fourth grade)
(After they got out all the oil) just a little would be left. CG 4Pz__

b. John (Fifth grade)
(After people had left their farms to hunt for gold on the island and were unsuccessful) they would find out that their crops didn't grow. CG 4Pz__

c. Fred (Sixth grade)
(After Argentina has shifted to another industry) they'll have a little extra money to hire workers. CG 4Pz__

4Po - Not related to the focus event.

a. Pamela (Fourth grade)
(If they used animals for transportation in the desert) they wouldn't have to pump tires or anything but the animals might get stubborn and just sit down. CG 4Po__

b. Larry (Fifth grade)
(When two groups of people get together) they will ask each other for advice. CG 4Po__

c. Nora (Sixth grade)
(When a country is in a depression) no-one is going to pay higher prices for food. * CG 4Po__

II Explaining and Supporting Predictions

F - Fact. 1F, 2F, 3F. A thought unit coded F supplied factual support for a prediction and answers the question, "What are the factual conditions in the situation which support the prediction." It accompanies the thought level codes 1, 2, and 3.

a. Harold Argentina depends upon the export of beef. CG 1 F

b. Yvonne (They would have to have a dam). They put irrigation water in canals. CG 1 F

* For graphic presentations of these distinctions, see Appendix G, Figures Beta, Gamma, and Delta.

I - Inferential Support. Thought units coded I give an inference or generalization as support of a prediction. They accompany the thought level codes of 5 and 6.

a. Claire . . . because most people can find out how to make a living raising crops. CG 6 I

b. Peter (We wouldn't know) because it wouldn't really affect us. CG 5 I

III Verifying the Predictions by Logical Inference

Lo - Logical conditional support. A thought unit coded Lo provides a conditional parameter in support of a prediction. "If such- and- such happens, then so- and- so will happen" is the most common form.

1 Lo and 2 Lo. These codes apply to connecting facts by logical conditional relationship to other facts or predictions.

a. Jack If we don't have very many friends/ (we're not going to be a very popular country). CG 1 Lo

b. Carrie If Argentina exports mainly beef and if the main industry in Venezuela is oil/ (they can trade with each other). CG 2 Lo

4 Lo and 6 Lo. These codes apply to making logical-conditional connections between inferences.

a. Jim If you sell the food for high prices,/ (then nobody's going to buy it). CG 4 Lo

b. Bruce If the government collapses,/ (you'll probably have a civil war). CG 4 Lo

Irrelevancies. In all four of the tapes, statements which were outside the focus of the discussion were coded irrelevant. They were designated by Ir.

a. Jean (During a discussion of what is found in stores) My mother always shops at Jones' market./ CG Ir

b. (During a discussion of what the class knew about California, a child remarked that it has many state parks).

T And you all know how full they get in the summertime.
TG Ir

Concreteness/Abstractness. It is possible to predict both concrete and abstract events. Values were therefore assigned to predictions according to the level of abstraction of the topic. The concreteness/abstractness rating is specific to the question asked and hence, in this study, to the grade level. However, within class levels the designations were consistent in general meaning. Every 4P or $4P_2$ given by a child was coded for concreteness/abstractness. (See Appendix for the breakdown of topics by concreteness/abstractness).

Every 4P or $4P_2$ given by a child was coded for concreteness/abstractness. 4P's or $4P_2$'s produced by teachers were given T values only when the teacher shifted the level of abstractness. Since all high level generalizations are fairly abstract, all 6P's, no matter who produced them, were automatically assigned a T_2.

T_1 - Fairly concrete, low level of abstraction, low value.

a. Glen . . . many of the families wouldn't have meat. CG 4P__T_1

T_2 - Fairly abstract, higher level of abstraction, higher value.

b. Harry . . . so there wouldn't be any tax money for the government to pay the teachers. CG 4P__T_2

Sample Pages of Coding.

To illustrate some of the complexities of coding and the coding sequences, sample pages follow, one for each discussion. Note that these samples were chosen to illustrate a variety of codes rather than excellence of teaching strategies or outstanding discussion sequences. All samples were taken from the same sixth grade class.

Cognitive Task 1: Concept Formation (Tape 1)

		Child No.	Code
T	A, would it be all right if I put the letter A for all the things that go together with A? All right, let's begin/ You want to start with the things that have to do with police? All right./Anne, why don't you start with that side and put a big A there on things that you think have to do with police/ Does anyone else see any other items here which would come under another group. Another group. Carol, do you see another group?		TG DM TG 21R TG CM TS II
Carol	Well, the architecture could be with the cities and the houses./ They're all architecture.	53	CG 21 CG 31
T	I see. Would you like to put a B in front of all the things that you think go together? All right. As you wish, if you think it goes together, then while you are doing that we will read Anne's list./ Anne, you feel that all the things that go together would be, under A, would be different uniforms for policemen, police departments, not as many policemen, any others that you might have missed? Jimmy? Sam.		TG 21/TSA
Sam	Lack of firearms could go with it./	05	CG 21
T	You think that goes with policemen./ Is there anything else that you could, that you see, boys and girls, that might go under A, policemen, things having to do with policemen, John.		TG 21R TS 21X
John	Wouldn't they be coming under, wouldn't they take their orders from government? They would be working under the government.	04	CG 32
T	All right./ You feel government is part of this group? O.K., can you show me where it is. John.		TGA TG 21R
John	Right there (pointing to board).	04	______
T	You feel government is part of this group. Butch.		______
Butch	Wouldn't hospital come under uniforms? They wear uniforms, huh?	10	CG 21
Several	Huh?		______

Cognitive Task 2: Inferring and Generalizing (Tape 2)

Child No. Code

John Well, it could have been that probably the well 04
was too far away/ - so that they had to take a bucket CG 5X
somewhere and they went to the well to get water each day/ CG 5X
and they had other purposes for its use -- a better use
for it at home/ and so they probably had more water at CG 5X
school and a bigger - something to hold it in. For the
children to wash their hands./ CG 5X

Anne About the same because they had water at the 52
dinner table there and then they had when they were CG 4X
eating dinner, they had water . . . /

Holly Well, I thought maybe because they don't go 51
home after they work in the corn fields, they go right to CG 3X
school. They don't have time to go home/

Howard Well, that man was sawing something - 15 CG 1
a coffin - that box./

T Coffin at the end? What do you think happened? TS 4X

Howard Somebody is going to die. 15 CG 4X
(Several: Yeah, that little boy).

T Well, we have had many interesting points brought out and quite a
picture that you boys and girls have painted so far about these people
and this family and these people in this village./ Can you TG DM
think of anything else that all of these things that you boys and
girls have been mentioning about these facts mean? Do you
think there's another idea here or other ideas - apart from the TS III
ones you have already mentioned? Terry?

Terry Well, a long time ago, some people say that 09
Africa was hooked on to South America/ well, there is a possi- CG 1
bility that their people knew it was hooked there moved over
there and/ they just followed customs all the way through. CG 4
And these are their customs today. CG 6X

T Oh, I see. Does anyone have any thoughts on this - what TS 6X
Terry just mentioned? Jane, do you?

Cognitive Task 2: Inferring and Generalizing (Tape 3)

		Child No.	Code
Dan	The country might not have enough money, to build a lot of schools - more schools than another country.	03	CG 5
T	Okay. That's a very good reason. Howard?		TGA
Howard	Well, ah, in Brazil why they wear their uniforms in the rural areas is because they -	15	CG 3
	these kids they don't have, you know, proper clothing		CG 1
	or anything like this./ They just wear these little rags/ and so they give them these uniforms to wear to school.		CG 1X
T	And this is in the city?		TS Sp1
Howard	No, this is in the rural areas.	15	CG 1 Sp
T	Oh, in the rural areas, I see.		TG 1 R
?	They have them in both.	?	CG 2X
T	Holly, you had your hand up. Can you think of some differences? I mean some reasons for these differences? Quality of education, the number of people going to school.		TS II/TGDM
Holly	Well, maybe the ah, people didn't have enough money to buy the different things so they can't send their children	51	CG 5X
	to school./ They have to buy clothing and the children work.		CG 1X
T	So both you and Dan feel that money is one of the main reasons for the differences in the amount of schooling people get in different countries./ Can you think of other reasons?		TG 4X/TS II
Anne	They might need them to help their fathers in the fields and other things more than to to to school and read and write./ They might not even need to write unless they were	52	CG 6
	born in the city and have to work in factories./ If they were		CG 6X
	in the country they could just work in the fields and they really don't need to.		CG 6X
T	All right, I'm going to hold up right here for just a moment. And I'm going to have a few more of you, in fact . .		TG DM

Cognitive Task 3: Application of Principles (Tape 4)

		Child No.	Code
T	Okay. And when people move to other places what would some of the other things that would be likely to happen?		TS III X
Harry	Well, they could - farmers may be could go back to cattle business/ if they're at some other place.	16	CG 4XPzT CG 4X Lo
T	Go back to cattle business - I didn't quite understand. Why would they raise cattle, do you think? If they couldn't sell any more beef?		TG 4R Pz TS 4X Pz TG 1X Lo
Harry	Well, if they moved to a different country or something/ and they raised beef, well, they know how to do it and-	16	CG 1X Cp CG 1X Cp CG 1F
T	I see. Oh, I see, they'd move to a completely different country that would be able to export it/. I see. Dick, let's talk a little bit more about jobs. Do you have any comments here about jobs?		TG4R+CPzT_2 TG DM TS III
Dick	Well, like Harry said, if they moved out,/well there would be less people to support./The government would have to support./And if enough people moved out/ like 20% would be from other crops/and they could start building up again.	09	CG 4XLo CG 4XPzT_1 CG 4XPzT_2 CG 4XLo CG 3XF CG 4XPzT_2
T	I see. Are there any other side effects that you think might happen/ when jobs become very scarce?/ What are some of the other side effects that are likely to happen? Lou?		TS III TG 4R+Lo TS 4X PyT_1
Lou	(no answer)	08	________
T	Suppose people couldn't get jobs any more./ Jobs became very scarce./ What are some of the other things that are likely to happen in Argentina? To most of the people? Dorreen?		TG 1XCp TG 3XCp TS 4XP_2y
Doreen	Well, they would all get real poor they wouldn't have good homes./ And a few kids - children if they had education/ wouldn't get an education. And they wouldn't know how-	62	CG 4XP_2yT1 CG 4XP_2yT1 CG 1X Lo CG 4XPyT_2
T	Okay. Loss of homes, decrease of education and Doreen carried that idea further . . .		TG DM

CHAPTER IX

CLASSROOM INTERACTION: ANALYSIS OF STUDENT RESPONSES

In considering the data presented in this chapter, several points need to be recalled.

First, because it was necessary to tape the three cognitive tasks at different points in the year, each task reflected a different degree of experience with cognitive skills. For example, at the beginning of the year when Cognitive Task 1 was recorded neither students nor teachers had become skillful at the type of discussion and the cognitive operations required. In contrast, the discussion which involved application of principles was recorded at the very end of the year and presumably reflected the experience of the entire year. The taping schedule also made it impossible to secure comparative growth data on skills involved in the same cognitive task.

Second, while the nature of cognitive tasks were similar from grade to grade, the content of each discussion differed greatly from grade to grade and to a lesser extent across classes. Because content obviously influences the nature of thought processes used and because it was impossible to analyze the content of the processes, such as the quality of generalizations, predictions, and the class categories, our generalizations about the nature of these processes are inevitably somewhat tenuous.

Third, in order to make the coding scheme reflect complexities of thought in the classroom and the intricacies of teaching strategies appropriate to stimulating thought, it was necessary to develop a very complex coding scheme. For example, it was necessary to develop a way to describe both the static characteristics of individual teaching and learning acts and strategies which represent the flow of the process. It was impossible to treat teacher behavior in terms that described teacher behavior only, i.e., simply noting whether he asked a question or made a statement. It was also necessary to determine the pedagogical functions of teacher acts, e.g., whether he was seeking information, generalizations, or explanations. These functions could be determined only when considered in the context of the total discussion.

A multidimensional coding scheme had several advantages:

First, combining the analysis of the pedagogical functions of teaching behavior with the assessment of the quality of student thinking made it possible to evaluate directly, rather than inferentially, the impact of teaching strategies on students' thinking.

Second, multidimensional scoring made it possible to do more than merely count the frequency of individual teaching acts and permitted detailed study of combinations and sequences of certain acts, and their cumulative impact.

The complexity of the coding scheme, however, introduced certain problems which were not resolved. A major problem was that professional judgments were required in scoring. Even professional judges found it difficult to maintain coder reliability. For this reason the usual method of jury coding was discarded, and regular staff members did the coding. Each staff member coded some tapescripts individually and also reviewed those coded by another staff member. Disagreements and conflicts were resolved by discussion and consensus. While this method maintained the validity and complexity of coding, it did preclude assessment of coder agreement.

Whenever one deals with two sets of complex processes, the number of uncontrolled variables increases. In the teacher variable alone the differences extended beyond the gross differences of whether or not the teachers had training. Such factors as the capacity for logical thinking or skill in conducting open-ended discussions markedly influenced the teaching style and therefore also the student output. Since there were only six teachers in each group studied, one teacher who was atypical in any of the above respects could affect the results markedly.

Similar problems were encountered in the analysis of data. It was difficult to predict the coding categories which would reveal significant differences in the dynamics of teaching strategies and of the evolving cognitive processes. Some categories with frequencies large enough to be analyzed proved to be unimportant in terms of the dynamics of learning. Others, with insufficient frequencies, seemed to influence student thought significantly. Differences between inferences and generalizations offered from recall and those produced from data at hand were extremely important, but it was next to impossible to distinguish them without being familiar with all class work prior to the discussion.

Ideally, these data should have been analyzed twice: first to determine the utility of the basic categories of coding and analysis and to discover the potent combinations of these categories, and second to employ the new categories derived from the first analysis. The time and money available for this study did not permit double analysis.

One serious flaw was revealed after the data analyses were completed. Two dimensions are relevant in assessing cognitive performance. One is the hierarchical position of the process involved. This hierarchy has to do with the capacity to differentiate, to abstract, to infer, and to see relationships. The second dimension is the level of the content to which these processes are applied and the abstractness and complexity of their product. The same inferential process can be applied to "TV dinners" and to "supplies" and can result in a generalization about "what the miners eat" or "standard of living." Thus, sophistication of thought can be exhibited first in the materials used, second in the processes performed, and third, in products of these processes.

Content analysis of the products of the use of the cognitive processes examined in this study would have been a monumental task. It was not performed because of the difficulty of creating a dependable hierarchy of these products across varied discussion content. Consequently, inferences, predictions, and conceptual categories of limited and sophisticated penetration and abstraction were only crudely distinguished in the coding system. Therefore, the data only partially reflected maturity of thought.

Finally, it must be noted that for all intents and purposes, the E1 and E2 groups were similar because, as explained in Chapter V, only 44 students out of 200 in E1 were in their second year of exposure to the curriculum. The teachers in both groups were selected in the same manner and had the same amount of training.

For these reasons the data presented in this chapter should be regarded as tentative descriptions rather than as definitive results despite the fact that a control group design was used. The data also did not reflect significant aspects of the dynamics of either the nature of thought processes or the teaching strategies employed.

Statistical tests were not performed because, for reasons discussed previously, generalization to other teachers, groups, tasks or discussions, is not justified.

The basic data on the analysis of the tapescripts prepared for each of the discussions are presented in Table 17. Four groups were identified: experimental groups E1, E2, and E3, and the control group C. The data included the means and ranges of thought units, the extent of participation and the number of statements in each of three categories: what the child gave and what the teacher gave, and what the teacher sought. So little "child seeking" occurred that it did not justify further discussion. These data are also represented in graphic form in Figures 3 through 7. Because the discussion content varied from tape to tape, each is discussed individually and cross tape comparisons are limited. The patterns have been combined because they were similar for each grade.

Thought Units - The Amount of Talk

Generally, the number of thought units produced by students and teachers was greater in Tapes 3 and 4 than in Tapes 1 and 2, particularly for the experimental groups. In all tapes the control group produced the fewest thought units of the groups and tended to have the least range from class to class. It should be noted that the number of thought units was not a direct measure of the amount of actual talk. It was dependent in part upon the rapidity and style of expression employed by students and teachers. Actually, the use of thought units as a measure of the amount of talk favored classes that tended to talk in single words or brief phrases; that was generally more true of the control group and was a distinct characteristic of one E3 class. In classes in which students tended to talk in sentences and run-on paragraphs, thought units characteristically were longer and hence there were fewer per unit of time. Furthermore, no strict time limit was imposed on the discussions. While they generally lasted a fifty-minute class period, some teachers stopped short of that time and others continued beyond.

Table 17

Thought Units, Percentages of Participation: Student and Teacher Talk

Groups	Thought Units Range	Thought Units Mean	Participation Range	Participation Mean	CG Range	CG Mean	CG + CS	TG Range	TG Mean	TS Range	TS Mean	TG + TS
					Task 1, Tape 1							
E1	309-530	383	73-90	84	38-51	44	44	28-42	36	14-27	20	56
E2	214-459	345	52-81	73	32-54	41	42	20-44	35	20-28	24	59
E3	123-571	304	56-100	78	40-86	54	54	5-44	29	9-33	17	46
C	171-261	226	61-79	70	36-69	49	49	16-42	28	15-26	23	51
					Task 2, Tape 2							
E1	125-310	228	44-85	58	44-80	61	62	10-32	18	7-24	20	38
E2	177-261	213	51-81	68	39-88	60	61	4-35	21	8-26	19	40
E3	200-393	309	58-93	74	36-71	55	52	14-36	24	11-28	19	43
C	212-262	241	47-88	69	38-59	57	59	3-32	21	7-30	21	42
					Task 2, Tape 3							
E1	411-775	535	58-89	68	53-69	58	60	15-27	20	13-24	20	40
E2	377-606	504	52-86	74	43-73	58	59	8-29	20	16-28	21	41
E3	402-971	623	55-97	79	38-68	48	49	10-37	27	16-30	24	51
C	209-393	304	50-74	60	41-82	59	60	5-33	18	13-33	22	40
					Task 3, Tape 4							
E1	434-739	599	53-85	64	55-76	62	63	11-34	23	12-20	16	39
E2	353-787	566	60-93	74	49-74	58	60	10-33	21	13-24	19	40
E3	310-873	608	65-91	79	37-68	55	58	11-44	28	9-20	14	42
C	162-598	313	42-78	57	42-83	59	60	9-37	24	8-25	16	40

Note. The following abbreviations are used:
CG = Child Gives. TG = Teacher Gives. TS = Teacher Seeks.
CS = Child Seeks.

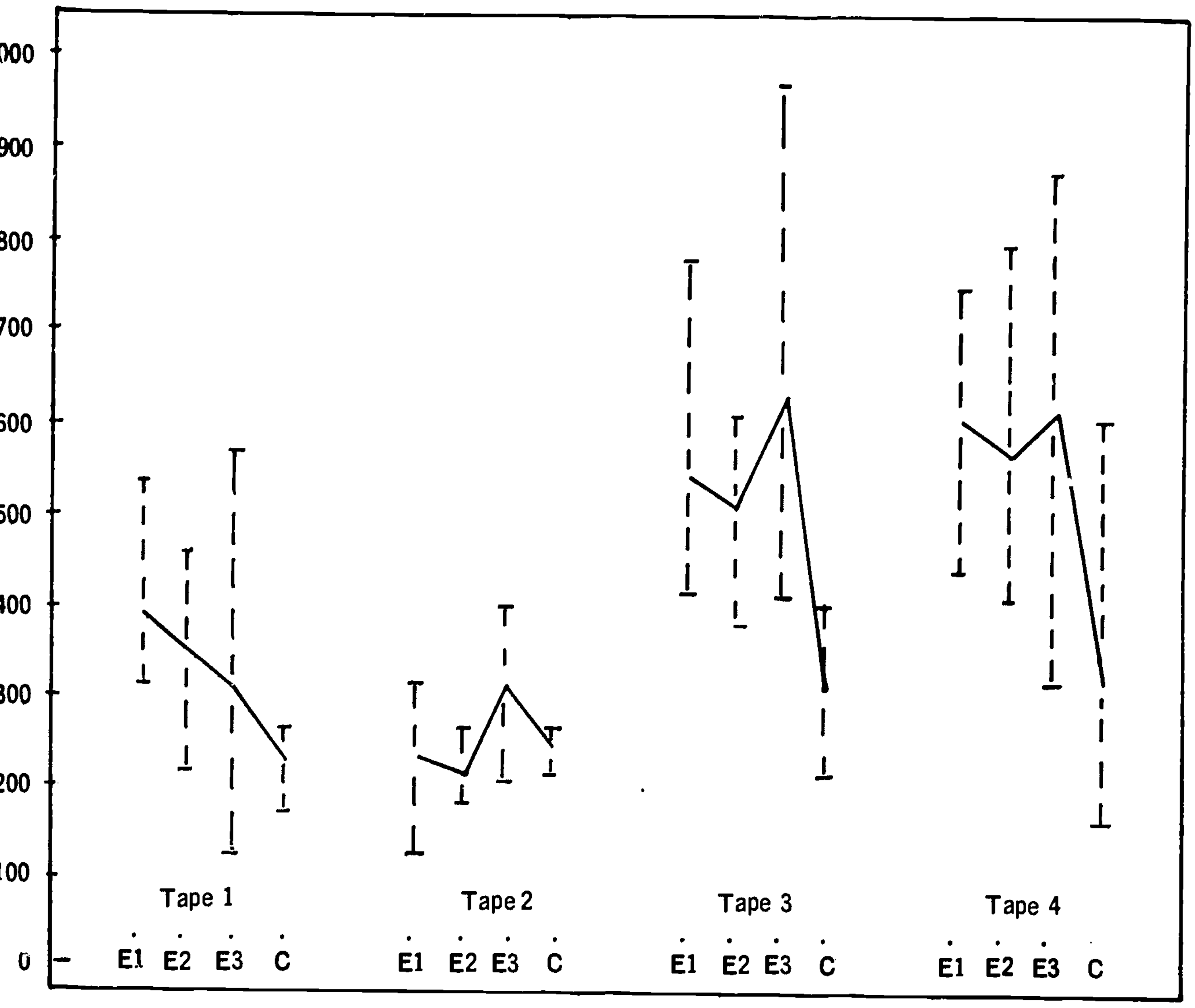


Figure 3 Thought Units

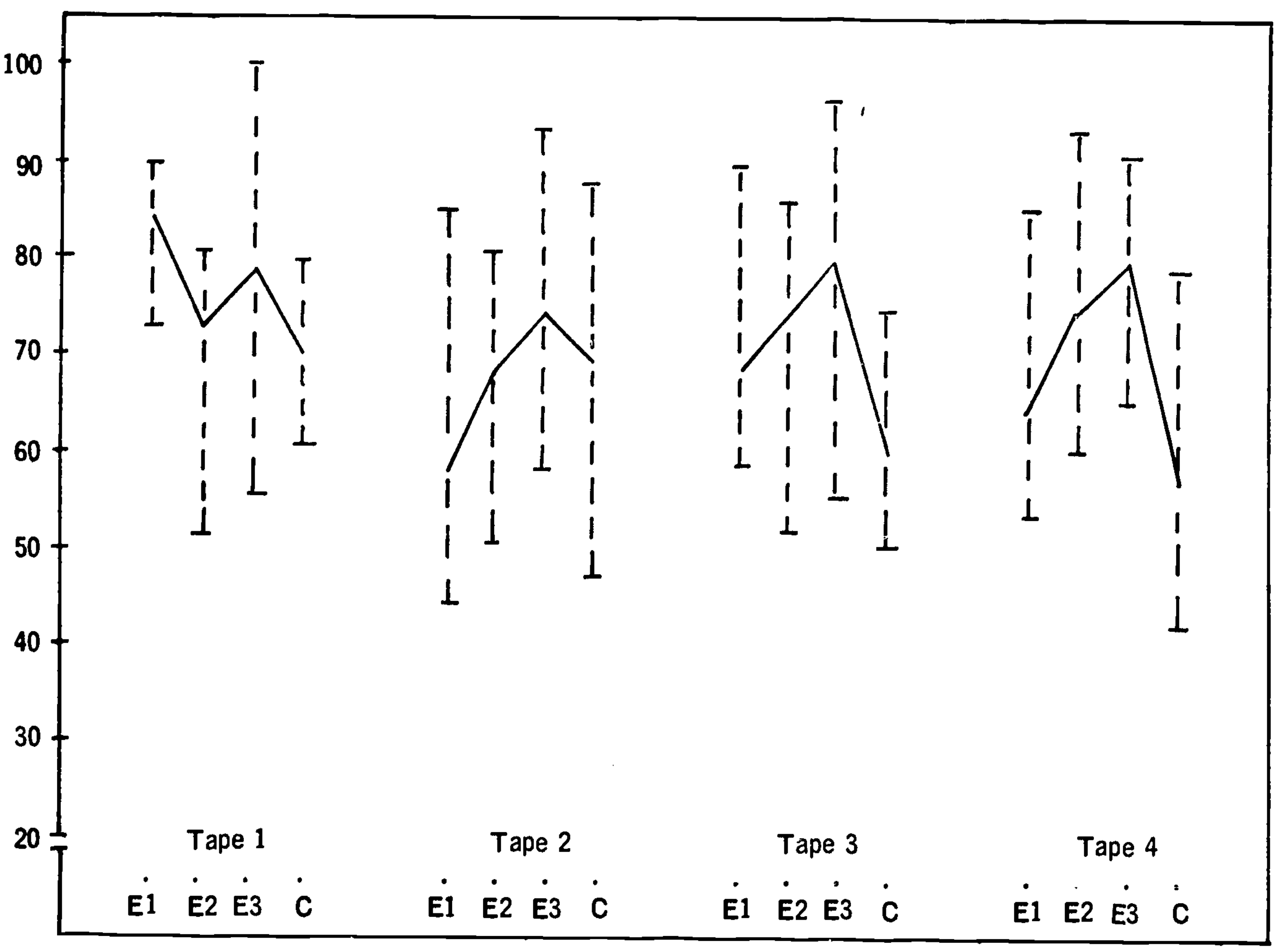


Figure 4 Participation

Note: In the above figures, each group is represented by range – the distance encompassed by dotted lines – and means – identified by line connecting groups.

Inspection of the content of the tapes supported the impression gained from the graphs and suggested that the discussion content of the control group (C) was relatively more meager than that of the three experimental groups. In the control group the thought units were shorter and less related to each other, there was less continuity, less building on previous ideas, and the content was less sophisticated.

Participation

Participation is an index of student involvement and of the extent of intellectual interchange between the teacher and the students and among the students. Generally speaking, the greater the number of students who are involved in a discussion, the more general the effects of the training.

An index of the percentage of participation was obtained by dividing the number of students who responded by the total number present for the discussion. These data are presented in Figure 4. The percentage of participation seemed relatively high throughout, ranging from 42% to 100%. In Tapes 1 and 2 the extent of participation was approximately the same for the experimental groups (E1, E2, E3) and the control group (C) although in Tape 2 E1 was lowest. Tapes 3 and 4 did show a consistent trend. In both tapes the mean participation for the control group was lower than those of the experimental groups. However, the percentage of participation in E3 was higher than in E1 or E2. This may be partly accounted for by the fact that E3 included one extremely able and verbal class under a rapidly talking teacher. The E3 teachers also used the curriculum guides that suggested the desirability of open-ended auestions and the involvement of all students. It is also possible that, in the earlier discussions, trained teachers tended to constrain participation by overconscientious expectations regarding levels of performance.

In the control group participation decreased steadily from Tape 1 to Tape 4. The amount of variability in classes within the same group was approximately the same on all tapes.

It is interesting to note that while the number of thought units increased toward the fourth tape, the percentages of participation did not increase proportionately. This might mean that a nucleus of participants became more voluble, as evidenced also by the appearance of chains of reasoning in later tapes (see p. 175).

Teacher Gives, Teacher Seeks, Child Gives

Teacher seeking (TS) included mainly the pedagogical functions addressed to generating thought. Generally these functions consisted of questions asked by the teacher. In rare instances, the teachers did seek responses pertaining to management of the class or of the discussion.

In contrast, the category of teacher giving (TG) included a variety of pedagogical and managerial functions: supplying information; reiterating student responses for the entire class to hear; controlling thought; agreement and disagreement; directing the process of discussion; and establishing discipline.

Students participated little in managerial functions. Their giving was therefore devoted primarily to responding to teacher questions and to supplying substantive thought.

Table 17 showed that the largest proportion of the total classroom interaction was absorbed by student responses. In all groups, student responses exceeded remarks made by teachers except for groups E1, E2 and C on Tape 1, and E3 on Tape 3. Teachers in all groups also tended to give with greater frequency than they sought and in Tapes 3 and 4 the untrained teachers tended to seek proportionately less than did the trained teachers.

As Figures 5, 6, and 7 show, no patterns were evident. All groups looked approximately the same on these variables. On Tapes 3 and 4 student responses in groups E1 and E2 increased slightly and teacher giving decreased slightly.

Levels of Cognitive Operations

Only the data on Tapes 2, 3, and 4 were used in tabulating the results on thought levels. The seven thought level codes were combined into three levels, as follows: (a) the concrete level (codes 1 - 3), which contained both the giving of concrete information, and the use of this information for explaining; (b) the simple abstraction level (code 4), which contained simple generalizations; and (c) the highly abstract level (codes 5, 6, and 7) which was comprised respectively of generalizations used for explanation, compound generalizations, and logical inferences.

Figure 8 portrays the relationships between thought levels by tape. The expected relationships are such that the lines representing the different groups should cross. For example, one would predict that groups E1 and E2 would have the lowest percentages of thought levels coded 1 - 3 and the highest percentages of thought levels coded 5, 6, and 7.

