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ABSTRACT

This book suggests alternative strategies and methods for construct validation, research, quality assessment of schools, and design and evaluation of new approaches to instruction. It is addressed to educational managers, educational researchers, and to faculty members and graduate students in education. The author deals with four problem areas in education and educational administration by suggesting that newly developed alternative scientific strategies and methods be applied to the problems. These problems are (1) research methodology in the teaching and learning process, (2) narrow professionalism, (3) curricular processes that fail to deal with the processes by which children maximize their human potential, and (4) a lack of perception of the nature and application of systems approaches to public schools. The book concludes with an extensive, 33-page bibliography organized by chapter and topic. (Author/DN)

MISSION POSSIBLE: SCIENTIFIC STRATEGIES AND METHODS FOR SYSTEMATIC IMPROVEMENT OF PUBLIC SCHOOLS

by

Robert W. Geisinger

November 1972

MISSION POSSIBLE:
STRATEGIES AND METHODS FOR SYSTEMATIC IMPROVEMENT OF PUBLIC SCHOOLS

Summary

This book deals with four problem areas in education and educational administration. It suggests alternative scientific strategies and methods designed to deal with these problem areas of concern where present strategies and methods are seen as inadequate or inappropriate.

The first chapter, on methodology, deals with the failure of the global criterion approach in meaningfully identifying the criterion variable domain that is so critically important in the analysis of educational processes and outcomes.

In this chapter, it is contended that there is now no agreed upon comprehensive strategy available which scientists can appropriately use to meaningfully partition the criterion domain, i.e., no established theory of the criterion applicable to education. Existing normative and criterion-referenced instruments are inadequate to the task of assessing the independent and criterion variable structures that must be identified because they are not based upon any theory of the criterion domain that appropriately reflects the hierarchical structure of the teaching-learning process.

It is contended here that the method of factor analysis, which has been widely used as an approach to the problem of construct validation, cannot, by the very nature of its basic assumptions, be depended upon to accurately or even adequately portray the complex structure of the independent and criterion variable domains.

The author, as an alternative, suggests the partitioning of the global task of the classroom teacher in terms of at least four teaching strategies where the student is responded to, and responds, as a "learner," as a "valuer," as a "thinker" and as a "thinker in the context of classroom topic discussion."

It is postulated that the teacher can be taught to assess his or her effectiveness in using these basic strategies by means of appropriate instruments of interaction analysis. Research evidence to support this contention is cited.

The author feels that by use of the minicourse model approach developed by the Far West Laboratory, between 20 and 50 minicourses could be developed as a means of providing self-instructional help to teachers in their efforts to master these strategies and related feedback assessment procedures.

Not only could the assessment procedures provide data helpful to the teacher as a measure of teaching effectiveness but also as non-global measures of the criterion domain useful to researchers in the creation of highly relevant and effective predictors of achievement or assessments of school quality.

To develop these instruments and assessment procedures and validate the hierarchical theories and taxonomies that may be developed, a particular statistical methodology is proposed that avoids some, if not all, of the limitations of factor analysis. This procedure, hierarchical cluster analysis, clusters variables on the basis of their empirical relationships and reflects the structure of these relationships as a complex hierarchy, if required. Use of this technique would enable the educational researcher to statistically partition the criterion and independent teaching-learning variables empirically or to validate the taxonomic or theoretical structure by which the assessment procedures were constructed or chosen, i.e., construct validation of existing hierarchical taxonomies using instruments presumably capable of detecting and measuring a hierarchical structure such as the "radex" structure identified by Guttman. Computer programs are available that will make hierarchical cluster analysis readily possible and these can be used to identify and plot the "radex," "simplex" and "circumplex" structures postulated by Guttman, developer of the cluster analysis approach recommended here.

If the suggestions in chapter one are implemented, then we should see (1) a real improvement in the ability of the teacher to teach effectively the subgoals of his or her overall "global criterion" goals due to the availability of appropriate evaluative feedback, (2) the creation of new and valuable interaction-oriented predictive and diagnostic instruments for the guidance of both teacher and learner and (3) the emergence of a powerful research approach to the understanding of classroom learning in all of its interactional complexity.

The second chapter, on professionalism, deals with the effect of our commonly held "Freudian" nature on the social interactions that occur within the professions and our institutions. The very nature of man is seen here as currently limiting the possible social interactions between men to bipolar structures of love and hate and dominance and submission (Carson, The Interaction Concepts of Personality). When this limited bipolar pattern is combined with the almost universal occurrence of hierarchical command structures in every organized institution of man (Morphet, et al), the only possible interaction pattern is seen by the author to be one of "normative" oriented autocratic behavior on the part of the superior in the hierarchical structure.

The author contends that other possibilities exist, that we need not be constrained to use only the pattern described above and that a truly viable system would require use of all of the alternatives where

appropriate, i.e., that there is a place for normative methods, command and control, but these must not be the only methods in use.

The alternatives identified by the author are: (1) a developmental process philosophy of management as contrasted to the existing prevalent conflict and competition orientation, (2) a heuristic experimental approach as contrasted with a commitment to an exclusive use of authority and command structures in order to make needed decisions and resolve problems and (3) strategic thinking for creative purposes as contrasted with the current emphasis upon analytic thinking.

In effect, this chapter postulates a system model of professionalism as a more viable and much needed alternative to the present simple bipolar hierarchical command structure pattern.

The third chapter deals with that fact that existing theoretical approaches to curricular process do not, in actual fact, deal with the processes by which children maximize their human potential. They deal rather with the processes by which the school as an institution administers the instructional program. The author contends that there is presently no explicit philosophy or theory concerned with the learner as a user of strategies, i.e., with the strategic nature of man. As indicated in the introduction to this book, the author argues that an interactional approach must be taken in the study of human development (Kohlberg). Children are seen here as developing both in terms of stages and in terms of taxonomic levels.

Man's potential does not lie alone in inner adjustments of his basic "Freudian" nature, but rather in the final development of his basic strategic abilities, i.e., in a transformation of the "Freudian" internal dialectic between "Id" and "Superego" into a dialectic of "questioning strategies." These "questioning strategies" are seen as being describable in terms of hierarchical taxonomies that may be listed in order of increasing complexity. Some of these strategies, in order of complexity, are: clarification, problem-solving, philosophic questioning strategies and religious questioning strategies.

The author suggests that we should attempt to develop "process curricula" based upon the strategic nature of man with the requisite philosophy of curriculum being seen as an experiencing or modeling of these levels of process based upon adequate experimentation and validated by appropriate methods of hierarchical analysis such as described in chapter one. The relevance of Piagetian developmental processes, the derived curricula of Glasser, Bessell and Palomares" semiformal methods of instruction and Erikson's identity crisis concept to the concept of "process" curricula are discussed. They are seen as possible ways of "eliciting" the desired processes of knowing, valuing and conating during the course of the child's definable Freudian and Piagetian developmental stages.

The final summary chapter deals with the problem that there is presently no adequate perception, in educational circles, of the nature

of system approaches or how these approaches can be realistically applied to public schools on a mass basis in our highly diverse democratic system. It is suggested here that there are existing techniques and system approaches that can be used in the schools. Chapter four contends that existing techniques and strategies could be profitably adapted to education. Examples are given in illustration of the fact that development in this direction is currently underway.

It is argued that if all the strategies and methods described in this book were used in a NASA-like institutional approach, it is conceivable that we can then begin to realize the full potentials in man using educational systems that have been designed to maximize and realize these potentials.

The approach recommended here constitutes, in effect, a "construct validation" of a "theory of the nature of man," but it will require statistical and evaluation procedures that are now at the leading edge of the state of the art and a genuine commitment to the idea that education's primary purpose is to develop the full potentialities of man on every level and that man is, in the final analysis, a questing, strategy-using, value-oriented being.

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Foreword

Education is faced today with constraints on many levels and in every activity. Even the conservative alternative of making no changes is not open to us. Pennsylvania's Secretary of Education David H. Kurtzman said this year that no matter where the money comes from, it is forecasted by Program Planning Budget System techniques that there will not be enough. May it then suffice to simply acknowledge that state systems of education are headed inexorably upon courses for certain failure. But significant changes, e.g., in instructional programs, cost massive amounts of money that cannot become available. Even if money was available, there are refractory problems of evaluation, quality assessment, roles of teachers and staffs, creation, revision and improvement of developmental instructional programs, organizations of schools and services.

In the face of these problems, methodologies are needed that have the potential for large increases in the efficiency of educational institutions, that get quickly to the heart of the principal problems and to the heart of the effectiveness of programs that are intended to resolve the problems without significant increases in the costs of activities.

Methodologies are suggested to deal with problems of evaluation, quality assessment of schools, teacher training and instructional programs. None of these approaches is conceived as a "final" solution. The purpose of each is to identify and deal with problems in terms of continual improvement. Grandiose schemes have been avoided and the most inexpensive means that appeared workable were selected from other alternatives.

In order to deal with efficiency of instruction in terms of system approaches, it is suggested that the largest single cost category, teacher

salaries, might be reduced over a period of years by a combination of several steps. More than 90 per cent of communications that are now attempted in classrooms could be consigned to various types of media. The teacher time that is freed could be made much more productive in terms of pupil achievements of wider and higher level educational objectives if teachers were trained to use strategies of verbal interaction with students.

The resulting increased productivity of outputs of the instructional processes would amount to increased efficiencies that could be very helpful to the schools. Since the suggestions are made to advance the possibilities for developmental schools, the improved schools would also be more helpful to public school students.

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Chapter 1

Suggested Methodologies to Improve Education

Introduction

Two broad streams of thought have guided teachers and other educators in their efforts to instruct students. A maturational stream holds that what is important in the development of a child comes from within. The instructional tasks are to create a climate in which inner abilities can unfold and mature. Another stream of thought holds that intelligence is acquired information processing skills. The task of instruction is to teach such cultural rules and information as will result in the transmission of culture to the student (Kohlberg, 1968). In this view, learning is accomplished by making associations.

There is a third alternative which is only beginning to be used as a basis for instruction. Stimulated by Piaget, researchers have concluded that an interactional type of theory of developmental process must be used to explain human development. While neither of the traditional streams of thought is negated for instruction of students that have passed beyond the limitations of childhood, the interactional theory is essential for guidance of instruction of children.

A child learns by interaction with his parents, teachers and peers, rather than by direct learning of external structure or by innate patterning (Kohlberg, 1968).

The purpose of this paper is to outline some of the implications of this conclusion for developmental types of instruction in the public schools. The implications of the contrasting streams of thought have already been discussed by Kohlberg so they will not be discussed in this paper. The reader is referred to the excellent discussion of Kohlberg (1968).

Basic Ideas and Postulates of Interactional Approach

The basic idea of the interactional approach to instruction is that

the cognitive and affective structures of personality emerge from the interaction between the child and his environment when this interaction is fostered. In this basic idea, structure refers to the general characteristics of shape, pattern or organization of response rather than the rate or intensity of response or its pairing with particular stimuli. All mental structure has a cognitive component and cognitions are viewed as organized "wholes or systems of internal relations"; as rules for processing information or for connecting experiences.

Interactions in events lead to cognitive stages. The characteristics of cognitive stages are the following:

1. "Stages imply distinct or qualitative differences in children's modes of thinking or of solving the same problem at different ages."
2. "These different modes of thought form an invariant sequence, order or succession in individual development."
3. "Each of these different and sequential modes of thought forms a structured whole." Responses are not to be considered as specific to a particular stimulus. Instead there are underlying general responses to many tasks that are not obviously similar. For example, in the Piagetian stage of concrete operations, a child will conclude that an object conserves its properties on physical dimensions in spite of apparent perceptual changes.
4. "Cognitive stages are hierarchical integrations." Stages form an order of increasingly differentiated and integrated structures to fulfill a common function." Higher stages reintegrate

> structures found at earlier stages. There is a preference within each individual for a solution of a problem at the highest level that is available to him. Structural stages define general ontogenetic sequences which cannot be explained as direct learning of the structure of the outer world or as innate patterning (Kohlberg, 1968).

Not only does the interactional theory furnish the bases for hierarchical structures for educational objectives, it also furnishes bases for process-type instruction and curricula.

1. The term "cognition" refers to adaptive actions upon objects or their internalizations. Mature cognition is an equilibrium between actions; function rather than content or faculty or ability. "The encouragement of cognitive development, then, is the provision of opportunities for activities of an organized or equilibrated form."
2. Cognition is radically different from one stage to the next.
3. The source of cognitive structure and development does not lie either in the maturation of the organism or in the structures of the environment but in the structure of the interaction between the human and the environment.
4. Optimal conditions for organization lie in conditions of discrepancy and match between behavior structures of the child and the structure of his psychological environment.

Consequences for Instruction

The interactional theory shares with the maturational theory a pessimism about the effects of specific instruction on cognitive development.

Limited specific training experiences cannot replace the effects of general types of experience; e.g., direct teaching of conservation through verbal instruction or reinforcement or observations of example has little effectiveness to induce conservation.

General formal school appears to have no influence at all upon attainment of conservation.

Some genuine acceleration of conservation may be obtained if the implications of Piaget's theory are followed. Notions of "optimal match," "cognitive conflict," "assimilation" and "accommodation" can be used to achieve some acceleration of conservation.

Piagetian theory requires three types of conceptual analysis to deal with the effects of experience, i.e., instruction upon children. First, the universal structural features of the environment must be analyzed. Second, concepts must be analyzed to determine the logical sequence with which the concept is learned. Third, there must be an analysis of the relation of a specific experience of a child to his behavior structure.

The suggestion of this paper is that multidimensional interaction analyses can contribute much understanding to teachers for the first and third types of analyses.

A child learns best by verbal interaction with teachers and peers. Teachers can therefore use verbal strategies of interaction to help students learn and they can assess their effectiveness in use of these strategies by interaction analyses.

The implication of this suggestion is that teachers can create the most effective kinds of informal curricula through their verbal responses to verbalcues uttered by students, rather than by transactions with media

or by lectures.

Unless some verbal or other kind of cue is given by a child, there is no way of knowing precisely where the child is in his learning and development. But children do furnish a wide variety of verbal cues that serve to inform the alert and prepared teacher what specific response can contribute most to the development of the child at that instant of time.

Children speak value indicators (Raths and others, 1966). If a teacher learns to observe these utterances as cues, he can use the guidance of Raths and others (1966) to help students learn values for themselves.

Children give verbal cues which show the level of their thinking (Gantt, 1969). A four-level model can be used by a teacher to diagnose the kinds of cues that a child gives in processes that reflect both thinking and learning. This particular model is based upon Guilford's Structure of Intellect model and it can be used by teachers to help them diagnose, organize and respond verbally to children in classrooms.

Children can be helped to learn in the cognitive hierarchy if teachers will use the right kinds of questions (Sanders, 1966). Similarly, pupil cues and teacher responses should be identified for each hierarchical level of the Piagetian theory.

Aspy (1971) suggested that teachers can help to promote the affective feeling of success in students by the manner in which the teacher attends to and responds to cues that are given frequently by students. These include their questions and self-initiated remarks. Success promotion is a process used by teachers when they use pupil's cues that indicate what they want to do with class time in terms of their own development. A

feeling of success is necessary to that development.

If scores of minicourses were developed on the model of the Far West Laboratory (Clark, 1968) and pre and in-service teachers did all they could to make the most of their opportunities for verbal interaction, then informal curricula could be used in every classroom. These curricula would be not only individualized, they would be personalized at the precise point of time at which student's personal cues indicated a readiness to learn in that particular dimension, e.g., values, cognition, etc. Informal curricula of these kinds are the primary means by which educational objectives can be learned at upper hierarchical levels of educational objectives, the sources of interest and the origins of the feelings of success. Strategies of verbal interaction in the classroom should be used to create and use informal curricula of unique effectiveness.

Strategies to Change the Schools

Research on teaching has long been preoccupied with use of a defective model of evaluation and a defective strategy with which to use it. The strategy has used too large global conceptually impossible variables in attempts to identify one or a few independent variables that would predict one large complex (dependent) variable of teacher effectiveness (1). The model of evaluation has used a mythical, amorphous criterion of teacher effectiveness. Both the independent and dependent variables are too global and they cannot be related effectively by one strategy.