Tape 2 provided mild support for the hypothesis. Although group differences with regard to low level thought were slight, groups E1 and E2 showed the lowest values there whereas these groups showed substantially more high level thought. The Tape 3 data strongly supported the hypothesis; groups E1 and E2 showing much less low level thought and much more high level thought than did groups E3 and control. The Tape 4 data provided no support for the hypothesis in that all groups were similar except for the E3 group which showed much more low level thought. These patterns were very

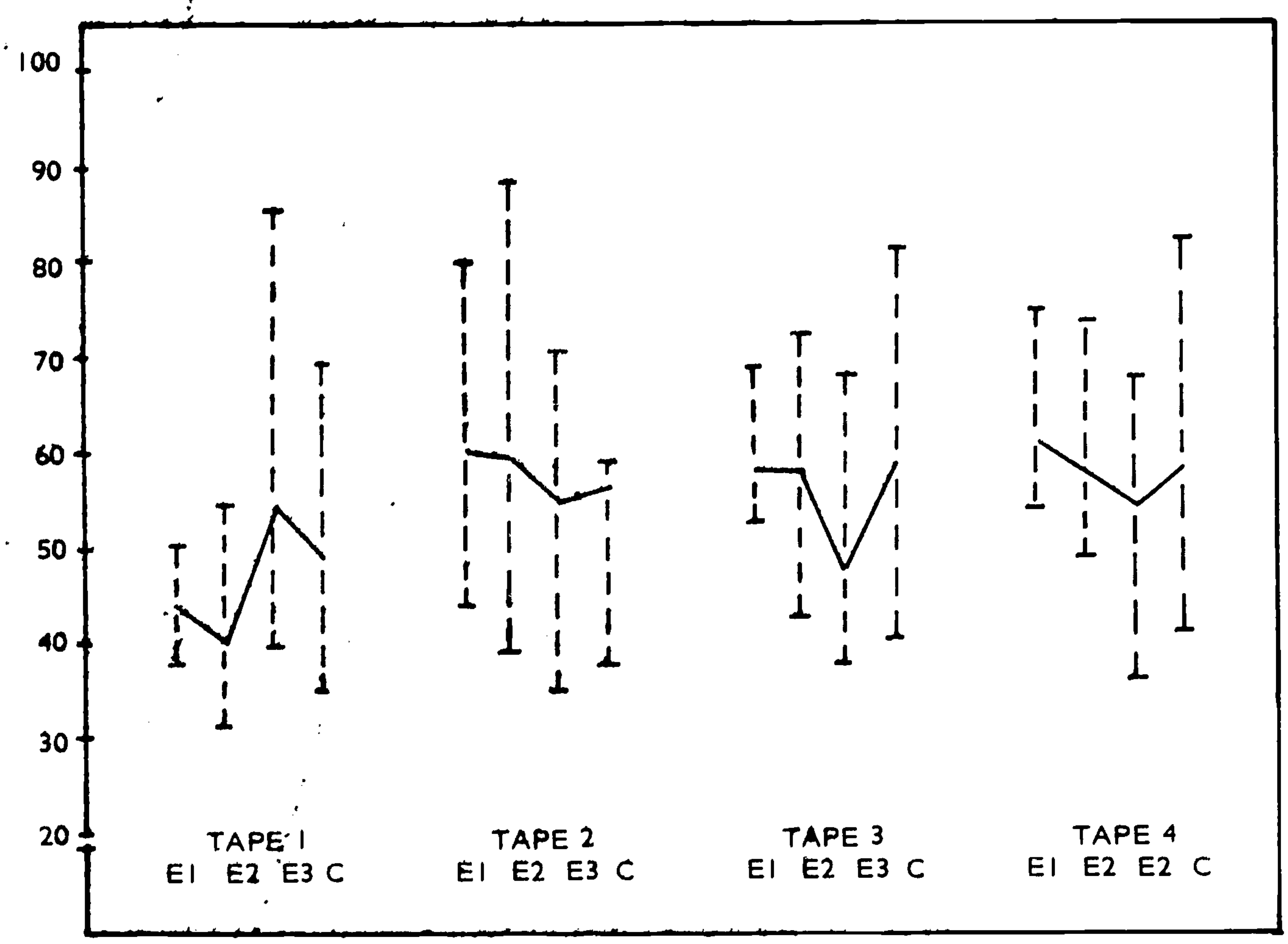


Figure 5 Child Gives

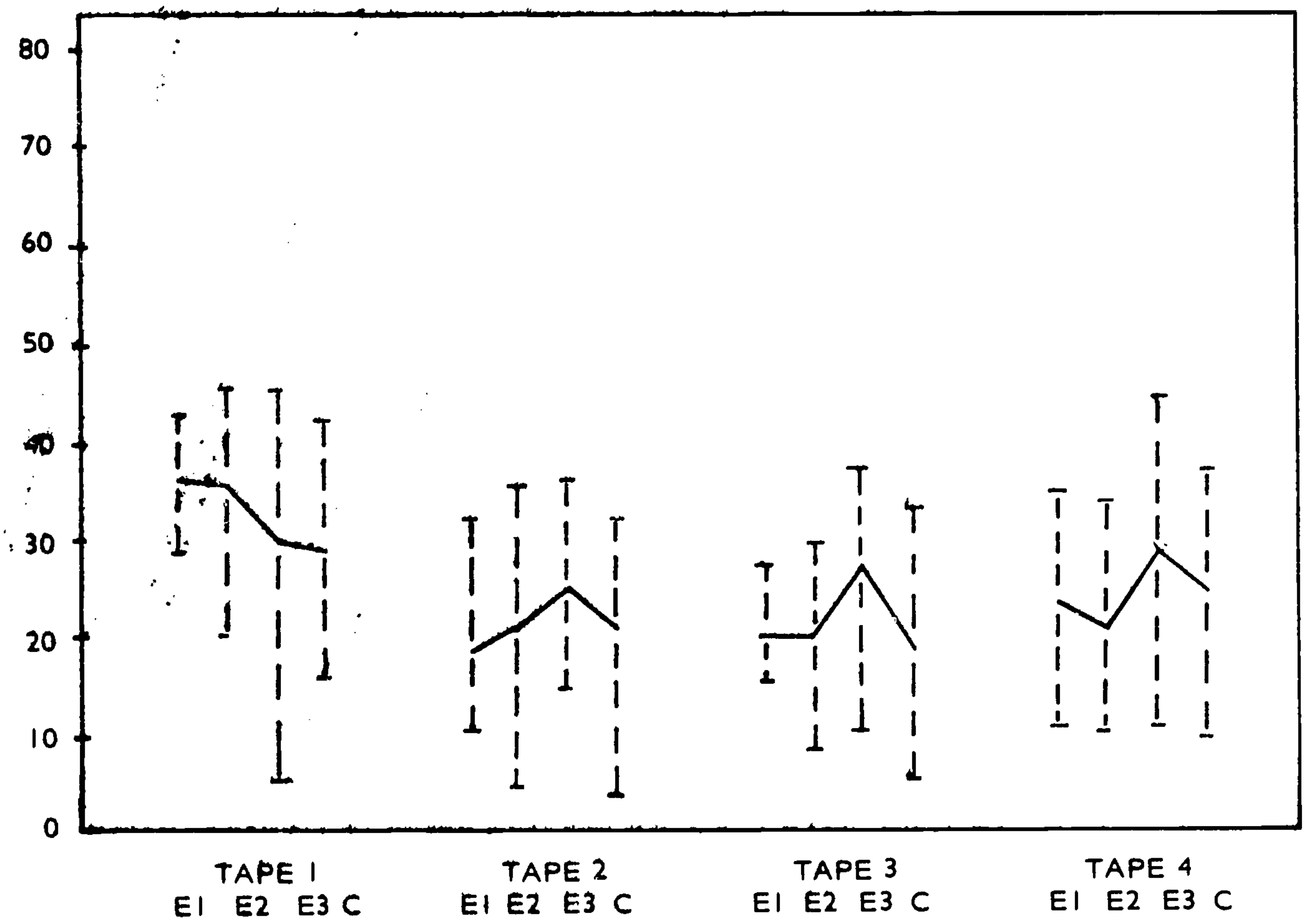


Figure 6 Teacher Gives

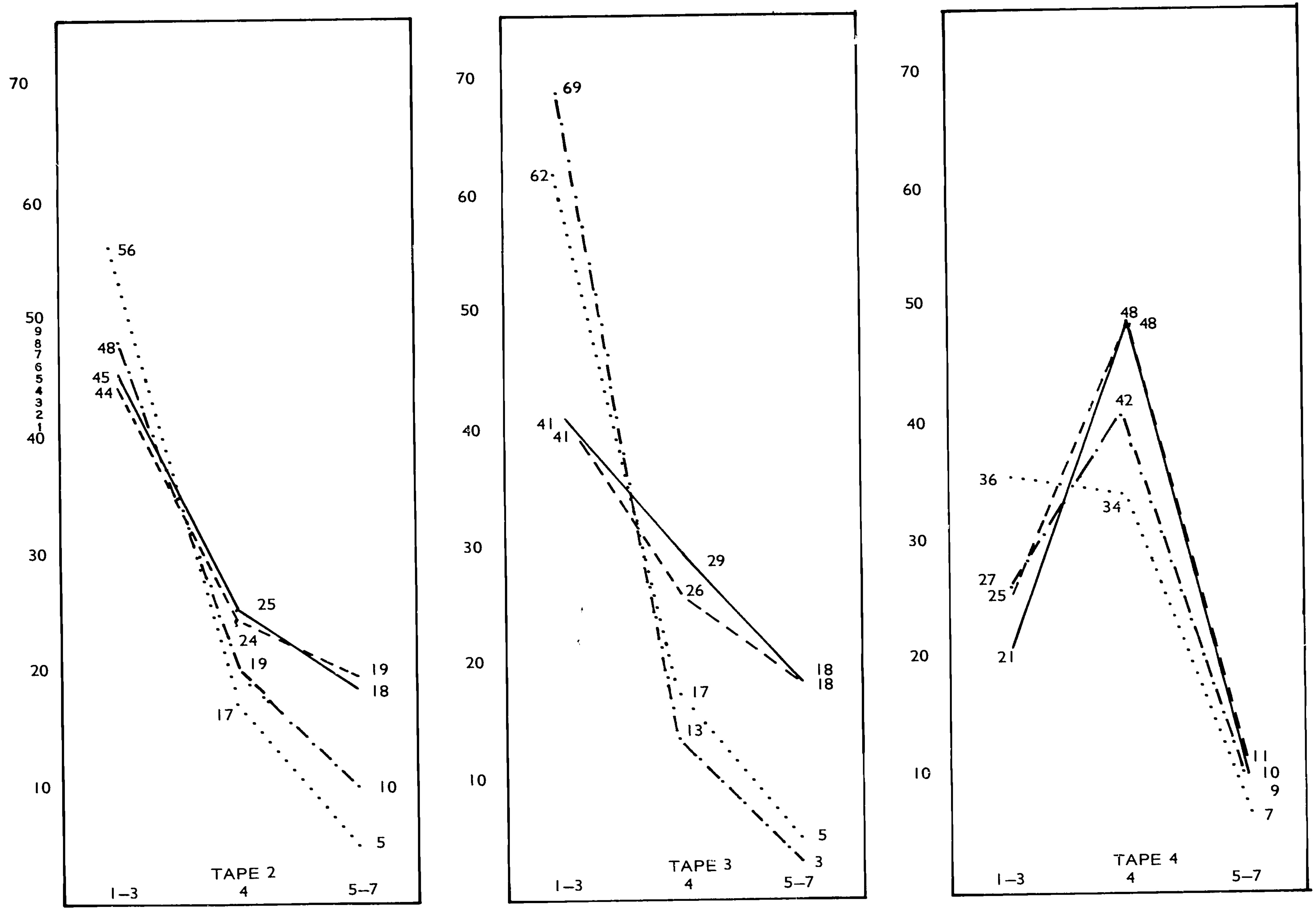


Figure 8 Percentages of "Child Gives" Thought Units by Three Levels.

E1 ——— E3 . . . . . .
E2 — — — C . — . — . —
All Grades Combined

similar in all grades except for Grade 4, Tape 2, in which the relationship was reversed, i.e., the control group showed less low level thought than did the three experimental groups.

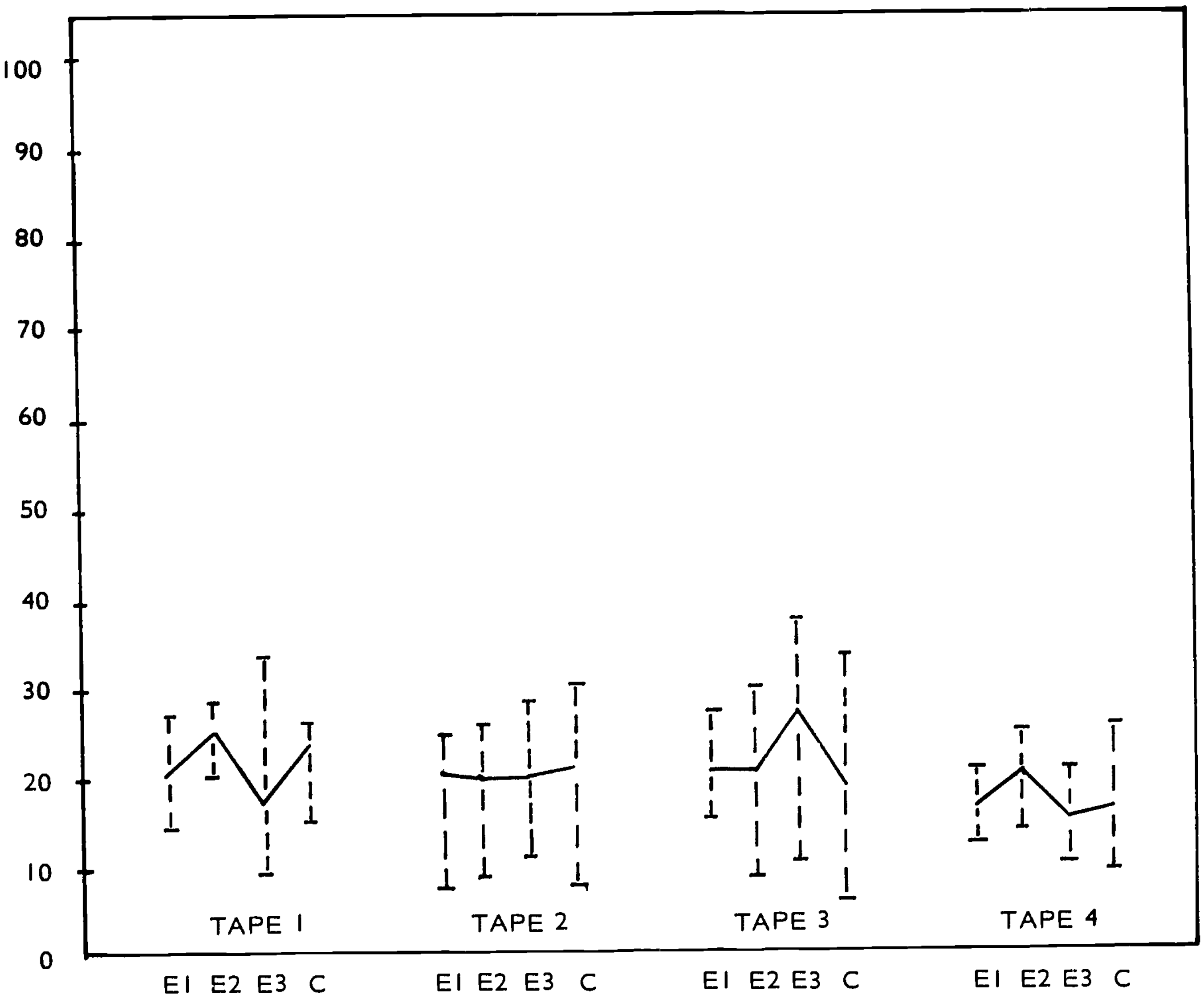


Figure 7 Teacher Seeks

Inconclusive as these data were, the trends were consistent with what one would have expected from the nature of the dynamics of each cognitive task. Tape 3 involved comparative interpretation of complex data in which it was difficult to arrive at reasonably high level inferences without a disciplined and orderly strategy – inferences had to be data-bound and produced on the spot.

In contrast, Tape 2 had involved an interpretation of a film. In this process it was possible to generalize without previous analysis of data and to use generalizations from recall. These latter were not differentiated in the coding system.

Inspection of the topics pursued in discussing the film supported the conclusion that the untrained groups produced many low level generalizations not too closely tied to the facts in the film, while the trained groups tended to limit their generalizations to what could be inferred from information in the film. Also, groups E3 and C tended to confine their discussion to the more obvious matters such as the specific processes the witch doctor used to cure a sick boy, while groups E1 and E2 dealt also with such matters as the role of superstitions in the culture, the conditions under which cultural habits change, and the reasons for their changing slowly.

Further, the meaning of the production of low level thinking differed depending on the function that this descriptive information served in a given discussion sequence: in one case, it might be a necessary antecedent to producing generalizations, in another it might be offered for its own sake. Again, the scoring scheme did not distinguish these two types.

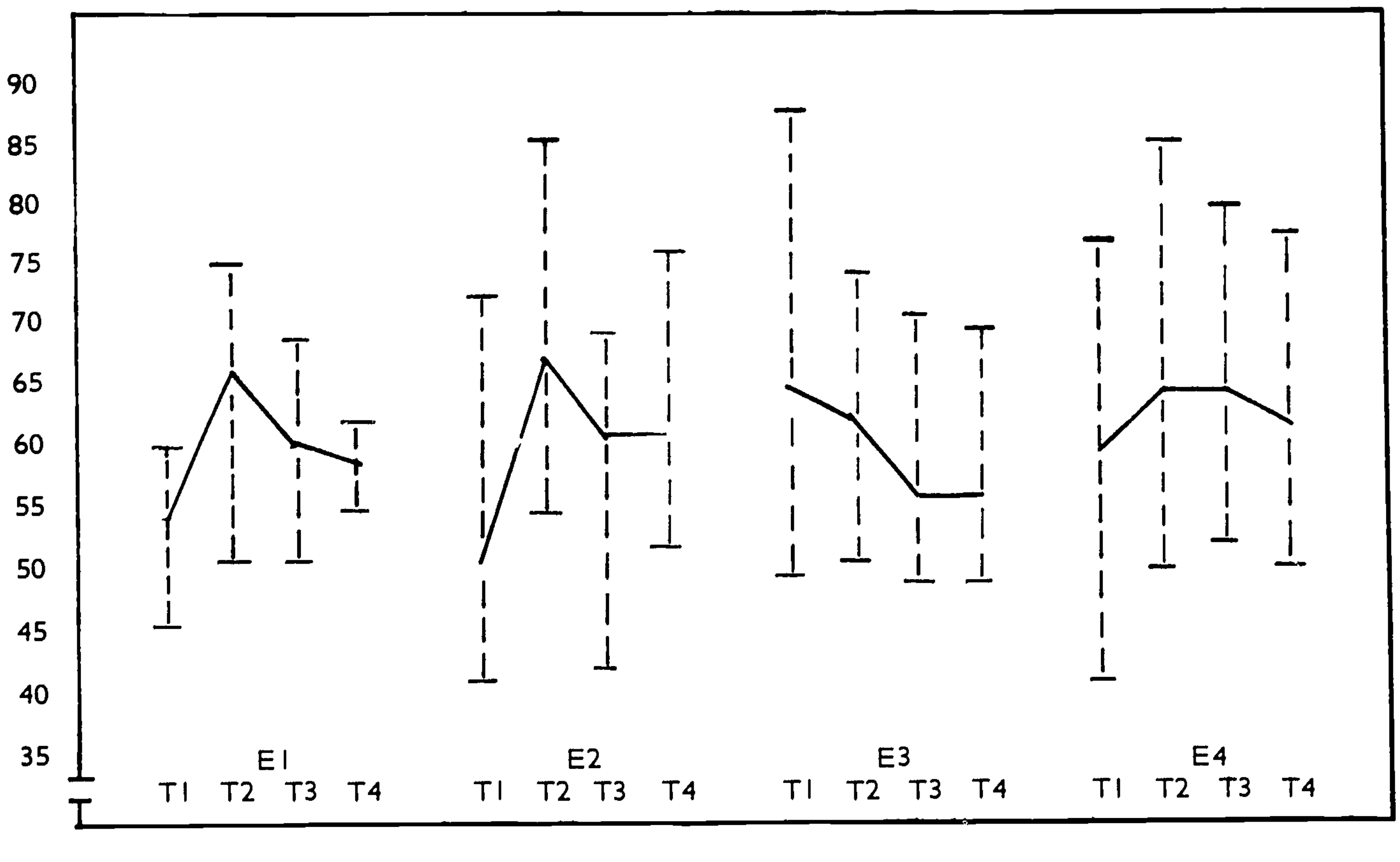
Still other factors were at play in Tape 4 in the task of applying facts and principles. Here, the focusing question imposed a minimum of data constraint. Examination of the tapescripts revealed considerable amounts of predicting in the control group that amounted to a fanciful storytelling - "what <u>might</u> happen if . . ." - in contrast to "what <u>is likely</u> to happen if . . .". Prediction is also the first step of the task and, as such, usually produces higher frequencies. The fact that all predictions were defined as inferences and therefore coded as high level thinking (Code 4) increased the proportion of high level thought for the groups that did less supporting and validating of their predictions. This amounted to a distortion of the meaning of good thinking, which in this task involved the ability to make reasonably data-constrained predictions, to support them, and to establish their validity.

Substantive, Managerial and Reiterative Thought Units

Substantive thought units are those that deal with the content and the cognitive focus of the discussion. Managerial thought units contain remarks addressed either to management of the discussion processes per se or control of conduct. Reiteration indicates repetitions of statements made in any part of the preceding discussion,* and may apply either to substantive or managerial thought units.

The percentage of each type of thought unit was obtained by dividing the frequency of the type (teacher and child, combined) by the total number of thought units.

Figures 9, 10, and 11 give the percentages of the substantive, managerial or non-substantive, and the reiterated thought units that teachers gave and sought.



In all groups, the substantive thought units constituted the major proportion of interchange, especially if one considered that reiterations were addressed also to substantive thought.

* These figures excluded the thought units that were coded as irrelevant to the focus or incorrect. The frequency of these thought units was small across all tapes and all groups.

On Tape 1, in which the task was the grouping and classification of items from recollection, fewer substantive thought units were produced by the two groups with trained teachers than by the groups with teachers that had had no training. The observers records showed that the trained teachers were quite conscious of establishing procedures in this first discussion of the year. Mechanics such as writing items on the chalkboard and color-coding them for grouping magnified the managerial activity at the expense of substantive interchange, and was reflected in a larger proportion of managerial and reiterative thought units.

These proportions tended to change in Tapes 2 - 4. The proportions of substantive thought units shifted upward for groups E1 and E2 and downward for E3 while they remained the same for the control group.

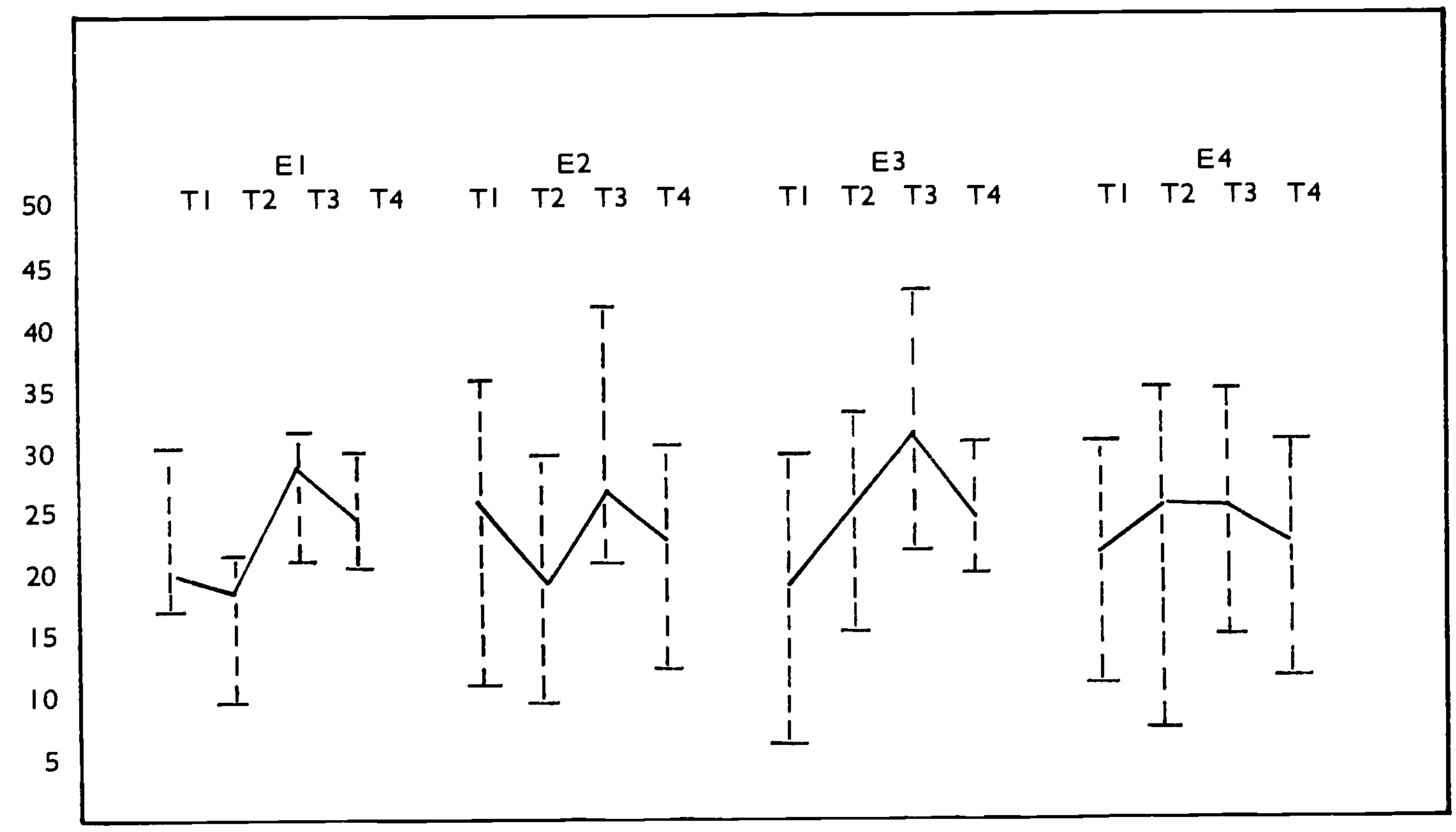


Figure 10 Percentages of Non-Substantive Thought Units

Of the four tapes, managerial or non–substantive functions were most frequent in Tape 3 in all groups. The trained teachers were the least directive on Tapes 2 and 4. The control group remained about the same on all tapes. These movements, however, were not very marked, and there were no special trends across tapes.

Reiterations, (Figure 11), may be a habit in some teachers or an effort to make students' comments audible to other students or the tape recorder. Hence, the meaning of the percentages of reiterations was not entirely clear. In the experimental groups the reiterations were the highest in Tape 1. A fair portion of these repetitions was probably part of writing it on the chalkboard. In Tape 4 reiterations were used in large measure to summarize in order to help students get perspective on divergent predictions.

While the particular reason for using reiterations may differ from group to group, the frequencies were practically the same.

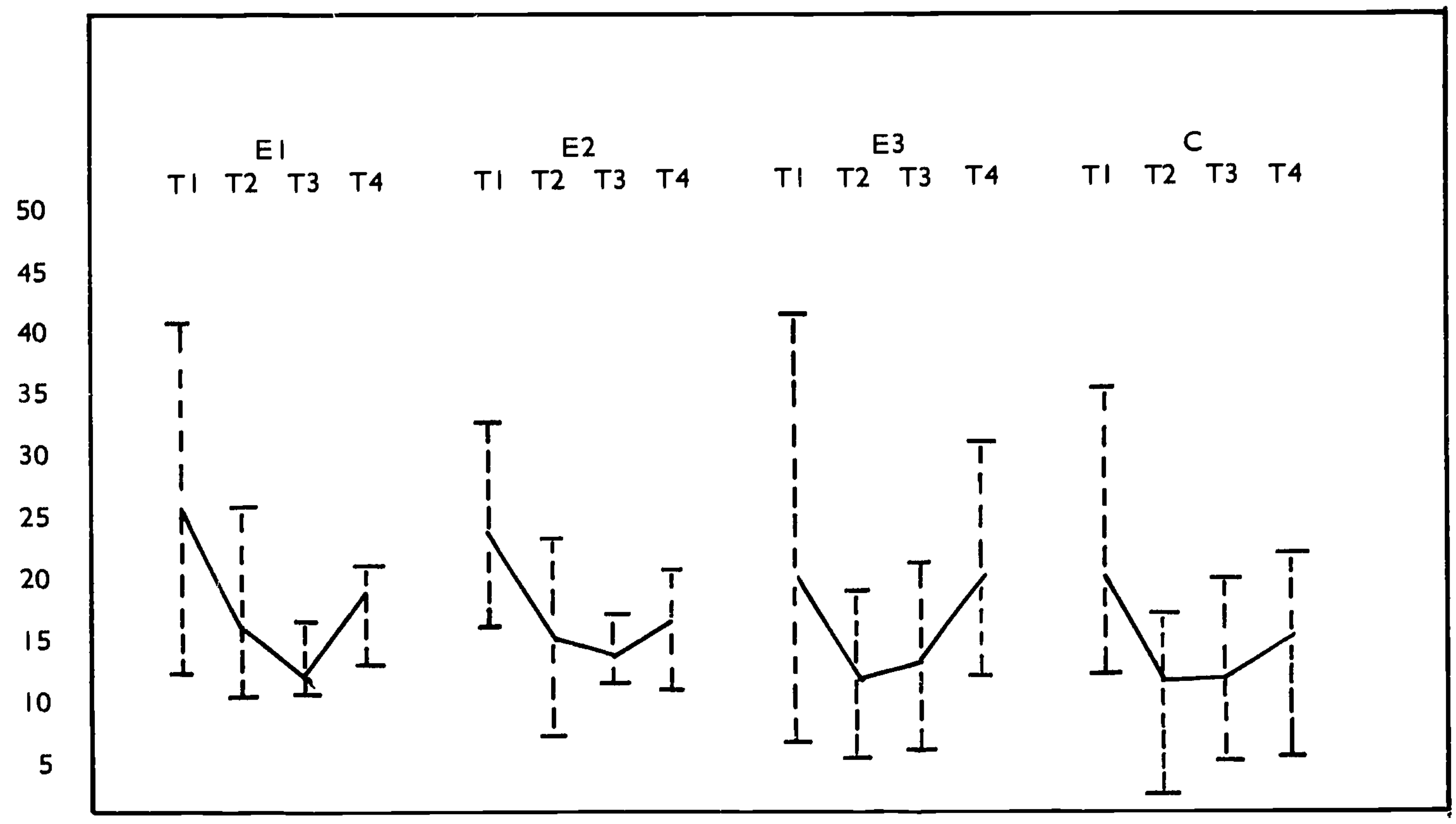


Figure 11 Percentages of Reiterated Thought Units

Generally, then, the trends across all three variables described above were inconsistent and showed no differences sufficiently large to be important.

Predictions and Support

Tape 4 constituted a special case because, in this task, it was impossible to assign a hierarchical order to the three steps of the process - (a) predictions, (b) support of predictions, and (c) validation of their generality and universality. For the above general analysis of thought levels the scheme of coding all items by levels from 1 - 7 that had been developed for Task 2 was used.

To describe the cognitive operations peculiar to this task, another analysis was performed. Table 18 shows the percentages of the modifications of the original conditions (Cp), of predictions (P), and of support or validation of predictions (Su). The support was further broken down into factual (F), inferential (I), and logical-inferential (Lo) types. The percentages of Cp were derived from the total thought units given by students. The percentages of predictions and of support were derived by dividing the number of predictions students gave by the total thought units they gave.

All groups attempted to modify the conditions set in the focusing question. The proportions of these modifications in comparison to the quantity of predictions was similar in all groups.

In all groups there were many unsupported predictions because the proportion of predictions exceeded that of supporting statements. The proportion of support to prediction was about the same in all groups. All groups, except for E1 which used the logical-inferential support most frequently, also favored factual support. Of

Table 18

Percentages of Predictions and Types of Support Given
by Students

	Total	Cp		P		Su		SuF		SuI		SuLo		Unclassif.	
	T. U.	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
E1	2054	184	9.0	1128	54.9	660	32.1	212	31.2	183	27.7	265	40.1	81	3.9
E2	1744	104	6.0	949	54.4	560	32.1	253	45.2	159	28.3	148	26.4	13[illegible]	7.5
E3	1715	120	7.0	809	47.2	502	29.4	220	43.8	110	20.1	172	34.3	2[illegible]4	16.6
C	954	97	10.2	474	49.7	302	31.7	147	48.7	71	23.5	184	27.8	80	16.6

Key: T. U. = Thought Units
Cp = Modification of Conditions
P = Predictions
Su = Support
SuF = Factual Support
SuI = Inferential Support
SuLo = Logical Support

the groups, E1 and E2 used inferential support most frequently and E3, the least frequently.

In all groups there were variations among grade levels in practically all categories. These ranges showed no particular trend, which suggested that idiosyncracies of teachers and of classroom groups were operating.

Also, inspection of the tapescripts revealed a greater variety of teaching strategies in Tape 4 than was apparent in Tape 3. These strategies included, in some cases, creating analogies and, in others, models. Some teachers encouraged fairly direct vertical piling up of predictions, while others explored many side effects. It would seem that the nature of this task encouraged this variety.

Analysis of Types of Predictions

A further analysis was made of types of predictions students made. Some predictions were not causally connected to the focus event (Po). Other predictions concerned its immediate consequences (Py), while still others were longer causal chains and were its distant consequences (Pz). These results are shown in Table 19.

Table 19

Percentages of the Types of Predictions Students Made

	P	Po		Py		Pz		Unclassif.	
	No.	No.	%	No.	%	No.	%	No.	%
E1	1128	119	10.9	776	70.6	197	17.8	36	3.2
E2	948	150	17.3	544	62.6	171	19.7	84	8.9
E3	809	56	7.3	609	78.8	94	12.3	51	6.3
C	474	106	24.3	296	67.8	34	7.8	38	8.0

The control group showed the highest proportion of unrelated predictions (Po) and E3 showed the lowest. There were only small differences in groups under trained teachers with regard to the proportion of predictions addressed to immediate consequences of the focus event, and these percentages showed no consistencies. However, groups with trained teachers exceeded the other groups in making predictions that involved long causal chains.

Complex Chains of Reasoning

Sequential reasoning is a better index of quality of thinking than is frequencies by level. First, sequential reasoning offers proof that generalizations were produced in class, rather than rendered from recall. Also connected thought in itself represents a more sophisticated form of thinking than do single statements, regardless of the level at which they occur.

To analyze the occurence of sequential thought, the complex chains or logically coherent sequences of thought units developed by the same individual were identified. These chains were logically-connected thought paragraphs that contained factual information, inferences drawn from these data, and inferences upon inferences. Being a product of one individual's attempt to develop an idea, the chains represented his way of initiating and carrying on an intellectual operation of some length without aid from teacher questions, as shown in the excerpt below:

> Well, part of the reasons for (differences in education) that this is so is that Brazil and Argentina, Costa Rica and Guatemala have had more stable governments than Haiti/. So the government has been able to spend its money on education/. But in Haiti the people have always tried to take over a dictatorship/. So they have not been able to spend as much time and money on education.*

* The slanted lines represent divisions of thought units.

Data for the complex chains in the four groups are shown in Tables 20, which refers to Tape 3, and 21, which refers to Tape 4.

Table 20 shows that the frequency of complex chains was much higher in the two groups with trained teachers than in the groups with untrained teachers. In the processes of interpreting data and making inferences, the groups with trained teachers (E1 and E2) produced more than twice as many chains as did the groups with untrained teachers. They also tended to produce chains of greater length, which in some cases included as many as ten thought units. The control group was especially low in production of complex chains, particularly in grades four and five. In all three grades the groups with trained teachers produced more complex chains than did groups with untrained teachers. This trend was most pronounced in chains that contain five or more consecutive thought units. (The exceptions in the sixth grade were produced by one control teacher who not only mastered the technique of open-ended discussion but also had access to the curriculum guides and the material on teaching strategies for the cognitive tasks).

The same pattern prevailed, in the main, on Tape 4 as shown in Table 21. Here, chains pertained to making predictions and then either to supporting them through facts or logical inference or to evaluating their validity and/or universality. In this process, the differences between the groups under trained teachers and those under untrained teachers are less marked. The students under trained teachers produced only 1.5 times as many chains as did the latter. All experimental groups (E1, E2, E3) produced more chains of greater length, especially in grades four and five. No particular tendency was discernible by grade levels.

Table 20

Complex Chaining in the Four Groups - By Grade

Tape 3

	Chain Length	E1	E2	E3	C
Grade 4	3	52	20	25	2
	4	15	9	10	2
	5 and over	19	1	5	3
	Total	86	30	40	7
Grade 5	3	43	36	20	8
	4	14	24	9	4
	5 and over	5	10	2	0
	Total	62	70	31	12
Grade 6	3	40	60	16	17
	4	13	33	12	7
	5 and over	8	27	1	14
	Total	61	120	29	38
Grand Total		209	220	100	57

Table 21

Complex Chaining in the Four Groups – By Grade

Tape 4

	Chain Length	E1	E2	E3	C
Grade 4	3	37	21	25	12
	4	27	7	11	7
	5 and over	42	8	13	5
	Total	106	36	49	24
Grade 5	3	50	28	35	12
	4	25	27	23	0
	5 and over	23	16	26	1
	Total	98	71	84	13
Grade 6	3	38	33	24	22
	4	19	20	17	12
	5 and over	18	15	19	18
	Total	75	68	60	52
Grand Total		279	175	193	89

Aptitude Variable: Analysis of Thought Levels in Relation to IQ

The study preceding this one (Taba, Levine, Elzey, 1964) suggested a low relationship between the IQ scores and the performance of the cognitive operations.

The procedure for determining the relationship between IQ and thought levels used in the present study was as follows: A distribution of IQ'swas obtained for all students and cutting scores were established for defining "high IQ" and "low IQ" groups by cutting at the first and third quartiles. The cutting scores for high and low IQ's were 124 and 102 respectively. To designate thinking levels, combined thought levels 4 through 7 were defined as high level, and categories 1 through 3 as low level.

The relationship between thinking level and IQ is shown in Figures 12, 13, and 14.

A major problem in this analysis was the fact that the proportion with high and low level IQ students differed markedly from class to class as shown in Table 22. One fifth grade class in the E1 group had no students in the low level IQ range. The two sixth grade classes in the E3 group combined had only one student in the high IQ range, and the fifth grade classes in the same group had only two students in the low IQ range. The proportion of high IQ students was also low in the fifth and sixth grades of the control group. This disparity in IQ ranges limited the amount of high level thought possible in some classes.

In order to compensate for this disparity, the analysis was performed in two ways. First, the actual percentage of high and low level thought units produced by high and low IQ students in each of the four groups was utilized. A second analysis was performed by weighting these percentages in proportion to the number of students in each IQ category in the class. In a group which had few responses, hence a small

Table 22

Number of Students in Each IQ Group
Participating in Discussion
Tape 4

	High IQ		Low IQ	
	No. in Group	No. Participating	No. in Group	No. Participating
E1 - Fourth Grade	13	11	15	15
E2 - " "	12	10	11	10
E3 - " "	25	19	9	3
C - " "	13	10	13	7
Total	63	50	48	35
E1 - Fifth Grade	20	18	12	8
E2 - " "	16	14	12	9
E3 - " "	22	21	2	1
C - " "	10	8	28	14
Total	68	61	54	32
E1 - Sixth Grade	21	20	14	11
E2 - " "	20	19	8	8
E3 - " "	1	1	43	37
C - " "	8	7	18	15
Total	50	47	83	71
All Grades				
E1	54	49	41	34
E2	48	43	31	27
E3	48	41	54	41
C	31	25	59	36

percentage, and which contained very few high IQ students who gave the responses, the percentage was increased in relation to the difference between the frequency of high IQ students in this class and the total sample. Because the conclusions presented below were essentially the same for both analyses, the data from the adjusted analysis are not presented. Results are shown in Figures 12, 13, and 14.

The most obvious result in Figures 12 - 14 was the tendency throughout for the high IQ pupils to contribute more of high level <u>and</u> low level units than did the low IQ students, indicating a tendency of high IQ students to participate more.

In grade four (Figure 12), the most notable finding for experimental, in contrast to control, groups was that there was a greater spread between the high and low IQ pupils in the three experimental groups than in the control group. In the control group, the high and low IQ pupils appeared to be contributing equally to the high and low level responses. The difference between high and low IQ groups was much greater

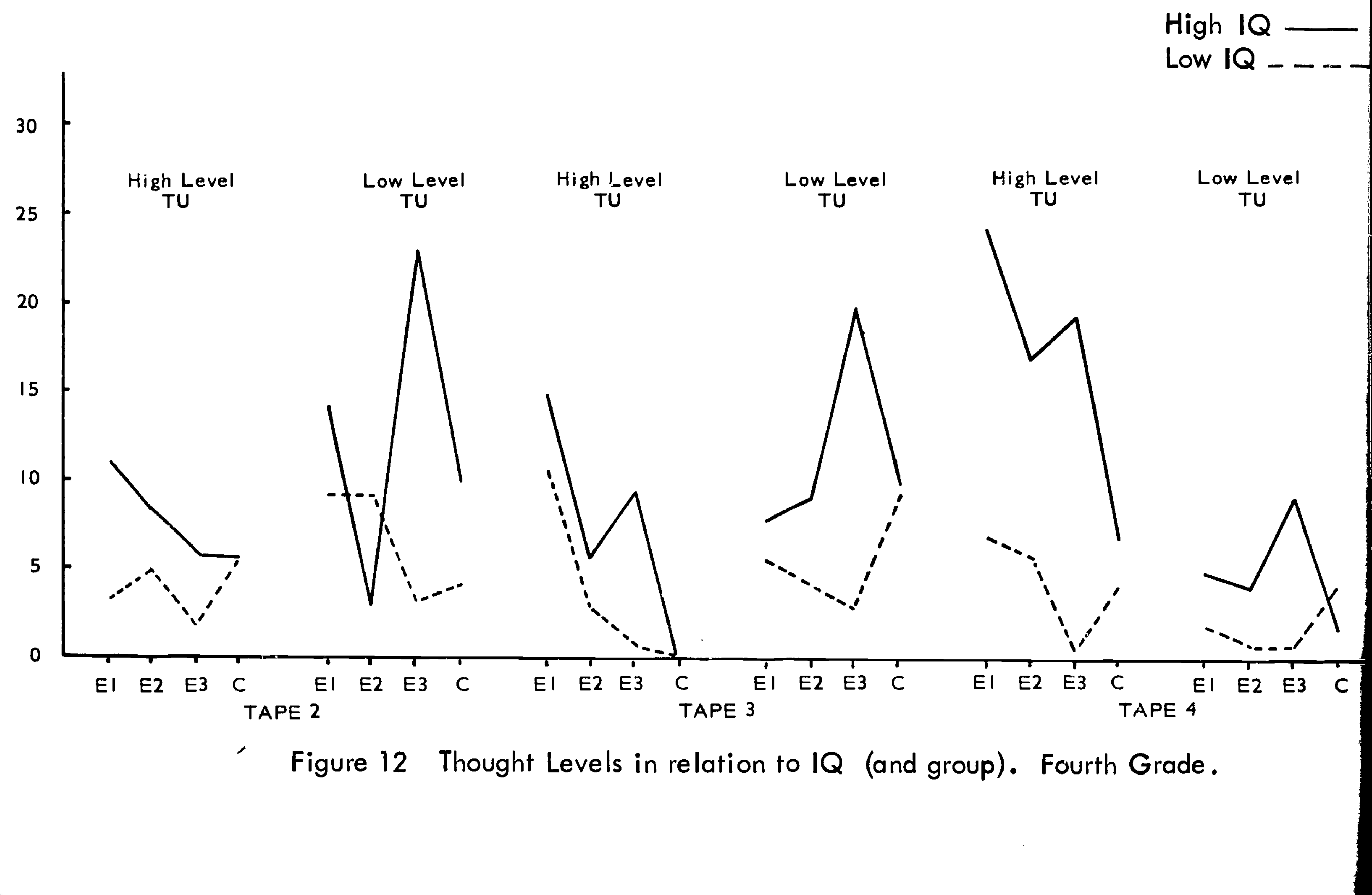


Figure 12 Thought Levels in relation to IQ (and group). Fourth Grade.

in the three experimental groups and was of approximately the same magnitude in both high and low level thought. The implication was that in the experimental groups the high IQ pupils were contributing more of both high and low level thinking.

In grade five (Figure 13), a similar pattern was found in that, within the control groups, the high and low IQ pupils were contributing approximately equal proportions of both high and low level thinking. Conversely, in the experimental groups, the high IQ students were contributing considerably more of both high and low level thinking than were the low IQ pupils within these grades.

In grade six, with the marked exception of group E3, the previously discussed patterns were found again. There were only slight differences between high and low IQ groups in both high and low level thought for the control group, whereas in groups E1 and E2, the high IQ pupils were contributing more of both high and low level thought than were the low IQ pupils. These results are diagrammed in Figure 14.

One very peculiar aspect of these data is found in group E3, grade six, where the differences between high and low IQ pupils were quite marked throughout but the reverse of what has been discussed. They suggested that the low IQ pupils were contributing much more of both high and low level thought. The explanation for this appeared to be the disparity between the number of the high IQ and the larger number of low IQ pupils to be found in the group.

There were certain variations according to grade levels, but considering the uneven distribution of the high and the low IQ students by classes and grade levels, these variations probably are not significant.

The greatest differences in performance between the high and low IQ pupils occurred in groups E1 and E3. The discrepancies in group E2 were generally smaller

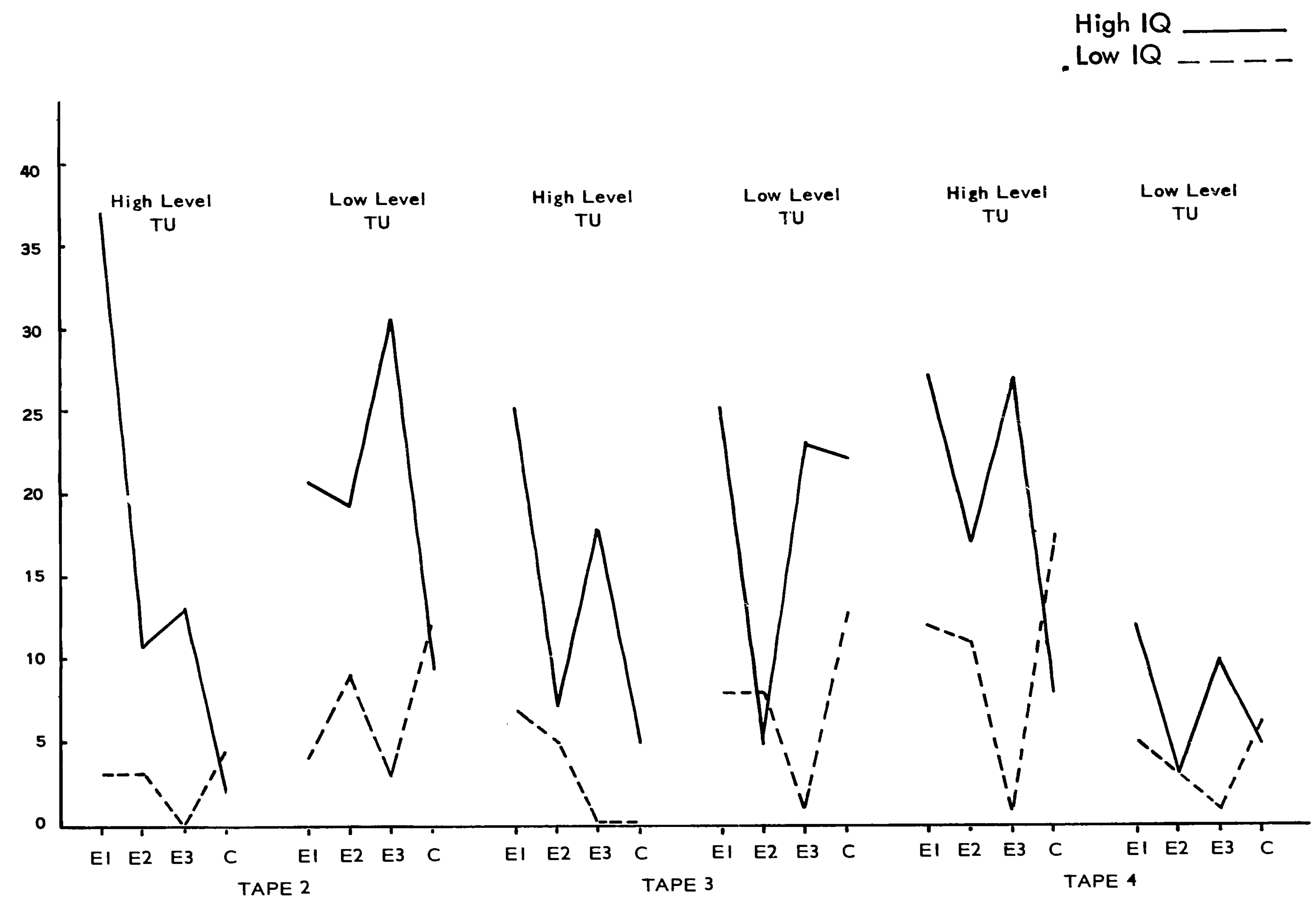


Figure 13 Thought Levels in relation to IQ and Group. Fifth Grade.

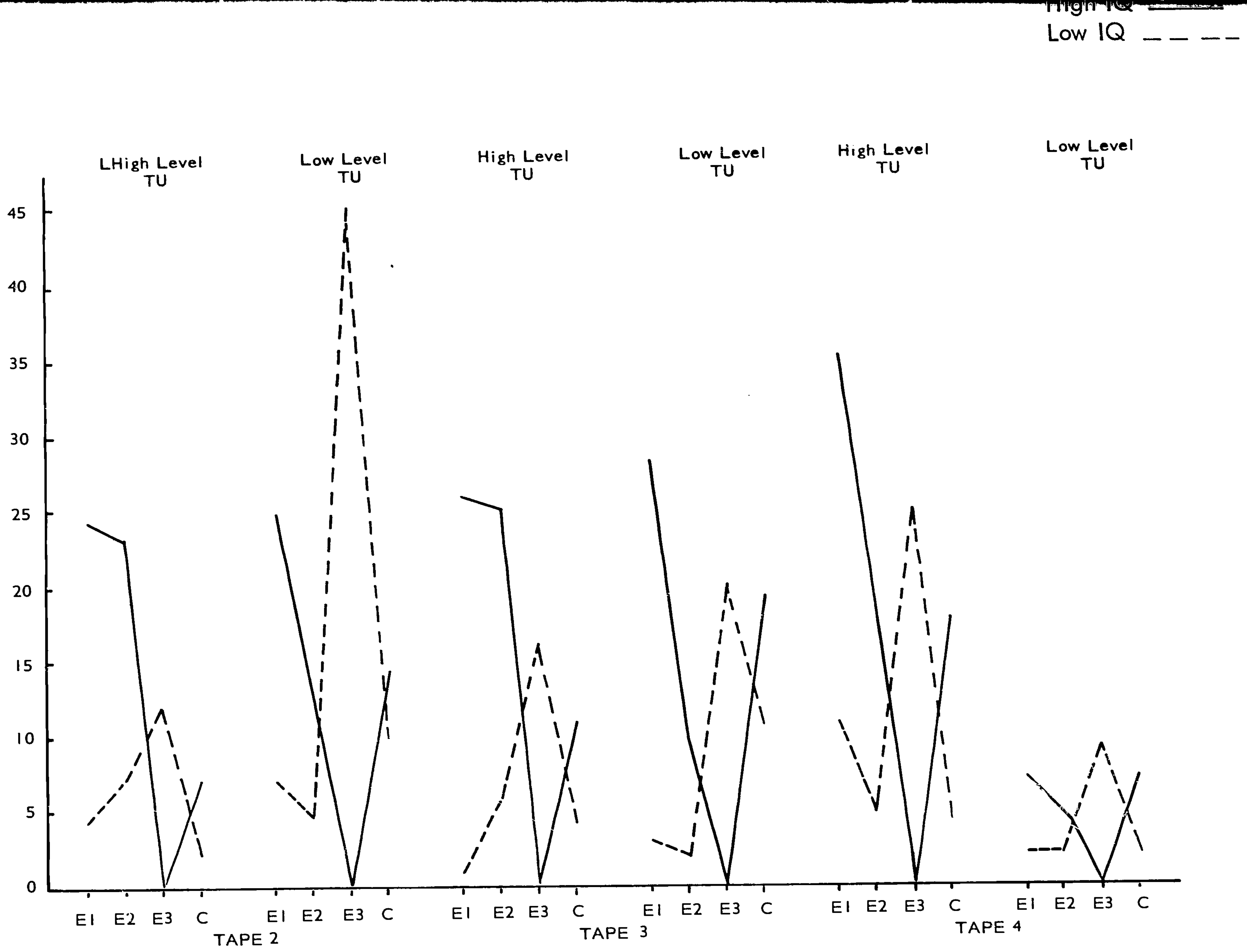


Figure 14 Thought Levels in relation to IQ and Group. Sixth Grade.

and, in some cases, were approximately equal to those in the control group.

Overall, it seemed reasonable to conclude that the experimental curriculum and teaching strategies fostered a greater incidence of both high and low level thinking on the part of high IQ students. In other words, if only the low IQ groups were considered, there did not seem to be a particular pattern or trend of differences between the control and the three experimental groups. In some instances the differences between the four groups were negligible. In others, patterns did appear but were not consistent. In contrast, there appeared to be a definite tendency for the high IQ pupils to produce a higher proportion of high level thought units in the experimental groups than in the control group.

This indicated that the high IQ students also tended to be what Gallagher (1965b) calls the expressive students. Their volume of contribution to classroom interaction was larger than that of students with a low IQ.

Relationships Among IQ, Tested Achievement (STEP Social Studies), Total Thought Units, and High Level Thought Units

In the preceding analysis we considered ability in relation to thought by identifying high and low IQ groups in each group. An alternate procedure was to correlate ability measures with thought measures within each class. These data are presented here. This analysis permits one to examine differences among classes as well as the overall relationship shown by the medians.

For each pupil a score reflecting his number of thought units and his number of high level thought units (defined as level four and above) was obtained for each of Tapes 2, 3, and 4. In addition, an IQ score and a STEP Social Studies Test score were available for each pupil. The intercorrelations among these measures were obtained for each of the three tapes.

The results for Tape 2 are shown in Figures 15 through 20. In each figure a separate distribution of the correlations was shown for each of the four groups, E1 through C. Within each of these groups the correlation for each of the six classes was plotted using different symbols for the three grades, four, five, and six. It will be noted that the correlation between IQ and tested achievement presented essentially the same picture across all groups and grades with the overall median being approximately .52, although the range across classes is from .18 to .82 (Figure 15). As seen in Figure 20 the correlation between total responses and high level responses was of considerable magnitude throughout the four groups. But it was considerably higher in the experimental groups E1 and E2 where the median value was in the .80's than in the E3 and control groups where the correlations were approximately .55. The range of correlations was from .33 to .95. There appeared to be no appreciable age or grade trends. Thus, there was a distinct tendency for high level responses to be produced by those children who talked the most. This is in part an artifact of the lack of independence of the two scores and, in addition, is to be expected.

As shown in Figures 16 and 18, there was a distinct tendency for the more able student (as indicated by IQ or achievement) to provide more thought units. The relationship was approximately the same in all groups, though the medians showed somewhat more variability on the achievement measure which also showed somewhat more variability from class to class. The range in median correlations with IQ was from .25 to .28 and with achievement, from .12 to .42.

With regard to the most interesting variables, i.e., high level thought in relation to IQ and achievement (Figures 17 and 19), there was once again a distinct tendency for the more able student to produce more high level thought units. The

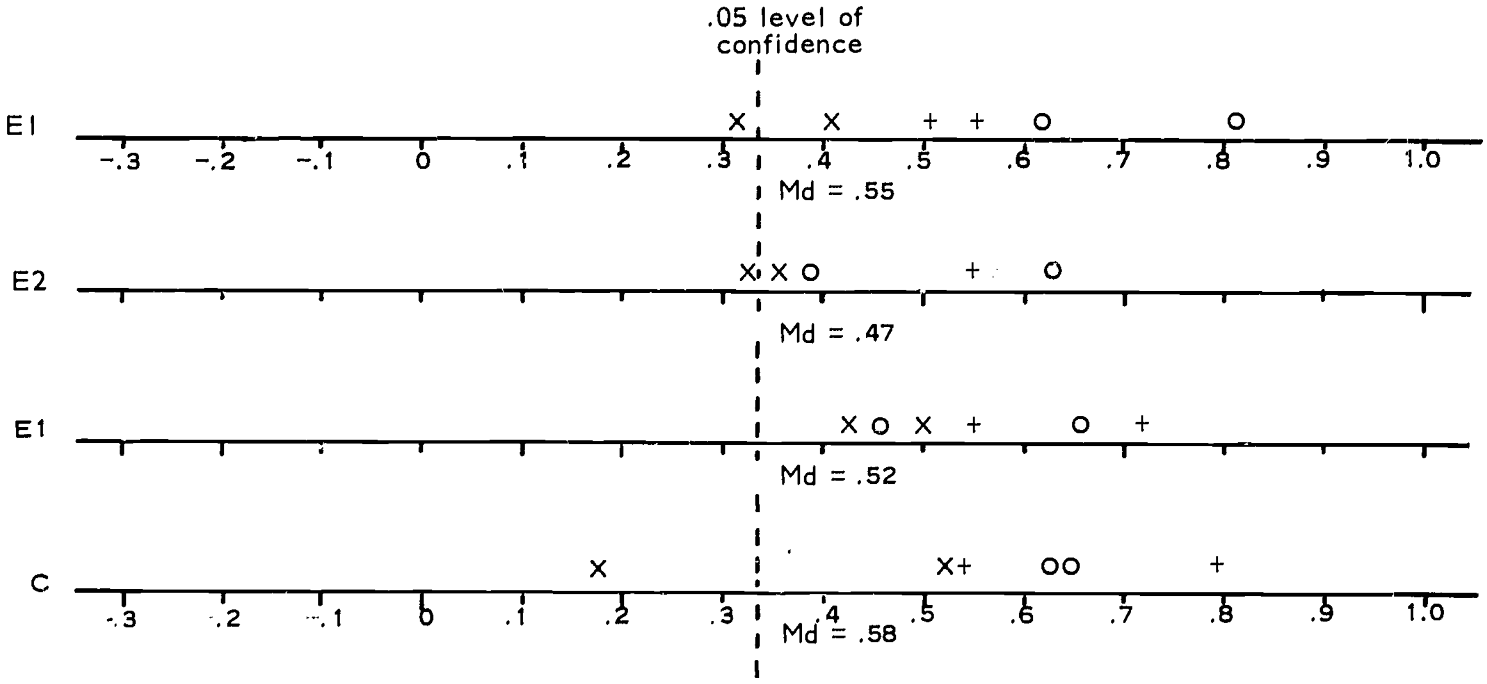


Figure 15 Correlation Between IQ and Achievement (Same for all Tapes)