Gage (1,2) summarized decades of research. The conclusion to which Gage and other researchers have come is that research has been on the wrong track. The global criterion approach has proved a fruitless paradigm. No adequate criterion is available or can be identified. Indeed, the search must terminate. The alternative that has been adopted at Stanford is to break down the levels of phenomena into different and less global combinations and seek lawfulness in these new approaches. The Stanford research program uses the technical skills approach which analyzes teaching into well-defined components that can be taught, practiced and evaluated in microteaching programs. Examples of such skills are establishing set, establishing frames of reference, achieving closure, using questions to elicit thought processes, etc. These ideas guide research on microteaching and technical skills. Research at Stanford is no longer crippled by the notion that because there is one word, "teaching," there is also one single global criterion of effectiveness in teaching. Even if the present research program is unsuccessful, Stanford will not revert again to using the old global complex variable approach, e.g.,

discussion method, lecture method, class size, etc. (2). Use of the old criterion of effectiveness model is futile.

Some reasons for futility are now reasonably clear. The strategy is too simple to give guidance where it is needed. We still do not know the particular variables and characteristics of learners or teachers that are vital. We do not have adequate means with which to establish relationships between these unknown variables.

In the area of achievement testing, e.g., neither teacher-made tests nor standardized tests appear adequate as measures of knowledge learnings. In the light of results of latency experiments with computer-assisted instruction, the meaning of correct answers to multiple-choice questions is questionable. Latency is the time interval intervening between the time a stimulus is given, e.g., a test item, and the time a response is given. This latency time has been observed to be essentially constant while a student is giving correct answers interspersed with errors. The latency decreases after the occasion of the last error (Glaser, 1970). Does one or more consecutive correct answer on a multiple-choice question mean that a student "knows" the answer to a question on knowledge?

To curriculum makers and educational psychologists, the meaning of learning a knowledge item has changed, but too few tests are available to apply their new insights upon the nature of learning. If a student learns something, his learning has structure which is measured as concept learning. Moreover, there are different levels with which a concept is learned and these are hierarchical levels of learning that can be observed and assessed. Thus, curriculum makers prefer to assess characteristics

of learners as concept learnings, rather than as memory of knowledge items. But there are not available the semantic differential scales, the Guttman-type scales, etc., with which to assess the characteristics of learners one by one in every one or any one course that is taught in the public schools.

If such means of assessment were available, and plans for regional computer centers materialize, then computerized testing might be developed to implement the piece meal strategy of evaluation. But these means do not exist, so it is not feasible to implement the strategy at this time.

Not only is the model of evaluation defective, the method is also defective with which relationships are sought. The observational strategy is a blind one that ignores the sequences of events in which the interest of a learner is engaged (or diverted); instead, blind correlations are sought between variables that are not proved to be the ones that actually operate.

The approach to learning in the classroom is defective. The rationale with which teachers function is that teachers' primary requirement is subject matter competence. Too little attention is paid to the manner in which communications are attempted with students. All too often, teachers talk too much and emphasize shallow memory questions both in their presentations and in their teacher made tests.

Modern approaches to learning processes are ignored. The processes with which students learn in the cognitive and affective domains are used too little, i.e., the educational objectives of the Bloom Taxonomy (comprehension, application, analysis, synthesis and evaluation) are not utilized in the classroom.

Efforts to change this situation are usually attempted within the constraints of the above-mentioned defective models of evaluation and research design. When implemented within these constraints, difficulties and failures can be anticipated.

The old strategy and constructs of variables are defective, but defects can be remedied. The suggestion of this paper is to remedy the defects of the old strategy, use a "new" strategy of an interactional approach to evaluation and combine the two strategies so that they complement the other. Both can be used together, along with other new approaches.

Teachers need a rationale of their own role in the classroom that goes further than subject matter competence; classroom strategies that are associated with student cognitive and affective performance. Pupils need a rationale of their own role in school; a strategy that lends perspective to their own growth and development toward competence and maturity. A rationale is needed that provides teachers and pupils the means to observe and evaluate their own activities as they perform these strategies; a strategy of evaluation that tells each where they are at a given instant and where they are going. If strategies like these are used, they can give meaning and purpose both to teachers and to students to a greater degree than is now the case; school and instructional programs can be changed from exercises in authority to growth and development, and interest and motivation can be aroused. Strategies are needed with which to teach and learn in the classroom.

Results of a survey of the professional literature indicate that particular strategies can be identified and utilized. Five strategies

are suggested with which to improve implementation and assessment of individualized programs of education. Assessment of the effectiveness of instruction can then be done in terms of effectiveness of the use of the strategies. The first strategy that is suggested underlies all others. It can guide implementation and assessment. The others are strategies for use in the classroom by teachers.

1. The pupil shows his readiness to learn and learns best in interactional processes with teachers and peers. To evaluate pupils effectively, these processes must be observed, so an interactional strategy of evaluation is used (3,4).
2. The pupil is a learner who can be helped to learn by indirect means and by use of cognition-clarifying techniques. Cognition-clarifying processes result in the development of structures of concepts. The Flanders' Interaction Analysis is used to assess the effectiveness with which the strategy is used (3).
3. The pupil is a valuer who can be helped to learn his values for himself by indirect means in the area of values and by the use of value-clarifying techniques. Value-clarifying processes result in the development of structures of values. The Interaction Analysis of Value-Clarifying Behaviors is used to assess the effectiveness with which the strategy is used.
4. The student is a thinker who can be helped to use productive thinking processes. Use of these processes result in the development of structures of intellect. The Aschner-Gallagher System is used to assess the effectiveness with which the

strategy is used (5).

5. The student learns to think in classroom discussions of subject matter. Teacher should select classroom strategies of topic discussion to contribute to student's development of conceptual and intellectual structures. The Topic Classification System is used to assess the effectiveness with which the strategy is used (4).

These are strategies for teaching and evaluation which can change the schools.

There is also a strategy with which students can regard their own career in education. Pupils need a rationale, a perspective with which to regard their experiences that gives them more to work for than continual criticism, generally failing or barely passing grades and training for a job in the future. If students are given a strategy of "living for their own best self," i.e., self-actualization of their own individual potential as a human being, then life in school can be changed into processes of continual inquiry and self-discovery. Faculties and schools should "sell" this strategy in all sincerity to students using minicourses and personal influence.

Each of the instruments of interaction analysis is intended for simultaneous use to achieve multidimensional assessment. Wood (6) found that more than one or two dimensions of classroom behavior must be used since new dimensions are being more sharply defined, e.g., cognitive, and new dimensions are falling into focus. Using the multidimensional approach and exceedingly more complex system of interrelationships may be identified and analyzed and contexts can be more effectively described.

The Gallagher instruments are based upon the processes of the Guilford Structure of Intellect Model. Just as the Flanders' paradigm envisaged more student learning from the use of indirect processes of interaction, so Gallagher forecast the development of the structure of intellect from the occurrence of the processes of the Guilford model in the classroom. Using the Aschner-Gallagher Classification and the Guilford Tests, this result has been observed (7).

The reader will note that the use of the instruments provided by Gallagher has the effect of implementing the Guilford SI Model in the classroom. We should test for the development of Structures of Intellect (8). There are significant reasons for doing this. The meaning of the strategy that regards the student as a thinker is that the student does develop a structure of the intellect. The problem of education is to provide processes with which this can be accomplished and the problem of assessment is to use means to evaluate the development. A model is needed both to guide the selection of the behaviors to be observed and to organize the large amounts of data that are obtained. While the Guilford model is inadequate in that it is not explicitly hierarchical, yet it is useful. The Guilford tests against which the observational instruments are validated do measure a hierarchical structure when appropriate statistical techniques are used. Haynes (9) using 34 tests and a Wherry hierarchical factor analysis, reported that the cognitive abilities that are measured by the Guilford tests are related in a hierarchical fashion. Thus inadequate but useful data regarding the development of these structures in pupils can be obtained by the use of the Gallagher interaction analysis instruments.

The interactional strategy of evaluation is a heuristic developmental perspective with which to organize thinking and activities. The developmental approach affects teachers' attitudes beneficially (10). It is necessary because it is impossible at present to measure directly the development of the structure of intellect for every student in the schools. It is not proved and it may not be subject to proof. It is a needed addition to the defective piecemeal strategy that is conceived in normative terms (sic) but is actually only another heuristic strategy on the same plane. The "validity" of the strategy lies in its values; it makes it possible to differentiate the too global criterion of teacher effectiveness into that of evaluating the degree to which each substrategy is effectively implemented, and there do exist observational instruments with which to accomplish the assessment. Moreover, the basic paradigm upon which all five classroom strategies depend is one that has been replicated enough that there is little reason to question its validity (11); it is Flanders' strategy that the use of an indirect strategy in the classroom by teachers will find pupils learning more and having better attitudes.

Each of the five strategies that are suggested for use in the classroom are based upon and assessed by the same paradigm and the instruments that are used to observe the dimension are tested and proved by competent researchers. The primary exception is the Interaction Analysis of Value-Clarification Behaviors. This instrument* has been constructed in tentative form by the writer upon the model of the Flanders' instrument using categories of indirect influence in matters of value that are

*Available from the writer at the Bureau of Educational Research, Department of Education, Box 911, Harrisburg, Pennsylvania 17126

provided by Raths and others (12). It has not yet been used in the classroom. Since the instrument is essentially the Flanders' in nature and structure but modified for use in the values dimension, it is anticipated that its usability will be about the same as the Flanders'.

The interactional strategy of evaluation has its difficulties and problems, but it is less defective than the old method. The sequence of interactional events is captured with the Flanders' instrument. The particular characteristics of classroom climate, teachers, pupils and verbal events can be observed as they focus and converge in verbal sequences. Research has already established the fact, e.g., that students do learn more under the guidance of teachers that use the indirect strategy. Thus, interactional observations do constitute measures of effectiveness, not necessarily of a global variable of teacher effectiveness, but of the effectiveness of strategies with which to conduct instruction. True, the measures are inadequate, taken by themselves, but the interactional strategy of evaluation can be used to complement the older strategy of evaluation. Both can and should be used together.

If new kinds of measures of structures of conceptual and intellectual learnings are developed, then a renewed attack can be undertaken on the problems of education, measuring the characteristics of teachers and pupils in these terms, combining and relating the results of both strategies. Research should undertake the development of new measures of pupil achievement: Guttman scales, semantic differential scales, cognitive preference instruments, measures of the abilities to use strategies, etc. Results of use of these new instruments should be related to results of observations by interaction analyses.

The significant feature of the interactional strategy of evaluation from a professional evaluator's perspective, is that lawfulness can be found by these observations. Each of the observations is inadequate, but many kinds of observations of classroom interaction taken together add up to significant knowledge and useful means of evaluation. In this case, inadequate does not mean insignificant. The interactional strategy is significant, it does observe the reality that must be perceived and it can be used to develop improved means of assessment.

Teacher preparation, e.g., methods courses in college and universities and in-service training courses can be changed to improve the effectiveness with which they use the strategies that have been outlined. The means to do this lies with the minicourse technology that is already developed extensively by the Far West Laboratory.

Twenty minicourses are being developed to teach teachers to use Flanders' Interaction Analysis, use questions in the classroom and use cognition-clarifying questions of Sanders. Using these minicourses, in-service training of teachers requires little time and does not infringe upon classroom time of pupils. Using the same model, minicourses can be developed to teach teachers the strategies that have been outlined and the use of the interaction analysis instruments with which to assess the use of the strategies in the classroom.

Minicourses are limited in cost to approximately $100,000, using the Borg model and a three-stage plan of evaluation. The result is materials that can be produced and distributed independently by a publisher for approximately $1500.00.*

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*Personal Communication, W. R. Borg.

The potential that lies in the use of minicourses is large. Programs of verbal emphasis can be used to serve pupils with a wide variety of educational objectives that otherwise require the development of expensive programs of humanistic education, creativity training, inquiry training, etc. after teachers master the minicourses. The same minicourses also serve as programs of self-improvement for teachers. The Far West Laboratory uses the rationale that if teachers are given the strategy with which to examine the effects of their classroom behavior upon students and the means to assess it, they can and will want to improve the contribution they make to students and appreciate the availability of the means to do this. The same minicourses also initiate the use of the interactional strategy of evaluation upon a local basis. This is a great deal of mileage to gain from small, inexpensive minicourses, to change the means of instruction, provide means of self-improvement for teachers and provide means for implementing a strategy of interactional evaluation.

Summary

Strategies have been suggested with which to change the schools. Every teacher could use them to guide his activities in the classroom. Thus he can view the pupil simultaneously as both a learner, a valuer and a thinker who alternates from one to the other kind of work in the classroom. He can also help the student to learn to think by means of the transactions that occur in subject matter discussions. He can evaluate the degree to which he is effective in implementing these strategies by the use of appropriate observational instruments that are available for the most part. If these strategies are implemented effectively, we just might engage the interests and motivations of students and teachers and succeed in changing the schools.

Classroom Strategies to Help Students Learn to Think

The well-known "two-thirds rule" of interaction analysis says that someone is talking in the average classroom about two-thirds of the time and that someone is the teacher. While educators generally agree that students need to learn more than facts, yet actual practice reflects this insight only meagerly. Gall (1970) reported "About 60 per cent of teachers' questions require students to recall facts; about 20 per cent require students to think; and the remaining 20 per cent are procedural."

Teachers may inadvertently overemphasize memorization and regurgitation of material both in classroom performance and in teacher-made tests. Pupil learning may then be too narrow and shallow. Even the concepts of intelligence and achievement that are embedded in currently available standardized tests are too narrow. "Indeed, as presently conceived, intelligence occupies extremely narrow dimensions and virtually completely overlaps the concept of achievement," (Michael, 1968). The result is a deleterious cycle that warps and stifles the potentialities of students and teachers alike. "Unfortunately, narrow teaching welcomes shallow testing, which in turn encourages colorless and mechanistic learning," (quoted of Lefever by Michael, 1968).

Teachers need to know and use strategies that are associated with student cognitive performance (Gallagher, 1968). One significant strategy has immense potential for aiding teachers to serve students. This strategy regards the student not only as a learner, but also as a thinker (Hutchinson, 1967). Students can be helped when teachers implement this distinction.

Thought development is an open-ended continuous process of formulation and reformulation of ideas that alternately reflects both thinking and learning. Verbal cues are given by students which indicate to the teacher when they are ready for thinking processes (Gantt, 1969). Teachers can help students to think by responses that develop the structure of intellect.

A recent discovery guides developmental work in curriculum and evaluation. Curriculum-makers now prefer to teach and test for structures of concept learnings. Evaluators now seek meanings of learnings in structures of values, concepts and the intellect. Education should test for the development of structure of intellect factors (Michael, 1968).

Teachers need a model of the structure of intellect to use in the classroom; to guide the selection of processes that pupils need to use at a given moment, of skills that are to be used that particular occasion to help students learn to think. When teachers use interaction analysis of their own activities, then they need a model to guide the selection of behaviors to which attention is paid.

A model is needed to interpret events that occur in the classroom. Experience in a large scale research project indicated that it would have been difficult to make any sense out of the vast amount of information collected without some model like Guilford's Structure of Intellect (Gallagher, 1965).

The operational question for teachers is not "Shall I use a model of thinking?" Every teacher does use a model, however defective it may be. The operational question for teachers is more like "What model of thinking shall I use?"

The Guilford SI model was suggested by Michael as a vast improvement over the model that is embedded in currently available standardized intelligence and achievement tests (Michael, 1968). We should test for the development of the Guilford Structure of Intellect. If achievement was defined in terms of such development, educators would be dealing with a far broader and quite possibly more valid concept of achievement. This could also lead to discovery of better understanding of the learning processes.

The use of the Guilford SI model is suggested by the writer for additional reasons. Cues or stimuli have been identified (Gantt, 1969) when a teacher should respond to a student in terms of the model, interaction analysis instruments are available, usable and tested with large-scale teacher training projects and the instruments have been used to validate the basic hypothesis of the model against the Guilford SI tests. An interactional strategy of evaluation can be used by individual teachers to assess their effectiveness in using the strategy that views the student as a thinker. The use of the Guilford SI model is suggested because the tools exist with which to implement it within an interactional strategy of evaluation.

Gantt (1969) suggested that a teacher can use a four-level model of cues in diagnosing the kind of response that should be made to help a student learn to think in the Guilford Model. The teacher should see the verbalizations of the student both in terms of learning and thinking. Learning is that which functions in thinking and thinking is a function of learning which moves toward new organization of behavior and extension

of knowledge. Verbalizations which reflect thinking occur in Level A - incomplete symbolization; Level B - formulation; Level C - wide association and Level D - reformulation. The teacher's cue for Level A is a grouping verbalism; in Level B is literal and specific descriptions; in Level C is a wider range of related associations and the use of complex metaphors; in Level D is the pupil's identification of changes in problem configuration. These pupil's cues can be used by teachers to diagnose the level of student's thinking and to respond at the appropriate level.