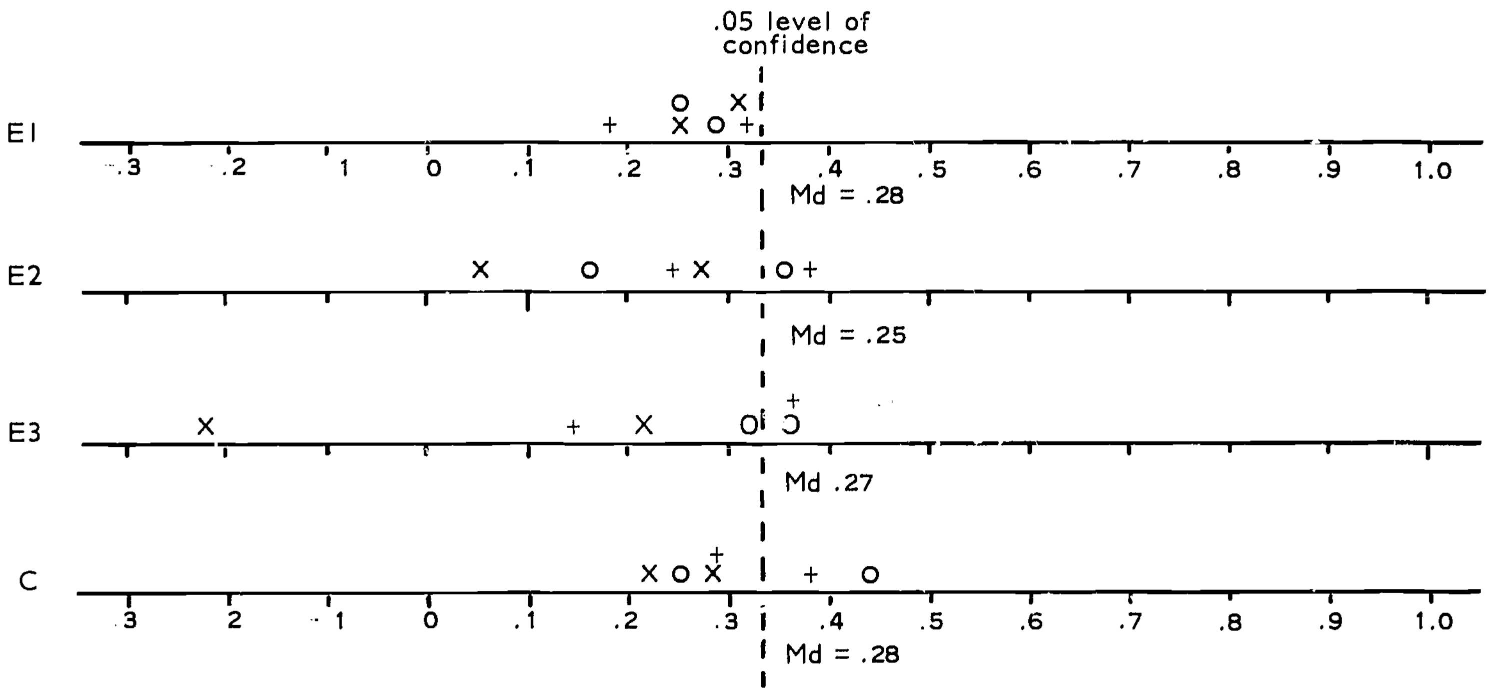


Figure 16 Correlation Between IQ and Total Response Tape 2

Key to Symbols: X = 4th Grade
o = 5th Grade
+ = 6th Grade

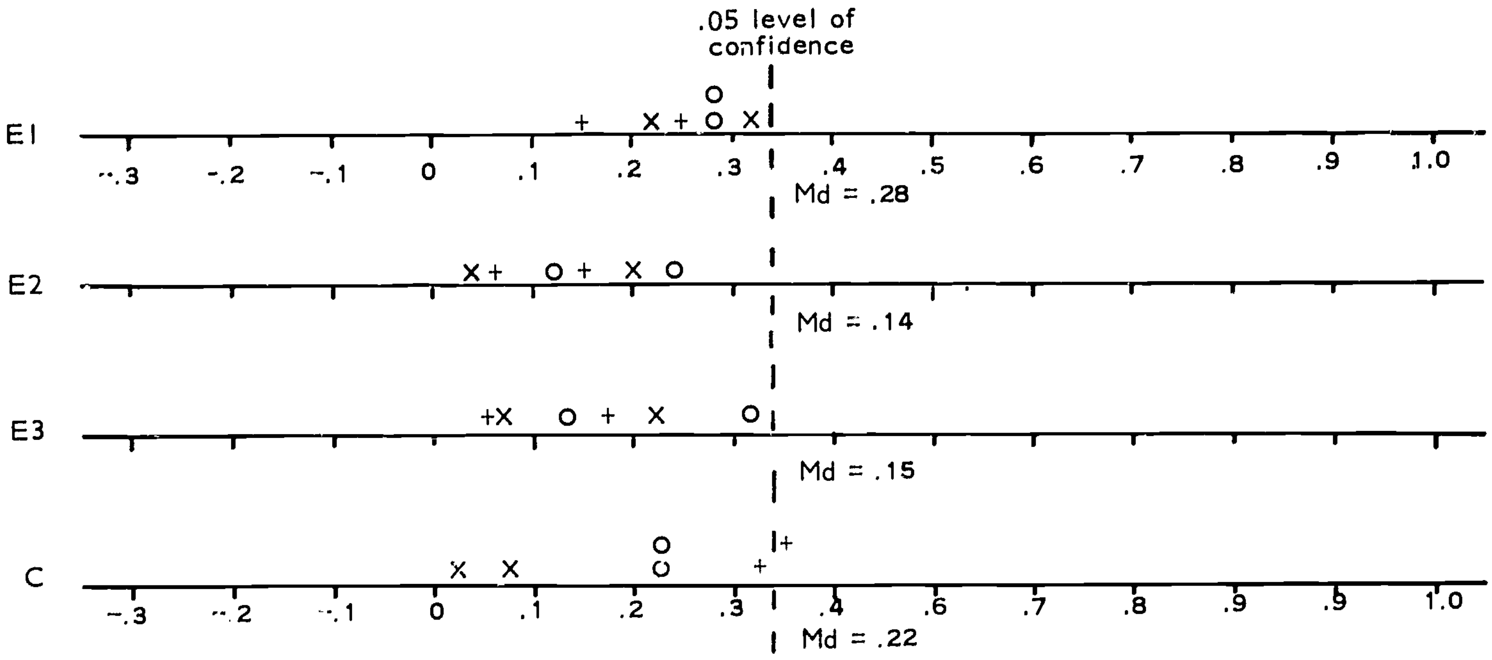


Figure 17 Correlation Between IQ and High Level Response Tape 2

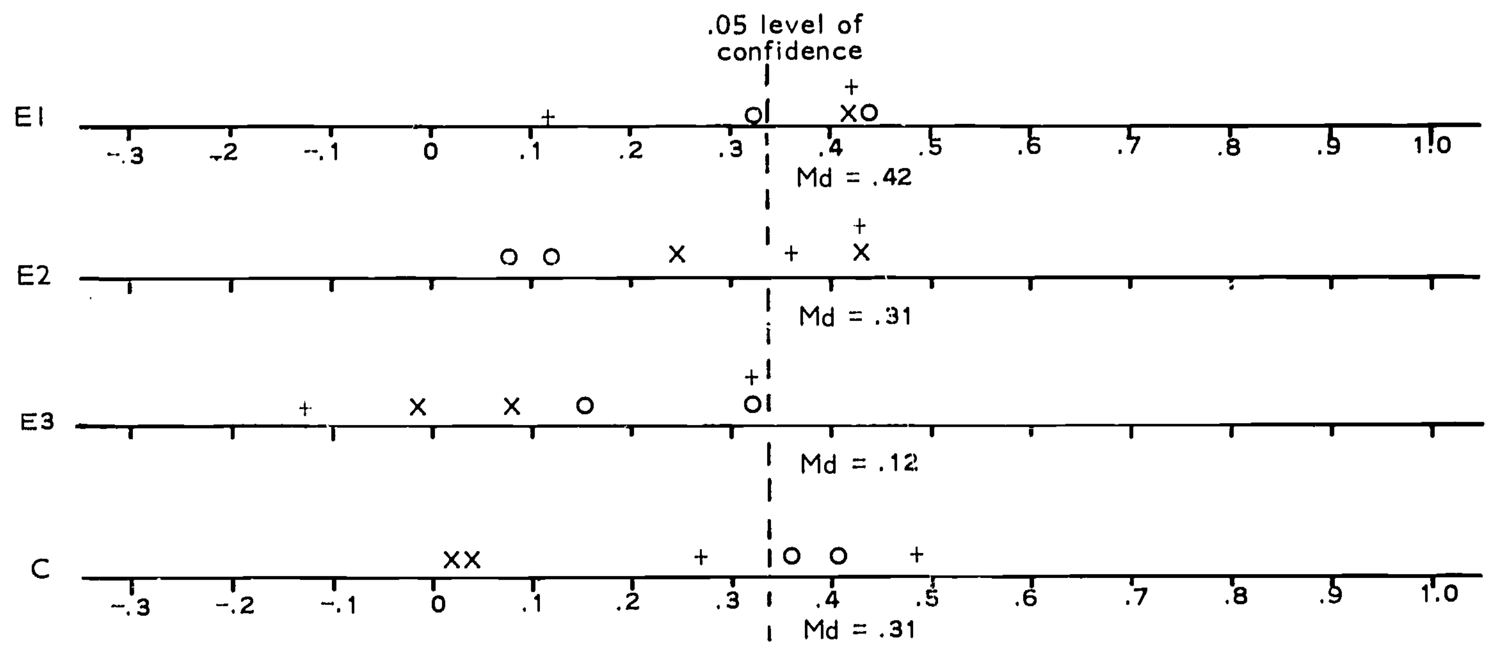


Figure 18 Correlation Between Achievement and Total Response Tape 2

Key to Symbols: X = 4th Grade
o = 5th Grade
+ = 6th Grade

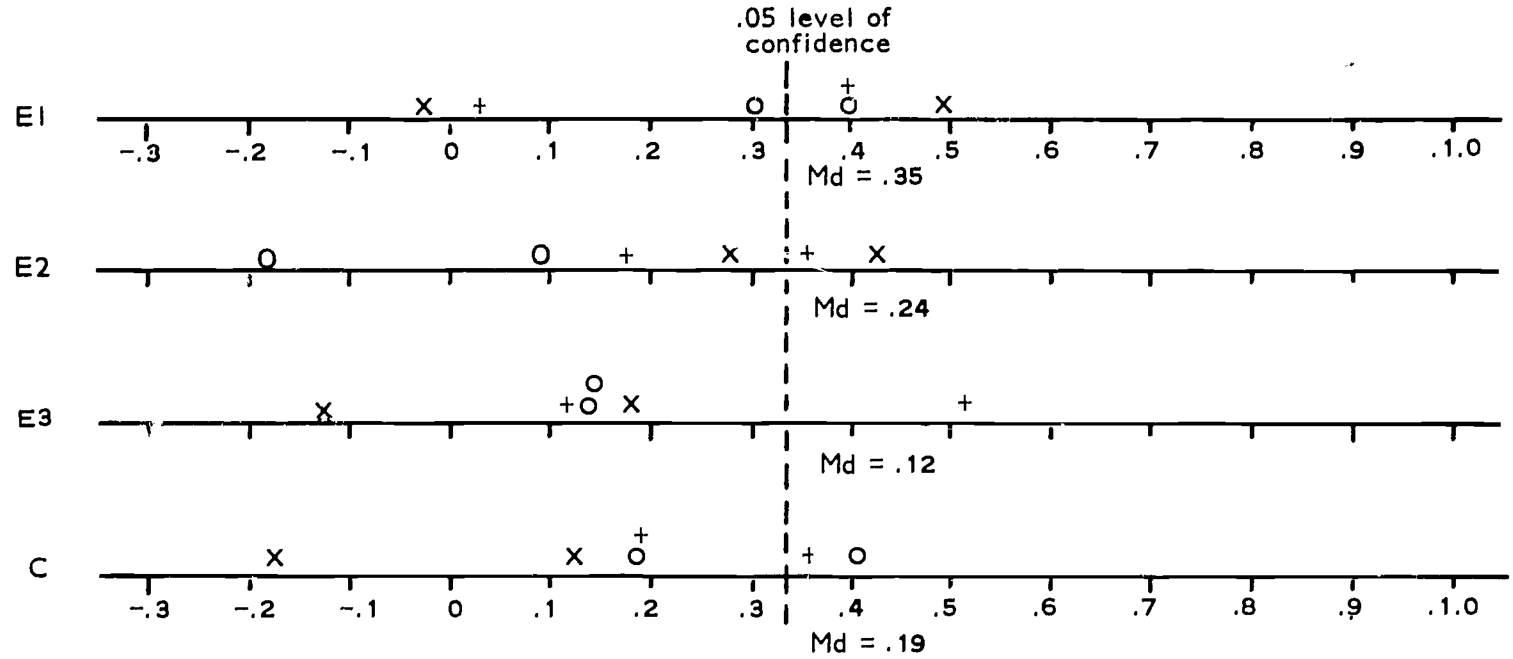


Figure 19 Correlation Between Achievement and High Level Response Tape 2

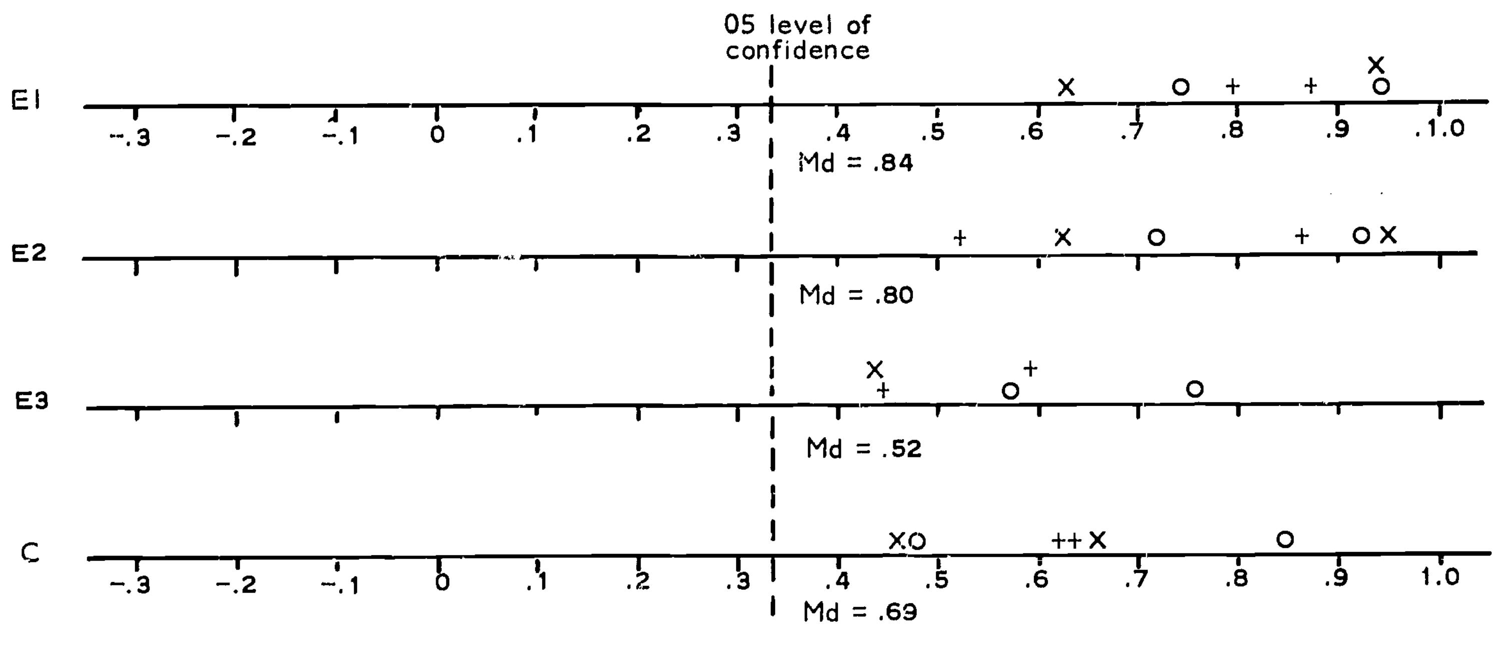


Figure 20 Correlation Between Total Response and High Level Response Tape 2

Key to Symbols: X = 4th Grade
o = 5th Grade
+ = 6th Grade

range in medians for IQ was .14 to .28 with no consistent pattern of difference from one group to another. A rather high degree of homogeneity was reflected in these correlations within and across groups. With regard to achievement, the medians ranged from .12 to .35 and the values were somewhat larger for the two experimental groups E1 and E2 than they were for E3 and the control group. Further, these correlations showed a good deal of variability from class to class, the range being from -.18 to .52.

The results for Tape 3 are presented in Figures 21 through 25. In contrast to Tape 2, the relationship between total thought units and high level units (Figure 25) showed a great spread in correlations in the E3 and control groups. In the control group the median correlation is only .09. In contrast, in groups E1 and E2 the median correlations were very high (.84 and .91), and there was very little variation from class to class. Thus, in those classes where high level thought units occurred, they were provided by those pupils who talked the most, which once again was partly an artifact and partly to be expected. The relationship between ability (IQ and achievement) and total thought units was exceedingly similar to that found in Tape 2, i.e., correlations of the magnitude of .25 and little variability from group to group or from grade to grade. There was, however, somewhat more variability from class to class on Tape 3 than was true on Tape 2.

With respect to the relationship between ability and high level thought units, (Figures 22 and 24), the picture was much the same as with Tape 2. The main difference was that the correlation with IQ dropped markedly in the control group, the median being .01 on Tape 3. As was the case with Tape 2, the correlations tended to be somewhat higher in groups E1 and E2 than they were in the E3 and control groups.

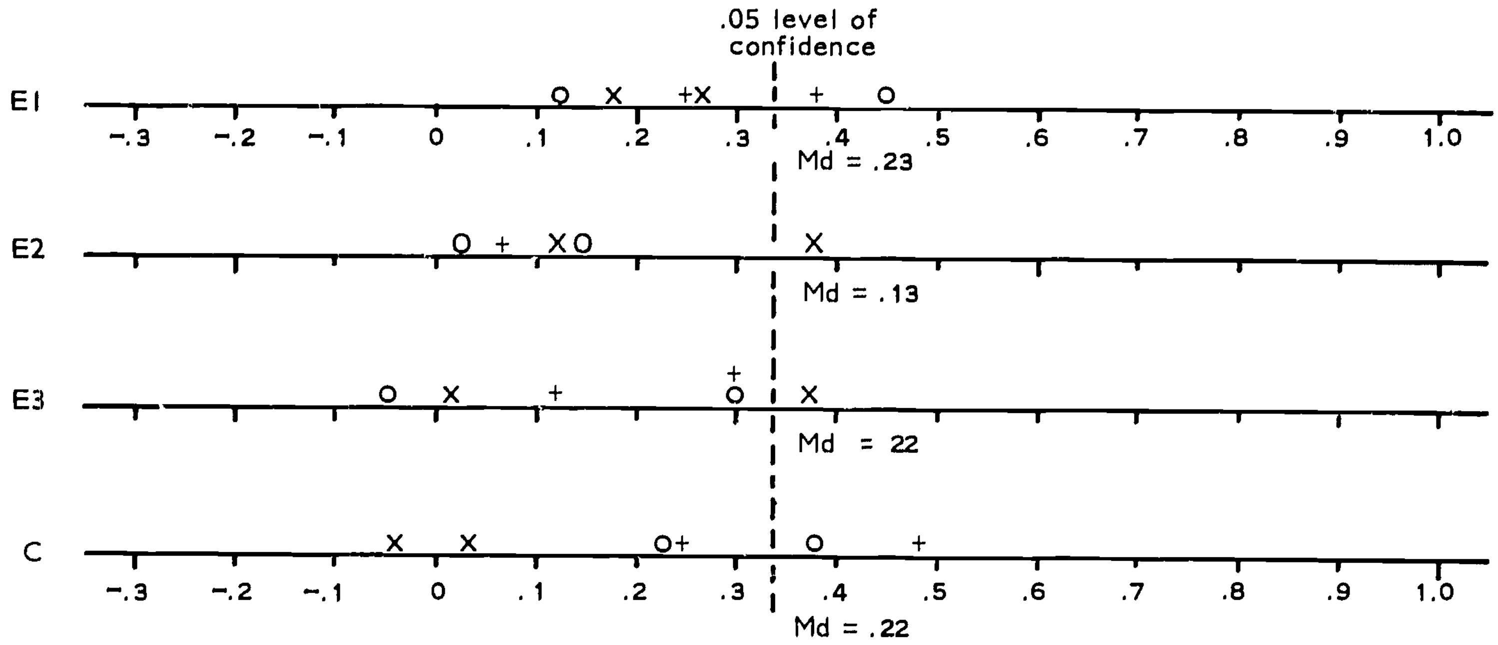


Figure 21 Correlation Between IQ and Total Response Tape 3

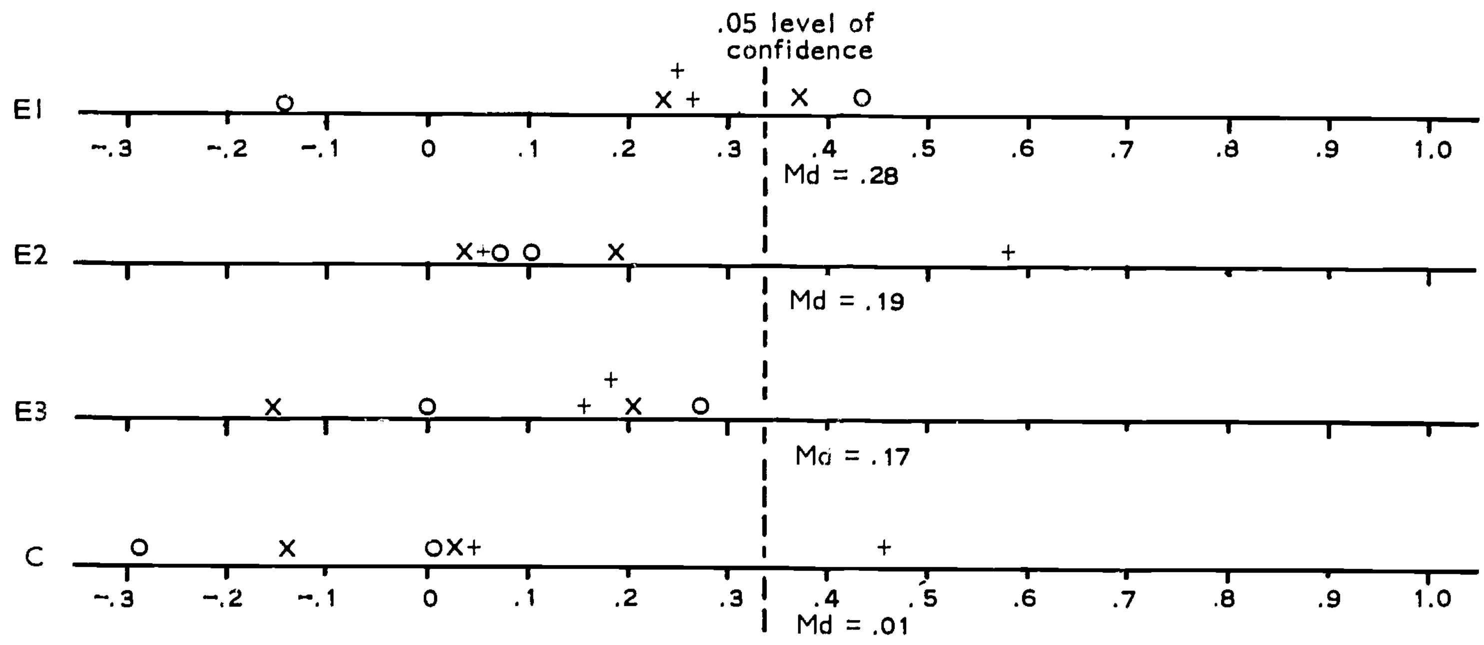


Figure 22 Correlation Between IQ and High Level Response Tape 3

Key to Symbols: X = 4th Grade
o = 5th Grade
+ = 6th Grade

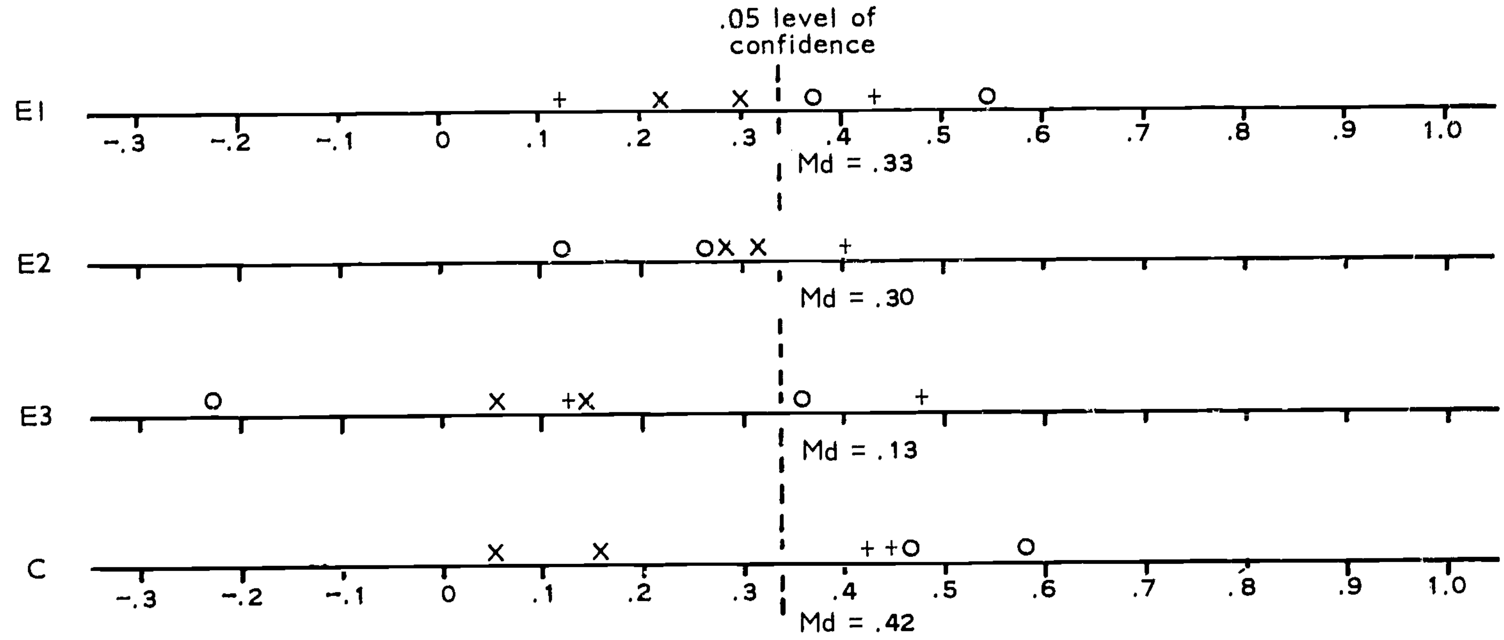


Figure 23 Correlation Between Achievement and Total Response Tape 3

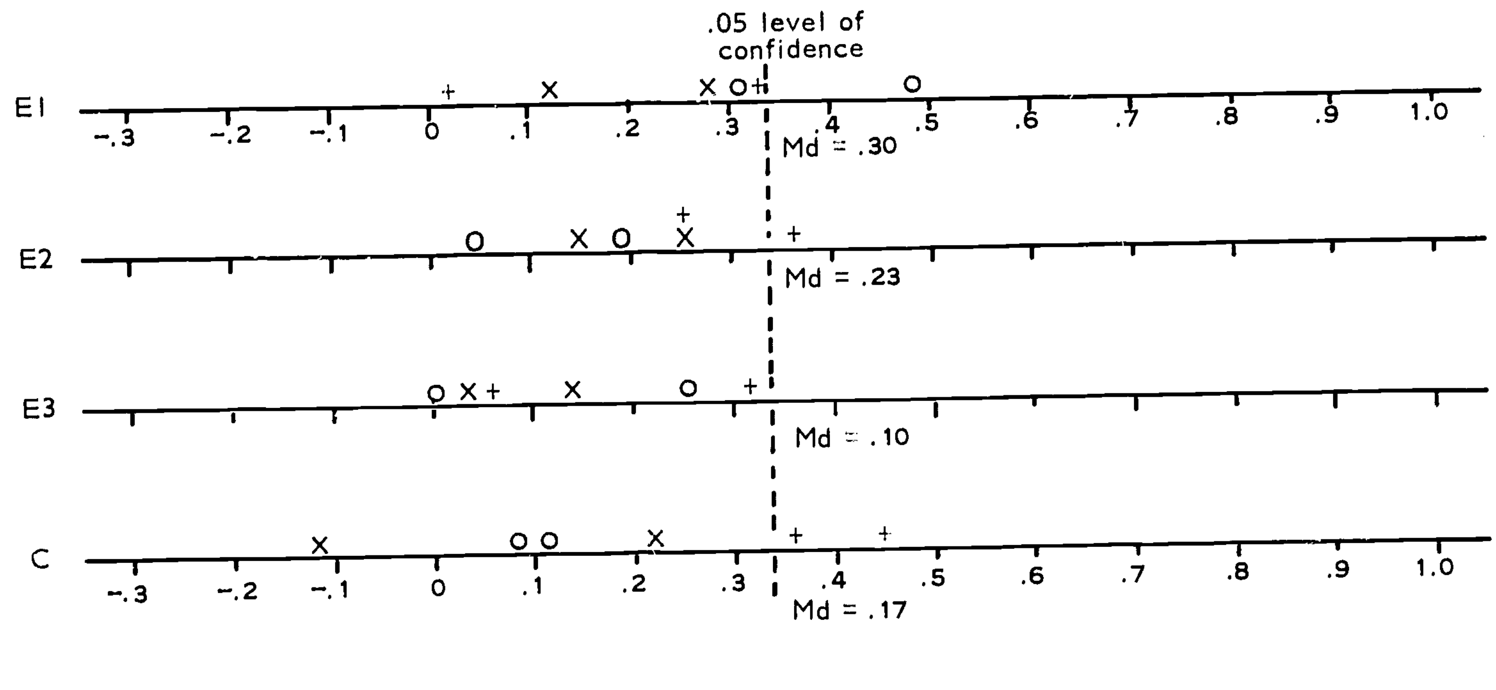


Figure 24 Correlation Between Achievement and High Level Response Tape 3

Key to Symbols: X = 4th Grade
o = 5th Grade
+ = 6th Grade

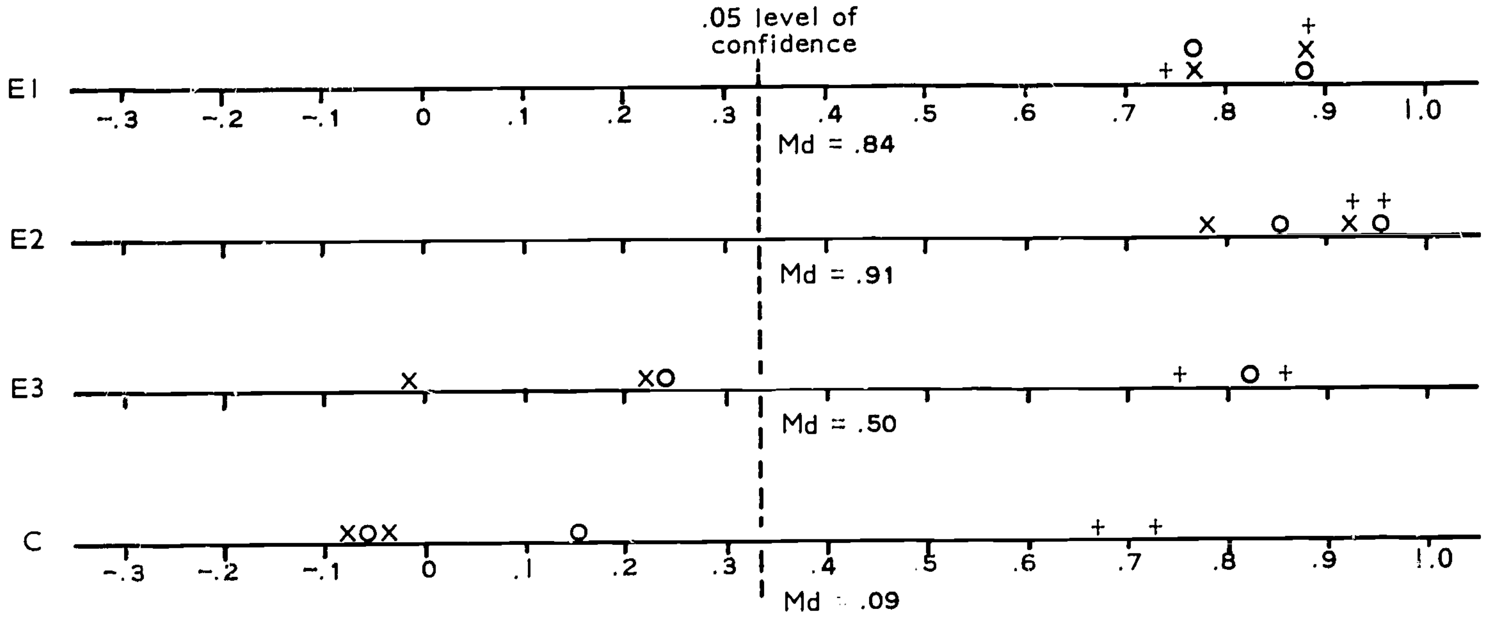


Figure 25 Correlation Between Total Response and High Level Response Tape 3

Key to Symbols: X = 4th Grade
o = 5th Grade
+ = 6th Grade

The class to class variability on the achievement measure was about what it was on Tape 2, ranging from -.10 to .48. The variability from class to class in correlations with IQ was, however, considerably greater on this tape than it was on Tape 2.

In Tape 4 (Figures 26 - 30), the correlation between total responses and high level responses presented much the same picture as it did in Tape 2. The correlation was high throughout the four groups, although it was somewhat higher in groups E1 and E2. The variation from class to class was considerable, however, the range being .28 to .95. The relationship between the ability measures and total responses showed a somewhat different picture than it did on Tapes 2 and 3. The

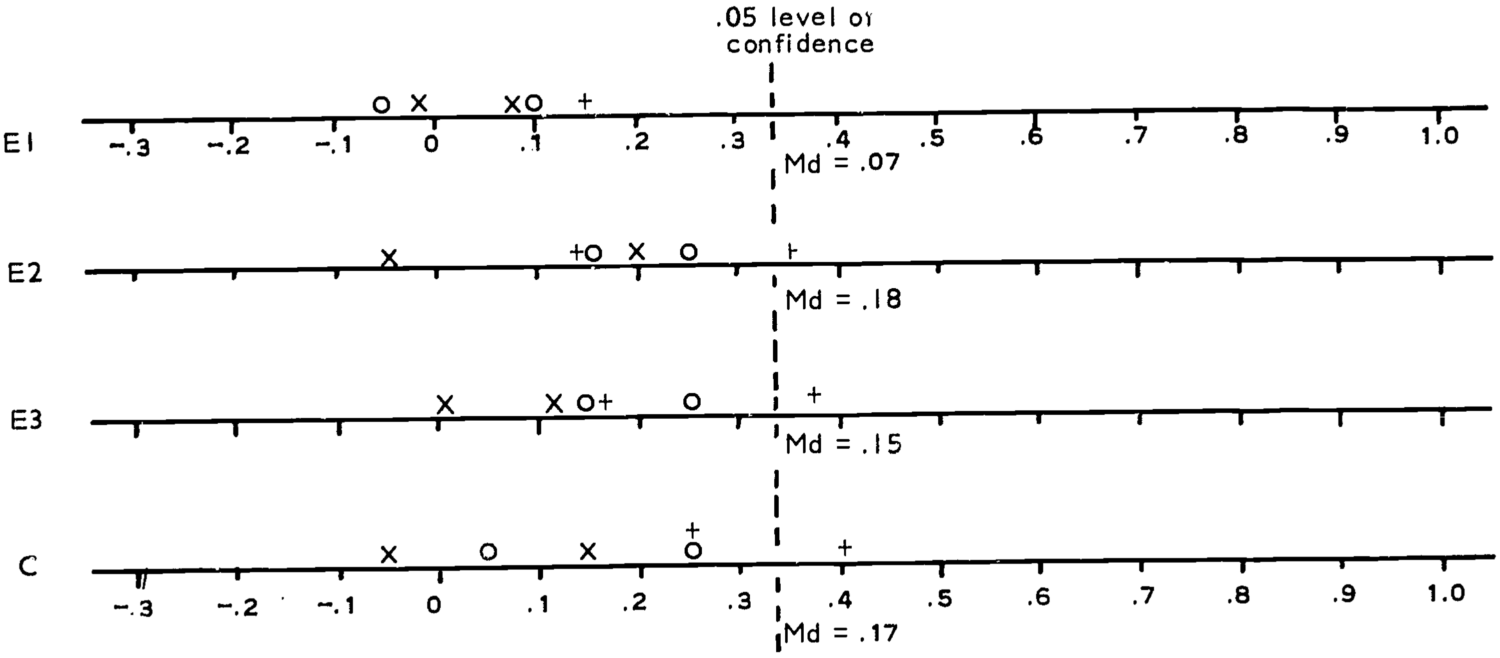


Figure 26 Correlation Between IQ and Total Response Tape 4

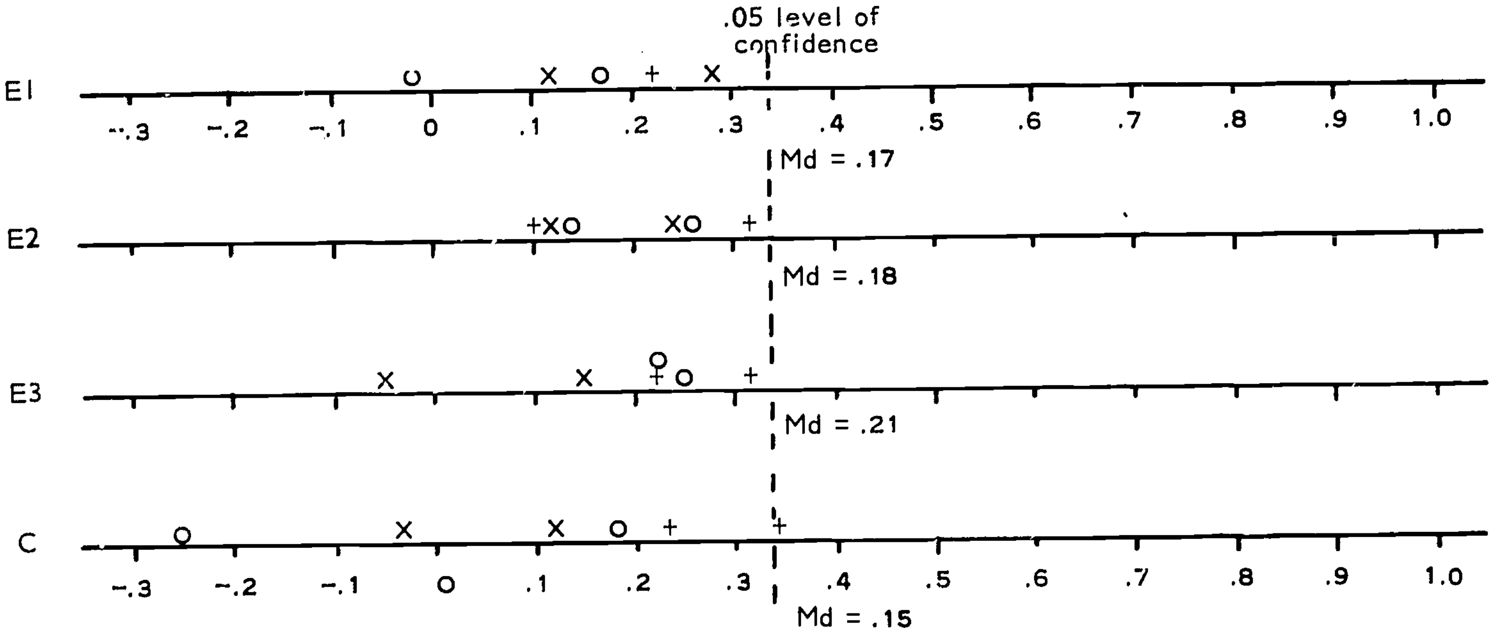


Figure 27 Correlation Between IQ and High Level Response Tape 4

Key to Symbols: X = 4th Grade
o = 5th Grade
+ = 6th Grade

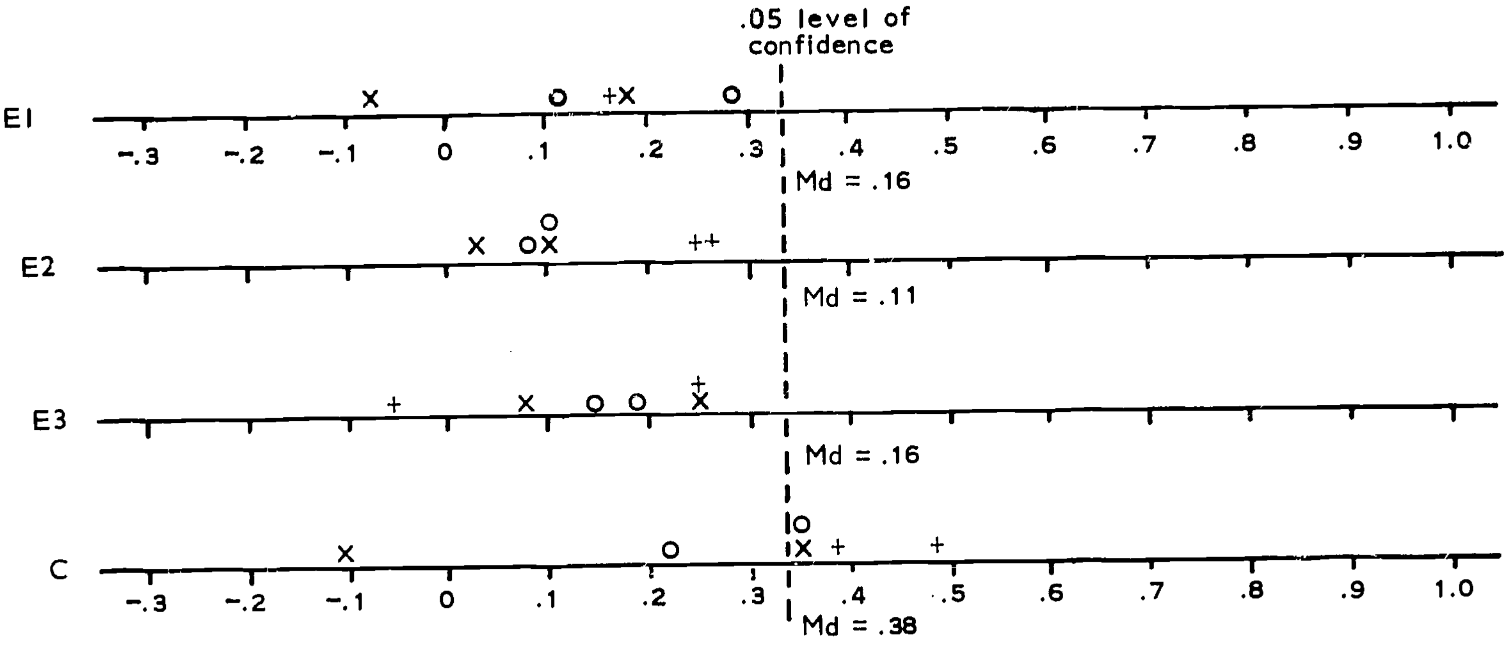


Figure 28 Correlation Between Achievement and Total Response Tape 4

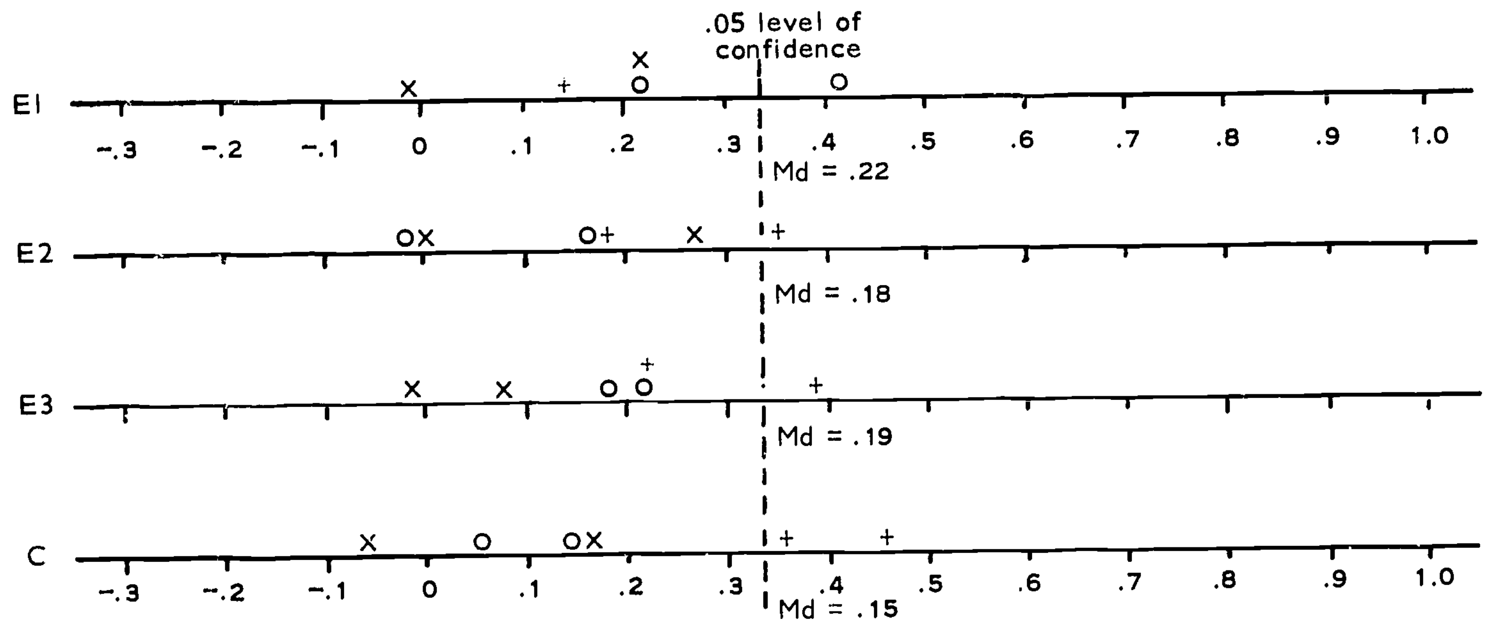


Figure 29 Correlation Between Achievement and High Level Response Tape 4

Key to Symbols: X = 4th Grade
o = 5th Grade
+ = 6th Grade

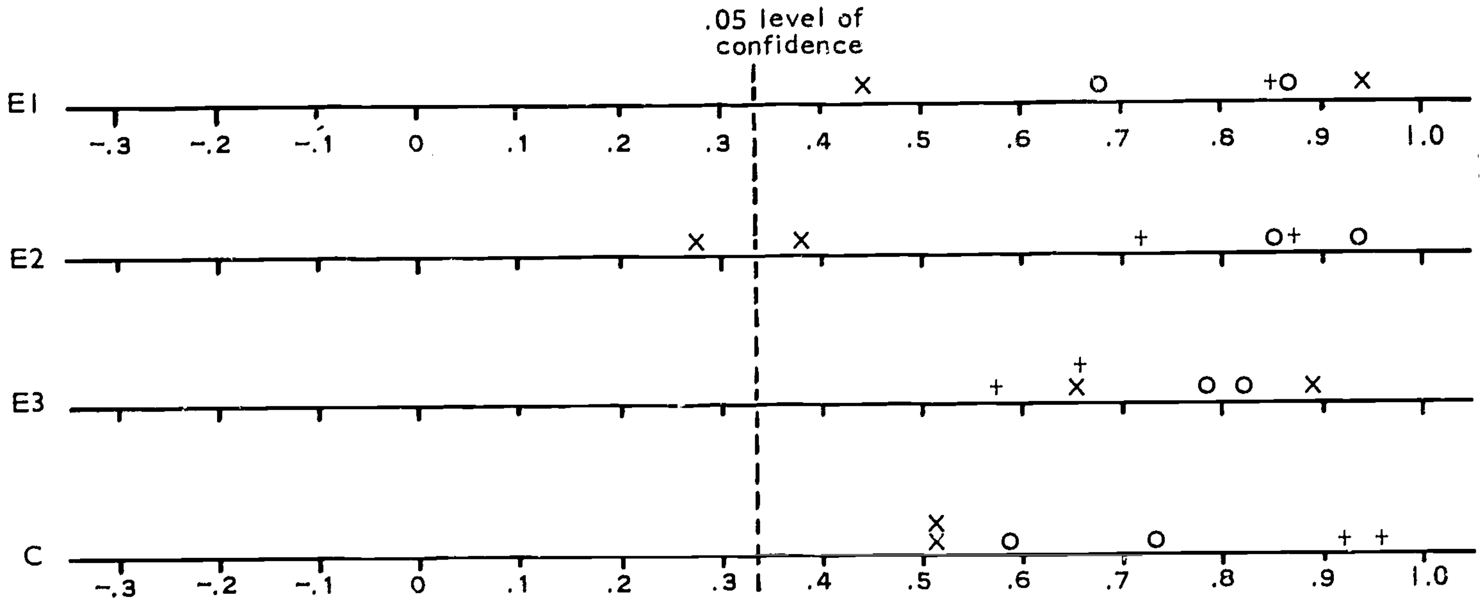


Figure 30 Correlation Between Total Response and High Level Response Tape 4

Key to Symbols: X = 4th Grade
o = 5th Grade
+ = 6th Grade

primary difference was that the correlations were considerably lower - having a median of .07 - than they were in the other tapes in group E1.

The correlations for the other three groups also tended to be somewhat lower than they were in Tapes 2 and 3. A similar pattern emerged with regard to achievement test scores in that the correlations tended to be considerably lower in groups E1 and E2. The medians were, respectively, .16 and .11. Within the control group, the correlation was approximately the same as it was on the other two tapes, the median value being .35.

The correlations between ability and high level thought units were approximately the same across all groups, being of the magnitude of .19. Thus, the trend toward higher relationships in the experimental classes was less marked on Tape 4 than it was on Tapes 2 and 3.

In summary, there was a very strong tendency for high level responses to be produced by those students who talked the most. This finding is somewhat trivial and is, in part, a function of the non-independence of these two scores. Therefore the one exception to that finding was of considerable interest; on Tape 3 the control group median correlation was .09 indicating that in this group on Tape 3 there was very slight relationship between quantity and quality of thought, although there was a great deal of variation from class to class within this group.

The relationship between IQ and total response was quite consistent throughout, showing no particular trends across the four groups, but showing somewhat lower correlations on Tape 4 and markedly so for the E1 group. Correlations between achievement scores and total responses tended to be slightly higher than correlations with IQ throughout and once again tended to be lower on Tape 4. On both IQ and achievement correlations the medians tended to hover around .15 to .35 although there was considerable variation from class to class.

There is a tendency throughout for high level thought production to be correlated with IQ. On Tapes 2 and 4 there were no marked differences among groups and the medians ranged from approximately .15 to .20. In Tape 2 there was rather marked homogeneity within each group although this was not the case on Tape 4. On Tape 3 the correlations with IQ were considerably higher in groups E1 and E2 than they were in the control group.

The correlations of high level response with achievement scores tended to be somewhat higher than with IQ and tended to be larger in groups E1 and E2. This trend was more pronounced on Tapes 2 and 3 where the correlations in groups E3 and Control had medians of the magnitude of .15 whereas in groups E1 and E2 medians were in the range of .25 to .35. On Tape 4 the differences among groups were negligible.

Although the correlations between ability and both total thought and high level thought were not large, it must be kept in mind that the measure of each was based on a brief sampling of behavior and the reliability of these measures severely attenuated thereby. Nevertheless there was a distinct tendency for the more able students to produce both more thought units and more high level thought units. That tendency was more apparent on Tapes 2 and 3 and, on these tapes, it was more apparent in groups E1 and E2 than in the E3 and control group. Finally, with the exception of the correlation between IQ and high level response on Tape 2, there tended to be a great deal of variability from class to class in the magnitude of these correlations.

One other observation seemed worth recording. In experimental groups E1 and E2, there was no apparent trend in the magnitude of the correlations across grades. The magnitude of correlation appeared to be largely independent of grade. In the E3 and control groups, that was much less the case. On all tapes, there was a distinct tendency for the ability measures to be more highly correlated with high level thought in the higher grades in the control group. On Tape 4, that trend was also apparent in the E3 group although to a lesser degree.

CHAPTER X

CLASSROOM INTERACTION: ANALYSIS OF TEACHING STRATEGIES

The preceding chapter reported on certain aspects of classroom interaction, such as the proportions of teachers' seeking behavior to their giving behavior. This chapter describes additional teacher behavior.

In interpreting the data reported here, a few points need to be kept in mind.

First, the teachers were trained in generic models which are represented in Chapter III in chart form, each of which furnishes three fundamental questions by which to pursue the particular cognitive task. The teachers, in the training described in Chapter IV, also explored the chief pedagogical functions necessary for guiding the discussions focused on the three cognitive tasks, methods of constructing developmental question sequences, and the rationale for determining the pacing of transitions from one level of thought to another. It was, of course, both impossible and undesirable to prescribe a question sequence in detail, because each teaching act also must be based on unique student responses to the preceding act. Therefore, it was necessary for the teachers to devise the intermediate procedures.

Second, as explained in Chapter V, the twelve teachers selected for training were a homogeneous group only in terms of their willingness to learn and their concern for and interest in improving their teaching. All twelve teachers made serious attempts to reconstruct their teaching strategies in harmony with the project training. However, the wide range of experience and personal teaching styles meant that the teachers learned the new procedures at varying rates and with various degrees of success (also discussed in Chapter IV).

Third, while it is evident that internalizing a change in fundamental orientation toward teaching and teaching skills is a lengthy process, the time schedule for the study required that the teachers be taped for a given task almost immediately upon completion of training for that task. As a result, particularly in the first two tapes, there was a certain degree of self-consciousness and some clumsiness in conducting the discussions. Despite that, the tapes revealed many new substrategies. These substrategies, however, tended to be unique to the individual teachers, making records of individual classrooms somewhat idiosyncratic.

Since Tapes 3 and 4 were recorded in the latter part of the school year, when the teachers had had the greater part of their training, the analysis that follows has been confined to those tapes. Another reason for concentrating on those tapes was that the questions assigned there required more disciplined interaction and thought processes than did those of the first two tapes. In addition to the cognitive tasks being further along the developmental sequence, the content itself was more complex.

What Teachers Sought and What Students Gave.

The rationale of the study assumes that what teachers seek and how they seek it influences the nature of the cognitive processes in which their students engage. Accordingly, comparison was made, by thought levels, of what teachers sought (TS) and how the students responded (CG).

The percentages shown in Figures 31 and 32 are computed from the total of substantive thought units. The data are grouped by modes of thought: the first mode (codes 1 and 2) includes factual information; the second (codes 3 and 5) includes the use of facts or of generalizations for explanation; and the third includes (code 4) simple generalizations, (code 6) compound generalizations, and (code 7) generalizations based on logical conditional inference (if - then).

In Tape 3 (Figure 31) the data showed that the trained teachers (E1 and E2) more frequently elicited the abstract levels of thought than did the untrained teachers. Seeking by untrained teachers surpassed that by trained teachers only in seeking of descriptive information. The order of the means for the seeking of specific descriptive information (Codes 1 and 2) was E1 $<$ E2 $<$ E3 $<$ C, but was reversed (E1 $>$ E2 $>$ E3 $>$ C), for the seeking of explanations. There was a close correspondence between what a teacher sought and what the students gave.

All teachers sought the explanatory mode of thought (codes 3 and 5) least frequently, but the trained teachers sought it more frequently than did the untrained ones. In this mode the discrepancy between what teachers sought and what students gave was greater. Students tended to give proportionately less of what the teachers sought. Evidently causal thinking is more difficult to generate. Also, pacing may have been a factor not apparent in these figures because a necessary precent to explaining (and generalizing) is assembling and organizing information. However, all the trained teachers sought, and got, explanations more frequently than did the untrained teachers, as shown by the order of the means.

Teacher seeking of generalizations in Tape 3 showed pronounced differences between trained and untrained teachers and students. While students in all groups gave more generalizations than the teachers sought, the trained teachers sought the generalizations nearly three times as frequently as did the untrained teachers. The teachers in the control groups were especially low in seeking generalizations.

On Tape 4 (Figure 32) the distribution of seeking and giving was different from that on Tape 3. The highest frequencies occurred at the generalization level. That

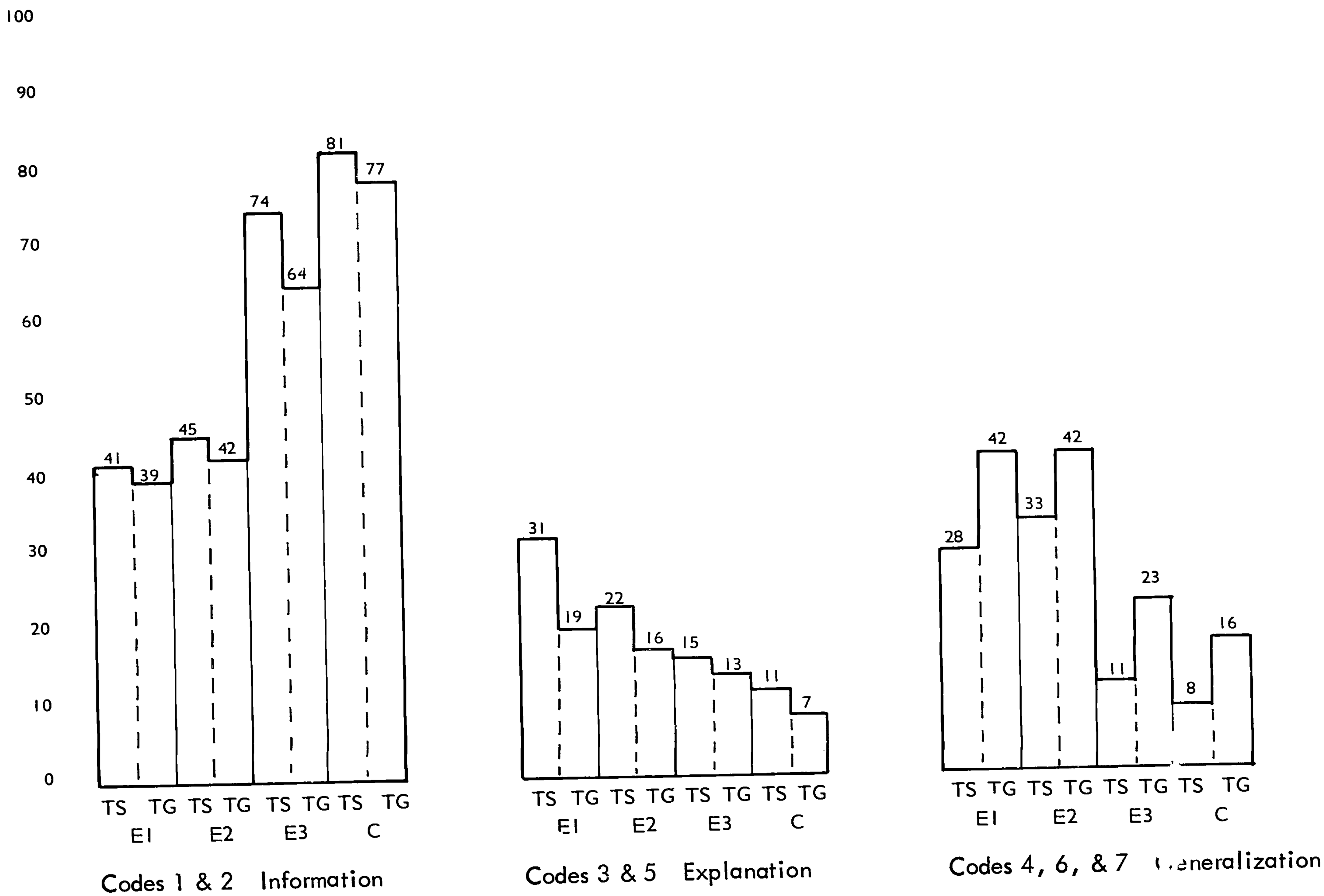


Figure 31 Percentages of "Teacher Seeks" and "Child Gives" Thought Units, (Excluding Non-substantive Units), Tape 3

* All Grade Levels Combined

was to be expected because predicting (coded 4 and 6) is the first step of this cognitive task, followed by support and verification (coded as 3 and 5). Therefore generalizing engaged the largest amount of time in this task, as did giving and seeking information in Cognitive Task 2, (Tape 3). Thus the reversal of frequencies by levels between Tapes 3 and 4 results at least partly from the differing natures of Cognitive Tasks 2 and 3.

Giving nformation which was not directly related to explaining predictions was the second most frequent cognitive operation. While students in all groups gave more information than the teachers sought, the untrained teachers sought information far oftener than did the trained teachers. Support of predictions, whether by use of information or inference, was the least frequent cognitive operation, and the differences there between the behavior of trained and untrained teachers were small.

The discrepancies between what teachers sought and what they got from students was most marked at the highest cognitive level. It was approximately the same for trained and untrained teachers.

These results could be interpreted several ways. The fact that students generally gave what teachers sought indicated the power that a questioning strategy has to determine the cognitive operations in which students engage. Teachers who consistently got what they sought might have accurately evaluated feedback from preceding questions and might have effectively paced the transitions from one cognitive operation to another. On the other hand, the teachers might have been given what they sought because they did not push for the limits, only asking students to do what they knew the students could do.

The data did not differentiate between these different types of seeking. How-

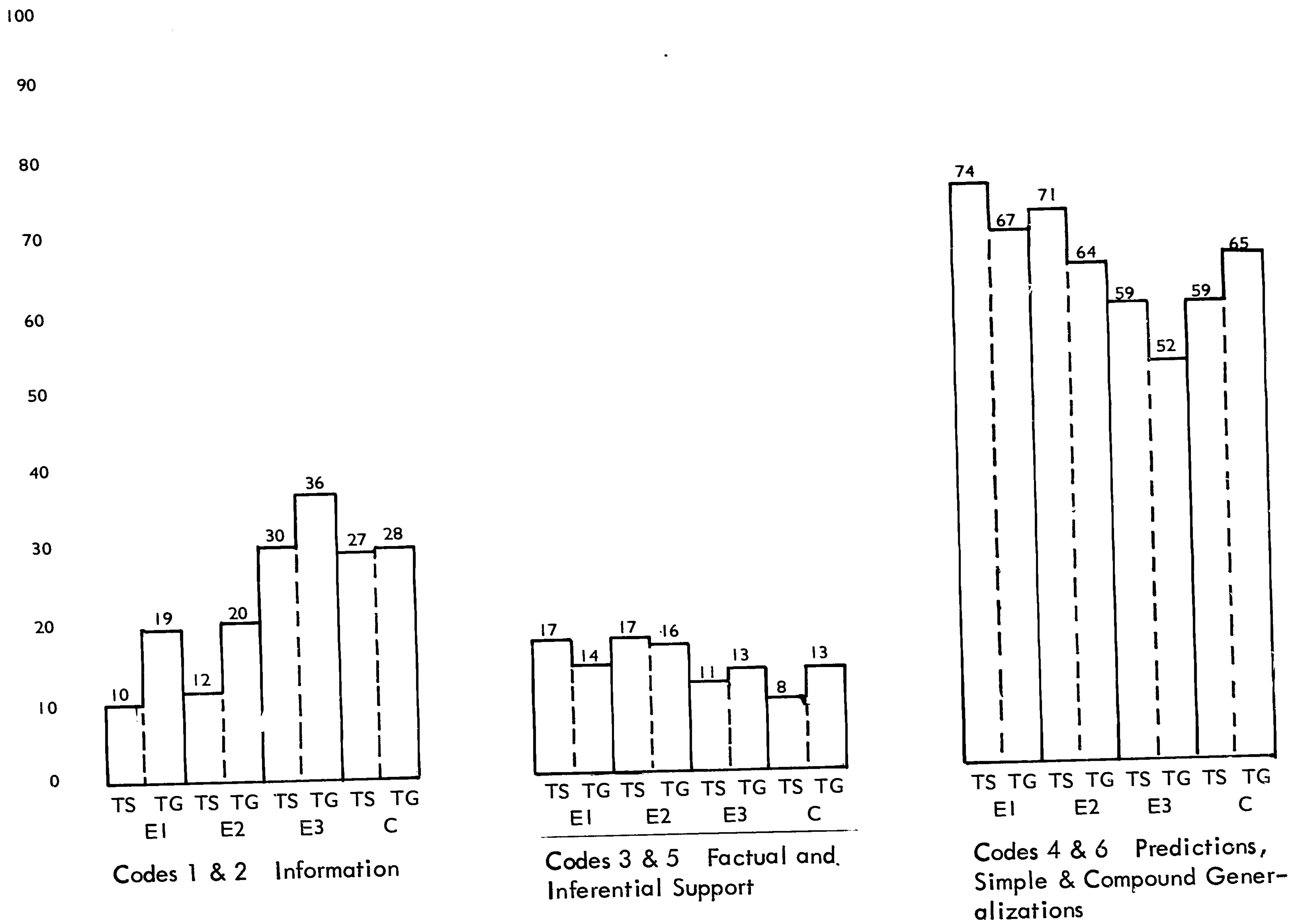


Figure 32 Percentages of "Teacher Seeks" and "Child Gives" Thought Units, (Excluding Non-substantive Units) Tape 4

* All Grade Levels Combined

ever, the fact that trained teachers successfully sought high levels of thinking and that their students produced a large number of coherent logical chains (Chapter IX) suggested that these teachers consciously employed techniques to raise the level of cognitive operations.

Discussion Management.

Among the many managerial (non-substantive) pedagogical functions, discussion management seemed most influential. Generally, discussion management serves to establish the proceedings, to make the structure of the processes clear to the students, to clarify the task, and to prevent deviation from the focus.

However, later analysis suggested that some teacher acts that had been coded as discussion management actually served to establish a new perspective for thought. Therefore the discussion management items were recoded to make this distinction. Table 23 shows the data on both plain discussion management (DM), and on discussion management which opened up new thought perspectives (DM_2).

All teachers used more discussion management (DM) on Tape 3 than on Tape 4, probably because Cognitive Task 2 is more data-constrained and requires a more systematic approach than does Cognitive Task 3. On both tapes, the trained teachers used discussion management more frequently than did the untrained teachers, with the exception of E3 on Tape 4.

Differences between trained and untrained teachers, however, were more marked in the thought-directing aspects of discussion management (DM_2). On both tapes a far greater proportion of trained teachers' management was directed to the development of thought. Many untrained teachers used no thought-opening discussion

Table 23

Percentages of Types of Discussion Management

	Total TG-TU	DM			DM2		
	No.	No.	%	Range	No.	%	Range
			Tape 3				
E1	663	242	35.9	19.9-56.9	65	9.8	4.4-17.9
E2	617	188	30.3	20.8-42.8	53	8.6	6.4-20.0
E3	991	228	20.4	11.5-27.2	12	1.2	0-3.4
C	315	95	29.8	12.2-55.6	6	1.9	0-6.0
			Tape 4				
E1	719	148	21.1	13.6-32.8	40	5.6	.8-13.8
E2	762	108	14.7	3.3-22.0	19	2.5	0-3.6
E3	1,097	143	14.0	6.8-20.1	7	0.6	0-1.9
C	469	56	13.2	10.0-21.6	7	1.5	0-2.7

management. There are large variations in the amount of both kinds of discussion management from class to class and teacher to teacher.

It is difficult to determine at this stage in our knowledge about conducting discussions for cognitive development what the optimal amount of discussion management is. Meager discussion management is likely to permit drifting and deviation from the focus, yet excessive management can restrict cognitive development.

Thought Control

Under the coding scheme teachers' remarks that furnished students something which they should have developed for themselves were coded C (Control - see Chapter VIII). In all preceding analyses this definition has been used. Later a more intensive analysis revealed that some of these remarks actually were summaries with only slight additions of preceding student contributions and that these teacher remarks opened up thought rather than controling it. Therefore, controls were differentiated in the same manner as were discussion managements. Plain control, as defined in Chapter VIII, was coded C. Control that opened new perspectives was scored C2. The results are shown in Table 24.

Table 24

Percentages of Types of Control

	Total TG-TU	C			C2		
	No.	No.	%	Range	No.	%	Range
			Tape 3				
E1	663	75	11.3	0-23.7	17	2.6	0-4.5
E2	615	99	16.0	0-33.6	43	7.0	0-13.9
E3	991	221	22.3	12.3-27.9	15	1.5	0-5.2
C	315	68	21.6	5.6-40.5	0	0	0-0
			Tape 4				
E1	719	122	17.0	.9-27.8	78	10.8	.9-20.3
E2	762	128	16.8	4.4-24.5	48	6.3	0-8.4
E3	1,097	204	18.6	6.6-37.8	15	1.4	0-2.6
C	469	93	19.8	10.0-32.0	3	0.6	0-4.0

On both Tape 3 and Tape 4 the trained teachers used fewer plain controls (C) than did the untrained teachers though the differences are more pronounced on Tape 3. The teachers varied greatly in the amount of control they used - some using no controls and others as much as a third or more of all their managerial functions. Teachers in the E3 and control groups were especially prone to the use of cueing questions in conducting discussions, although some trained teachers used them too.

On both tapes the trained teachers used constructive controls (C2) more frequently than did the untrained teachers. In fact, the teachers in the control group used the restrictive types of control to the virtual exclusion of constructive controls.

Teaching Modules

Tabulating the frequencies of single teaching acts with certain specified pedagogical functions seemed an unsatisfactory way to analyze the dynamics of teaching, and to determine whether those acts produced high level thought. It seemed necessary to examine the sequences of acts, the particular ways they could be combined to meet the exigencies of a developing discussion sequence, and the way they matched student responses.

Two alternatives were available for examining these dynamics. One was to postulate that there was an ideal total sequence for a given cognitive task that could be discovered through analysis of empirical data. It seemed impossible to pursue this approach because the total behavior of classes and of teachers was too idiosyncratic and too full of "noise" for the discovery of a single approach. In addition, it also became evident that this approach was undesirable for it would lead to an inflexible programming of teaching acts. Such a program would disregard the unique variations in discussion features and learning patterns which evolved in each class as a result of interaction among students with different skills, styles of learning, and backgrounds. In effect, such an approach would eventuate, for cognitive development, in the kind of prescriptive formula for a "good" teaching strategy that has been so thoroughly criticized as a characteristic outcome of methods courses.

Therefore an attempt was made to identify short sequences of teacher behavior in the coded tapescripts which seemed productive in that they tended to bring about high-level thinking in students. These sequences were called teaching modules. The hope was that, if such productive modules could be identified, they would represent the elements of teaching strategies which other teachers could learn to use and which could be used in different combinations. Such an approach would be an effective compromise between relying completely on intuitive procedures and using a rigidly prescribed complex strategy.

The concept of teaching modules could also provide a third alternative to the usual dichotomy between teaching as a science and teaching as an art. The former conceives of good teaching as a rather rigid procedure following certain scientifically determined criteria. The latter relies upon a rather free-wheeling creative approach that requires exceptional teachers. Both concepts have a grain of truth. Both also have difficulties and deficiencies.

It seemed that the concept of smaller productive teaching modules provided the means for constructing a flexible, yet scientifically definable strategy, which teachers could master, and which they could combine in a variety of ways depending on the requirements of the situation. This concept could serve both the science and the art of teaching. Furthermore, if the processes of teaching thinking could be made as explicit as are the processes of presenting content, it should then be possible to pursue the teaching of thinking as intensively as we now pursue the teaching of content because a greater number of teachers could master the necessary teaching strategies.

The first step toward the discovery and the analysis of these modules had been taken in that all codes had been entered on a flowchart, and the sequences of codes representing teacher acts and student responses could be seen easily. (See Figure 33). The term, "teaching module," was defined as "a definable sequence of teacher-pupil interaction that results in, or includes, high level pupil thought."

Initially the procedure was to study the Tape 4 coded tapescripts of each of three specially trained and three control teachers; (both experimental and control groups contained one class from each of the fourth, fifth, and sixth grades). Project personnel used their judgment in looking for what appeared to them to be productive and recurring modules in the tapescripts. Their judgment was then checked against the flowsheets, in which all thought units in tapescripts appeared by their codes, and the sequence of codes representing teacher acts and student responses could easily be seen.

The first step in this checking process was to look for examples of high level pupil responses. They were defined as any of the following:

1. An inferential explanation, coded 5, e.g., "The colonists had more security because they were more in bunches than the pioneers."
2. A generalization upon a generalization, coded 6, e.g., "The witch doctors are trying to do with wands and cracked eggs what our medical doctors do with words and needles."
3. A logical relationship among inferences, coded 7, e.g., "If you can't educate enough people to teach, then you don't have enough teachers."

Class No. 16
Tape No. 4 - Page 6

				102	103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118	119	120	121	122	123	124
THOUGHT UNITS				102	103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118	119	120	121	122	123	124
CHILD NUMBER					16	16				16	16	16				09	09	09	09	09	09					
IDENTIFICATION				TS			TG	TS	TG				TG	TG	TS							TS	TG	TS	TG	TG
	6 5																									
Thought	4 3		III II	III	4	4	4	4					4		III	4	4	4	4	3	4	III	4	4		3
Levels	2 1		I						I	I	I	I													I	
	0 Ir																									
Thought Related X C RC		R	R^+	X	X	X	R	X	X	X	X		R^+C		X	X	X	X	X	X	X	X	R^+	X	X	X
F Cp P	P_2	I	Lo		Pz	Lo	Pz	Pz	Lo	Cp	Cp	F	Pz			Lo	Pz	Pz	Lo	F	Pz		Lo	Py	Cp	Cp
T_1 T_2					T_1								T_2	T_1			T_1	T_2			T_2			T_1		
Managerial A D CM	DM													DM												

Figure 33 Example of a Flow Chart

This is a portion of the same discussion which appears as a sample page of coded tapescript, Cognitive Task 3: Application of Principles, Tape 4, in Chapter VIII.

Whenever an example of this kind of response was found, it was considered as a possible signal for a segment of high-level thinking and the five pupil thought units immediately preceding and five immediately following it were examined. If in the five preceding pupil thought units there were one or more high level responses in a sequence building up to the signal and the sequence showed a coherent pattern, the total segment was considered to represent high level thinking. If in the five pupil thought units following the signal response one or more of them gave relevant factual support to it, that segment of the discussion was also considered to represent high level thinking.

Next, the teacher-pupil sequences of thought units immediately preceding and immediately following the signal response were examined for any recurring patterns. This empirical, largely subjective procedure resulted in the identification of the four modules described below. Each was a part of a class discussion which centered around the focus question, "What will happen if . . . ?"

Module A

Example:	Grade 4	Code
Thomas:	If they brought water into the desert,/they'd probably make it into a crop land just like the valley.	CG 4 X Lo * CG 4 X Py
T:	All right -- all these people are here. We said that many people were coming./ What problems might they have?/ Can you think of something that might happen? Donna?	TG 4R+ Py TS III X TS III X
Donna:	It would get crowded./If everyone came in one bunch, it would get crowded.	CG 4 Py CG 4 R Py
T:	It would get crowded/-was there anything that would happen because of this? Martha?	TG 4R Py TS III X

* Abstractness codes (T1 and T2) have been omitted in these module examples.

Martha:	Well, if they lived in the valley in that climate,/ in the nights they might freeze/-they might die because the climate is so different.	CG 4 Lo CG 4 X Py CG 4 X Py
T:	All right, it is a different climate./ Now can you think of any problems that would be presented with all the people coming in to this area? Louann?	TG 4 RC Py TS III X
Louann:	Well, it would be so crowded the new people would crowd out the old ones.	CG 6 X P

1. This module starts at the point where a pupil responds with a statement which is a logical-conditional expansion (Lo) of the original question, followed by a prediction (4Py) which is immediately causally connected with that statement. A typical example of this would be, "Well, if they were going to build a town in the desert, (CG 4 Lo) they would have to get places to get water (CG 4 X Py)."