James Gallagher and others have provided instruments for interaction analysis that can be used by teachers to implement the model in the classroom.

The primary source of data on the student as a thinker is the student in the classroom as he verbalizes his thoughts (Hutchinson, 1967). To tap this source of information, it is helpful to observe verbal interactions. The Aschner-Gallagher Classification System (Aschner and others, 1965) was devised to aid teachers to observe the degree to which they were effective in initiating the productive thinking processes. AGCS was built upon the Guilford SI Model and it has five primary categories: cognitive-memory, convergent thinking, divergent thinking, evaluative thinking and routine. Usage in the classroom is based upon the hypothesis that if productive thinking processes are used in the classroom, then the Structure of Intellect will develop in students.

Hutchinson (1967) tested this hypothesis, using the AGCS to categorize teacher and student behavior and testing students' performance on the Guilford SI tests after instructional treatments that were designed to develop productive thinking. Results appeared to validate the AGCS as

a process measure of the development of the Structure of Intellect. These data support Gallagher's report that the AGCS is potentially useful in describing teacher and student behavior and in categorizing differences in students and teachers.

Another strategy that is associated with student's cognitive performance is to help the student to learn to think by subject matter discussions. The Topic Classification System (Gallagher, 1966) could be used by teachers to assess their own effectiveness in implementing this strategy. TCS was used in three demonstration studies to determine if teachers could be trained and to determine its usefulness (Gallagher, 1968).

The TCS was developed on the basis of the Guilford SI Model and experience with the AGCS. In an ordinary classroom discussion session about 20-25 topics will be discussed. A topic is a unit of discussion that centers on a given action, concept or principle. It is classified in three dimensions: content-skills, concept-level and style. Categories included in the first dimension are content and skills; in the second dimension are data, concept and generalization; and in the third dimension are activity, description, explanation, evaluation-justification, evaluation-matching and expansion. Results indicated that teachers can be trained to use the system and it is useful for analyzing teacher objectives and student performance (Gallagher, 1968).

The TCS is helpful in elucidating the weakness of a discussion. Of the four major areas of topic style--description, explanation, expansion and evaluation--it appears that the teachers are able to use only the first

two areas extensively. Rarely are expansion and evaluation used by teachers. The ability to stimulate divergent thinking in students is uncommon with teachers. Many teachers had none or almost no skills topics represented among their classroom discussions. Also lacking were generalization topics even with groups of talented and gifted students.

The disciplines seem to differ systematically in the kinds of classroom discussions. Science classes emphasize description and explanation most heavily and seldom use expansion topics. Most discussions occur at the concept level. English uses evaluation more than others, but even here it is rare to find explicit criteria developed by which such evaluations can be made. Social studies had potential for topic variation, but even here there was little time devoted to the generalization level.

The overall picture that is revealed by the use of TCS is severe limitations that are placed upon student initiative, avoidance of the area of evaluation, lack of adequate presentation of skills topics and the lack of development and presentation of larger ideas and associations of ideas; the area of generalizations. Thus TCS can be helpful in perception of shallow and narrow habits of subject matter discussion.

TCS can be used to help teachers plan their lessons and assess the effectiveness of their classroom presentations, to use feedback on their own performance. The TCS is claimed to not only help a teacher know when he is doing something incorrectly, it can also give some conceptual scheme how to approach near to his objective (Gallagher, 1968).

The use of strategies that see the student as a thinker requires teachers to think more flexibly than heretofore and also to observe student performance on several dimensions at once. For example, if a teacher decided to use the interrogative mode of instruction, then questions are used to achieve educational objectives. But the strategy that sees the student as a thinker can use questions in at least three ways: convergent, divergent and clarifying.

Convergent questions are used by a teacher as a sequence of stimuli originating with the teacher for the purpose of eliciting a response by the student. By skillful selection of a sequence of questions, a teacher expects the student to achieve a new concept, word, principle, idea, etc.

Divergent questions are used by a teacher as stimuli originating with the teacher to elicit a response from the student that results in new alternatives.

Clarifying techniques are different. A verbal expression by the student, e.g., a value indicator or a thinking cue is perceived by the teacher as a stimulus that requires a clarifying response, i.e., usually a teacher's question that is intended to induce the student to think about his value or his idea. The purpose of the clarifying response is to induce cognitive valuing or thinking processes that are more advanced or at a higher level in terms of the model than the student has attained; it is to advance the student through the levels and stages of the model.

The convergent and divergent questions differ from clarifying questions in that the former are initiated by the teacher as stimuli to

which the student responds, while the latter should be perceived by the teacher as stimuli to which the teacher should respond. All are alike in that they are used to advance the student through the model of the structure of intellect.

The SI Model, the AGCS and the TCS are not suggested as the final means of evaluation, but as a helpful means which can be made to work. Assessment is inadequate but useful. If this interactional strategy of evaluation is used along with the four strategies that have already been suggested to guide instruction in the classroom, then new constructs can be conceived, new and better tests can be developed, new and better instruments for interaction analysis can be constructed and better teacher strategies can be perceived. Suggestions to use the model and instruments are only modest steps along continua of development of testing, evaluation, instruction and learning.

The SI Model itself is inadequate. Based upon work with about 350 sixth graders, Gallagher (1965) reported that the model is not correct when it is pictured as a cube with independent categories across the Operations dimension. Gallagher suggested another model which subsumed the categories of the SI Model and added the hierarchical principle, but the latter model has not been instrumented at this writing. Future development will result in a new and improved model of the structure of the intellect, so the Guilford Model should be perceived as an inadequate but helpful one that can be made to work at the present time. It can be used to help differentiate the criterion of teacher effectiveness into four classroom strategies.

The Guilford SI Model and the SI Tests that were developed to measure the model do succeed in measuring in some degree the hierarchical structure of the unknown criterion of the structure of the intellect. Haynes (1970) administered 34 SI Tests to 200 college Ss and used a Wherry hierarchical statisitcal analysis on the results. Analysis revealed "The concept of cognitive abilities being related in an hierarchical fashion was supported by the results." This is a remarkable result to obtain from tests that were developed by rigorous use of factor analytic techniques to implement a linear model of intellect.

Thus the teacher can use a strategy that makes students thinkers by eliciting productive thinking processes in the classroom. While it is not possible to administer 35-50 SI tests to every student in American schools to assess the formation of the Structure of Intellect, there is reason to believe that these structures develop as the thinking processes occur in the classroom. In approximate terms, the degree to which these processess are used is positively related to the degree to which the structures develop. So the teacher can try to use these processes and assess his effectiveness by means of the AGCS.

The teacher can help students learn to think by means of his classroom discussions. While it is not possible now to construct and administer hundreds of tests of structures of concepts, values, attitudes and personality to every student in American schools for direct measurement, it is possible to use the TCS to guide the preparation and assessment of classroom discussions.

Teachers can use productive thinking processes in the classroom and assess the degree to which they are effective by using a multidimen-

sional interactional strategy of evaluation. The AGCS and the TCS can be used to implement the strategies that the student is a thinker and he can be helped to learn to think by classroom discussions.*

*Note: Zimmerman and Bergan used a seven-category system that is an alternative to the AGCS. See Merrill Palmer Quarterly 17:19-29; January 1971

Interaction Analysis of Value-Clarification Behaviors

Learning is largely controlled by one's value hierarchy. An individual acts in accord with his internalized values and a principal bar to learning may lie in a conflict of values (Lippincott, 1969).

Teachers can unwittingly create conflicts of values and value disturbances with children by telling students what to believe and what to value, rather than helping them to work them out by themselves. The basic failure of the schools is that children are forced to settle for their lower Freudian nature because they have no other alternative. Values are introjected (a Freudian mechanism) by students as a result of the exercise of authority that is part of any educational institution rather than working them out by valuing processes (Pilder, 1968).

This unthinking use of authority can create hostility, resentment and antagonism against schools and school personnel, or it can create a variety of behavior problems that can be usefully seen as resulting from value disturbances. Indeed, perceptions of values can be understood as being distributed along a behavioral continuum. People that are clear in their values lie at one end of the continuum. They are adjusted, mature, positive and purposeful, but others lie at the other end of the continuum. They are uncertain, apathetic, flighty, inconsistent and immature (Raths and others, 1966). When children develop values which differ drastically from the mainstream of American life, one is apt to find apathy toward school; a flighty child who is dissatisfied with his own self-concept (Paschal, 1968).

These kinds of problems can be created through unprofessional use by teachers of direct influences upon the values and beliefs that are

held by students. While it may seem natural to a teacher to express his own opinions, goals, purposes, aspirations, attitudes, interests, feelings, beliefs, activities, worries or problems, this is excessive subjective involvement and interference in the right of the student to learn his own values. So a teacher should exert less direct influence upon value learnings of his students.

Children need help in working out their own values. So great are the complexities and confusions that prevail in contemporary life, it is not surprising if even adults are confused about their values.

Values are those elements with which a person decides to use his life. Each person must wrest his own from the available alternatives (Raths and others, 1966). Greater emphasis is needed upon the processes with which these values are selected. Asking questions and learning to ask questions, particularly on values, must be a child's privilege. Educators must talk realistically with children about their beliefs, purposes, attitudes, interests, aspirations, feelings, activities and ways of thinking (Paschal, 1968).

All these matters need clarified because it is the acquisition of values that makes a self. A child grows with growth in self-awareness. Humans can achieve maturity by essential processes of choosing, prizing and acting. To help teachers to contribute to development in selfhood, in values, Raths and others (1966) provided a theory of valuing processes, methodologies for clarification of values and practical ways to use them in the classroom.

Children grow by engaging in the processes of valuing; choosing, prizing and acting. A child can choose freely, choose from alternatives, and choose after consideration. He can prize values in the senses of cherishing and affirming them. He can act in regard to values by doing something, e.g., by asking questions, and by doing it repeatedly (Raths and others, 1966).

A child is ready to grow in matters of values when he utters orally a value indicator. This is an expression by the child about his goals, aspirations, attitudes, interests, feelings, beliefs, activities, worries, problems, or obstacles. A child says something of the general form of: I'm for, I'm against, think believe, prefer, like, if you ask me, my choice is, etc. Statements like these are classed as value indicators. They indicate to the observant teacher that a child is ready for valuing processes.

To help children to use valuing processes, a teacher uses strategies of value clarification. A teacher responds to a child's value indicator with a clarifying response; a question like one of the many questions listed by Raths and others (1966). Clarifying responses are questions that are directed by the teacher to an individual pupil to elicit thinking about the pupil's values. The test of the worth of a clarifying response is whether it results in a pupil thinking on what he has said or done, getting to know himself better, examining his choices, considering what he prizes and why, etc.

This kind of use of questions creates the clarifying environment. A value-clarifying environment can be created by the teacher's use of value-clarifying questions (Raths and others, 1966). Herald (1969) suggested that teachers could use both the value-clarifying questions of Raths and the cognition-clarifying questions of Sanders (1966). This idea was tried out with a group of six elementary teachers, using Raths' approach. Herald reported that value-clarifying responses are a good way to achieve basic changes in teacher behavior and a good first step in altering classroom interaction. These indirect influences upon pupil's behavior have the effects of opening their thinking, helping children to acknowledge their own thinking, evaluate their choices in life, learn the consequences in their use of words, examine their attitudes, etc., without direct insistence by the teacher.

A teacher can influence pupil's learnings favorably in the realm of values through indirect means consisting of value-clarifying responses.

This rationale is only an extension into the realm of values of a similar rationale that is being implemented in the cognitive realm by the Far West Laboratory for Educational Research and Development. FWL uses the Flanders' Interaction Analysis with a rationale that teachers will be more effective and pupils will learn more if teachers will exert less direct influence upon cognitive learning and more indirect influence. Minicourses are being developed for use in pre- and in-service training of teachers to help teachers to use the rationale, the Flanders' Interaction Analysis and the use of the cognition-clarifying questions of Sanders (1966).

Interaction Analysis of Value-Clarification Behaviors

The Flanders' Interaction Analysis Behaviors can be used as a model to construct a similar instrument for use with value-clarifying responses by teachers. The instrument entitled "Interaction Analysis of Value-Clarification Behaviors" is constructed on this model. Accordingly, there are the same basic categories of teacher talk, student talk and silence or confusion. As with the Flanders' instrument, all categories are mutually exclusive, yet they include all value talk in the classroom.

The Categories

The teacher's direct talk comprises those occasions in which a teacher tells a pupil what he should believe, what he should do, what one ought to do, what is better than something else, etc., or the teacher attempts to influence directly some student in matters of value. Direct talk includes moral and ethical imperatives (you shall, you must, you ought) value judgments (I believe you should,--is good), normative statements (the best rule is, professional practice is, most people feel, you must conform to), value indicators by the teacher, descriptive statements (--is better than) regarding some value. Rhetorical questions by the teacher are included when no real response is expected by the teacher and no real opportunity is given for response by the pupil. All these responses are labelled Lecturing as the first subcategory of direct talk by the teacher.

The second category is rebuking or punishing a pupil verbally following a verbal comment by a student expressing his own value. Instead of accepting or praising a student for his expression, the teacher re-

jects the student or rejects the concept of the competence of the student to make his statement on values. Ridicule is included in this category.

The third subcategory of direct talk by the teacher is dissonant response. Dissonant response are verbal attempts by the teacher to influence directly what a student or a group thinks about a value or about the pupil who has expressed a position on a value. Klevan (1968) has done an excellent job of analyzing and discussing these dissonant responses and his discussion should be studied with care. In brief terms, dissonant responses are questions that are used to distort a pupil's utterance, discredit it, counter it, focus on extreme and indeterminate matters, criticize or judge (condemn it outright or damn it with faint praise). The 18 dissonant questions of Klevan are included in this subcategory.

The teacher's indirect talk on values comprises the three kinds of clarifying responses of Raths (1966) and of Klevan (1968), and a fourth subcategory of a teacher initiated question. The difference between the first three subcategories is that these are responses by the teacher to the pupil's expression of a value indicator, while the fourth subcategory is a question that is initiated by the teacher, e.g., in the course of a lesson to emphasize an implication of the lesson with reference to a value.

The three subcategories of value-clarifying responses are: (1) choosing, (2) prizing and (3) acting. In each subcategory, the teacher responds with a question that is intended to lead the pupil into the value response that is named. Raths lists more than 100 questions, each classified into one of the three valuing processes. The observer should study these lists of questions.

The choosing and prizing categories need no more discussion in addition to that of Raths' and Klevan's, but the acting category needs additional clarification. If the observer will attempt to classify the questions that are listed by Raths for this acting category, he is likely to find that most or all can be clearly perceived in terms of the cognitive categories of Bloom's Taxonomy. In other words, Raths is saying that teachers act in the domain of values by means of questions and the purpose of these questions is to lead the pupil to gain more information (knowledge), gain understanding (comprehension), apply their understandings, analyze, synthesize new understandings and evaluate learnings in matters of values. Acting responses by teachers are questions leading pupils to the cognitive activities of the Taxonomy in matters of value.

There are three categories of student talk; response by the student, a value indicator and a question initiated by the student (inquiry).

The student talk-response subcategory is a response by the student to a value-clarifying question by the teacher.

The student-talk value indicator is an expression by the student to his own goals, purposes, aspirations, interest, activities, worries, problems, obstacles, attitudes, beliefs and feelings. Each value indicator is an indicator to the teacher that a clarifying response is called for.

The third category of student talk is the initiation by the student of acting processes. These include clarifying questions on values that are conceived and uttered by the student as part of his personal inquiry and growth and development. These use the cognitive Taxonomy as a guide.

They include questions that are formulated to gather information (knowledge), try to understand (comprehension), apply, analyze, synthesize and evaluate.

The last category of the IAVCB is that of silence or confusion. This is a three-second time period in which there is no communication on values (if there was a communication within the preceding three-second interval).

As with the Flanders' instrument, ground rules are needed to deal with problems of categorization. Pending the results of a pilot study, the five ground rules that are used with the Flanders' instrument are tentatively accepted for use with the IAVCB:

1. "When not certain in which of two or more categories a statement belongs, choose the category that is numerically furthest from Category 5" (middle category).

2. "If the primary tone of the teacher's behavior has been consistently direct or consistently indirect, do not shift into the opposite classification unless a clear indication of shift is given by the teacher."

3. "The observer must not be overly concerned with his own biases or with the teacher's intent."

4. "If more than one category occurs during the three-second interval, then all categories used in that interval are recorded; therefore, record each change in category. If no change occurs within three seconds, repeat that category number."

5. "If a silence is long enough for a break in the interaction to be discernable, and if it occurs at a three-second recording time, it is recorded as a 10." As with the Flanders' instrument categorization should be done in terms of the effects upon the freedom of students to respond in matters of values (Amidon and Flanders, 1963).

Usage and Interpretation of Results

Data are recorded with the IAVCB in the same manner as with the Flanders' instrument (Amidon and Flanders, 1963). An interaction matrix is then formed using 11 columns, rather than 10, and analyzed in terms of percentages of teacher talk, and of student talk. The indirect to direct ratios are computed as follows, modelled after the Flanders:

ID ratio = sum columns 1-4 divided by sum columns 5-7
Revised ID ratio = sum columns 1-3 divided by sum columns 6-7
Adequacy ratio = sum columns 1-3 divided by column 9

(Amidon and Flanders, 1963)

Categories For Interaction Analysis of Value Clarification Behaviors

TEACHER TALK	INDIRECT INFLUENCE	1. Choosing: Teacher asks questions leading student to select, elect or choose a value a. Freely b. From Alternatives c. After Consideration 2. Prizing: Teacher asks questions leading student to express his liking for a value a. Cherishing b. Affirming 3. Acting: Teacher asks questions leading student to do something, to act repeatedly, to clarify his value a. Do Something - inquire, seek more information, comprehend, apply, analyze, synthesize and evaluate a value b. Do Repeatedly - ask questions repeatedly 4. Asks Question: Teacher initiates a question on a value
	DIRECT INFLUENCE	5. Lecturing: Teacher gives his own opinion on values in various forms. Imperatives - you must --. Judgments - -- is good. Normative statements - The rule is --. Descriptive statement - This is better than --. Ask rhetorical questions. Included are statements, e.g. You ought to --. I believe you should do --. Most people do --. Most people feel that --. Informed perspective --. My feeling about that is --. 6. Rebuking and/or Punishing: Teacher rejects pupil's questions and/or value, devaluates the worth and competence of the question of the pupil. A threatening manner and punishment may be added. 7. Dissonant Responses: Teacher uses the dissonant responses of Klevan to distort pupil's utterance, discredit it, counter it, focus on extreme and indeterminate matters, critize, judge.
STUDENT TALK		8. Student Talk - Response: Student responds to teacher's value - clarifying question indicating Choosing, Prizing or Acting on a value. 9. Student Talk - Value Indicator: Student expresses his own attitude, interest, purpose, aspiration, past or intended activity.

10. Student Talk - Inquiry: Student initiates a question to the teacher about a value or asks a question in response to the teacher's question, seeking more knowledge, comprehension, application, analysis, synthesis, evaluation about a value.

11. Silence or Confusion: Silence for short periods, pause in which no verbal communication occurs on a value or its indicator.

Strategies for a New Methodology of Evaluation
and Quality Assessement

As Cheong (1970) pointed out, teacher effectiveness is a controversial area which has produced a vast amount of writing. No other aspect of education has been more investigated in the last fifty years, but findings have been insignificant, often contradictory and few, if any, generalizations can be made (Saadeh, 1970).

Why are findings so meager? The value of information that is received depends to a great extent upon the strategy used for selection and processing of independent and dependent variables. Strategies are needed for these purposes and conceptualization and sophisticated analysis must go hand in hand (Saadeh, 1970).

The purpose of this paper is to present strategies and concepts with which to deal empirically with the problem of teacher effectiveness.

Gage's (1968) criticism still stands as the jumping off point to a new methodology. This focused upon the lack of an adequate theory of the criterion and suggested the beginnings of a new approach to the criterion theory. The Stanford program of research, which has been guided by Gage's proposal, has adopted the strategy of breaking down the global criterion theory of the past into less global elements in order to seek lawful relations between less globally conceived dependent and independent variables. Using this strategy, attempts have been made to identify teaching skills that can be specified, taught and assessed. This has been a fruitful modification from conventional approaches.

Conventional alternatives have usually attempted to frame some theory regarding the nature of the criterion, formulate constructs from the theory regarding the dependent (criterion) variables and independent (predictor) variables and relate them by e.g., regression analysis.

Conventional alternatives have usually attempted to frame some theory regarding the nature of the criterion, formulate constructs from the theory regarding the dependent (criterion) variables and independent (predictor) variables and relate them by e.g., regression analysis. All such constructs have been too global. The basic paradigm itself is defective and the conventional theory of the criterion must be revised (Gage, 1968).

The strategy underlying the Stanford research program should be extended and additional strategies and means should be used to partition the global criterion.

A criterion theory must deal with at least two problems:

1. What is the nature of the criterion (a)?
2. What are the dependent variables that are related to the criterion (a)?

To deal with these problems and to differentiate (partition) the criterion, strategies are suggested for research and teacher training. Use of the first four is suggested to identify the criterion and the last two are suggested to deal with the independent variables.

1. Divide the global task of the teacher in the classroom into at least four different areas and deal with each in terms of a strategy: the pupil is a learner, a valuer, a thinker and a thinker in subject matter discussion. [1,2]
2. Assess the effectiveness of the teacher by the use of four instruments for interaction analysis. Use multidimensional interaction analysis. [1,2]
3. Use variables of interaction as dependent variables for analysis.
4. Use hierarchical cluster analysis to differentiate the criterion measures into orderly uniform hierarchical clusters. Identify the criterion structure. Assess adequacy of instruments.

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[1]R. W. Geisinger, Strategies to Change the Schools

[2]R. W. Geisinger, Classroom Strategies to Help Students Learn to Think

5. Use hierarchical cluster analysis on results of EQA instruments, Grade 7. Assess adequacy of instruments.
6. Use hierarchical cluster analysis course grades and teacher-made tests, Grade 7. Assess adequacy of courses as contributors to clusters. Assess adequacy of tests.

The effect of using four teacher classroom strategies, measuring the teacher's effectiveness by multidimensional interaction analysis and using the results as measures of the dependent variables is to partition the unknown criterion into several hundred variables. Instead of one or a few measures of the dependent variable(s), we should have many hundreds of variables of unknown relationships and meaning.

If a computational method can be found to organize the data gained by observation of these variables into homogeneous groups and into structures that can be meaningfully conceptualized, then means is available to identify the global criterion. Just such a method is found in hierarchical cluster analysis. Hierarchical clustering techniques are means for partitioning objects into optimally homogeneous groups on the basis of empirical measures of their similarity (Johnson, 1967).

Campbell (1966) used the Holzinger-Harman method of hierarchical cluster analysis to differentiate (partition) a global criterion, specifically Grade Point Average. If Campbell can use this kind of method to differentiate the global criterion of GPA, then it should be possible to apply the method to differentiate, i.e., cluster and structure the global criteria embodied in multidimensional interaction matrices.

Campbell (1966) suggested the use of hierarchical cluster analysis to break down the global criterion of GPA in order to identify factors in course content that account for variation in the total GPA, which predictors in the test battery predict which course clusters best and what content factors need better predictors to account for their variance. Criteria which were clustered were final grades in 20 core courses in an engineering curriculum. The procedure clusters the first two variables with the highest correlation. Then a third variable is clustered with the first two or two other variables are clustered depending upon the value of the B-coefficient for the three-variable cluster or the average of the B-coefficients for the two-variable clusters. The B-coefficient (of belonging) is the ratio of the average intercorrelation within a cluster to the average intercorrelation of variables outside the cluster. The method maximizes this ratio. Using indices of relative cluster independence, homogeneity of clusters, predictability and psychological meaningfulness, it is possible to gain much information about the criterion that the principal components method does not give and to uncover weak spots and inconsistencies in the test battery and the curriculum. The adequacy of tests is revealed as measures of criterion clusters. The clustering method was superior to the principal components method of factor analysis with varimax rotation (Campbell, 1966).

Hierarchical cluster analysis is suggested as an alternative to factor analysis for a conceptual reason that deals with the critical question in the theory of the criterion "What is the nature of the criterion?" The cognitive and affective taxonomies of Bloom, Krathwohl

and others integrate some of the best known wisdom regarding the nature of the criterion. When successful teaching occurs, learning has taken place (Cheong, 1970). The taxonomies of educational objectives are alike in formulating learning objectives in terms of hierarchies of increasing internalization.

Pupils internalize learnings not only by rewards and punishments, but also, according to the taxonomies, by means of the processes described in their systems. The rationale is that, if the processes occur in the classroom, then internalization products are formed. The ultimate criterion(a) are these internalization processes and products. These are hierarchically structured.

It follows that to assess hierarchical structure in the data, a hierarchical method of computation must be used. Hierarchical cluster analysis can be useful both with measures of dependent variables and with measures of the structures of intellect and personality.

Hierarchical cluster analysis may be useful to characterize the structure of intellect that develops in students. Even when tests were used from the linear Guilford Structure of Intellect model, results indicated the Guilford tests did identify a hierarchical structure, even though they were developed very carefully on a linear factor analystic model. Haynes (1970) reported the results of a Wherry (1959) analysis on data from 34 tests of the SI model. Analysis revealed 15 first order orthogonal factors at three levels. The highest level was a general factor related to awareness and understanding of symbolic and figural information. The second level consisted of two subgeneral

factors of higher level cognitive functioning. There were 11 specific group factors that were identified at the third level that were similar to the factors in the Guilford model. "The concept of cognitive abilities being related in hierarchical fashion was supported by the results" (Haynes, 1970).

McQuitty and others (1969) used a new method of hierarchical analysis as a means of investigating individual personality structure. The method was reported as useful both for assessing an individual's deviations from his own pattern of behavior and from a normal pattern.

Wherry and Waters (1968) used a hierarchical method to assess personality structure. A survey of feeling states was constructed and categories were added that were related to self, others and accomplishments. Fifteen categories were obtained in test items for measurement of individual states, social states and accomplishment states. Five positive and five negative synonyms were obtained for a 150-item pool. These were administered to 235 schools and responses were analyzed by the Wherry-Winer (1953) method. The results were analyzed by the Wherry Hierarchical Method (1959). Two separate hierarchies were obtained that were interpreted as supporting White's concept of competence: competence and satisfaction.

This hierarchical theory of the criterion(a) regards tests as measures of cluster structures, rather than as measures of a construct. Measures of a construct can never be fully adequate, because there are many unknown gaps between the tests, the behaviors that are represented in the construct and those that actually occur in the reality that the

construct models only imperfectly. These gaps are closed only by inferences, of which there may be sequences that are connected by little if any evidence. On the other hand, the hierarchical cluster method of computation clusters variables on the basis of their empirical relationships and tests and test items can be assessed for their adequacy as measures of a cluster structure. Thus an empirically based method is available to improve tests as measures of the cluster structure.

The hierarchical theory of the criterion offers a helpful answer to the critical question "What is the nature of the criterion(a)?" The answer is that the criterion is the hierarchical structure. The meaning of test data is found in cluster structure, rather than in the distance of a measure from a mean.

The hierarchical theory of the criterion can also clarify the relations of independent variables that function in curricula and are assessed by measures of these variables. If the same hierarchical method of computation is used to test achievement obtained by the use of courses or curricula, then the contribution of each course or curriculum to the criterion cluster can be computed and the adequacy of tests of independent variables can be computed, using indices like those used by Campbell (1966). Then curricula can be selected on the basis of their contribution to the formation of criterion cluster structures in students.

Both dependent and independent variable measures shoud be analyzed by hierarchical cluster analysis.

The effect of using hierarchical analysis of independent variable measures will be to reveal associations or relationships of independent variables that are unknown at this time. When the attempt is made to interpret the meaning of these relationships, it should be possible to discern new and better constructs regarding the nature of the independent variables that produce the criterion structures in students. Then the curricula can be changed to obviate useless material and to accentuate the use of essential material and increase the efficiency of instruction.

The same principle should hold true regarding the nature of the criterion clusters that are the goal of instruction. When better information is secured and the attempt is made to interpret the meaning of the cluster structures of the criterion(a), it should be possible to discern new and better constructs regarding the nature of the criterion. The results can be better understanding of the goals of education, in terms of precise knowledge of the structures of the criterion(a).

The hierarchical analysis used by Campbell (1966) used indices that provide information regarding the contribution of a course to the criterion. A course that contributes more to the criterion clusters can be selected in preference to another that contributes less. So there lies within the hierarchical theory of the criterion and independent variables the potential for quantifying the relationships between the inputs of instruction, e.g., in curricula, the processes of instruction, e.g., verbal interactions in the classroom and the

products of instruction. This is the goal of the system approach to education and the way to achieve it is through the use of hierarchical theory of the criterion(a) and independent variables.

It should be understood that direct measurement of the products of instruction cannot be done at the present time. While there are available some reasonably good tests, e.g., the Guilford SI tests and tests of creativity, these are not available in the group administered, brief, machine scorable, etc. form that is needed for mass administration to all students in American schools. Most of the tests of achievement are not available, so adequate direct measurement of internalization and achievement is not possible at this time.

Fortunately there is available a workable alternative in process measures of instruction. The affective and cognitive Taxonomies, the Guilford Structure of Intellect Model and the Flanders' Interaction Analysis are all alike in one respect; they state that, if the processes of the model occur, then the products will be formed. Therefore, an interactional strategy of evaluation can be used as an approximate index to the formation of internalization structures.[3]

To measure any dependent or independent variable for a human subject in the schools, an evaluator must find means to make some behavior visible. Thus we have no way of knowing if a student learned some higher level cognitive behavior in individual study unless an evaluator finds means to make visible some behavior that produces evidence the learning occurred.

Verbal interaction in the classrooms can be the most productive

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[3]R. W. Geisinger, Strategies to Change the Schools

environment that is conceivable at the present time. Pupils learn higher order cognitive and affective behaviors in classroom interaction as an abundance of evidence has demonstrated, they internalize values and beliefs, even if only by introjection and they give verbal evidence of their learnings by the kinds of questions and comments they can be induced to make. Therefore the opportunity for verbal interaction that is presented to teachers in the classroom is of the utmost importance.

Verbal interaction is the locus of formation of the criterion(a) and the arena in which evidence is given of this event. All the individual characteristics of students, teachers, media, communications, curricula, etc. come together and focus upon what is said and done in classroom interactions. These interactions are the reality, at least that which is observable of the reality of the criterion(a), so the data from interaction analyses should be used as dependent variables in hierarchical analysis.

Unfortunately, much of the time that could be spent profitably is squandered. It is common knowledge that interaction analyses reveal teachers generally talking about 70 per cent of the time. Most of the time that is spent in classroom interactions is wasted. When French and Galloway (1970) analyzed classroom interactions as communication events, they reported that 25 per cent were institutional events, 69 per cent were task events and only 3.8 per cent were personal events.

Most of the communications that deal with institutional and task events could and should be relegated to media, e.g., single concept lessons, minicourses and learning activity packages. If this was carefully done, then 94 per cent of classroom time would be freed for personal interactions.

Teachers can train themselves (by self-instructional minicourses) to use special teaching skills in classroom interactions. If the proportion of classroom time that was devoted to personal interaction, e.g., to helping students to learn to ask questions, was increased ten-fold, the potential for improvement of the schools and for helping students is incalculable.

If teachers were trained to use the above-mentioned strategies to aid pupil development and to assess their effectiveness by means of multidimensional analysis, a problem is created of the use of voluminous quantities of data that are generated. Fortunately, recent advances in computer technology can reduce this problem to manageable proportions. If teachers were taught to categorize their own classroom sessions by marking mark sense cards, the latter can be read by a computer and suitable computer programs can generate interaction matrices and perform all the necessary computations.[4] Computer programs and other resources are available or can be prepared to deal with this problem.

In summary, it has been proposed to divide the global task of the teacher in the classroom into at least four different areas and deal with each in terms of a strategy of verbal interaction. A pupil

[4] Dan Fetter, Lock Haven State College, unpublished manuscript.

is a learner, a valuer, a thinker and a thinker in subject matter discussions. To contribute to student development in these areas, teachers need to be taught to practice skills of verbal interaction, thus creating in classrooms programs of verbal emphasis. Teachers can assess their own effectiveness in using those strategies by means of multidimensional analysis. Data gained from instruments can be used as dependent variables and organized into meaninful structural relationships by means of hierarchical cluster analysis. The effect of these operations would be to identify the nature of the criterion structure in terms of cluster structures. In like manner, curricula and curricular segments can be tested and data can be analyzed by hierarchical cluster analysis. Using indices like those that have already been reported, it is possible to gain quantitative information of the contribution of independent variables, e.g., curricular segments to the criterion, i.e., cluster structures. In addition, the adequacy of tests can be assessed quantitatively as a measure of a cluster structure, rather than as measures of a construct. There lies within this methodology the potential for quantifying the relationships between inputs, processess and products of education.