2. The teacher then repeats (TG R) the prediction and asks for an inference (TS III X) about the particular prediction, e.g., "What problems might they have about this?", or for more predictions, e.g., "Is there anything else that would have to be done?" (TS III X)

3. The teacher then repeats the new prediction and either asks for a restatement of it (TS 6 P) or for further information (TS III X), e.g., "Can you think of some of the side effects?" either of which leads to a high level response (CG 5, 6, or 7).

<u>Module B</u>

Example:	<u>Grade 5</u>	<u>Code</u>
Steve:	Well, they are sure to have industry in this town.	CG 4 X Pz
T:	Industry, good. All right, Erin?	TG 4RPz/TGA

Erin:	If they did have a town,/they'd need law.	CG 4R+ Lo/ CG 4 X Py
T:	All right, why would they need a law there in this town?	TS II X
Erin:	With all this gold/they might fight over it,/ and they would need law for that./I mean you have to have law to protect people from others wanting what they don't have.	CG 1 R+ F CG 4 X Py CG 3 X F CG 6 X I

1. This module starts immediately prior to the point where the teacher repeats exactly or slightly rephrases a pupil's prediction (4Py) which is immediately connected with a particular event, e.g., "Then they would have to bring water in."

2. The teacher then either asks for a) more information (TS III X) on the particular prediction which has just been made, e.g., "How would this affect the area?" or for more predictions, e.g., "Who else has an idea?", "What else is important?" or she asks for b) an explanation (TS II X) of the prediction, e.g., "Why would this be important if it happens?" The outcome in either case is a high level response.

Module C

Example:	Grade 4	Code
Steve:	Well, if they brought water in/ then the desert could be made into farm land.	CG 4 Lo CG 4 Pz
T:	Now, why would it be important to have farm land?	TS II X
John:	Well, if people came down to the desert/ and there was no farming/then they wouldn't be able to survive very good.	CG 4 R+ Lo CG 4 X Lo CG 4 X Py
T:	Why not?	TS II X
John:	Because you need to have growing things to live on as well as things to sell.	CG 5 I

1. The starting point for this module is a pupil's prediction which is either immediately connected with a particular event (4Py) or is a somewhat longer range prediction (4Pz). The teacher then asks for an explanation (TS II X) of the prediction, e.g., "Why do you suppose they'd do that?"

2. The teacher's request for an explanation is then repeated, usually in a slightly different form, e.g., "What are the reasons do you suppose people behave this way?", if a high level response does not come out of the first query.

Module D

Example:	Grade 6	Code
Robert:	Well, their money--like Brazil--their money would be worth less./ Like if you took a dollar there/it would be worth more than here.	CG 6 X P CG 1 X Lo CG 4 X Py
T:	This is one idea you haven't mentioned yet, and it's a kind of interesting one./ Can you tell the class why you think the money would be worth less?	TG D M TS II X
Robert:	Well, they wouldn't have any more exports/and if the things would go down/the prices on things they'd have to/-and then when they work people would earn less money.	CG 3 F CG 4 R Py CG 4 X Lo CG 4 X Py

1. This module is found in the study of thought units immediately following the signal response. It starts at the point where the teacher asks for an explanation (T S II X) of a plausible high level response (CG 5, 6, or 7) for which there has been little or no preliminary build-up.

2. The pupil responds to the query, e.g., "Why do you say this?" with relevant factual support (CG 1 or 3F).

Figure 34 represents the summary of the significant elements in modules, while at the same time indicates the important similarities and differences.

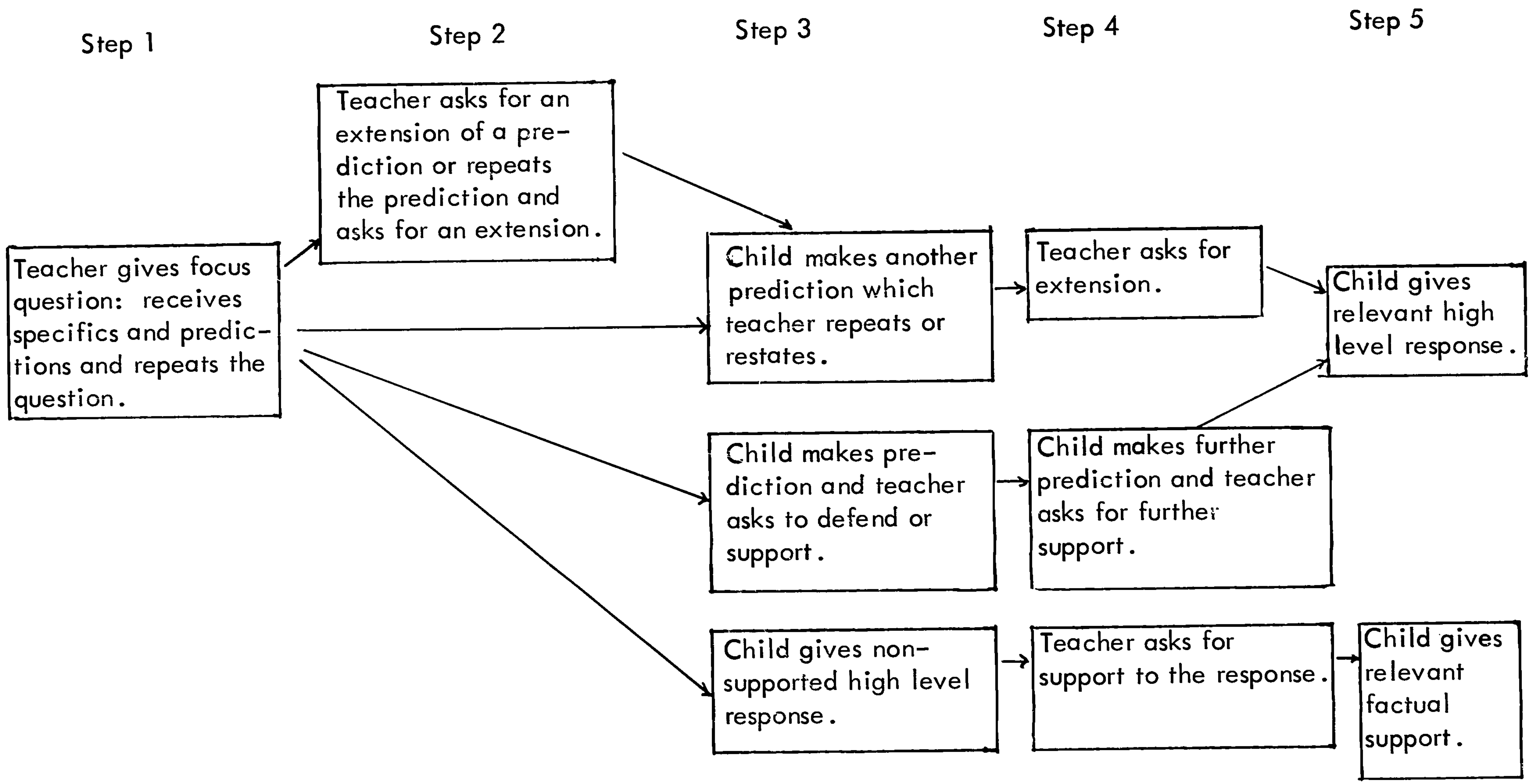


Figure 34 Diagram of Sequencing of Modules

In order to test the validity and reliability of these modules the following steps were taken:

1. A new sample of teachers was selected paralleling the first in grade level and experience with the curriculum. Tapescripts of their Tape 4 discussions were examined and, as with the original group, specific high level thought units of levels 5, 6 or 7 were identified and the five thought units on either side of each one studied. A tally was made of the number of previously identified modules which occurred in these tapescripts.

2. Then all the tapescripts of all groups were again examined for examples of sequences of teacher-pupil interaction which had all the elements of the modules described here except the high level responses.

This analysis provided data as to how often high level pupil thought units in these tapes were preceded by one of the modules, how often high level thought was preceded by other teacher behavior, and how often there were examples of all elements of the modules except high level response.

The data summarized in Tables 25 and 26 indicated that while the group of experimental teachers studied in this analysis used a variety of teaching strategies which were in part related to variations in subject matter and teaching style, it was possible to identify from the spontaneous inventions of teachers certain recurring modules within their strategies. By contrast, the number of identifiable modules in the control groups was negligible.

However, it was also apparent from the high level responses which were not the result of any recurring patterns of teacher-pupil interaction that there are other ways of generating the kinds of high level responses that are identifiable by

Table 25

Number of Module Elements in Tape Four Tapescripts
Of Two Experimental Groups (Three Classes in Each) and Two Control Groups
(Three Classes in Each)

Module Type	No. of Module Elements With Signal				No. of Module Elements Without Signal			
	Experimental		Control		Experimental		Control	
	Group 1	Group 2	Group 1	Group 2	Group 1	Group 2	Group 1	Group 2
A	7	16	0	0	1	1	0	0
B	7	3	0	2	1	0	0	0
C	6	11	2	0	0	0	0	0
D	6	3	1	0	0	0	0	0
Totals:	26	33	3	2	2	1	0	0
	59		5		3		0	

Table 26

Numbers of High Level Responses Without Module Elements
In Tape Four Tapescripts of Two Experimental Groups (Three Classes in Each)
And Two Control Groups (Three Classes In Each)

	Experimental		Control	
	Group 1	Group 2	Group 1	Group 2
	25	51	31	29
Total:	76		60	

this code than through these modules. These results could be interpreted to mean that while the generation of high level thinking was partly an idiosyncratic matter, there were certain productive teaching modules which were used by experimental teachers and which might produce similar results with other trained teachers.

A criticism which might be made of the few teaching modules that have been identified here is that they are an unnecessarily elaborate and complex way of saying that high level thinking comes from asking good questions.

It would appear that the evidence given here supports the contention that modules are more than good questions. They include such elements as a good sense of timing and a particular sequence which give children opportunities to think through ideas for themselves. At present the sense of timing is not amenable to objective analysis through the existing code, but it appeared from inspection of the modules that the selection of a particular prediction for extension or justification was an important factor in a productive discussion sequence. Repetition or restatement of the children's predictions, and repetition of extension and justification questions in a slightly modified form were also judged to be important factors in encouraging children to think through ideas and to build on each other's contributions rather than reiterating ideas which are vaguely related to the focus of discussion and which they recollected from one source or another.

CHAPTER XI

SUMMARY AND OBSERVATIONS

Today developing the cognitive potential of students is considered to be central to education. There is also a strong suspicion that children can learn vastly more and on a more mature intellectual level than they now do if they are redirected from mastering information preprocessed by other people to mastering the systematic intellectual skills of processing the information themselves. Therefore, any information leading to the development of more adequate skills of reasoning and of inquiry is a useful contribution.

In a study of this kind, two kinds of data emerge -- the quantifiable data which have been discussed in Chapters IX and X, and the qualitative data. These qualitative data, the observations of participating teachers on changes in their students, general impressions from the analyses of the tapescripts, and impressions of other products of students' work, are susceptible to the criticism that they may be biased by unexamined assumptions and theoretical predispositions of the participants. Yet all studies yield data which for the time being cannot be statistically quantified. The qualitative data are especially prominent in studies of new areas and of highly complex behaviors where the available instruments are most likely to be inadequate to the objectives of the studies.

While qualitative evidence may be called "impressionistic" and therefore not the best kind of evidence, the tests and the special procedures and techniques from which statistical data are derived are limited also and do not always yield the best kind of evidence on the significant events in a complex learning situation.

It must be noted again that this study, as is true of all studies, had certain built in limitations which restrict both the results and their interpretation. The specially obvious limitations were the imbalanced sample and the difficulty in clearly identifying the more complex patterns of teaching and thinking. Recognizing the limitations of both kinds of evidence, then, let us first briefly consider the quantitative data.

The chief hypothesis of the study was that if the students were given a curriculum designed to develop their cognitive potential and theoretical insights, and if they were taught by strategies specifically addressed to helping them master crucial cognitive skills, then they would master the more sophisticated forms of symbolic thought earlier and more systematically than could be expected if this development had been left to the accidents of experience or if their school experience had been guided by less appropriate teaching strategies. The assumption was that conscious attention to the various intellectual processes would be the chief factor that would affect the students' facility to transform raw data into useable concepts, generalizations, hypotheses, and theories.

It had been specifically postulated that teachers' actions were one of the most important influences in guiding the thought processes of students. These actions could, on the one hand, encourage divergent styles of thought and develop both discipline and autonomy in the use of cognitive skills, supporting students and giving them freedom to explore alternatives, or, on the other hand, these actions could limit the kind of cognitive operations in which students engage and the answers considered acceptable.

Generally speaking, the results of this study confirmed these hypotheses.

The data on the STEP Social Studies Test indicated that the time spent on the processing of data did not preclude high achievement in learning information which is favored by this kind of test.

Evidence from the tests developed within the study showed that in ability to discriminate, to infer from data, and to apply known principles to new problems, the groups which had been trained in the skills of the three cognitive tasks were superior to untrained groups. However, these results were not consistent. It was not clear to what extent these inconsistencies were influenced by inadequacy of the tests, by imbalance in the composition of the sample groups, or by variations in teaching style over and above the variable of training.

The results from the analysis of the tapescripts showed a slightly different picture than did the analysis of test data. Generally speaking, the use of specific teaching strategies designed to foster development of cognitive skills seemed to make a difference in the general productivity of thought as well as in the type of cognitive operations in which students engaged.

The trained groups produced not only a greater number of thought units, but also thought units of greater length and complexity. They also tended to deal with more sophisticated content. They tended to operate more frequently on higher levels of thought, for example categorizing data on multiple bases or employing class categories instead of the functional ones in organizing the data. Evidently the experimental groups had a better grasp of a scientific conceptual hierarchy than did the control group. The experimental groups also tended to produce more abstract and complex inferences. They tended to engage in consecutive and logically related sequences of thought, and they were both inclined to and capable of supporting their inferences. Through these chains of reasoning the trained groups gave evidence of actually producing generalizations in class, instead of appearing to recite or recall them as did the untrained students. Perhaps the most distinct difference was the trained students' inclination to constrain their hypothesizing to the data and to a realistic view of the problem. While long causal leaps often characterized their thinking, so did also their willingness and ability to reinstate these causal chains when pressed to do so. Also the students under trained teachers seemed to be more inclined to extend the hypothesizing across a longer chain of causal factors than were those under untrained teachers. The latter seemed to specialize more in immediate consequences and possibilities. In all groups the explanatory mode of thinking tended to be the least favored while the inclination to hypothesize ran rather high.

Student participation was high in all groups. Probably the fact that a similar task, i.e., a specific question for discussion was given to all groups induced all teachers and students to a greater freedom to talk and gave a similar impetus to expressiveness. Since the discussion questions were not typical of the ordinary classroom procedure of the control groups it is likely that differences between the trained and untrained groups would have been greater had the control group been asked to follow their usual procedure instead of the questions designed for the experimental groups. However, on the more complex tasks, such as inferring from data and applying principles in order to hypothesize and predict, the trained group showed higher participation than did the control group.

In all groups, teachers were fairly successful in getting students to give the response they sought. However, the untrained teachers tended to be less successful in getting the responses they sought even though they sought low-level responses more frequently than did the trained teachers. Their tendency to concentrate on descriptive-information showed up especially strongly on Tape 3 where the orderly process of transforming descriptive information into generalizations was central. In other words, the evidence of training showed most markedly on intellectual tasks in which sequential procedure was the most essential.

An interesting phenomenon was the great variation among teachers and classrooms. In spite of the pursuit of common generic strategies these variations of style and strategy were even greater among the trained teachers than they were among the untrained teachers. This fact seemed to suggest at least two possibilities.

The first possibility was that the teachers had not discarded their former styles when the discussions were recorded immediately after training in the new strategies. Ten days of training, focussing on a single aspect of teaching, were understandably insufficient to establish a new and coherent style of teaching. Such a short period of training could not offset the other variables that influenced the teachers' strategy: their personal capacity for logical thinking, their relative skill in formulating open-ended questions, their facility at managing the divergent thought produced by those questions, and their capacity for rapid and accurate diagnosis of student responses both in terms of the quality of the cognitive processes and the content of these processes. Some teachers could not emancipate themselves from long-established habits, and compulsively elaborated descriptive information to the point of warping perspective or deviating from the focus. Others had difficulty in patiently laying the foundations for the pertinent cognitive operations: they tended to rush toward an end product, unmindful of the fact that the students could not produce it until they had first mastered the required cognitive operations.

The second possibility was that an open-ended and generic teaching strategy, especially when supported by an understanding of its rationale, encourages invention of variations upon the theme. This hypothesis was supported by observations from two sources. First, many tapescripts of the trained teachers included examples of specific strategies for which no models were provided in the training program. (See Chapter X). From the start these teachers began to invent procedures (as the training program had intended them to), instead of blindly following formulas.

Second, the videotapes made (in the classes of some of the same trained teachers) two years later (as part of another project) suggested that they had tightened and systemized strategies which appeared only sporadically in the tapescripts of this study. The videotapes also suggested that ripening time, a clearer perspective on the task, and more practice assessing feedback had produced a considerable number of new strategies. Among these improvements and inventions were such devices as interposing the making of a retrieval chart between preliminary sifting of data and generalizing on that data. The initial model of classification was refined to include two specific strategies: 1) a systematic specification of highly abstract statements or of statements that appeared to be verbalizations, for greater precision and concreteness, and 2) the converse, the generalizing of statements in which specific detail or verbal clumsiness obscured the crucial point. Still others began to use models for certain cognitive operations, either by themselves introducing such models or by exploiting the spontaneous models created by individual students.

There is little doubt on the part of those who have studied teaching and learning in the classroom that it is possible to modify and to improve the teaching process. The question is with what kinds of teachers, what kind and how much improvement, and over what period of time. The present study left no doubt that certain teacher behaviors can be modified in ten days of training. However, it was equally clear that not all teachers modified their teaching behaviors in the same amount. Neither did any become perfect representatives of the open-ended style of teaching required for the development of autonomous use of cognitive skills, because variables other than those affected by training in strategies for cognitive development remained in effect.

It is clear therefore, that studies of the effect of a greater number of variables affecting teaching strategies are needed to delineate the impact of training on modifying teaching strategies. Data on the variables which we now believe to be involved would not only be useful to control sampling of teachers in future studies, but also for a more accurate analysis of the conditions that affect the success of certain teaching strategies and to ascertain which points need emphasis in training teachers.

The relationship between general ability as measured by intelligence tests and level of thinking is still baffling, probably because general ability and verbal fluency seemed to be related. By and large the more able students talked more and consequently also produced more high level thought units than did the less verbal or less expressive students. On the other hand, the low ability students also participated more than they did usually. Many teachers remarked on their surprise at seeing the "silent phalanges" become active participants. The whole question of the role of language in articulating thought is under debate. Consequently, neither the theoretical ideas nor the data gathered were sufficient to determine whether increased expressiveness enhances thought or vice versa.

Further, the strategies fostered a greater incidence of both high and low level thought in the more able students. Since orderly thought requires the thinker to establish facts before generalizing, and factual support also is necessary to validate predictions and hypotheses, the above results seem reasonable enough. With the available time and techniques it was impossible to establish beyond doubt when low level thought was used for its own sake and when it was used as material from which to produce more abstract and complex forms of thought.

However, reading the tapescripts left a strong impression that the trained groups assembled descriptive information for the purpose of discovering general principles from comparing and contrasting the descriptive data, while the untrained groups more often were satisfied merely with assembling it. A more continuous recording and a more sophisticated analysis of data are needed to establish this differentiated meaning of the frequencies of the low levels of thought.

General Observations

It seems evident that the impact on cognitive processes of the specific teaching strategies is greater than the impact of the curriculum guide which only gives general sequences of learning experiences and generic teaching strategies. If this is a case with a curriculum guide that outlines learning sequences and teaching strategies in unusually great detail, the impact of curriculum guides that supply either relatively meager or relatively rigid guidance for teachers will be even less. This conclusion reinforces the general impression that unless teaching methods consistent with the innovative curriculum are used in the classroom, that curriculum becomes diluted, misused, and ineffectual. The most important observation that can be made from the data collected in this study is the centrality and power of the teacher's role in initiating cognitive operations and determining which kinds are open to students. From that follows the importance of implementing curriculum innovations that focus on behavioral objectives by making adequate teaching strategies available to the teachers.

The problem with variability in teaching strategies experienced in this study suggested that for research based on results of training in processes as complex as teaching strategies, the ideal sequence would be to defer securing evidence on changes until at least a year after the training was completed. In this way teachers would be given time to internalize the new style, to attain a clear perspective on the tasks, and to practice accurate assessment of student feedback on which to base their next act. Observations indicate that results from this study would have been different had such an interval been possible.

The complexity of analyzing the cognitive aspects of student and teacher interaction described in this study is overwhelming. To derive anything of either theoretical or practical value from this study, it was necessary to identify the specific elements of 1) the pedagogical functions of specific teaching acts; and 2) the thought levels of specific units of student verbal products. But as the study progressed, it appeared that it would be equally valuable to examine the ways in which teaching acts were combined, the order in which they occurred, and the flow and sequence of students' thinking.

For example, the sharpest differences between the thinking of the trained and the untrained groups were found in the frequencies of "chained thought,", the combination of both low and high level thought units into logical inferential sequence. Similarly, some single teaching act, such as the insertion of a model into the discussion, might affect all subsequent student behavior. Yet, the very existence of such a model might not be apparent in quantitative terms. Still other acts were significant only as parts of a constellation or pattern.

While the coding scheme used in this study did in fact take these interactive factors into account, there was not sufficient time to translate the codes into patterns of statistical analysis. A double analysis of data seemed indicated: firstly, to identify the analytical elements of both the teaching acts and the thought processes; and secondly, to identify the dynamic and productive combinations and sequences of those elements. A limited attack on this problem was made through examining the thought chains mentioned above and the productive "teaching modules." The significant power of the module lies in the sequence of the specific acts, rather than in the single acts. The modules, or sequences can be combined into large strategies to provide simultaneously elements of known impact and the possibility of combining them flexibly into larger strategies according to the needs of the group and the requirements of individual teaching styles. Such a combination would provide a useful compromise between the two dychotomous orientations to teaching: the one that is usually referred to as the science of teaching, and the one that is called the art of teaching.

There are, of course, obvious problems in adopting the suggested method of double scoring and double analysis. Scoring complexes of thought sequences and teaching strategies would be bound to reduce the reliability of the scoring and would require an acute professional judgment in the scorers that the limited financing of such projects usually prevents. However, it is possible that such expensive efforts by pioneering projects would lead to the discovery of simpler signals for these complexes. Consequently a way would be opened up to analyze the essentially dynamic characteristics of thought in a normal classroom setting.

Determining the ultimate effects of special teaching strategies on the development of thinking would require longitudinal studies. It is quite obvious that thinking is not learned instantly. To acquire such competencies as going beyond what is immediately given, generalizing, performing multiple classifications, or engaging in a probabilistic and hypothetical mode of reasoning, takes time and practice.

There is also the question of the amount of time required to complete a cycle of growth; it takes time to transform poor data discriminators, students with no models for going beyond what is immediately given, or students who are afraid to think for fear of being wrong, into students who not only attempt to make inferences but also have the requisite skills. Just as the full effect of the training on the teachers' behavior was not visible within this study because they had not had time to internalize and practice the new behaviors, so it was not visible with the students. Models, once acquired, produce incremental learnings as they are practiced. Thus to the extent that they represent radical changes in thought patterns they also represent potential for cumulative learning. Longitudinal studies of substantial duration would seem to be indicated in order to determine the nature of such transformations, the meaning of each behavior at a given point in a sequence, and the time required to complete the cycle. The assumption that the effects of teaching and learning at one point become the inputs at the next point also would suggest the usefulness of continuous and comprehensive records of classroom processes. For example,continuous practice in generalizing may affect the students' ability to use the generalizations produced in predicting and hypothesizing in new situations. Opportunities to see the multidimensional properties of objects and hence to perceive the possibilities of their multidimensional classification may help develop the capacity to make explanations or to verify predictions.

It is evident that an analysis of the levels of cognitive operations without a simultaneous analysis of the level and the validity of the content of the inferences, generalizations, predictions, and hypotheses, would be incomplete. Ideally, an analysis would be made of four dimensions: of the pedagogical functions of teaching strategies, of the hierarchy of the cognitive operations, of the validity and significance of the content of these processes, and of the impact of each on all others.

Finally, it must be pointed out that studies of thinking will be defective as long as they focus only on the nature and the quality of forms of thought without also investigating the processes by which they are produced: what induces perception, how students decide, how they arrive at perceptions of causal connections of differences and similarities among objects and events, how associations produce particular hypotheses, etc. If such information were obtained it should also be possible to determine to what extent differences in cognitive style are learned and to what extent they are influenced by affective factors, such as an individual's attitude toward taking risks, his feelings about ambiguity, or his capacity to respond to and interact with other people.

The current study is modest indeed, compared to the scope of the work that remains to be done.

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Appendix A

Social Studies Inference Test

Grades 4-6

Explanation to students:

This booklet has some stories. After each story there are some sentences about the story. First, I will read the story out loud to you and you can follow along in your booklet. Then I will read each of the sentences and you are to decide whether the sentence is probably true, probably false, or if you can't tell whether it is probably true or false.

You have 3 different colored cards. Take the blue card first. You see on this card spaces for marking your answer.

Decide on an answer for each sentence that I read to you. Mark your answer with a heavy black mark. If you think the answer is probably true, mark in the space under "Probably True." If you think the answer is probably false, mark in the space marked "Probably False." If you can't tell from the story whether the sentence is probably true or probably false, mark in the space under "Can't Tell."

For some of the sentences "probably true" may be the correct answer. For some of the sentences "probably false" may be the correct answer. For some of the sentences "can't tell" may be the correct answer.

Example:

Mr. Jones was a farmer in the midwest. When he heard about the discovery of gold in California, he left his family and went to California.

1. Mr. Jones went to California with his family.
2. Mr. Jones went to California because he did not like the place in which he lived.
3. Mr. Jones went to California to look for gold.
4. Mr. Jones will find gold in California.

BLUE CARD

PEOPLE X AND PEOPLE Y

This is about two groups of people, People X and People Y.

People X hunt and fish to get food. They often have to move because the herds of animals move from place to place.

Most of People Y are farmers. However, many of them make simple tools. The toolmakers trade the tools to the farmers in exchange for food.

1. People Y are more likely to build schools for their children than People X.

2. People X and People Y live in Africa.

3. People Y have machinery.

MECANO AND GROWLAND

Two countries, Mecano and Growland, are next to each other. The people of Mecano have developed modern industry. They are well educated. There are colleges that train doctors, lawyers, engineers, and business men. The people who live in Growland lead more simple lives. Mostly they work on their farms. Some of them make baskets and jewelry. Their goods and farm products are traded to the Mecanos in exchange for manufactured items. There is a valley near Mecano and Growland. People from Mecano and Growland are going to live together in this valley.

4. The Growlanders in the valley will become more like the Mecanos, but the Mecanos will not become like the Growlanders.

5. The Mecanos and the Growlanders speak the same language.

6. The Mecanos and the Growlanders live together in the valley because all of their land has been used up.

BLUE CARD

MR. JONES' GROCERY STORE

Mr. Jones owns a grocery store. Often, in the last few weeks, he has not had enough bread for his customers. It has been an unusually dry season in the area and the wheat crop has not done well this year.

7. The delivery trucks have broken down so Mr. Jones is unable to get bread.

8. There was as much rainfall this year as last year.

9. The bakers have been very busy this year.

10. Mr. Jones will start baking his own bread.

11. They are using the wheat to make other things this year rather than for making bread.

12. Mr. Jones will close his store until more bread is baked.

13. The wheat crop was of poor quality.

14. The price of bread is higher this year than last year.

15. More wheat will be harvested this year than last year.

PEOPLE A AND PEOPLE B

People A: The vote had been very close. A number of the representatives did not like the outcome. They decided to go back to their districts and ask the people for support. This was the fourth vote on which the President had been defeated.

People B: The Chief asked his council for advice and then he told his people what he had decided. The people listened to their Chief. When he was through talking, they cheered.

16. People A and People B have the same system of government.

17. The representatives of People A are selected by the President.

18. People A will re-elect the representatives who voted for the bills the President supported.

19. The Chief of People B knew his people would do what he wanted them to do.

20. Most of the representatives of People A agreed on the issue that they had just voted on.

21. People B vote for the members of the council.

YELLOW CARD

MR. EDWARDS' FARM

Mr. Edwards' farm was in the valley. He had just finished planting his seeds. He could see the snow on the mountains. He hoped the snows would not melt too fast. The fire last summer burned most of the trees on the mountainside.

1. More water will flow into the valley this year than last year.
2. Mr. Edwards' seeds will die of frost.
3. Topsoil from the mountain will be washed down into the valley.
4. Mr. Edwards planted his seeds after the snow fell.
5. Mr. Edwards' farm is on the mountainside.

SEAL HARBOR

The city of Seal Harbor is a rapidly growing transportation center. It has been served by planes, railroads, and ocean-going ships. It has just improved the airport and extended the runways so it can serve the largest and fastest jet aircraft.

6. More business and new businesses will be attracted to Seal Harbor.
7. Propeller planes will not be used very much at the Seal Harbor airport.
8. Trade with other cities will be increased.
9. Salaries in Seal Harbor will increase.

YELLOW CARD

HENRY AND TARO

Henry's father is a farmer. Henry is twelve years old. During the week Henry goes to school and he wants to become a teacher. On weekends he works on the farm and has learned to drive a tractor. His father is happy that Henry wants to become a teacher.

Taro is also twelve years old. Taro's father is a hunter. Taro's grandfather also was a hunter. Taro is learning to hunt from his father. Many times on the way home from hunting Taro stops to watch the fisherman. One day Taro asked his father, "Can I become a fisherman?" Taro's father said, "No, because I am a hunter."

10. Henry's father wants Henry to become a farmer.

11. Henry's grandfather was a farmer.

12. Taro will leave the tribe and become a fisherman.

13. Taro's sons will become hunters.

THE PICKER

Three months after the Picker had been invented, more flander had been picked than for all of the year before. All of the machines at the textile mills were working day and night. Six months after the Picker had been put to use, the mills realized that they could not process the amount of flander sent to them.

14. Flander is used in making cloth.

15. The mills will change the way they process flander.

16. Less flander will be grown next year.

YELLOW CARD

PAMBO AND TOM

Pambo is twelve years old. There are no schools where Pambo lives. He does not read or write. He fishes with his father every day. Pambo is learning to cut bark from trees to make a canoe. His father teaches him many things and is proud of how well Pambo can do them.

Tom is also twelve years old. He works hard at school and gets good grades. When he comes home from school he reads his books so that he will learn things that will help him.

17. Tom is smarter than Pambo.

18. Pambo's father can read and write.

19. Pambo is having trouble learning how to make canoes.

20. Tom reads every day because he is behind in his school work.

21. If Pambo and his family move to the city where Tom lives, Pambo will go fishing every day with his father.

GREEN CARD

RAND'S LAND

Thirty years ago Mr. Rand bought a thousand acres of farmland. Many new industries have developed in the city nearby. About ten years ago Mr. Rand sold half his farmland to people who build homes. Last year Mr. Rand sold two hundred acres more and many homes have already been built on this land.

1. The people who bought the houses are coming to work on Mr. Rand's farm.
2. Mr. Rand will sell the rest of his farmland to the people building homes.
3. Mr. Rand still owns half of the farmland that he bought thirty years ago.
4. Mr. Rand sold his farmland for more money than he paid for it.
5. They are building houses for the people coming to work in the industries.
6. The people who had worked on Mr. Rand's farm went to work for industry.
7. The people who bought Mr. Rand's farmland were farmers.

PACIFIC ISLAND

An island has just been discovered in the Pacific Ocean. The natives of this island cannot read or write. Most of them are farmers. Some are fishermen who get fish from the ocean. Several food companies in California want to get the fish from the ocean around the island. These companies will send fishing boats from California and build a cannery on the island. Many people will be needed to work in the cannery.

8. Most of the islanders are fishermen.
9. The islanders will build fishing boats for the people who own the cannery.
10. The islanders will become wealthy from the fishing industry.
11. The natives will be happier because of the cannery.

GREEN CARD

MR. HARVEY'S SPEECH

Mr. Harvey spoke to the Founders Club last night. Here is part of what he said:

> "In the early days of our country many people settled here from other countries. They came here to establish a way of life that was better than they had in their own countries. They helped build a strong America because they believed in America. Today the foreigners who come here do not seem to appreciate the freedom and opportunity America offers them. We ought to be more careful about who we let in and require an oath of these foreigners before we accept them."

12. Mr. Harvey feels that people who take an oath can be trusted.

13. Mr. Harvey had studied a great deal about America.

14. Mr. Harvey is running for political office.

THE KOSKIS

Mr. and Mrs. Koski remembered the day they docked in New York. They had been married only two months when they arrived from Poland. America was a strange land to them. Mr. Koski worked hard for many years so his children could go to school. Ed, the oldest child, is now in college and will one day become a lawyer.

15. The Koskis came to America last year.

16. Ed is proud of his father.

17. The Koskis will return to Poland to live.

SOCIAL STUDIES INFERENCE TEST

Item Key

	Blue Card				Yellow Card				Green Card		
Item No.	PT	CT	PF	Item No.	PT	CT	PF	Item No.	PT	CT	PF
1.	I	C	E	1.	I	C	E	1.	E	C	I
2.	OG	A	E	2.	OG	A	E	2.	OG	A	E
3.	E	E	D	3.	I	C	E	3.	E	E	D
4.	I	C	E	4.	D	E	E	4.	I	C	E
5.	OG	A	C	5.	E	E	D	5.	I	C	E
6.	OG	A	C	6.	I	C	E	6.	OG	A	E
7.	E	C	I	7.	OG	A	E	7.	E	E	D
8.	E	C	I	8.	I	C	E	8.	E	E	D
9.	E	C	I	9.	I	C	E	9.	E	E	D
10.	E	C	I	10.	E	E	D	10.	OG	A	E
11.	E	C	I	11.	OG	A	E	11.	OG	A	E
12.	E	C	I	12.	E	C	I	12.	D	E	E
13.	OG	A	E	13.	I	C	E	13.	OG	A	E
14.	I	E	C	14.	D	E	E	14.	OG	A	E
15.	E	E	D	15.	I	C	E	15.	E	E	D
16.	E	C	I	16.	E	C	I	16.	OG	A	E
17.	E	C	I	17.	OG	A	E	17.	E	C	I
18.	OG	A	E	18.	E	C	I				
19.	I	C	E	19.	E	E	D				
20.	E	E	D	20.	E	E	D				
21.	OG	A	E	21.	E	C	I				

Key: C = Overcaution D = Discrimination I = Inference

OG = Overgeneralization A = Accurate E = Error

APPENDIX B

APPLICATION OF PRINCIPLES TEST

Grades 4 - 6

Explanation to students:

This booklet has some stories. After each story there is an incomplete sentence. Below this sentence there are four reasons which can be used to complete the sentence. First, I will read the story out loud to you and you can follow along in your booklet. Then I will read the incomplete sentence and the four reasons and you are to decide which reason is the best one that completes the sentence. After you have decided which reason is best, pick the reason you think is next best.

You are to mark your answer on the answer card.

To show the reason you like best, mark in one of the bubbles, A, B, C, or D next to "1st", like this:

		A	B	C	D
1.	1st	0	0	●	0
	2nd	0	0	0	0

In this example, "C" was marked next to "1st" because it was selected as the best reason.

To show the reason you like second best, mark in one of the bubbles, A, B, C, or D next to "2nd", like this:

		A	B	C	D
1.	1st	0	0	●	0
	2nd	●	0	0	0

In this example, "C" was selected as the first choice, and "A" was selected as the second choice.

WHITE CARD

HENRY

Henry lives in California. His father is a farmer. Henry's father did not go to college. When Henry was a little boy he worked on the farm and his father taught him how to drive a tractor. Henry could do everything on the farm very well. Henry wanted to become a teacher. Henry's father was very happy when Henry went to college to learn how to be a teacher. Henry now teaches the sixth grade in a big school in the city.

1. It was possible for Henry to become a teacher

A. because in this country a person can choose to learn the kind of work he is interested in.
B. because in this country you need teachers to teach farmers how to use machinery.
C. because in this country people do not have to have the same occupation as their fathers have.
D. because in this country anyone who works hard can become anything he wants.

2. Henry's father wanted Henry to go to college and learn to be a teacher

A. because in this country there are not as many small farms as there used to be.
B. because people who have not gone to college want their children to go to college.
C. because in this country a college education is important.
D. because people who teach are more important to a country than people who farm.

WHITE CARD

COLOMBO AND HARMAN

The people who live in the country of Colombo have always gotten their food by hunting and fishing. The people lived quietly and peacefully and had very few visitors from other countries. One day someone discovered that there was iron ore in the mountains. The people did not know how to get the iron ore out of the mountains and they did not have machinery.

The people in nearby Harman country heard about the new discovery in Colombo. They brought in engineers and equipment to get the iron ore out of the mountains of Colombo.

3. After the people of Harman came to Colombo the Colombo people learned how to do many things

A. because people from one country can learn ideas and skills from people of another country.

B. because the use of metals is important in developing a country's resources.

C. because when skilled people and machinery come into a country they cause changes.

D. because new ways of doing things are better than old ways.

4. The mining of ore has become Colombo's main occupation

A. because people who have hunted all of their lives want to learn how to do the new things.

B. because the development of a country's resources will allow them to buy many things they need.

C. because using natural resources requires a great deal of knowledge.

D. because the discovery of natural resources brings about changes in a people's way of life.

WHITE CARD

PAMBO AND TOM

Pambo is twelve years old. There are no schools where Pambo lives. He does not read and write. He fishes with his father every day. Pambo is learning to make canoes from tree bark. His father teaches him many things and is proud of how well Pambo can do them.

Tom is also twelve years old. He works hard at school and gets good grades. When he comes home from school he reads his books so that he will learn things that will help him.

One day Pambo and his family moved to the city where Tom lives. Pambo and Tom became good friends.

5. Tom helps Pambo to learn to read but Pambo does not teach Tom how to build canoes

A. because certain things that are important in some cultures are not important in others.

B. because people of modern cultures tend to teach the people of primitive cultures instead of learning from them.

C. because a newcomer to a culture has difficulty in learning the ways of that culture.

D. because people who come from primitive cultures are not as smart as people living in modern cultures.

6. Pambo's father will have a hard time finding a job

A. because people from primitive cultures cannot learn the skills necessary to do jobs in modern cultures.

B. because canoes are used very little in modern culture as they have faster forms of transportation.

C. because skills that are highly needed in one culture may not be needed in another culture.

D. because older people have a harder time finding jobs than do younger people.

WHITE CARD

MR. JONES

Mr. Jones and his family had always lived in a small town in the eastern United States. Mr. Jones was a very good blacksmith and he made the best horseshoes in town. When the automobile was invented there were not as many people riding horses as there used to be. Mr. Jones and his family moved to a big city to look for a job.

7. Moving to a big city was a wise move for Mr. Jones

A. because people who move to cities usually do not have difficulty in finding jobs.

B. because in cities you can find new ways to use skills that you have.

C. because in cities newcomers can meet many people and make new friends.

D. because in cities there are many jobs needing skills like those of a blacksmith.

8. Mr. Jones may have a hard time finding a job in the city

A. because it is not easy to find your way around in a big city.

B. because skills that may be useful at one time may not be needed at a later time.

C. because people who have lived in small towns all of their lives usually do not know how to do many things.

D. because there has been a shift from making things by hand to machine work.

RED CARD

THE AJAX COMPANY

There are 100 men employed by the AJAX Machine Company. Here are four of them:

Mr. Jones' job is to pour melted steel into a mold which makes parts for a machine.

Mr. Smith's job is to make holes in the machine part so that it can be screwed to the frame.

Mr. Adam's job is to put the wheels on the frame.

Mr. Thomas' job is to paint the machine.

1. Each man has a different job in this factory

A. because each job in the factory depends upon the work of others.

B. because it is easier to train or replace a man who does just one thing.

C. because one man cannot be skilled in more than one job.

D. because each man can produce more if he has fewer skills to perform.

2. The company can make more money

A. because, by giving each man a different job, each man can work at his own speed.

B. because, by giving each man a different job, the same number of men can produce more in less time.

C. because, by giving each man a different job, the company can pay less to the men who have unskilled jobs.

D. because, by giving each man a different job, all men are working at the same time.

RED CARD

FARMER JIM AND FARMER TOM

Farmer Jim lived a long time ago. He raised food for his family, chopped trees to build his own farm house, and had his own horse to pull his plow. He rode his horse to Georgetown once a month to get supplies.

Farmer Tom, who has a farm today, hired carpenters to build his farm house. He has a machine to cut wheat which he sells to other people who make flour. He owns a truck which he drives to Georgetown every week.

3. Farmer Tom did not build his farm house himself

A. because today people are hired to do jobs for which they are highly trained.
B. because today farmers do not know how to build houses.
C. because many years ago farmers were able to get their own wood from the forests.
D. because today house-building requires a number of skills.

4. Farmer Tom goes to town more often than Farmer Jim did

A. because modern farmers cannot make all of the things that they need to run their farms.
B. because today farmers replace their machines often.
C. because modern farmers depend on what the city provides.
D. because modern farmers must get their farm products to market faster than they used to.

RED CARD

MONA COUNTRY

The people who live in Mona country have always been farmers. The land is very good for raising cotton and almost all of it is cotton fields. There are large plantations in Mona Country. Most of the workers work in the cotton fields. There is poor transportation in and out of Mona country because it is cut off from the sea by a high range of mountains. Almost all of the cotton is carried out by small trucks that can go over the mountains to the seaport.

5. The people in Mona country probably have a low standard of living

A. because most of the people in a one-crop country do the same kind of work.

B. because, in one crop countries, all of the people make about the same amount of money.

C. because it is harder to improve things in a one-crop country than in one that has a lot of resources.

D. because, in one-crop countries, large land owners do not want to change the way the people live.

6. If Mona country decides to improve its standard of living, it will have problems

A. because the fewer the resources a country has, the harder it is to improve the standard of living.

B. because it takes a lot of money and no-one can make very much money raising cotton.

C. because it is hard to make improvements in a one-crop country.

D. because rich land owners travel a great deal and leave managers in charge of their land.

RED CARD

7. Mona country is offered aid from another country which wants to help Mona to develop its mineral resources. This aid is going to cause problems in Mona country

A. because, in a one-crop country, the owners of the farms will not want the people to leave the farms to work in the mines.
B. because people who have always lived in the same way will probably not want to change quickly.
C. because people who have always worked in the cotton fields will not be able to learn how to do anything else.
D. because it takes a lot of machinery to develop mineral resources.

8. If Mona country does begin to develop industries, they will have more people living in cities

A. because the people can earn more money working for industry.
B. because the farmers will be able to drive from their homes in the cities to their farms.
C. because cities usually develop where there are industries.
D. because the skills of farmers can easily be used in industry.

APPLICATION OF PRINCIPLES TEST

Item Key

White Card

	A	B	C	D
1.	1	R	2	X
2.	R	2	1	X
3.	1	R	2	X
4.	X	2	R	1
5.	1	2	R	X
6.	X	2	1	R
7.	X	1	R	2
8.	R	1	X	2

Red Card

	A	B	C	D
1.	R	2	X	1
2.	X	1	2	R
3.	1	X	R	2
4.	2	X	1	R
5.	R	X	1	2
6.	1	X	2	R
7.	2	1	X	R
8.	2	R	1	X

Key:
1 = higher order generalization
2 = lower order generalization
R = irrelevant generalization
X = error

APPENDIX C

VOICE COMMENTARY FOR TOM AND PAMBO

Hello. Today we are going to do something you have never done before. Many of you have taken tests that can be answered "true" or "false." This is something like that, but not quite. In this particular test, I am not going to give you the whole story at once. Instead, I am going to give it to you piece by piece. First, I am going to give you a bit of the story. Then I am going to give you a statement, and I want you to decide if it is probably true, probably false, or if you can't tell if it's probably true or false.

Instead of marking your answer on paper as you usually do, I want you to make your answer by pressing a button on the box you have in front of you. Let's look at this box for a moment. It contains four buttons, a, b, c, and d. As you can see, a is going to mean probably true; b is going to mean probably false, and c is going to mean can't tell. The d button has a special use, and I will tell you when to press it.

Let's try this a few times. First, let's all now press the d button. Suppose you wish to answer "probably true." You would press which button? The a button, of course. Everyone now press the a button. If you wish to answer "probably false" you would press the b button. Let's all press the b button now. If you can't tell if the statement is true or false, you would press the c button. Press the c button now.

All right. That's how we make our answers using this box. Remember, you have a choice of three answers, a, b, or c. Let's try it with a sample story.

First, everyone press the d button. Here is a sentence: Tom's friend lives in a house. Now the statement that I want you to decide about is in the box: Tom's friend is a girl. If you think that this statement is probably true, press the a button. If you think that it is probably false, press the b button. If you can't tell from the story whether it is true or false, press the c button. Make your answer now.

Of course, the answer should be c for can't tell. All we know is that Tom's friend lives in a house. We can't tell from that whether his friend is a girl or not, can we? Now let's all press the d button, and I will give you some more information about Tom's friend. Press the d button now.

Here is some more information. Tom's friend likes to watch television. Now I want you to decide again about the statement in the box: Tom's friend is a girl. Do you now think it is probably true? Do you think it is probably false? Or do you still think the answer should be, can't tell? Press the correct button for your answer. Make your answer now.

Everyone who pressed the c button for can't tell is correct. You can't tell if Tom's friend is a girl, although you do know that his friend lives in a house and likes television. Everyone now press the d button.

Here is one more bit of information. Tom's friend wears perfume. Now, knowing this, again make a decision about the statement, Tom's friend is a girl. Do you think it is probably true, probably false, or can't tell? Press the button for your choice now.

Yes, now that we know Tom's friend wears perfume, it is probably true that Tom's friend is a girl. You should have pressed the a button for your choice. That is how I want you to make your answers in the following tests. I will give you a little bit of the story each time, and there will be a statement in the box that you are to decide about. I will keep giving you more information each time, and you can change your answer as often as you wish. Or you can keep it the same. It's up to you. I want you to think carefully and choose the answer that seems best. Now, everyone press the d button, and we are ready to go.

Here is the first part of this story. This is a story about two boys. Both are twelve years old. One is named Tom. The other is named Pambo. Now you decide if the statement in the box, Tom is smarter than Pambo, is probably true, probably false, or if you can't tell if it is true or false. Press the correct button for your answer. You may answer now.

Now that everyone again has answered, press the d button, and I will give you some more of the story. We already know that Tom and Pambo are two boys, both 12 years old. Here is some more information. Tom and Pambo wear different kinds of clothes. Now again, make a decision about the statement, Tom is smarter than Pambo, and press the button for your answer. You may answer now.

Now everyone again press the d button, and I will give you some more of the story. We know now that Tom and Pambo are twelve year old boys who wear different kinds of clothes. Here is some more. Tom lives in a city in the United States. Pambo lives in a jungle in South America. Now again, make a decision about the statement, Tom is smarter than Pambo, and press the button for your answer. You may answer now.

Now, everyone again press the d button, and I will give you some more of the story. Here is some more information. Tom goes to school every day. Pambo goes fishing with his father every day. Now again make a decision about the statement, "Tom is smarter than Pambo," and press the button for your answer. You may answer now.

Now, everyone again press the d button, and I will give you some more of the story. Here is some more. Tom knows how to read. Pambo does not know how to read. Now, again, make a decision about the statement, "Tom is smarter than Pambo," and press the button for your answer. You may answer now.

Now everyone again press the d button, and I will give you some more of the story. Let's see what we now know. We know that Tom and Pambo are twelve year old boys who live in different countries and wear different kinds of clothes. Tom goes to school every day and knows how to read. Pambo goes fishing every day with his father and does not know how to read.

Here is some more. After school, Tom does his homework. After fishing, Pambo helps his father build canoes. Now again, make a decision about the statement, "Tom is smarter than Pambo," and press the button for your answer. You may answer now.

Now everyone again press the d button, and I will give you some more of the story. First, let's review what we've learned. We know that Tom and Pambo live in different countries. Tom goes to school and does his homework. Pambo fishes and builds canoes with his father. Where Tom lives, people have to read and write. Where Pambo lives, people have to fish and build canoes.

Here is some more. Tom is usually behind in his school work. Pambo has built the best canoe of any of the boys where he lives. Now again, make a decision about the statement, "Tom is smarter than Pambo," and press the button for your answer. You may answer now.

Now everyone again press the d button, and I will give you some more of the story. Tom needs a great deal of help on his school work from his teacher. Pambo helps some of the other boys who have trouble learning to build canoes. Now again, make a decision about the statement, "Tom is smarter than Pambo," and press the button for your answer. You may answer now.

Now, everyone again press the d button, and I will give you some more of the story. We already know that Tom and Pambo live in different countries. Tom goes to school and is usually behind in his homework. He needs help from his teacher. Pambo fishes and builds canoes. He helps the other boys build canoes.

Here is some more. The teacher told Tom's mother that he was a poor student. The chief told Pambo's father that Pambo would some day become a leader of the tribe. Now again, make a decision about the statement, "Tom is smarter than Pambo," and press the button for your answer. You may answer now.

Now everyone again press the d button. That is very fine. That is the end of the test. Thank you very much.

APPENDIX D

VOICE COMMENTARY FOR NEW APT FOR EDEX

Hello. Today we are going to do something that is likely to be very new to you. First, we are going to see some pictures and hear some stories that go along with them. Then we are going to ask you certain questions about the stories. The questions will be something like a test but not quite. They will not be like a test because you will not be given a score or a grade. All we want to know is what <u>you</u> think the answers to the questions should be. We want you to think for yourself and to give the answer that <u>you</u> think is best, no matter what answers you think others may give.

We have a special way for you to show your answers. You will show your answers to some of the questions by pressing a button on the little box that is now on your desk.

We shall use these buttons very soon but first, I want to show you some pictures and tell you a little story that goes with the pictures. Here is the story:

> ' It was recess time. The class had only one ball to play with that day. After Billy played with the ball for a while, some of the other children asked if they could play with it, but Billy did not want to give it up.'

We shall leave the pictures on the screen for a while to help you remember the story.

Now I'd like to ask you a question. Do you think Billy did the right thing? Let's use a button on the box for your answer. <u>Look</u> at the buttons on the box. See one on the end with the 'A' on it? There is another button with a 'B.' The one next to it has a 'C.' There is one more button at the other end; it has a 'D.'

We shall not use the 'D' button right now; only the 'A', 'B', and 'C' buttons.

Here are some of the ways you might answer the question on whether Billy did the right thing. Look at the screen now and try to follow along as I read them to you: A. Billy should have let the other children use the ball. B. Billy was right in keeping the ball for himself. C. Can't tell - need to know more about it. If you believe Billy should have let the other children use the ball, press the 'A' button on the box. If you think Billy was right in keeping the ball for himself, press the 'B' button. If you can't tell what the best answer is because you need to know more about it, press the 'C' button. Would you please make your answer now, by pressing one of the buttons 'A', 'B', or 'C'. Does everyone know how to show the answer? If you do not, please raise your hand. Now that we have your answers, we'd like you to tell us why you answered the questions the way you did. Did anyone press the 'A' button, meaning that Billy should have let the other children use the ball? If you did, please raise your hand.

Let's look at some more pictures now, and I'll tell you a new story that goes with them. Here is the story: 'Farmer Jim lived a long time ago. He raised food for his family, chopped trees to build his own farmhouse, and had his own horse to pull his plow. He rode his horse to town once a month to get supplies. Farmer Tom, who has a farm today, hired carpenters to build his farmhouse. He has a machine to cut wheat which he sells to other people who make flour. He owns a truck which he drives to town every week.'

Here is a question about the story: Did Farmer Jim's neighbors build their own houses, too? A. Yes; B. No; C. Can't tell - need to know more about it. Remember now, Farmer Jim is the one who lived long ago. Press the 'A' button if you think your answer is 'Yes,' that Jim's neighbors did build their own houses. Press the 'B' button if your answer is No. Press the 'C' button for 'Can't Tell.' Please make your answer now.

Let's talk about your answers for a while. Did anyone answer 'A' for 'Yes'? If you did, please raise your hand.

Would everyone please look at the pictures again so it will help you remember the story about Farmer Jim who lived a long time ago and Farmer Tom who has a farm today.

Here is another question. Which farmer went to town more often? A. Farmer Jim who lived long ago, B. Farmer Tom who has a farm today, C. Can't tell - need to know more about it. What do you think is the best answer as to who went to town more often? Press the 'A' button if you think it was Farmer Jim, press the 'B' button if you think it was Farmer Tom, and press the 'C' button if you can't tell because you need to know more about it. Please make your answer now.

Let's talk about your answer to this question. Did anyone answer 'A' for Farmer Jim? If you did, please raise your hand.

Would everyone please look at the pictures again. Remember, Farmer Jim's pictures are at the top and Farmer Tom's are on the botton.

Here is another question about the story. Who did more of the repair work himself on the farm machinery? A. Farmer Jim who lived long ago, B. Farmer Tom who has a farm today, C. Can't tell - need to know more about it. What is your answer as to who did more repair work? Press the 'A' button if you think it was Farmer Jim who lived long ago; press the 'B' button if you think it was Farmer Tom, or press the 'C' button if you can't tell. Make your answer now.

Let's talk about your answers now. Did anyone answer 'A' for Farmer Jim? If you did, would you raise your hand.

Here are some new pictures and a story that goes with them: 'This story is about Mr. Jones. Mr. Jones and his family had always lived in a small town in the United States. Mr. Jones was a very good blacksmith and he made the best horseshoes in town. When the automobile was invented, there were not as many people riding horses as there used to be. Mr. Jones and his family moved to a big city to look for a job.'

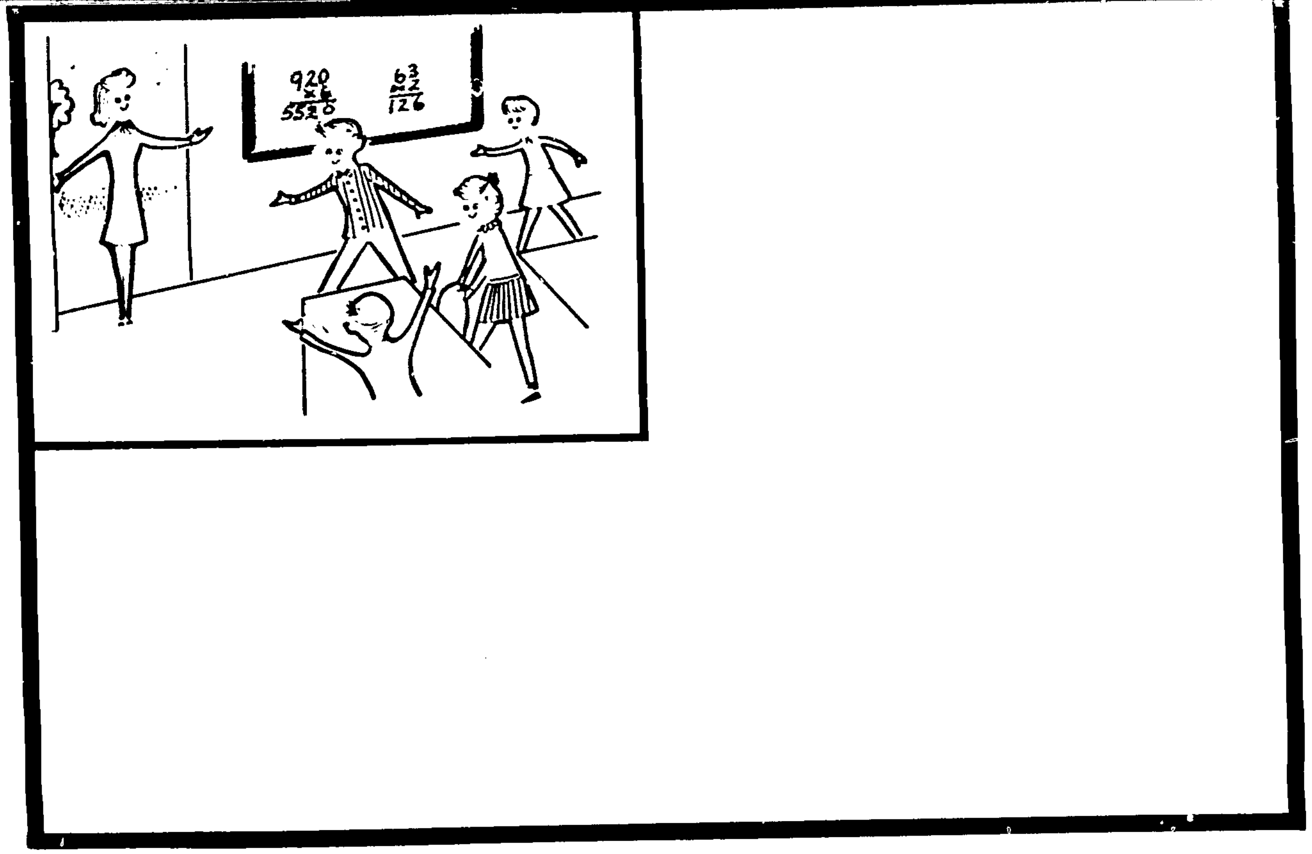
Here is a question about the story. Was moving to the city a wise choice for Mr. Jones? A. Yes. B. No. C. Can't tell - need to know more about it. What do you think is the best answer? Press the 'A' button for 'Yes, it was a wise choice'; the 'B' button for 'No'; the 'C' button if you think the answer is, 'Can't Tell.' Please make your answer now.

Let's talk about your answers once again. Did anyone answer 'A' for 'Yes?' If you did, please raise your hand.

Would everyone please look at the pictures again and let's review the story. Mr. Jones had been a blacksmith in a small town but the coming of the automobile put him out of work. He moved to the city to find a new job. Here is another question. Will Mr. Jones have a hard time finding a job in the city? A. Yes. B. No. C. Can't tell - need to know more about it. Press the 'A' button if your answer is 'Yes, he will have a hard time finding a job.' Press the 'B' button if your answer is 'No, he will not have a hard time.' Press the 'C' button if you think the answer should be, 'Can't Tell.' Make your answer now.

Let's talk about your answers once again. Did anyone press the 'A' button for 'Yes?' If you did, will you please raise your hand.

Here is the last question about the story. Will Mr. Jones and his family be happy right after they move to the city? A. Yes. B. No. C. Can't tell - need to know more about it. What do you think? Press the 'A' button if your answer is 'Yes, they will be happy.' Press the 'B' button if your answer is 'No, they will not be happy.' Or, press the 'C' button if you think the best answer is, 'Can't tell.' Please make your answer now.



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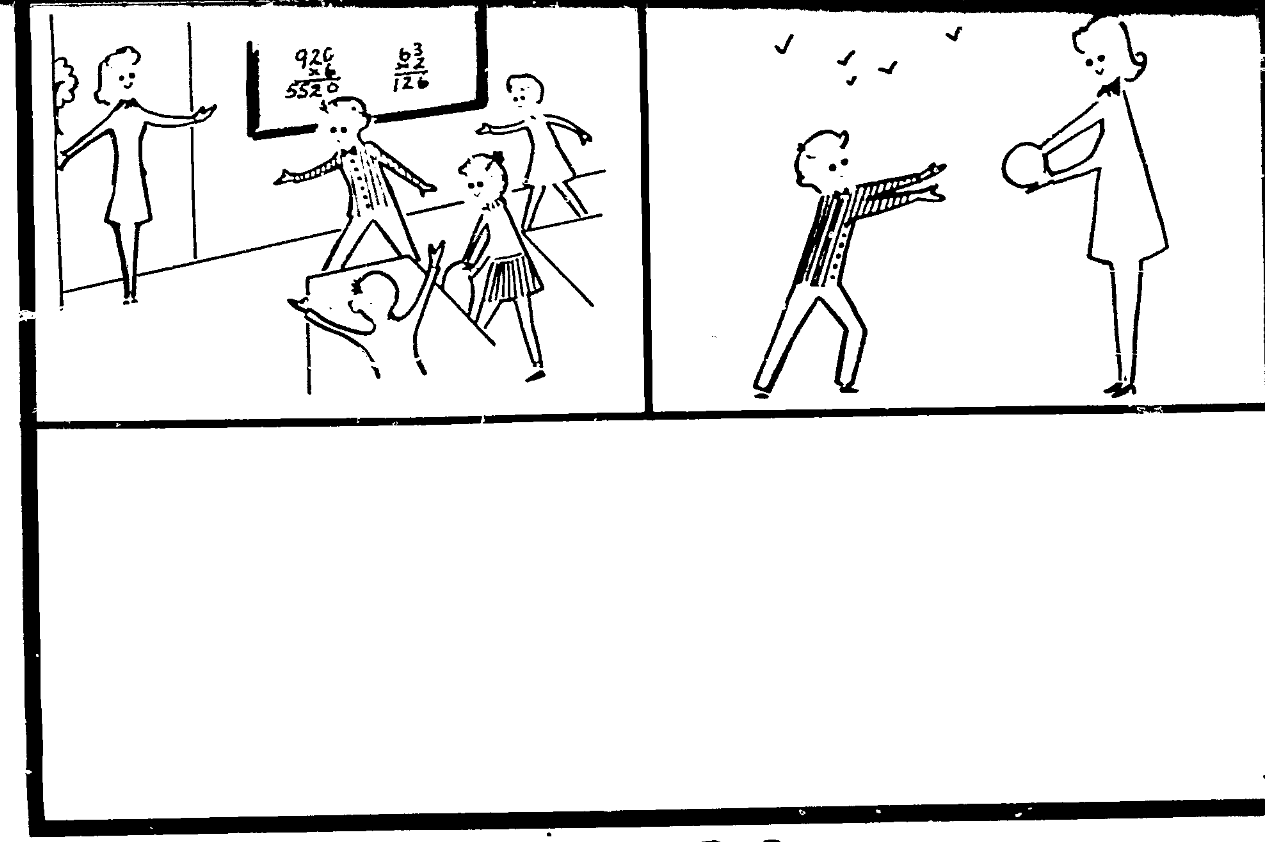
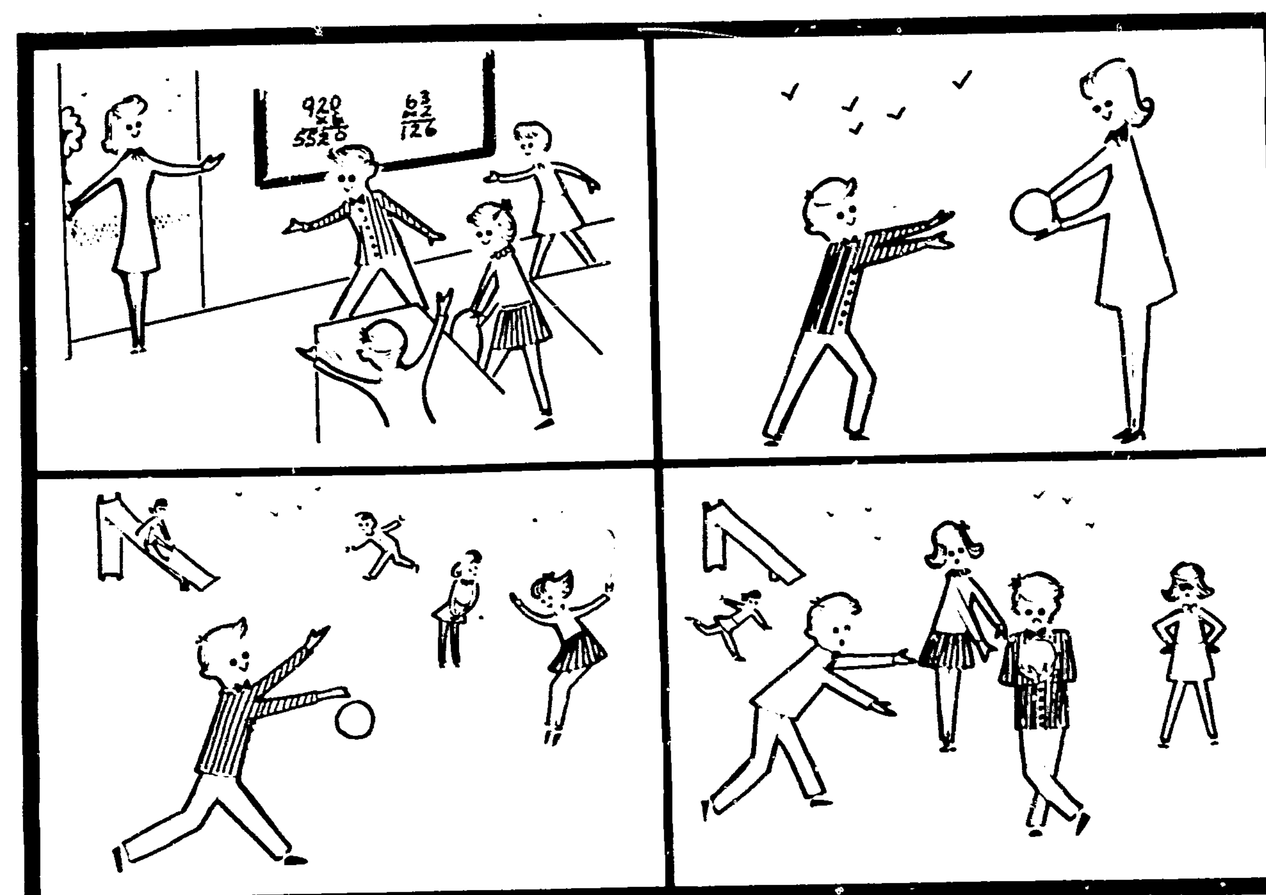