Validation of Educational Quality Assessment
and School Achievement Tests

Validity is sometimes conceived in normative terms and the meaning of a test score is sometimes ascribed absolutist interpretation, i.e., a student is "failed" on a test. This is a mistaken view of validity and of testing. Validity is a relative concept. For any test, the question is "What is it valid for?" The best answer to the validity question at present is factorial validity, so no one number can indicate adequately the validity of a test. The validity of a test is best seen as a list of factors and their proportions of common variance (Guilford, 1956, p. 462).

If factorial validity is a good answer to problems of validity, then hierarchical cluster analysis is also a good answer on the same rationale. Since it also affords additional resources and information and will do things that cannot be done by factorial validity, it is a better answer. The purpose of this paper is to clarify these matters, to suggest concepts of synthetic validity and structure-referenced tests and to outline the contributions that are possible to the state EQA assessment program.

The Problem

The purpose of factor analysis has been to discover the factor structure of a domain of variables. Factor analyses of results of many tests have been successful in reducing the number of dimensions from many to a few factors that are needed to interpret the nature of a group of variables. Computations can show the amount of systematic variance that is associated with each factor and the factor loading of each variable, so that the scientist's desires for parsimony and accounting for all the variance in a group of events are satisfied.

Weiss (1971) reviewed different approaches to factor analysis and the assumptions and problems of the techniques. There are many problems and questions that are involved. Choice of a method is only the first of many decisions. Will the total or just the common variance be analyzed? How is communality to be estimated? How many factors will be extracted and retained? Is rotation necessary? What rotation will be used? How should variables be weighted to compute the factor score? Some methods decide upon the number of factors to retain prior to rotation, but Weiss followed Thorndike in suggesting this decision should be made after rotation. Gains achieved through one decision may result in losses in another area.

The choice of factor method is a relative one. The principal components method is a popular choice, but this method is the only one that analyzes both error and common variance, using maximization computational methods. Some factors can then represent correlated error variance which is not replicable in a subsequent experiment. Decisions regarding unreplicated principal components analysis are rarely justified in psychological research (Weiss, 1971).

The choice of a method of factor analysis should be made carefully with the purpose of forecasting the structure of the variable domain that is under investigation. Since the purpose in using the technique is to discover the structure of the domain, the method that is chosen must be capable of eliciting the hypothesized structure under the conditions in which testing occurs. The validity of a test is its forecasting efficiency ... (Guilford, 1956, p. 463).

What is the hypothesized structure of educational objectives? The cognitive Taxonomy of Bloom and others and the affective Taxonomy of Krathwohl and others are both hierarchical in structure. This is the best guess of leading authorities in the combined professions of education and psychology regarding the relationships of educational objectives.

What is the testimony of research? Do research results support the hierarchical structure of educational objectives? All the evidence is not in yet on this question but there is support for the hierarchical hypothesis.

Children learn the concept noun at differing hierarchical levels (Eustace, 1969). The number concept developes through increasing levels of abstraction (D'Mello & Williamson, 1969). Children may behave at concrete, functional or conceptual levels and testing must take this into account (Chase, 1969). Older and higher-ability students learn more higher levels of selected concepts based upon the cognitive Taxonomy (Carey, 1960). The global criterion of Grade Point Average in engineering core courses is hierarchically structured (Campbell, 1966). Group verbal interactions possess hierarchical structure and can be characterized by hierarchical fields (Mackenzie, 1970).

When results of 34 factorially-pure Guilford Structure of Intellect Tests with 200 college students were analyzed with a Wherry hierarchical solution, it was found that the concept of cognitive abilities being related in an hierarchical fashion was supported (Haynes, 1970).

The nature of educational objectives is probably hierarchical in structure. The structure of a hierarchical criterion cannot be adequately represented by a linear factor analytic solution with rotation to simple structure.

Perhaps the most questionable practice in the application of factor analysis to educational data is rotation of factor matrices. True, the analyst hopes to obtain a solution by this practice that is less dependent upon his specific experiment and is more likely to be replicable (Weiss, 1971). But the purpose of most rotational methods is to obtain "simple structure," a concept of Thurstone. Simple structure is approached when each factor is loaded highly by only a few variables and each variable loads mostly on only one factor. This concept has the appeal of parsimony, but the structure of educational objectives is probably not correctly seen as simple structure. If the leading researchers are correct in their view that the structure of educational objectives is hierarchical, then the meaning of results is very questionable when principal components analysis with varimax rotation is used.

A Proposed Solution

If the structure of educational objectives is hierarchical, then it follows that the kinds of tests and the kinds of statistical methodologies that are used should be capable of eliciting hierarchical structure. If these tools are used, then it is possible to develop structure-referenced tests, as opposed to criterion- or norm-referenced tests.

A variety of hierarchical clustering methods is available that do not have the weaknesses and problems to which factor analytic schemes are subject. They can be devised to accomplish the same ends for which factor techniques were created and they can constitute, like factor analysis, a means of validation.

Cluster analytic methods have been compared to factor analytic methods. Campbell (1966) compared the effectiveness of the Holzinger-Harman method with results from principal components analysis with varimax rotation. He found that the hierarchical method was superior to the factor analytic method for the purpose of discovering the structure of a global criterion.

Campbell's (1966) clustering technique also yielded much vital information that the other method did not. Indices were used that were very helpful for the interpretation of results: cluster independence, homogeneity of clusters, predictability of clusters, and psychological meaningfulness. Through the quantitative variations in these indices, it was possible for the investigator to identify factors in courses that accounted for variations in the global criterion that was under investigation, which predictors in the test battery predicted which course clusters best, and what content factors needed better predictors, i.e., tests to account for their variance. In effect, the adequacy of tests can be observed by indices as measures of cluster structure and the adequacy of a course or course segment can be observed as a contributor to the formation of a criterion cluster structure.

There is reason to believe, though it is not proved, that the structure of a hierarchical criterion can be adequately represented through the use of a suitably chosen clustering method. If factorial

validity was the best kind of determination of validity under an earlier technology, then a better kind of validity determination is available in modern technology using hierarchical cluster analysis with indices like those devised by Campbell (1966).

The cluster structure of a criterion test is precisely the reality of the criterion. Cluster structures should be seen as the criterion structures, at any rate all that is observable now.

The cluster structure of a predictor test should be seen as the portion of the criterion structure that is embodied in the predictor. Predictor tests should be constructed to delineate a selected portion of the criterion structure.

Validity should be seen as relative to the cluster structures of the criterion. Validity is measures of and indices of relationships of tests to the structure of the criterion. Validity measurements lie in the indices that uncover weak spots and inconsistencies in the test battery and selection scheme (Campbell, 1966). If the levels of indices show that a test is weak in delineating a cluster, i.e., the level of cluster independence is low, then the test needs improved as a measure of the cluster. If the index of predictability of a cluster is low, then the test needs improved. Similarly, the index of psychological meaningfulness might be seen as a kind of validity index. With cluster techniques, we can and should use many indices of test validity. The adequacy of a test as a measure of cluster structure can be indicated by several indices, each of which is an aspect of the validity of a test.

Tests can and should be revised when evidence is gained in the variation of the indices indicate that this is necessary. Tests are relative to the clusters which they are intended to delineate, so we should speak of structure-referenced tests.

Clustering methods can combine or synthesize separate factors into a whole, based upon empirical relationships between the factors. The clustering method used by Campbell (1966) and Haynes (1970) used the B-coefficient of belonging to a cluster and a computational method that maximized this value of the B-coefficient. Clusters are formed on the basis of changes in this statistic. The two variables that have the highest intercorrelation in a matrix are clustered first. Then the computer program searches the correlation matrix to find the variable that has the highest correlation with the first two and clusters that with the first two. A B-coefficient is them computed both of the average intercorrelation of the first three variables and also the B-coefficient of the next possible variables for clustering. The B-coefficient is used to cluster variables on the basis of the empirical relationships between the variables.

This is a great advance, similar fundamentally to the concept of synthetic validity (Lawshe & Balma, 1966). The most that factorial validity can provide is a list of factors of often dubious replicability with the amounts of variance that are accounted for by the factors. It can, using assumptions, indicate the loadings of factors on variables. But there are many problems and difficulties embedded in these products and there is no way of building the separate factors and variables into

a whole. Gaps in understanding can be bridged only by inferences that are as questionable as the assumptions upon which they are based. But the clustering methods provide means of synthesizing the structures of the criterion and of the portions of the criterion that are embedded in predictor variables on the basis of the empirical relationships between them. The structures of dependent and independent variables can then be examined and compared as a whole.

Here is an extremely valuable means with which to group together variables that are adventitiously observed, perhaps by some rationale that is an approximation to the actual reality of the criterion or dependent variable domain. The cluster analysis can answer a question that factor analytic methods were intended to answer, but in fact cannot. "What is the real structure of the criterion domain?" Then, what the clustering method succeeds in presenting the hierarchical structures to the perceptions of the investigator, the investigator can ask himself the essential question "What construct can explain better this structure?" With this question and the data of cluster studies, theories can be improved.

With improved theories and constructs, better experiments can be planned, better tests can be constructed to yield more and better information and the pace of experimental advance can be accelerated.

In the event that it is found helpful or necessary to distinguish during cluster analysis between variance that is due to cluster class variation and quantitative change within clusters, then it is possible to rotate multidimensionally in order to separate the subspace of classes from the subspace of quantitative variation (Degerman, 1968).

Through experiments and cluster analysis of the data that are obtained, it is possible to determine the cluster structure of the criterion and the proportions of variance that are associated with each cluster. Through the quantitative changes in the indices that have already been discussed, it is possible to assess the adequacy of tests that are used to observe the criterion domain.

It is even possible to use clustering methods to measure the development of an individual student's structure of intellect and personality. This approach could be used to literally personalize instructional methods because the method can assess an individual's deviations from his own pattern of behavior as well as from a normal pattern (McQuitty and others, 1970). To accomplish this, tests of achievement and structural development would be administered to individuals and the results would be treated in each individual case as measures of the individual's criterion domain. Then, using indices like those devised by Campbell (1966), the contribution of each course or course segment to the development of the criterion domain could be assessed. Then the purpose of evaluation could be changed. Each student, instead of being required to conform to an imposed outward criterion or standard could be required to develop his own personal structures, with criteria emphasizing both differentiation and integration of the criterion structures. In that event, clustering methods could be used to aid students to complete the development of their own particular structures, simply requiring them to complete the development.

Applications to Educational Quality Assessment

To validate EQA tests, the suggestion is to use them as measures of independent variables. Condition variables should also be used as independent variables. These suggestions are in harmony with the recommendations of Werts and Linn (1970), in which they suggested that final status variables should be used as dependent variables and initial status variables should be used as independent variables.

The primary question then is "How can the global criterion(a) be partitioned?" This question has already been resolved by John P. Campbell (1966), who proposed the use of hierarchical cluster analysis to break down or partition the global criterion variable of Grade Point Average. Campbell used data from a set of 20 core courses and 406 engineering students. Indices of relative cluster independence, homogeneity of clusters, predictability of clusters and psychological meaningfulness were evaluated to determine if the contribution of each course to the global criterion could be assessed, which tests were effective, and the cluster configuration of the criterion domain. The Holzinger-Harman cluster analysis method was compared to principal components factor analysis with Varimax rotation. The results indicated that the cluster method was superior to the factor analytic method, weak tests could be identified by the cluster method, the cluster structure of the criterion could be specified and the contribution of each course to the formation of the cluster structure could be assessed.

If Campbell can partition successfully the global criterion of GPA by means of cluster analysis, then it should be methodologically

feasible to partition the global criterion domain of the EQA tests. If similar indices are incorporated into the computer programs, it should also be possible to accomplish the same methodological aims of Campbell: identify weak tests, specify the cluster structure of the criterion domain, identify and perhaps quantify the contribution of each course to the formation of the cluster structures, etc.

Hierarchical cluster analysis can provide evidence that is relevant to at least four significant questions regarding EQA methodology:

1. What is the cluster structure of the data obtained from the use of all EQA instruments? What is the structure of the goals of EQA? How many goals, i.e. clusters are there?
2. Can assessment be done with fewer instruments?
3. How adequate are individual EQA instruments as measures of goal structures?
4. Is the linear regression growth model adequate?

The output of computer programs that use cluster analysis is the actual number of clusters that account for the common variance in the EQA instruments. These clusters are precisely the structures of EQA goals. The EQA tests should be regarded as predictor tests of the criterion domain and the clusters that are obtained by analysis are the actual goals that are observed by the instruments. Thus the cluster analysis method provides a means of evaluating the existing formulation of EQA goals, as they are implemented by the EQA tests. Are the goals independent? The results of analysis should answer this question, just as it could answer the question regarding the relationships of every other goal to each goal. This is an exceedingly valuable means of evaluating the goals of EQA as a whole and in relation to each other. Cluster analysis can show the relationships of goals of EQA.

The output of the cluster analysis could show, in an R^2 statistic, the amount of variance that is associated with each cluster. The sums of the common variance of each cluster would account for most of the common variance that is associated with the EQA tests. Then it is possible that one or more tests could be eliminated from the EQA battery, still accounting for a known amount of common variance, while saving costs of test administration and data processing.

The adequacy of and contribution of each EQA test could be assessed quantitatively by observing changes in the indices that have already been mentioned. Tests that are weak or inconsistent in their place in the EQA test battery can be identified. Then they can either be improved or excluded. Thus cluster analysis can provide means of continual improvement of the EQA test battery.

If the progress of change in criterion cluster structures can be followed through the grades by means of the EQA battery, as it can be through cluster analysis, then the actual rate of change of each cluster can be measured. This observed rate can then be compared to the assumed or guessed linear model that is now used in the regression equations of EQA. Is the linear model applicable? The cluster analysis can perhaps be adapted to answer this question by empirical data and empirically-based computations.

In the case of a goal, e.g., creativity, is the growth rate in this goal area linear? In view of the fact that the complex Structure of Intellect Model of Guilford and the tests implementing the model are relevant to this goal area and have been used to validate shorter tests

of creativity, it is probable, in this writer's view that the linear model does not apply to criterion domain.

The method of hierarchial cluster analysis has potential to obtain empirical evidence that is relevant to at least four basic questions of the EQA assessment program. Experiment and development of the proposed methodology is suggested.

Suggested Multivariate Strategies and Methods to Improve Education

The purpose of this chapter is to suggest the use of multivariate strategies and methods for the use of group tests for quality assessment of schools. Suggestions are made, not in lieu of, but in addition to existing methods to improve the developmental uses of the tests. Suggestions are limited to the developmental uses of tests.

Multivariate methods consider variables together in combination as systems (Cooley and Lohnes, 1962). They furnish strategies for systematic investigations of combinations of variables, research questions and the selection of statistical techniques. Problems are resolved in a sequence of strategies, questions and techniques that has undergone considerable development.

If the multivariate strategies are not used, then the sequence of problems is unlikely to be resolved by univariate methods. Then observed differences in goal test means can be attributed logically to other sources than the criterion behaviors, e.g., differential responses to items of males and females, grade levels, socioeconomic levels, etc.

Multivariate strategies provide systematic means for dealing with essential questions. They are suggested to deal with the following research questions that arise in the use of group tests for developmental purposes:

1. Do test items provide differential stimuli for various groups: males and females, grade levles, socioeconomic levels?
2. Do tests discriminate between criterion groups?
3. Are there developmental changes in criterion group goal means that are attributable to changes in the quality of schools?

Multivariate strategies provide systematic methods with which to deal with these questions. Indeed, they are the origin of the questions and the sequence with which they are resolved by experimental and statistical methods. The statistical methods are chosen to fit into the strategies of multivariate assessment.

Question 1

Before it is possible to infer logically that differences in goal means are due to criterion behaviors, it is necessary to deal adequately with alternative hypotheses. Changes in goal means may be due to the fact that test items constitute different stimuli to various groups in the criterion group. Males may respond differently to the same test item than do females. Students from middle class homes may respond differently to the same test items than do Negro students from lower income levels. In that event, the factor structure of the group tests will differ for each group that is tested.

The Multivariate Analysis of Variance (MANOVA) provides a convenient and effective means of dealing with this problem. The test of the H_1 hypothesis resolves this question through a test of the equality of the group dispersions. If the null hypothesis is accepted, then the variance-covariance matrices of the groups do not differ significantly and the factor structures of the matrices are similar for all the groups. Equality of variance-covariance matrices is a sufficient condition for equality of factor structures (Stewart and Ronning, 1964, p. 51). If the null hypothesis is rejected, then differences in goal means of criterion groups may be due to differential responses of one or more groups to the

test items. In either event, essential information is obtained through the use of the MANOVA program. The first step in the statistical analysis of group data should be the use of MANOVA to test the H_1 hypothesis.

Question 2

Before it is possible to infer logically that differences in group goal means are due to developmental changes in criterion behaviors, it is necessary to determine if it is reasonable to suppose that the multivariate differences, taken as a whole, are statistically significant. Even if one or more goal means are observed to be in the expected range for a significant difference, as forecast by multiple regression equations for each goal area, the question still remains to be answered: how many goal areas have to be significantly different before one can conclude that there is a significant difference in the multivariate combination?

MANOVA provides a convenient and effective means with which to deal with this problem. The test of the H_2 hypothesis provides a test of the equality of the group centroids, where the groups in question can be organized to be the criterion groups. If the null hypothesis is supported, then the inference would be that the battery does not discriminate between the criterion groups. If the null hypothesis is rejected, then the inference would be that the battery does discriminate between the criterion groups.

In the event of rejection of the null hypothesis of H_2, then it is logical to proceed with further multivariate analyses to determine the nature of the differences.

In summary to this point, it has been suggested that multivariate methods provide strategies and methods with which to attack systematically

the problems of developmental assessment of schools. The test of the H_1 hypothesis of Cooley and Lohnes, (1962), is needed to screen alternative hypotheses for differences in goal means; these are due to differences in group responses. The test of the H_2 hypothesis is needed to determine if the tests discriminate between criterion groups. Only if the null hypothesis is accepted for H_1 and it is rejected for H_2, is it logical to use a statistical method to analyze differences in goal means. MANOVA provides quick and effective means with which to solve the problems.

Question 3

Assuming that H_1 is accepted and H_2 is rejected, then it is logical to proceed to identify the nature of differences in group means in goal areas.

The multivariate procedure that appears helpful is the Multiple Discriminate Analysis (MDISCRIM). Chen (1967) explained the discriminant function in the following manner:

> In a real sense, discriminant analysis is the multiple regression technique with a different purpose. Whereas in multiple regression the purpose is to seek a composite score (predicted score) that is a linear function of several independent variables such that it has maximum predictive power for a given group, in discriminant analysis the purpose is to seek a composite score (the discriminant function) that is a linear function of several independent variables such that it can best differentiate two groups. In either case, the problem is to find the proper coefficients (weights) for the independent variables such that the composite score is functionally optimal.

The multiple group discriminant model has characteristics that make it useful with group tests of pupil development. The criterion variable can be categorical, i.e., nominal, so it can be used with grade levels

or different schools as criterion groups. It provides a means of testing whether differences between criterion groups are significant and it can show the nature of the differences, i.e., the goal areas that account for the differences.

The battery of group tests could be administered to the same subjects in 5th grades and then in 7th grades, or it could be administered to the 7th grades in different schools or the same school every time, i.e., to different Ss. In either event, two (or more) sets of scores would be obtained, i.e., a set for each criterion group.

The differences between the groups could be determined by computation of the discriminant function. MDISCRIM projects a line (the discriminant function) between the criterion groups to maximize the separation and the line intersects with an axis in the discriminant space in such a way that the intercept is the discriminant score. This score reduces the nine total scores of the battery to one score which can be interpreted by means of Wilks' Lambda. If Lambda is significant, then there is significant separation between the groups. The program also determines if one or more discriminant functions are needed to interpret the data.

If one or more significant discriminant scores are obtained, then the nature of the differences between the groups can be determined by examining the group mean vectors, the scaled discriminant vectors and the group centroids (Cooley and Lohnes, 1962, p. 119). The largest values of the scaled discriminant vectors indicate the significant contributors to the discriminant functions. Detailed analysis of these features would identify the precise features that account for differences in group means. Since

alternative hypotheses have been screened out through the prior use of the above-mentioned multivariate strategies, then observed differences in group means might be interpreted as changes in criterion behaviors.

Group Test Development

Group tests that are used to monitor educational development in multiple goal areas face a series of problems and questions that can probably be resolved by multivariate strategies and methods. Each problem contains an alternative hypothesis for any change in criterion group means. The course of test development should be seen as a series of processes that are undertaken to deal with these alternative hypotheses in order to qualify each test item for service as a criterion measure.

Test items should be qualified through the same multivariate strategies with which they are used as a criterion measure. These strategies are used to deal with specific problems.

The Problem

Test development should deal adequately with each of the following questions:

1. Do test items provide different stimuli for different groups in the population?
2. What criterion(a) should be used to select test items? What scores do items make on each criterion?
3. Does the test itself discriminate between criterion groups?
4. Based upon previously discussed concepts of cluster, i.e., factorial validity and structure referenced tests, what is the cluster structure of the item domains of the battery? How many clusters account for the common variance? What is the adequacy of each test item as a measure of cluster structure?
5. Can individual student differences be determined with respect to the goal areas?
6. How can group tests be validated?

The test developer will devise his multivariate methods to deal with each of these questions.

Question 1

Assuming that data are available from an adequate sample of the criterion and other groups, MANOVA will be performed. The purpose of analysis will be to test Cooley and Lohnes' H_1: the equality of the variance-covariance matrices of the various groups. If the null hypothesis is accepted, it will be inferred that the group dispersions are equal. Factor structures of the test items are essentially the same for each of the groups that might offer an alternative hypothesis as already discussed. In that event, further analyses would be indicated. If the null hypothesis is rejected, then the statistician would infer that the dispersions are not equal, and the test items do in fact provide differential stimuli for males or females, grade levels, socioeconomic levels, etc. Then the meaning of test scores differs from group to group, depending upon the idiosyncratic factor structures of each group. To continue the analyses of criterion behaviors, the group with the idiosyncratic data might be removed and further work might proceed if the null hypothesis was supported for the balance of the data with the exclusion of the offending group.

To improve the test items, the test developer would examine the analysis closely to determine which group was the origin of the differences observed. Then test items would be reviewed or new alternatives would be used until a similar analysis did not result in rejection of the null hypothesis. After development, the test developer will obtain data in which the null hypothesis for H_1 is accepted. In that event, the factor structure of the test items is similar for the

groups tested, within the range that can occur by chance alone. Observation of this condition qualifies the test items for assessment according to the next question.

Question 2

Does the test discriminate between the criterion groups? Again assuming that the experimental design has provided for obtaining data from the administration of the experimental battery to an adequate sample of the various groups, the statistician will proceed to test Cooley and Lohnes' H_2 using Wilks' Lambda. The test of H_2 deals with the statistical question "Are the group mean vectors (group centroids) equal?" Failure to reject the null hypothesis would mean that the test does not differentiate between the criterion groups. The test does not have adequate validity, so other test items must be discovered.

The test developer would then ask, "What criterion can be used to select discriminating test items?" To select discriminating test items, the index of Menne and Tolsma (1971) may be useful.

$$I = 100 \times \frac{\text{Between Groups Sums of Squares}}{\text{Total Sums of Squares}}$$

The significance of the index is tested using the table of F. Systematic application of this index may result in improvements in the discriminating power of test items. Discriminating items have a high ratio of between sums of squares (criterion groups) to the total sums of squares. The use of this index is conjectural at the present time.

Question 3

After systematic application of several indices of item performance, a revised test is administered as before and the data are obtained from

criterion groups. Using MANOVA and testing Cooley and Lohnes H_2, the test developer finds that the null hypothesis can be rejected. This result qualifies the experimental test for the next question.

Question 4

What is the cluster structure of the battery? How many clusters account for the common variance? What is the adequacy of each test item as a measure of cluster structure?

Since the multivariate strategies and methods that are used to deal with these questions constitute the means with which the criterion domain of education, whatever it is, is identified, controlled and measured, the means of dealing with these questions are critical. The purpose of the statistical methods is to identify the cluster structures that will provide the equivalent of Guilford's factorial validity. It is with reference to these structures that the meanings of each test item and the battery are interpreted.

The wisdom of Guilford should be used to guide the selection of the multivariate strategies. The first principle is to select each test item for its contribution to the total structure that is assessed by the battery as a whole. The second principle is to maximize both the reliability and the validity of the battery. Cluster structure variance, i.e., systematic as distinguished from error variance, is the source of validity. To increase validity, heterogeneous test items should be added to a battery, items that share common variance with the complex criterion domain. To increase reliability, a test must be homogeneous. But no one test can be both maximally valid and reliable. The solution to this problem is to strive for factorially, i.e.,cluster homogeneous tests

and cluster heterogeneous batteries (Guilford, 1956, p. 426).

Multivariate statistical techniques should be selected to accomplish these principles.

To implement the first principle, the experimental battery should be factor, i.e., cluster analyzed as a whole. It is only recently that computer programs and computer technology have advanced enough to do this. There are more than 500 test items in the quality assessment battery and this large number of items taxes the capabilities of the technology. Matrices as large as this have been factored rarely and unexpected results can be obtained. Sells and others (1970) selected 600 test items embodying the most stable factors that have been identified by Cattell and Guilford. There was a principal component analysis of the 600x600 matrix with 18 factors identified for one rotation and 15 for the second rotation. Varimax and promax methods of rotation were used. Results indicated that almost all of the Guilford and Cattell factors converged into only 18 promax factors. Analysis at the item level with 600 variables was very destructive to factors previously assembled without regard to their loadings in large matrices. The remaining variance was distributed among a large number of minute specific factors and error. A clear need was reported to reclassify at least 400 items. Based on these results, the number of test items that is required to measure the Guilford and Cattell factors could be shortened to one-third of the original number.

Convergence as in the above example would not be unexpected when an adequate cluster analysis of the quality assessment battery is performed.

Tryon's V Analysis, B.C. TRY program should be used as an approximation. This is part of a group of computer programs that can construct sets of

120 test items as samples of the test item domain and perform the V Analysis upon each set of items. Results should be used to select test items for the experimental battery.

The objectives of V Analysis are as follows: (1) identify clusters that capture all the systematic general covariance of the test items, (2) select homogeneous subsets of test items that are observable representations of the basic clusters, (3) describe the statistical properties of the clusters, (4) construct a geometrical description of the cluster structures (Bailey, 1970).

V Analysis selects for each cluster a key or pivot variable with the largest covariance (Σxy) and then selects a subset of mutually collinear variables that are collinear with the key variable. (Collinearity clustering selects variables on the basis of proportionality of patterns in score profiles, in contrast to proximity or distance clustering methods.) After each cluster is discovered in this matter, the cluster is defined as a linear composite with equal weights of the variables in the cluster and the length of this line varies. Cluster homogeneity is insured by setting lower limits on the mean collinearity that is acceptable for a cluster definer.

The results of the V Analysis include the number of clusters that are defined by the responses to the test items. This number should be considered as an approximation, for reasons that will be considered later. It is a desirable and useful approximation.

The Cluster Structure Analysis (CSA) component of B.C. TRY computes the reliability with which each cluster is measured. The contribution of each test item to this reliability is computed sequentially.

The validity with which the observed clusters measure the estimated cluster domains is computed. Hypothetical clusters, perfectly reliable and collinear with the centroids of the observed clusters are called cluster domains. Correlations of the cluster composites with the estimated domains indicate the validity with which the cluster composites estimate the domains.

The degree to which each cluster composite accounts for the correlation matrix is computed by CSA. One measure is provided based upon the actual correlations accounted for by each cluster and the other measure is based upon the communality of the variables accounted for by each cluster.

B.C. TRY computes the communality of each variable to the third decimal place. Cluster analysis is similarly exact, according to the authors. Investigators who are used to the factorial instability of principal components analysis will find it necessary to change their expectations. Unlike principal components analysis which factors error variance and common variance by a maximizing least squares method and inserts large amounts of error into communalities by assuming unity in the main diagonal, the key cluster method of B.C. TRY partitions only common or systematic variance. The factorial instability of principal components is inherent both in the inefficient method and in the presence of large and unknown amounts of error, but the key cluster method is both more efficient and it deals only with common or systematic variance. In addition to this, none of the seven or more indeterminate questions and problems that is essential to factor analytic methods (Weiss, 1971) need be confronted. While it may be true to some degree that principal components (and other methods of factor analysis) have achieved some common acceptance, this is only a

kind of acceptance that is based upon rather common usage. Factor analysis has never been validated scientifically, according to Tryon (1935, 1958), and Campbell (1967). In contrast to the approximate and indeterminate methods of factor analysis, Cumulative Community Cluster Analysis (CCCA) is exact (Tryon, 1958).

B.C. TRY can be useful to select test items for homogeneous tests and a heterogeneous battery. The test items that measure a cluster are identified and the exact contribution of each item to measurement of the cluster is specified in indices that vary quantitatively. Tryon (1966) used B.C. TRY with Minnesota Multiphasic Personality Index data. The SAMPLER component program selected sets of 120 variables, i.e., test items for analysis. Four principal clusters were identified and plotted geometrically. Only 192 test items were found necessary to assess the cluster structure of the test as a whole. About 220 items measured particular behaviors that did not cluster with any domain of the test. The balance of the items amounted to "noise". The adequacy of a test item is reported as a cluster domain validity score, i.e., a correlation of the item with the domain. Thus the V Analysis of the B.C. TRY system will determine the cluster structure of a battery and the adequacy of each item as a measure of the cluster.

B.C. TRY can be used to select the minimum number of test items that will measure a set of clusters. The results of analysis will indicate the exact amount of error and validity with which each cluster is measured and the intercorrelations of the clusters. This can be done with batteries of items exceeding 500. As mentioned in the above paragraph, the capability of B.C. TRY for battery construction has

already been successfully demonstrated in the MMPI analysis. Using B.C. TRY, a reliable and valid battery can be selected for quality assessment. The battery would have a minimum number of items and known amount of error and validity for the measurement of each cluster domain.

The use of B.C. TRY is suggested because the computer programs that are capable of identifying the hierarchical structure of the battery, i.e., smallest space analysis programs, do not have (so far as is known to this writer at this time) the capabilities of B.C. TRY for battery construction. The item cluster indices are not available, so both types of programs should be used to resolve the problems for which each is suited.

Tryon's CCCA method is probably a significant advance beyond factor analytic methods. It computes communalities exactly. It does not deal with error variance, only with common variance. It specifies the amount of error with which a cluster is measured. It does the same for validity and none of these contributions is available at present from principal components factor analysis. The exact contribution of each test item to measurement of a cluster is given and none of the seven or more indeterminate questions and problems that plague factor methods is vital to the CCCA method. Surely it is better not to have a half-dozen indeterminate questions involved in the structural analysis of a battery. So long as these are indeterminate, the structure that is computed is indeterminate and the reliability and validity of the measures is really indeterminate. Indeed, factor analytic methods do not at this time specify the amount of error that is involved in a factor loading and the principal component method probably can never

do so because error is inserted into the common variance when communalities are assumed at unity. Reliability of a test is reported globally, not as reliability of cluster measurement, but as reliability of the entire test, so Tryon's method appears to be a considerable advance over principal components analysis in being more exact, giving more statistical information and in quantifying both error and validity of cluster measurement. It succeeds in doing what principal components purports to do but does not do: it partitions common variance into clusters. Principal components partitions both error and common variance, but the amount of error in a factor is unknown and perhaps unknowable. Therefore, Tryon's CCCA method is indicated in preference to factor analytic methods for the purposes of selecting homogeneous tests and a heterogeneous battery for normative type quality assessment of schools.

Tryon's CCCA method is not a complete or final answer. Guttman (1954) pointed out that Tryon's cluster analytic method resembles his own smallest space analysis techniques (SSA), but would probably fail to cluster a simplex correctly, i.e., some clusters that rightfully belong together might be falsely fragmented into one or more extra clusters because of the gradient in correlation coefficients. In addition, the order information that is present in types of hierarchical structures would not be adequately portrayed. Still, Tryon perceived correctly that the problem of analysis should be formulated in terms of dimensional analysis. This perception culminated in a computational breakthrough by Shepard (1962) which accepts ordinal type data, i.e., rank order, preferences, similarities, etc., and outputs ratio type monotonic functions for nonmetric

multidimensional analysis. This contribution stimulated a number of investigators to produce computer programs for a variety of purposes.

This contribution of Shepard's has been used by Guttman and Lingoes to produce groups of computer programs that use a facet theory of content of test items and a radex theory of hierarchical order of variables. The SSA programs of Guttman and Lingoes should be used to determine the hierarchical structure of the battery of quality assessment tests.