SLIDE 2

SLIDE 3

APPENDIX E



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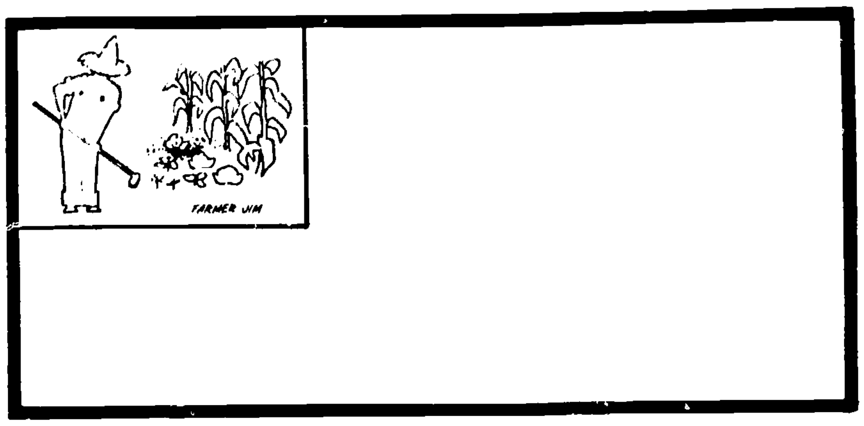

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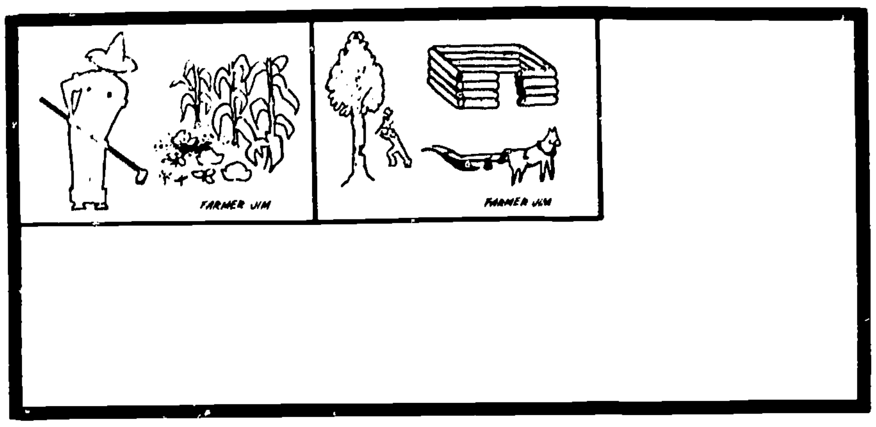

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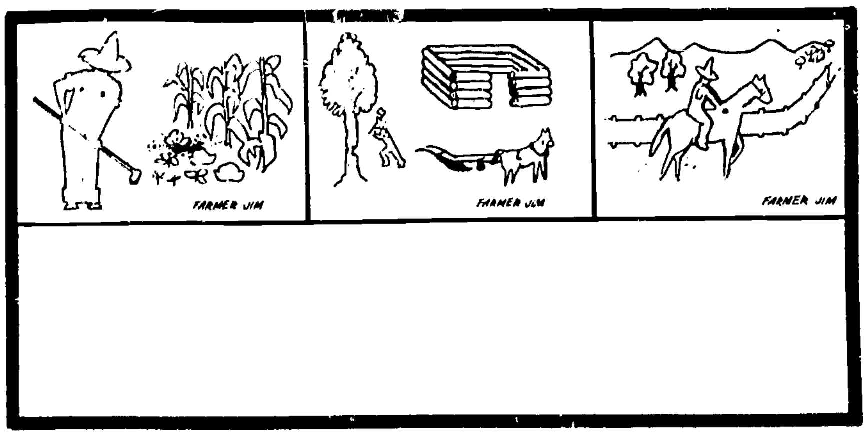

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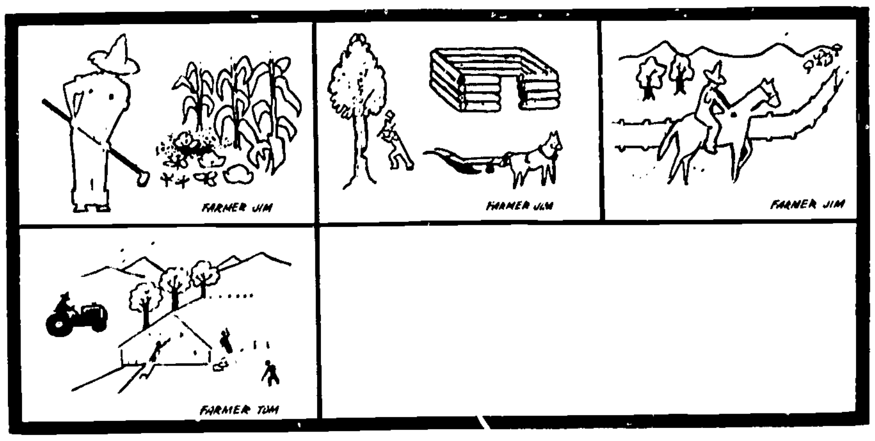

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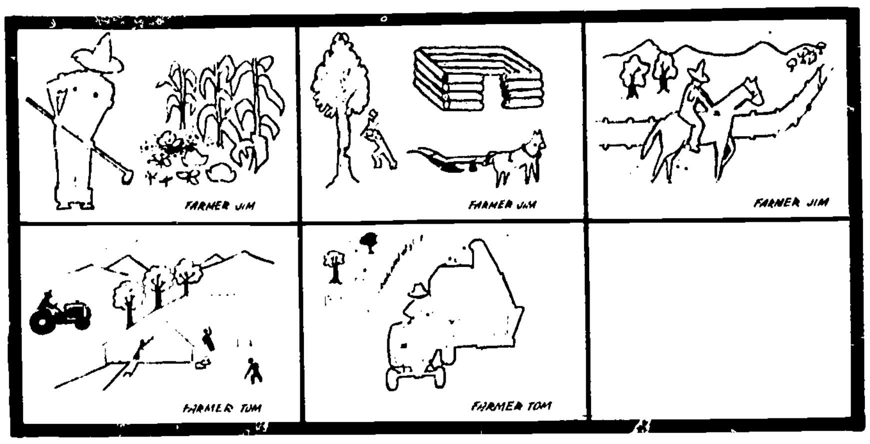

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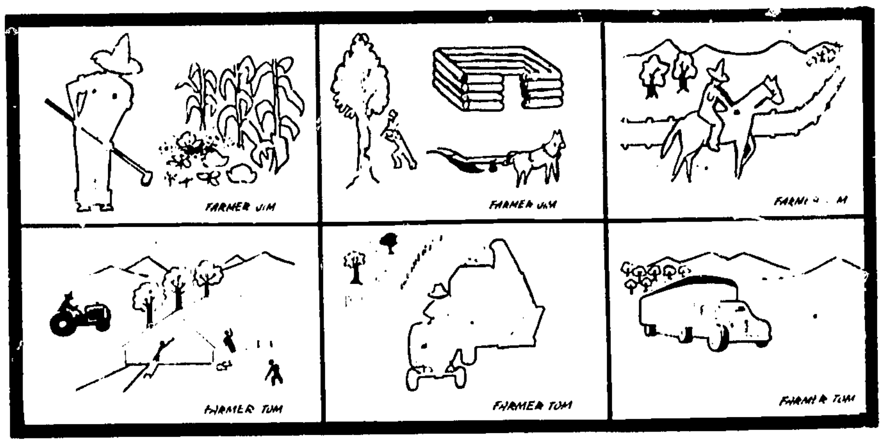

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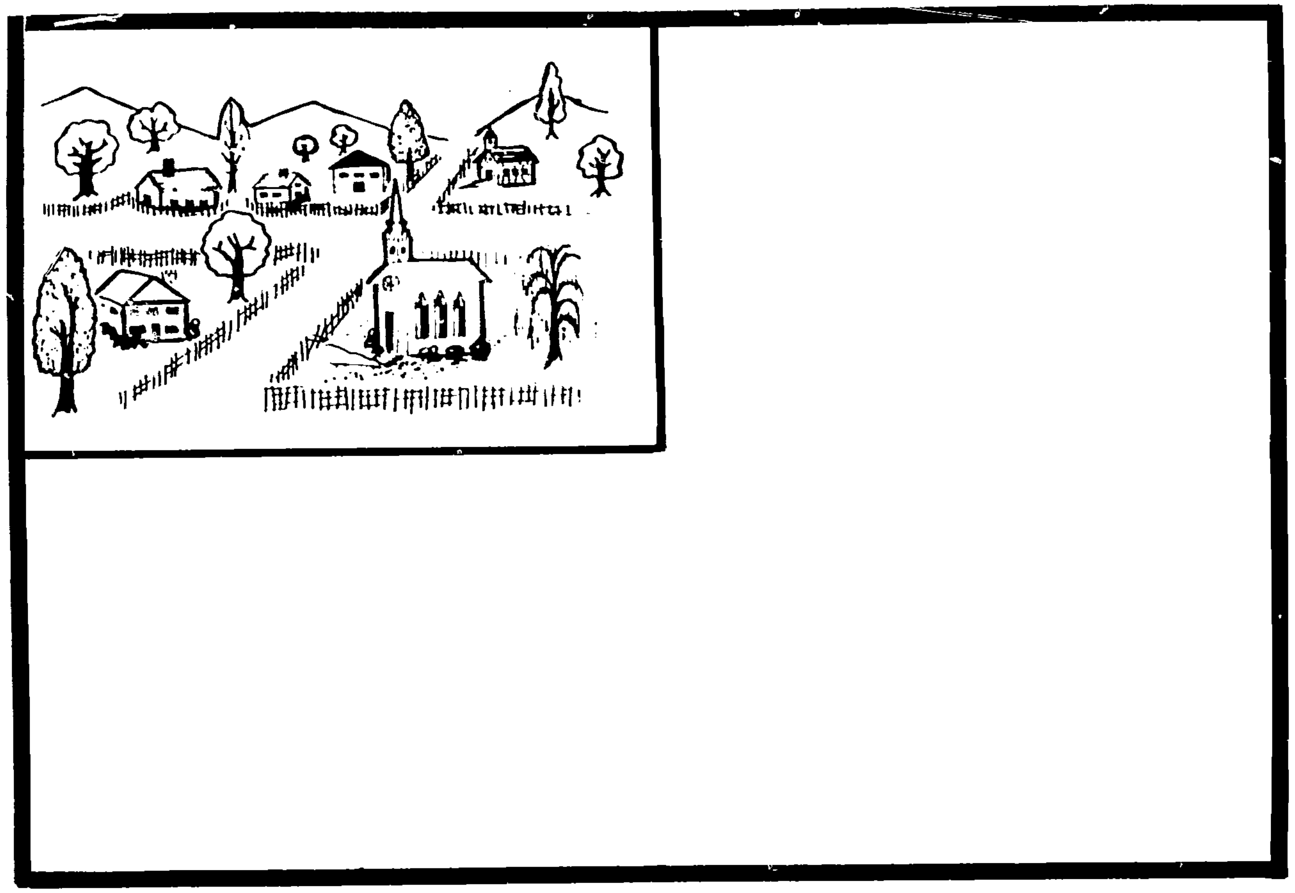

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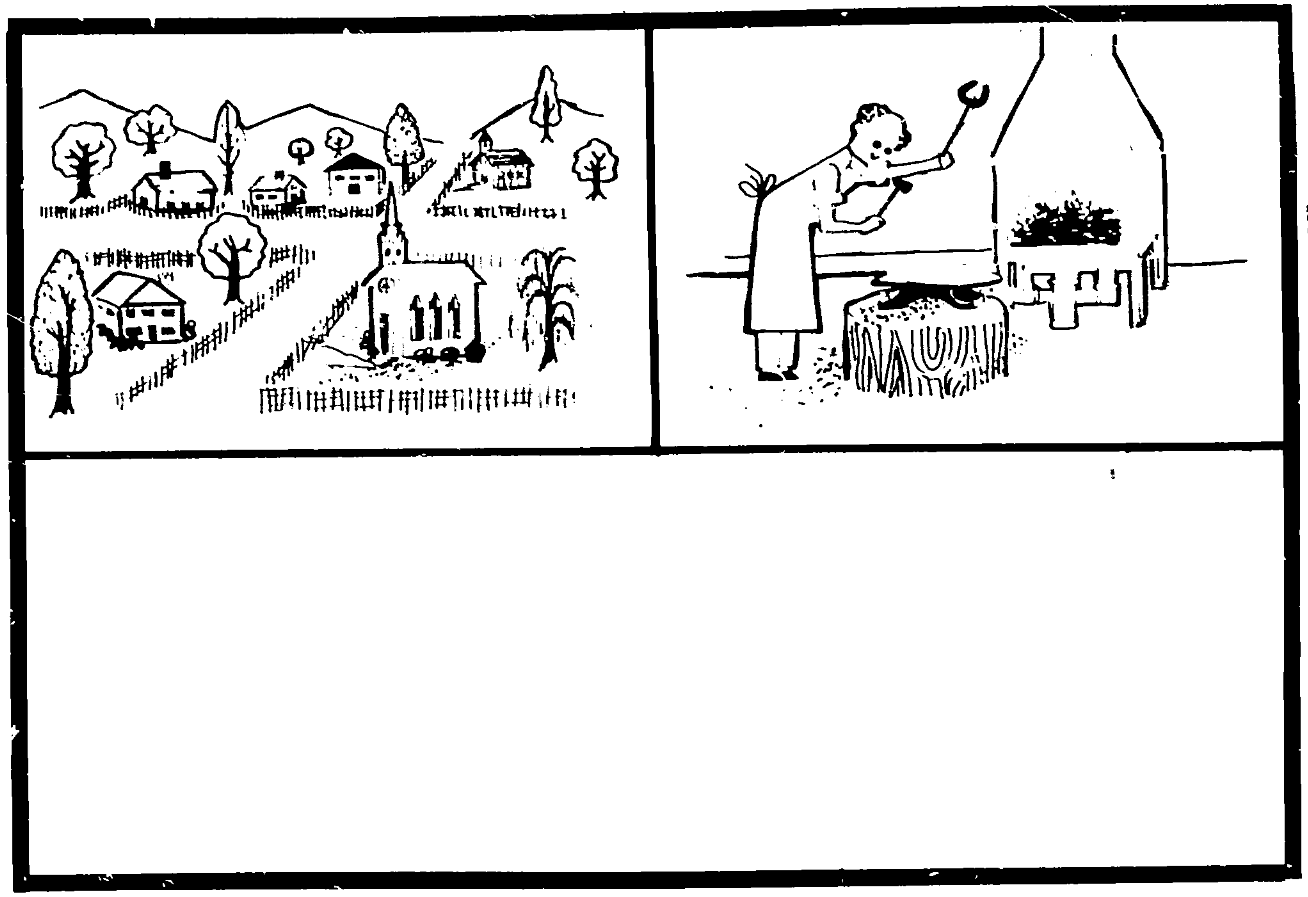

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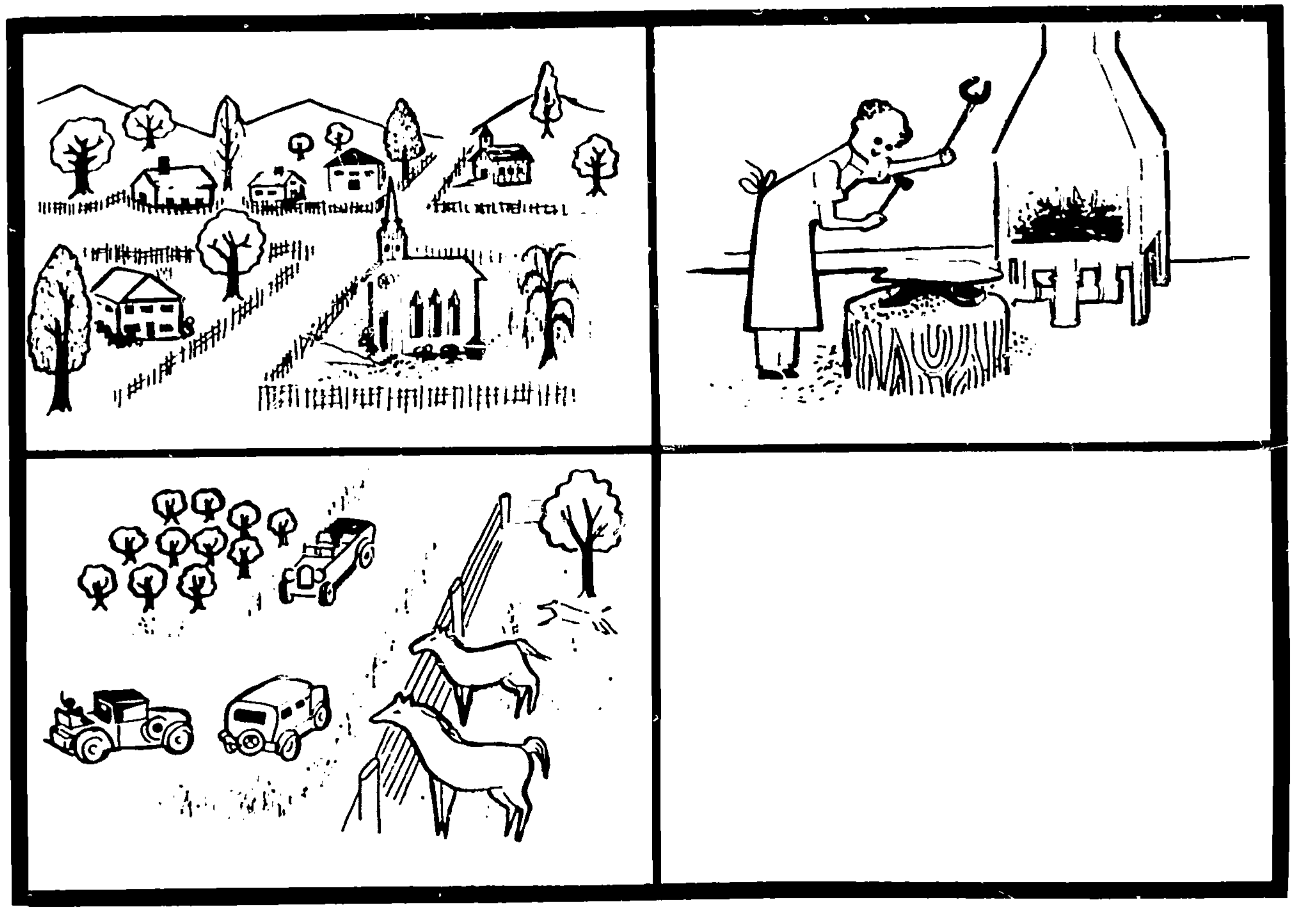

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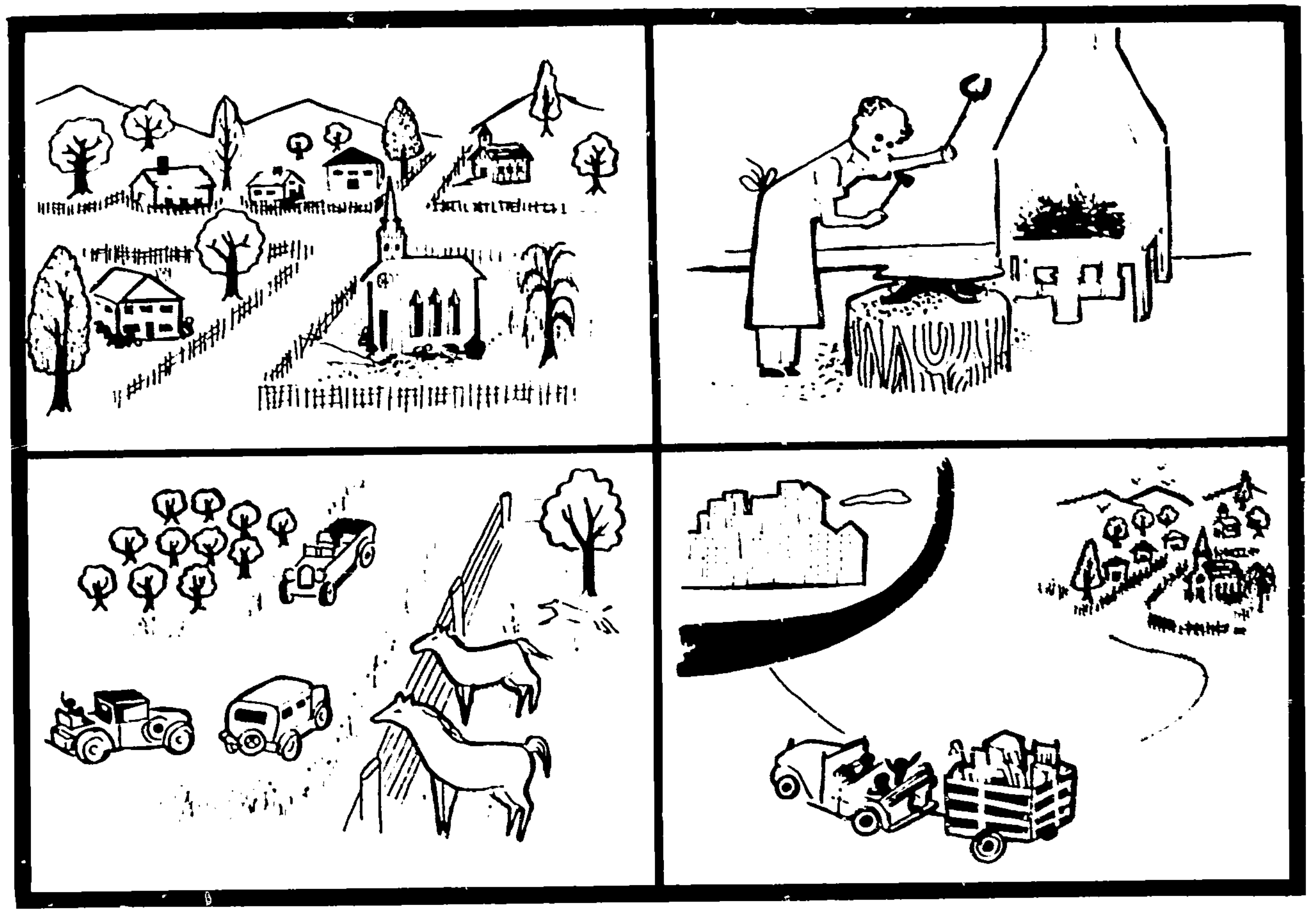


SLIDE 4

APPENDIX F

EDEX RESPONSE PATTERN

The results of the pattern analysis described in Chapter VII are shown on the next page. Each group of ten letters represents the responses of one student to the ten items. Response patterns very high in agreement are printed very close together vertically (single spaced). The criterion used for very high agreement was nine out of ten, or ten out of ten identical responses. If the extent of agreement was eight out of ten, the response patterns were separated by three or more spaces vertically. In very few cases exceptions were made to these rules, because of the inevitable difficulties in representing such relationships in a two-dimensional columnar configuration.

Other patterns rather closely related to the main patterns are shown above and below the main patterns. The amount of spacing between lines indicates the degree of similarity of the patterns to each other.

The patterns are arranged according to similarities in the horizontal dimension also. The entry for the most frequent pattern in the first column is placed immediately to the left of the pattern most similar to it in the second column. The entry for the most common pattern in the third column is placed immediately to the right of the most similar entry in the second column, and so forth.

The patterns shown in the bottom left section represent very small clusters of students with patterns of responses rather unlike those in the five main patterns. The patterns in the extreme right hand column are comprised of the responses of individual students who show relatively little agreement (five out of ten or less with other students, for the most part).

CBAAAAACBB
CABAAAAC-B
CACAAAACAB
CAAAAAACDB
CAAAAAAAAB

CCCCCABCBB
CCCCAABCBB
CCCBBABBBB
CCCCACCBBB
CCCCAACBBB
CCCAAA-BBB
CCCAAABBBB
CCCAAAABBB
CCAAAAABBB
CCAAAAABBB
CCAAAAABBB
CCAAAACBBB
CCAAAACBBB
CCAAAACBCB
CCAAAACCCB
CCAAAAC-CB
CCAAAACBCC
CBAAACCBCC
CCAAAA-CBB
CCAAAA-CBB
CCADCACBBB
CCAACA-CCB
CCAACA-CDA
CCAAB--CCC
CAAACACCBB

CCCAAAABCD
CCCAAAABCA
C-BAAAABCA
CCCAAAAAAA

CCCCAACCCC
CCCAAAACCC
CCCAAAACCC
CCCAAAACCC
CCCAAAAC-C
CCCAAA---C
CCCAAAC-BC

CCCACACCCC
CCCACCCCCC
CCCCCCACCC
CCCADCC-CC

CCAAACCCA-
CCACA--ABB
CCCACACBBA
ABBAAAABBB
CCAACBBCBB
CCCACBACCB
CACAACACBC
CCACAACAAA
CCBBBCCCCB
CABBBAACBA
CACCCACCCB
CBABCBCB-B
ABABABDAAB

CBBACCCBBC

CBBAACCBBB

CCAABA-BBA

CCAACA-BBC

CCCBBAAACA
CACBBAAACA

CCACACBDCB

CACABC-C-C

CCAA----CC

CDAADA-AAB

CDDDDD-CDC

LEGEND:

A: Probably True
B: Probably False
C: Can't Tell
D: D button not released (to be interpreted as "omit")
-: Omit

APPENDIX G

CODE REFINEMENTS

In the process of refining the coding scheme, a number of distinctions were made and explorations were made into the theory of those distinctions.

One of these was a construction of a model for distinguishing predictions according to their positions in the chain of causality links. Figure Alpha represents that model and depicts ways of representing various relationships between predictions and the causal chains. Figures were drawn according to that model. These cognigrams of causality were each composites of all the discussions held at that grade level. They were used in designating the causality codes for individual predictions.

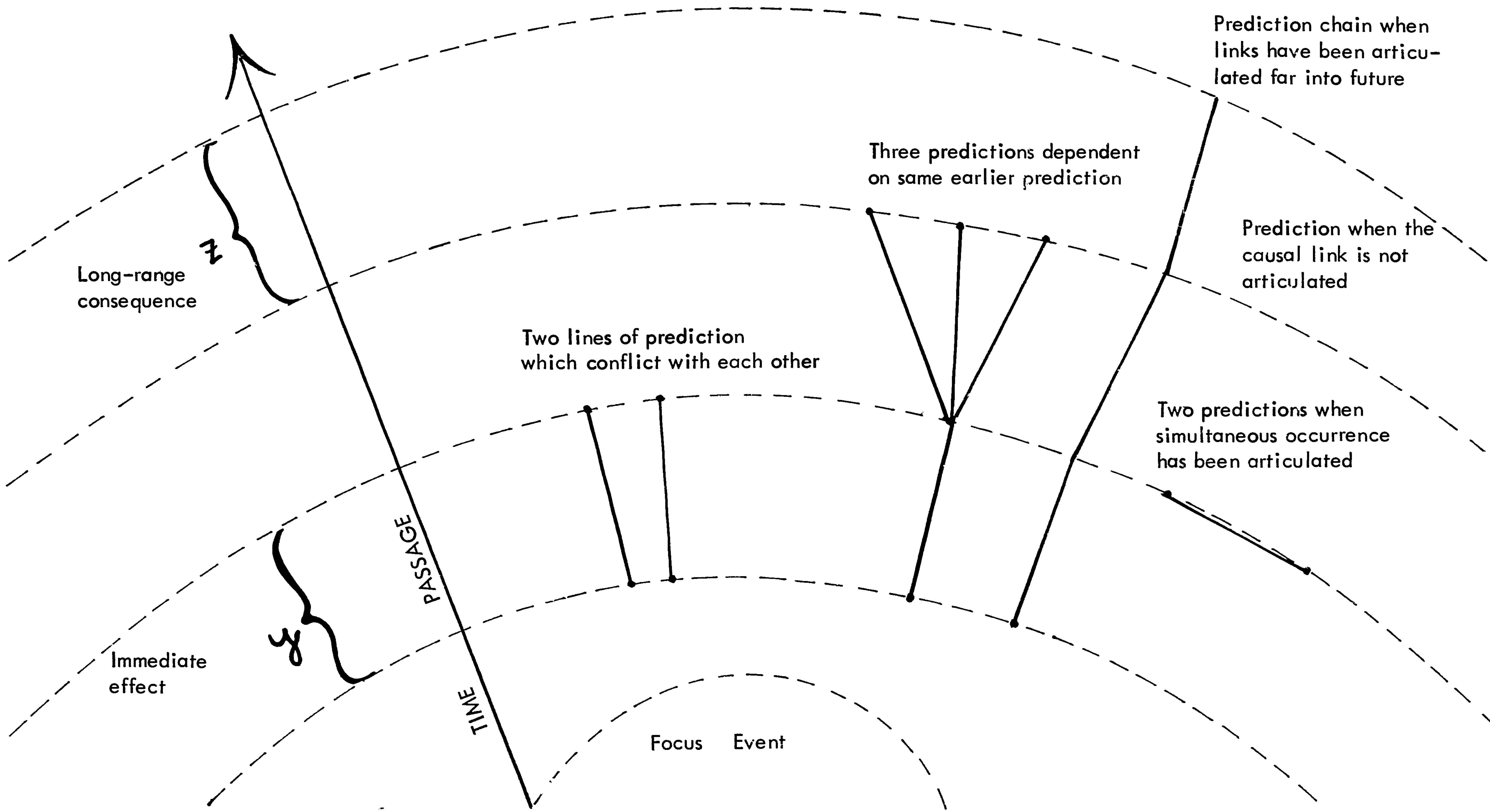
Another attempt at refinement was to produce, after study of the composite cognigrams, a comprehensive list of concrete and of abstract topics for each grade level. This list was used in scoring the tapes. Such a list would also help teachers to assess their own discussions.

Fourth Grade: What would happen if a prospector found oil in the California desert?

T-1 - fairly concrete, low level of abstraction, low value

Spread of the news of oil strike.
Migration to oil site, including routes; movement of peoples.
Necessities of life for oil community: food (including raising crops), clothing, housing, education, recreation, build churches, emotions (e.g., they get mad), health, and sanitation. Water.
Water: bringing it in, pipes, dams, etc. Irrigation.
Motives of oil seekers (e.g., they're greedy).
Exploitation of oil; ownership of mineral rights, individual or company, tools and technology, selling oil.
City on oil site; eventual ghost town.
Fighting over oil claims, law enforcement.
Transportation: cars, roads, gas stations, airplanes, airstrips, and animals.

Figure Alpha Scheme of Organizing Cognigram of Causality



Key
Py - Immediate effect of focus event
Pz - Long-range consequence of focus event, following upon immediate consequence
Po - Not related to focus event (not on map)

T-2 - fairly abstract, higher level of abstraction, higher value

Transportation per se: * oil out; railroad.
Government: units of government, make laws, regulate exploitation of oil.
Finances, including cost of bringing in water.
Taxes.
Population per se.
Communication.
Power, sources of; electricity.
Geographic regions.
Effect on places people leave.
Industries other than oil.
Necessities of life per se.

* By per se is meant the conscious use of the term by the children.

Fifth Grade: What would happen if a large island, inhabited by a rather primitive people who did a little farming, were discovered off the coast of California, and on that island were gold?

T-1 - fairly concrete, low level of abstraction, low value

Movement of peoples.
The gold seekers: their motives, transportation to island, (migration) necessities of life for them, their health.
Exploitation of gold, fighting over it.
The natives: enslavement or relocation of them. Bargaining or trading with them. "Make treaty." "Give them jobs." "Educate them." "Build schools." "Become modern." "Headhunters/cannibals." "Sungod worship." "Natives' chief." "Send Peace Corps." "Send missionaries." Necessities of their life.
Wars and Weapons.
Possession of island.
Location of island and physical resources of island. Effect of gold-seeking on physical properties of island.
Name of island.
Statehood for island.
Island as tourist attraction, movie site, or park.
Town or naval base on island.
"Communication," unelaborated.

T-2 - fairly abstract, higher level of abstraction, higher value

Finances.
Government of island.
Discussion of international relations per se, U. N., and international trade.
Population per se.
Transportation per se, railroads.
Power - sources of, electricity.
Industrialization of island, factories, skilled labor per se.
Encounter of cultures per se, communication with natives, government protection of natives, study of culture and life of natives, native assimilation of twentieth century ways.

Sixth Grade: What would happen if 80% of Argentina's exports were her beef, and it could not be sold anywhere?

T-1 - fairly concrete, low level of abstraction, low value

Beef to export.
Discussion of why the beef could not be exported.
Use of former grazing land.
Housing and slums.
Health, illness, and death.
Scarcity of jobs, i.e., effect on butcher and packing industries, enumeration of industries affected by their decline.
What to do with surplus cattle.
Barter or trade instead of selling.
Migration to other countries.
No money for imports.
Price of money for consumer - e.g., food.
Education per se - not connected with government.
Shift to another main crop, industry/export. (singular)

T-2 - fairly abstract, higher level of abstraction, higher value

Diversification of crops/industries per se. New crops and industries (plural).
Have a depression.
Government - revenue taxes; support of education; stability.
Finance - necessity and means of acquiring money to refinance the country, establish new industries, etc.
International effects - anything touching upon another country.
Lack of skilled workers as an effect of decline in education.
Labeling and discussion of attitudes and feelings.
Chain reaction - articulation of chain reaction per se rather than enumeration of items affecting each other.
Standard of living per se.
Migration at a later date to Argentina of certain skilled workers.