In contrast to the common factor approach of Spearman and others, Guttman proposed order factors. These embody rank orders of variables in a correlation matrix. One type of correlation matrix is the simplex. This matrix has the largest correlation coefficients in the cells adjacent to the main diagonal and the size of the coefficients decreases as one inspects closer to the upper right and lower left corners of the matrix. A circumplex has the largest coefficients adjacent to the main diagonal and they decrease as one inspects toward the same corners and then increase at the corners. A radex can be of many dimensions, but in its simplext illustration, it is a simplex and a circumplex varying together. In the latter case, it has only two dimensions, varying, e.g., along dimensions of process and complexity.

Kropp and Stoker (1971) reasoned that if the Bloom cognitive taxonomy is hierarchical in structure and the right kinds of taxonomic type tests were constructed to sample the hierarchy, then there should be observed a radex structure with variations along a process and a

complexity dimension. Accordingly, they constructed tests to measure the six levels of the cognitive taxonomy. Each test, which consisted of 20 multiple choice questions, was used with grades 9 through 12. Results were computed by the SSA-I program for each grade and for all grades and the computer plotted the structures assessed by the tests. All five graphs gave evidence for a radex; a set of concentric circles with comprehension, application, analysis, synthesis and evaluation in that order.

It appears that the radex structure is a unit of behavior that is observed over a wide variety of human activities. It is applicable whenever there are differences in kind and in degree. Guttman (1954) said that radexes were based upon two very elementary laws of functional interdependence of variables: contiguity and combinability--separability of elementary components. When other laws apply to human behavior, then multidimensional radexes or other types of structure must be used to portray the relationships.

However, when these laws apply, the radex theory can be of great benefit in the development, use and evaluation of a quality assessment test battery. Guttman suggested that better predictions can be made with shorter tests. Theory helps the investigator to sample variables and to predict order structures from a given sample of variables to new variables of the same design. For example, behaviors of addition, subtraction, multiplication and division differ largely in the degree of complexity. This set of variables is a simplex and the tests can be arranged in a simple rank order from least to most complex.

Correspondingly, tests of the same degree of complexity will differ among themselves only in the kind of ability they define. Different

abilities such as verbal, numerical reasoning, etc., form a circular order of complexity and the matrix is called a circumplex. Kellerman (1968) used a theory of personality that suggested that personality traits can be conceived as mixtures of eight primary emotions. Twelve personality trait test items were selected to represent the trait universe. These were paired in all possible combinations for form 66 pairs of polar opposites and used as a self report personality test with adult women. A circumplex was obtained, suggesting that personality traits were adequately represented in terms of structure. Test-retest reliability was above 0.90.

Carson (1970) suggested that a two-factor circumplex of love-hate and dominance-submission accounts for the variance in social interactions.

It is suggested that the radex theory can be used in several ways to aid the construct validation of the ten goals of education, to provide for adequate range in content (process) and complexity for each goal test(s), to improve the reliability and validity of tests, to shorten the tests, to provide an empirical means to evaluate hierarchical structures of educational objectives and to guide the research methods with which the goal structures are identified and measured.

Research Methods

Kellerman (1968) held complexity of personality constant and varied content. The result was to identify a circumplex. This procedure can be used to identify circumplexes in each of the goal areas of quality assessment. Tests would be developed at one level

of complexity with varied content.

Simplexes can often be isolated by holding content of abilities constant and varying complexity, as in tests of addition, subtraction, etc. This procedure could be used to identify simplexes in each of the goal areas of quality assessment.

At least two different item types must be used to assess each goal area. One is taxonomic type multiple choice item that is suitable for assessing levels of complexity and the other is an ordinal type item that is suitable for assessing content or process in a goal area. Examples of these items are reported in the research literature.

An example of the taxonomic type tests is reported in the work of Kropp and Stoker (1966). The data in which a radex was found were from that study. The tests used were entitled "Atomic Structure," "Glaciers," "Lisbon Earthquake," and "Stages of Economic Growth." Tests of the first four levels of the taxonomy contained 20 multiple choice questions. Each synthesis test consisted of five free response questions scored zero to four. Each evaluation test consisted of 10 free response items, scored zero to two. A maximum of 20 points could be earned on a test. The multiple choice items consisted of two parts. The first part was a reading passage which could be read and referred to at any time. The second part (in the final form) consisted of 20 multiple choice items for each level of knowledge, comprehension, application and analysis.

Item development was very difficult and it proceeded on an eclectic approach. Of the three alternatives open to the investigators-select previously learned content, teach the content prior to administering

the test and to provide the content with the test—the latter was chosen. It proved very difficult to find published reading passages that met the requirements. Similarly, random presentation of test items proved impracticable, so it was decided to present all items of each level at one time, beginning with knowledge and knowledge items were ordered according to the appearance of the answers in the reading passage.

The development of taxonomic type tests in which a radex can be found is probably the most difficult of all the various types of tests that have been mentioned in this paper. The practice of writing all items at one level first and then proceeding to the next higher level was discarded in favor of writing one item for each level on a round-robin basis. Items were entered into the item pool for each level on the basis of item analysis from preliminary forms, student's comments and proctor's observations. Items were discarded which failed to correlate with the subject of which it was a part or in which a technical deficiency could be identified through the above sources.

Taxonomic type tests could be developed to assess each of the radexes that belong to each goal area. Radex assessment should be made the basis of assessment of each goal area when the nature of the laws governing the goal behavior permit. If the criterion behaviors are observed as radexes, then there is some assurance that the test battery possesses adequate range in content and complexity for the goal area. On the other hand, if the best efforts at goal assessment in an area fail to detect that goal behaviors possess adequate range to be observed as a radex, then this would be evidence that the goal

area may not be formulated in large enough terms to be worthy to be a statewide goal of education. One or more radexes should be assessed in each goal area to qualify the goal as worthy of assessment.

Emmerich and others (1971) used a taxonomic research design that may be quite useful for development of the battery of group tests. To resolve the experimental problems of measuring the differentiation and development of social norms, a taxonomy of normative differentiations was used. The taxonomy considered four facets (excluding the self): sex of the source of behavior, (male vs. female), generation of source (parent vs. peer), sex of object (male vs. female), and generation of object. Subjects (3rd through 12th grades) judged the normative importance of statements differing in behavioral content (agree with other, help other, argue, etc.). The taxonomic strategy of classifying sources of action, generation of source and objects according to sex and generation was highly successful in isolating prominent bases of normative differentiation and development.

Similarly, Tuckman (1968) used a strategy of classifying subjects according to their level of conceptual functioning and successfully related personality variables and satisfaction with occupational choice. Satisfaction among concrete dependent subjects was related to the size of the actual ideal discrepancy on security and structure, among concrete independent subjects satisfaction was related to the discrepancy in self-expression, among abstract dependent subjects satisfaction was related to the discrepancy on social contact, esteem, autonomy and self-expression. There was no

relationship for abstract independent subjects with satisfaction with occupational choice. Subjects completed the Interpersonal Topical Inventory.

Fruchter and Fleishman (1967) suggested a simplicial design that should be useful for assessing the relative importance of curricular components for achievement of learning objectives. This is a trials by measures research design with several independent measures of learning for each trial. This design permits inferences on the relative importance of different components of task performance at different stages of learning. This design would contribute to developmental uses of the group tests.

The facet theory of Guttman can be used to construct tests that hold complexity constant and vary in content or process. If the facet theory for construction of distractors says that figures are used in the distractors and the figures vary according to four facets--shape, size, orientation and place--then distractors can be constructed systematically. The resulting test items yield information that cannot be obtained by dichotomizing answers into those that are correct or incorrect or by items that rank responses from most to least. Rather, distractors can be constructed on the basis of different degrees of difficulty and on the basis of kinds of errors. The method of construction of distractors calls for varying the distractors in every possible combination within a test item that consisted, in an example, of a three by three matrix of small squares. Distractors appear in each of the eight squares and the correct answer is supplied in the empty ninth square by the subject.

Using the SSA-II program, it is possible to assign a score for each type of error that is made systematically by the subject. A student's profile of error scores can tell not only how much content achievement a subject has made systematically in a given area, but also what are the typical errors he makes. This kind of information can be useful for diagnostic, remedial and developmental purposes. In addition, there are significant advances that make for tests of shorter length and increased reliability:

1. "Successful prediction of relative empirical difficulties of distractors,"
2. "Reduction of variation in test results due to undesired factors,"
3. "Possibility of differential scorings of subjects on the types of wrong answers to which they are attracted."

To apply this principle of facet design to the selection of distractors for a typical item on an arithmetic test, the distractors can be developed according to the following facets:

1. application of wrong formula,
2. copying a number appearing in the question,
3. a number close to the correct answer
4. other

An example was given (Guttman and Schlesinger, 1967).

Smith (1968) reported a type of multiple choice test item that might be useful for isolating simplexes. To use the taxonomy in the area of the physical sciences, the attempt was made to hold content constant and vary complexity according to the taxonomy. Eight multiple choice items were presented that built logically upon each other so that each succeeding item requires all the knowledge and

processes of the item preceding it and a little more. Reliability of item sets appeared to be satisfactory.

Kellerman and Plutchik (1968) used a type of test item that can isolate a circumplex. The item holds complexity constant and varies the type of content or process exhaustively. Eight primary emotions were conceived as polar opposites on the rationale that personality traits can be conceived as mixtures of the eight primary emotions. Using a taxonomy of trait terms, all possible combinations of trait items were selected to obtain a self report instrument of 66 pairs of emotions. A circumplex was obtained.

Guttman scales and multiple scalogram analysis can be useful to identify the nature of the dimensions of a goal area. Krause (1966) reported a type of dichotomous monotone test item that provides for convergent validity as Guttman scales do not. Data obtained by use of the scale (an example is given) can be used with multiple scalogram analysis of the Guttman- Lingoes programs. These items can be designed to assess some unidimensional attribute and the relative degree to which this attribute is present in the dimension that is observed. Results can be depicted as the core of a radex centering on the first principal axis or scale vector.

Determination of Simplex, Circumplex and Radex Structures

The actual cluster structure of a battery of tests should be determined by the use of one of the SSA programs of Guttman and Lingoes. Programs are available for both rectangular and square matrices.

Several rather new ideas are embodied in these programs. Instead of finding communalities which reduce rank to a minimum, the authors

suggested determining the smallest space that was consistent with minimizing a stated loss function such that derived theta coefficients are a weak monotonic increasing function of the rank orders of the correlations or covariances or real numbers of similarity or proximity. If this suggestion is made the basis of analysis, then the task is to find a solution which is order rather than metric preserving. The SSA programs reduce any real symmetric matrix to Gramian form having rank equal to dimensionality under the sole restriction of preserving the order among the correlations (factor analysis is rank reduction of a matrix).

The SSA programs do not produce statistics that aid in battery construction. They do accomplish two essential contributions. They reduce the rank of a matrix and they map the data. All SSA and SSAR programs appear to produce a simplex, circumplex or radex if the structure is in the data. They use different bases to accomplish this and some are faster than others. SSA-II is seven times faster than the improved I (Lingoes, 1965). All map from data space to a representational space. For SSA-I, a ranking function provides the basis for mapping. For SSA-II and-III, Guttman's rank image principle provides the basis for mapping. For SSA-IV, Guttman's absolute value principle provides the basis for mapping (Lingoes, 1968). There is a coefficient of deformation which is minimized to reduce the rank of the matrix. There is also a coefficient of alienation which is minimized. This refers to the spread in the scattergram that is mapped; a zero coefficient of alienation would indicate a perfect fit to simplex, circumplex or radex structure.

The use of the SSA computer programs is suggested for the purposes of determining the empirical cluster structural relationships. If the criterion requirement was set for each goal area of obtaining radex structure, then there would be some assurance that adequate range was provided in the goal test items for both content and complexity.

In addition, multidimensional scalogram analysis series and the conjoint measurement series of computer programs could be quite helpful for test development and research purposes.

Question 5

How can individual differences in students be determined in terms of the goal areas?

B.C. TRY has computer programs for O Analysis or object (subject) analysis. Clusters are identified by V Analysis and are plotted geometrically by component SPAN. Then subject's, i.e., student's scores on the cluster dimensions are simply the standard scores of the subject on the variables in the cluster.

Using the Condensation Method, a typology was produced of profiles of children in mental abilities: verbal (V), speed (S), form perception (F) and memory (M). Data were reported in an experiment with 301 children using 24 paper and pencil tests. Each child was described by his cluster scores on V, S, F and M. These four scores were used to form an orthogonal Cartesian space of four dimensions. An individual psychograph was given for several children in which four vertical axes gave individual profiles on F, S, F and M (Tryon, 1967). The condensation method clusters individuals in terms of their interspace differences where their cluster scores

are expressed as standard scores on each cluster with a mean of 50 and a standard deviation of 10. This same kind of individual profile could be obtained on the clusters assessed by the quality assessment battery, assuming test items produced clusters representative of goal areas. If the battery was administered at the beginning of the school year and again at the close of the school year, the changes in individual score profiles could be obtained through the use of component program FACS.

Component program OTYPE sorts subjects into sectors of cluster score space and component program EUCO computes Euclidean distances that are useful with component program SPAN which plots groups of subject clusters into geometric space in relation to the dimensional clusters that were identified through V Analysis.

Question 6

How can group tests for quality assessment be validated? Any formulation of state goals for public education represents an attempt to structure the criterion domain. Since the criterion domain of education has never been identified, the exact means to do it is unknown. Further, the real structure of the domain is unknown. How many distinct and independent goal structures are there? To suggest that the statement of goals should be validated does not detract in the least from the contribution of those who formulated the goals. On the contrary, scientific validation of the goals, the instructional programs and the means of evaluation is essential if the goals are to have any meaning or reality in the schools of the commonwealth. Until success is achieved scientifically, the statements of goals are only words that are

irrelevant to the realities of the classroom. That is, means must be found to operationalize the goals or the goals have no contribution to the schools.

Research programs should be planned to culminate in the identification of the criterion domain of public education, the validation of the statements of goals and programs with which the goals are achieved and of the tests and other means of evaluation. Problems of statistical analysis, test development, curriculum development and goal formulation can be resolved by the use of feedback from one program to another.

Validation of Individual Goals

Radex and facet theories can provide guidance with which to analyze experimentally the content of each statement of a goal. Lists of concepts, principles and processes should be prepared for each goal area. Lists should be rank ordered experimentally into ranges of processes and complexity. Tests should be constructed to identify the minimum number and kinds of simplexes and circumplexes that comprise a goal area. These tests will hold process constant and vary complexity and they will hold complexity constant and vary processes. If the work is done exhaustively, the results should be identification of the circumplexes and simplexes of the goal area.

As success is gained in identifying the circumplical and simplical structures, taxonomic tests could be developed to determine the manner in which the structures are combined into radexes in actual learning experiences in the classroom. Enriched classroom environments should be developed by teams of teachers that are known to be effective and the various kinds of circumplical simplical and taxonomic tests would be

used and improved in these environments.

B.C. TRY V analysis should be used to analyze the data gained by use of these tests. The cluster structures of the responses would be approximated and the item statistics would be adequate to select test items.

SSA programs of Guttman and Lingoes should be used to determine the simplical, circumplical and radex structures of each goal area. Taxonomies of learning objectives should be determined in each goal area, using taxonomic research designs like that of Emmerich and others (1971).

Criteria for validation of each individual statement of a goal might include the following:

1. specification of simplical, circumplical and radex structures from the analysis of test data,
2. specification of formal taxonomies of objectives in the goal area,
3. publishing tests and test statistics that are the basis of 1 and 2,
4. publishing curricular syllabi, specifications and activities that are detailed enough so that they can be used for pre- and in-service training of teachers that can elicit the goal behaviors in the classroom.

Normative philosophies of developing one single test or test battery for assessment of a goal area should be replaced with the philosophy of developing several means of measurement for any one radex, simplex or circumplex. The tests we need will be short (10-15 items), highly reliable and valid. As Campbell and Fiske (1958) pointed out, method variance must be segregated from trait variance so structures must be measured by several methods.

Validation Through Classroom Observation

The ultimate goal of classroom observation will be to use the data

as measures of the criterion domain in the course of test development. When structures of the domain are identified by statistical analysis, then homogeneous tests can be developed to assess each cluster structure of the domain. Thus a battery of homogeneous tests can be validated eventually with reference to the cluster structures of comprehensive classroom observation.

Research should be done with multidimensional interaction analysis to develop instruments and methods for classroom observation that are capable of detecting the many simplexes, circumplexes and radexes, etc. that constitute the global units of learning in the classrooms. As work proceeds in each goal area, insight will increase regarding the ranges of process and complexity that must be observed. Then new kinds of instruments can be devised that can cover the full ranges of process and complexity. These instruments should be tested in enriched instructional environments in which everything possible is being done to achieve every goal of education. Data should be gathered by sign and category systems of multidimensional interaction analysis.

Methods of statistical analysis of data from classroom observation should be developed to determine the structures of the criterion domain. The problems of statistical analyses have not been fully worked out.

Approximation to the structures of the criterion domain should be attempted by the use of B.C. TRY V Analysis. Several thousand variables that are used in classroom observation should be clustered directly. How many independent clusters actually occur? The goal of analysis will be to isolate one or a few clusters of which the content of the variables is clearly relevant to each individual goal of education.

If a cluster structure is identified for a goal of education, then the computer data cards with which the cluster was detected by V Analysis could be separated and analyzed by SSA to determine if a simplex, circumplex or a radex structure can be detected in the data from classroom observation. If a radex is obtained, this would constitute validation of the particular goal for the purposes of quality assessment. That is, the goal has been formulated in sufficiently precise behavioral terms that it has been used as part of the instructional processes of the classroom and it has been measured. In this example, validation means the goal has been operationalized in the classroom.

If a radex structure cannot be identified for a goal, then there are several possibilities. There may be no correspondence between the manner in which the goal is formulated and the methods with which it is learned in the classroom. This is an example of the present situation in much of education of which Gage and Bloom have spoken; a goal that is conceived in excessively global terms. In this instance, the goal must be stated in less global and more concrete terms. It is also possible that the formulation of a goal is not excessively global or otherwise defective: the instrument that is used does not provide enough range in process or complexity (or both) so that the structure cannot be detected. It is also possible that both a goal and an instrument might be adequate, but the instructional program has not been modified to initiate the behaviors in the classroom with which the goal is learned. An example might be found in valuing behaviors which are generally ignored. Another variation might be found in defective research design, e.g., sampling methods or taxonomic designs with which to separate categories of behavior in such

a way as to detect taxonomic behaviors.

Research should be done with multidimensional classroom observation until every goal has been validated in terms of observed cluster structure, using both the B.C. TRY and SSA programs. If no such structure can be detected after adequate use of all available techniques, the consideration should be given to obviating or revising the statement of the goal.

The product of adequate research through classroom observation will be comprehensive cluster structures, i.e., sets of radexes that have been identified in the data of classroom observation. These sets of structures constitute the structures of the criterion domain of education. Each goal of education would then be formulated with reference to the creation and development of each one of these structures with each student in the public schools of the Commonwealth, i.e., the objective reality to which the goal refers is its reference structure.

Validation of Group Tests

Group tests of individual goals should be validated as independent variables against the criterion structures that are found in classroom observation. Homogeneous tests should be assembled into heterogeneous batteries for the purpose of assessing the criterion structures, i.e., one test to measure one cluster and one battery to measure one radex. The question of the necessity of measuring each simplex and circumplex when each radex is already being assessed is left unanswered for the present.

B.C. TRY item statistics and SSA would be used for validation of group tests.

Summary

The structure of the criterion domain of education has been stated

in the form of ten goals for the Commonwealth. Since the nature and structures of this domain have never been identified, the exact means to validate the goals, programs and tests are unknown. Suggestions are given with which to deal with problems of test development, statistical analysis, curriculum and goal formulations.

Among the suggestions that have been made are the following:

1. Multivariate strategies with which to identify questions and sequences of questions to be resolved by multivariate methods.
2. Multivariate statistical methods to deal with questions in test development and administration in quality assessment: MANOVA, MDISCRIM and cluster analyses.
3. Use of principles derived from Guilford for test construction.
4. Use cluster analysis instead of principal components factor analysis: Tryon's B.C. TRY and Guttman and Lingoes' Smallest Space Analysis.
5. Evaluate hierarchical learning objectives as radexes: evaluate goals of quality assessment as radexes.
6. Use the item indices of B.C. TRY to construct tests.
7. Develop and use new kinds of test items and batteries to measure circumplexes, simplexes and radexes: use Guttman's radex and facet theories with quality assessment.
8. Evaluate individual student performance in reference to goals of education using B.C. TRY, FACS and OTYPE.
9. Identify cluster structures and cluster statistics of the goals of education.
10. Validate the goal structures of the goals of education in terms

of observed cluster structures, i.e., radexes observed in multidimensional interaction analysis: validate goal tests against cluster structures observed in interaction analysis.

Conclusion

Development of a battery of quality assessment tests is an enormous, expensive and laborious series of tasks. On the one hand, if the goals on which they are based are not scientifically validated, if there is insufficient range in processes, content or complexity either in the goals or the battery, if any one of the various steps in multivariate strategies or methods is slighted, the battery may have only limited usefulness for the conventional normative purposes. On the other hand, if adequate attention is paid to each of these matters that is necessary to qualify the battery for normative purposes, the hypothesis of this paper is that the battery can then be quite helpful as part of an evaluation plan for developmental schools.

Moreover, the per cent increase in costs to construct and use a battery for developmental purposes will probably be negligible compared to the costs of developing and using the battery for the usual normative purposes. The additional costs would lie largely in additional computer time using computer programs that are needed to qualify the battery in the first place. The use of the programs for developmental purposes would require limited additional expenditures for computer time. The largest categories of cost would lie in the development of the battery through multivariate techniques and in the administrative costs.

If large sums of money are spent to develop and use a test battery, it would seem logical to extract all the useful information from the

data. If this is done for developmental purposes, then new kinds of information can be obtained at little additional cost. The new information could introduce valuable possibilities leading to a developmental kind of school.

Chapter 2

The System Approaches in Education: A Model of Professionalism

Harold Koontz (1962) wrote a paper in 1956 which has become a classic in the literature of management. The principal thesis is:

> In the field of management, then, what is needed is groupings of interrelated principles - theory if you will - dealing with the various aspects of the managerial job.... Principles describe the nature of the managerial job, crystallize the purpose of management, and act as a kind of checklist for the manager to follow in applying the art of management...In addition, principles increase managerial efficiency.

This paper proved to be a germinal one which keynoted general discussion.

Three years later, Harold Smiddy (1962) President of the Academy of Management (1961) and Vice-President of General Electric Company, said that managers should not be tied to the past, but open to the future, thinking of change as normal, anticipating it causatively and using research to bring it about. Philosophic activity, he said, is essential to management research. To do this kind of research, to attain an adequate comprehension of the whole that is essential regarding the problem he is addressing, the researcher must philosophize. This is necessary regarding the search, the creation and the evaulation aspects of the task. If any of these three functions is overemphasized at the expense of the others, the knowledge gained is unbalanced. If, e.g., search is subordinated to creation and evaluation, the researcher becomes a dilettante whose credibility is open to question. If the search is unduly accentuated, emphasizing facts without proper context or values, he becomes a technician who does not lead. He must use his philosophy, his metaphysics and his ethics to bring the problem into focus, to relate it to the larger system of which it is a part. "If

the researcher is successful in balancing these three aspects, he attains a sense of the whole that appears to be essential to doing truly effective work."[1] Philosophic principles and their use are necessary to achieve balanced understanding of large enterprises.

Indeed, this emphasis is only being rediscovered. Philosophic principles were emphasized in the argument between the profit ethic and the social responsibility ethic (Petit, 1969) some decades ago. The specific American philosophy is pragmatism and the common management philosophy that derives from this theory is a highly practice-oriented theory that aims at control over means and ends. Under the pragmatic philosophy of management, there is little effort devoted to intensive, disciplined philosophic thinking; the manager simply philosophizes in effect "Quit philosophizing and stick to the facts." This kind of philosophy was already laboring under the products of its defective thinking in the first decades of the 20th century, e.g., labor troubles. A related but more modern philosophy is called Operationalism. This theory analyzes the objectives of management into service, social and profit categories and attempts to accomplish these by dividing the tasks of management into planning, organizing, motivating, innovating and controlling (Wadia, 1969).

The pragmatic philosophy of management, like other prevailing theories, is defective (Litzinger & Schaeffer, 1969). Not only are existing theories defective, but our methods of philosophizing are also faulty. Present discussions repudiate metaphysics (the division of philosophy that includes the theory of reality) "In order to free the mind from futile speculation and center it upon ends." Although

[1]Quoted of A. J. Grossman by Smiddy (1962)

Americans have little temperamental bent for philosophizing, metaphysics is inescapable. We must be concerned with questions of the nature of reality (ontology), goals and values (axiology), knowledge and how it is gained (epistemology) and all these matters are precisely the content of philosophy (Litzinger & Schaeffer, 1969).

Pethia (1969) suggested differentiating the theories of administration into two broad categories to facilitate comprehension of the values of the theories. Distinctions are made between the "positive" or descriptive theories and the normative ones. Descriptive theories deal with questions of fact or knowledge, describing what is, while a normative theory deals with what ought to be, comprising some imperative and/or prescriptive content.

In the confused and uncertain state of philosophic knowledge and method in management, where can educators turn for guidance? Where can educators find and identify principles that they need to administer the most complex human enterprise of all: Education? Even if principles are identified, how can their significance be understood, applied to concrete situations? How can consensus be gained about these principles? Management philosophy is an enigma for which there is no obvious solution.

> No philosophy of management worth the name can emerge without a disciplined habit of mind. One implication of this for management is clear. If the ageless dsicipline of philosophy is to have an influence on the emerging discipline of management either those in management submit themselves to the rigors of philosophy, or a way must be found to involve philosophers in this field.
>
> Truth is more likely to emerge through the interplay and conflict of ideas resulting from the exercise of individual reason than through the imposition of uniform and standardized opinions by authority. Arthur Lovejoy. (Litzinger & Schaeffer, 1969).

Based on the experiences of the National Aeronautics and Space Administration, the suggestion or thesis of this paper is that the systems approaches can furnish essential philosophic principles and special methods to guide the activities of all professional educators, particularly administrators. These principles, taken together, can be considered as part of a model of professionalism in education, and they can be used as the origin of guiding principles of management. Systems theory can introduce scientific theoretical framework for organization and administration.

NASA has achieved spectacular successes in space programs through the use of systems approaches and has developed them to a greater degree than any other institution. To enable industry, education and other governmental agencies to benefit from NASA's experiences and findings, the Office of Technology Utilization has issued a series of publications reporting them in various ways. One such publication (Applications, 1968), is the source and basis of the suggestions that are made in this report. Three generalized philosophic principles are suggested, and, at a somewhat lower hierarchical level, three general system-creation strategies are stated as characteristic of NASA's strategies and of systems approaches in general.

Accordingly, this paper is addressed to administrators who want to make administration more scientific and less artistic, to educators who seek to develop programs and institutions that function more by processes than by hierarchical command structures and authority, to those who want to elicit creative processes in programs and to those

who desire to advance professionalism in education. It is assumed that a large scale product development enterprise is the goal of an organization, e.g., instructional systems development.

As a theoretical structure, systems approaches are descriptive and metaphysical, i.e. philosophic. Rather than being normative or absolute, they are explicitly heuristic.[1] The word "system" has ontological connotation. It means that the nature of the reality that is under consideration can be taken as a system with an interrelated set of sub-systems that can be dealt with by means of agreed methods, techniques and retionales. These rationales and methods, taken together, provide means of dealing with philosophic content by experimental means; goals, objectives, values, purposes, methods of knowing and evaluating, etc. The systems approaches can be viewed as a philosophic approach to reality that utilizes experimental means.

The systems approaches not only furnish principles with which an administrator can function, they also furnish perspectives and methods (axiological and epistemological) with which to select, evaluate and secure the acceptance of principles for the guidance of administrators.

What are the systems approaches? Based upon reports of NASA, it is at least three general philosophic principles: (1) it is a developmental-process philosophy of management vs. an in-conflict-competition theory, (2) it is commitment to and use of heuristic experimental approaches vs. commitment to and use of authority and command

[1]The germinative concept of heuristics is Polya's How to Solve it. Princeton: Princeton University Press, 1944

structures to make decisions and resolve problems and (3) it is strategic thinking for creative purposes vs. emphasis upon analytical thinking. Taken together, these principles and contrasts are suggested as essential first principles for a model of professionalism; a part of a larger perspective.

Assumptions regarding this systems model of professionalism should be clarified. First, the systems approaches are understood in hierarchical terms. The three principles that have been suggested are simply the highest in the hierarchy of system principles. Others can be detected at lower levels.

The hierarchical assumption should not seem confusing to educators, for educational objectives have been formulated in hierarchical terms for cognitive and affective domains. The meaning of the word "hierarchical" is the same when it is used to describe system approaches as it is when it is used to describe educational objectives. It means in part that there are many levels of activities and each higher level depends upon adequate results obtained at lower levels, just as a learner must gain knowledge and comprehension of an activity before he can apply it; knowledge and comprehension underlie application in the taxonomy. Systems approaches have many levels.

Second, a perspective is given, i.e., contrast, how to perceive the reality with which the systems principles deal. The probabilities of seeing the reality whole are improved if one sees the reality in terms of contrasts. The purpose of presenting contrasts is not to compare to the detriment or exclusion of one or another pole, i.e.,

alternative, it is to increase the effectiveness of the administrator to see things whole, to enhance epistemological effectiveness, to aid managers to meet the demanding question that all managers of large endeavors will face ultimately and live or die professionally on the adequacy of their response "Have I thought of everything?"

CONTRIBUTIONS OF SYSTEMS APPROACHES IN EDUCATION

Principle One - Developmental Processes and Conflict

Principle One compares a developmental process theory with an in-conflict principle with the idea that both are necessary in a contrast that should be used to see reality whole. The problem is the exclusive, even if disguised one, of conflict as the basis of structure and process of organizations. To deal with this problem, the contrast can be useful.

In connection with a discussion of planning, Ohm (1966) asserted that planning is necessarily in-conflict management. His view is that life in organizations is exclusively conflict and competition. This is a philosophic (ontological) principle on the nature of reality. There is considerable discussion of this principle in the literature of management.

The in-conflict principle has implications for organization and administration in education. There is a variety of vague, undependable assumptions that support the principle.

Morphet and others (1967) emphasize systems theory in order to introduce a rational, scientific framework for studying organization and administration in education. Two major positions are compared as

to their basic assumptions and principles: the monocratic, bureaucratic concept and the emerging pluralistic, collegial concept. The former is the prevailing model of organization that is found in every advanced country in the world, while the latter is emerging from the impact of systems theory and of behavioral science studies.

Some of the assumptions that underlie the bureaucratic concept are discussed.

1. "Leadership is confined to those holding positions in the power echelon." The population is divided into two groups: leaders and followers. Leaders should be assigned positions of power and it is their responsibility to use it. If the superordinate allows leadership to develop, his own position is threatened. He will lose his position if he does not protect it.
2. "Good human relations are necessary in order that followers accept decisions of superordinates." Decisions of the superordinate must be accepted or implemented, or the enterprise fails. Force can be used, but this requires rigorous inspection and supervision which is expensive in energy and time, so good relations are needed to save time and energy.
3. "Authority and power can be delegated, but responsibility cannot be shared." All responsibility is ultimately the superordinates.
4. "Final responsibility for all matters is placed in the administrator at the top of the power echelon." The top executive has authority to veto any decision of his subordinates.

5. "The individual finds security in a climate in which the superordinate protects the interests of subordinates in the organization." The power echelon is essentially a feudal system under the kingship of the entrepreneurial leader or king. To be successful, one proceeds up the feudal hierarchy.
6. "Unity of purpose is secured through loyalty to the superordinate." Subordinates are expected to defend the superordinate and accept his decisions without question.
7. "The image of the executive is that of a superman." The executive is assumed to be the ablest, most industrious, loyal, reliable, etc. Executives deserve and should be paid the most.
8. "Maximum production is attained in a climate of competition and pressure." People excel when they compete against each other. Life is a struggle for survival and greater rewards should be given to those who are successful in the conflict.
9. "The line-and-staff plan of organization should be utilized to formulate goals, policies, and programs, as well as to execute policies and programs."
10. "Authority is the right and privilege of a person holding a hierarchical position." Authority is inherent in the position itself. Superordinates would not be in the position is they did not have the greatest ability. This assumption can be traced to the divine right of kings in aristocratic theory, it was reported.

11. "The individual in the organization is expendable."
12. "Evaluation is the prerogative of superordinates." The superordinate rightfully has the exclusive authority to evaluate persons and production. Evaluation is one of the means with which he enforces discipline in the organization (Morphet, 1967).

Morphet and others (1967) emphasized two major defects of bureaucratic organizations. The first is that they are not innovative. The second is that each of the formal principles of organization and many of the assumptions are in conflict with the psychological needs of the healthy adult personality, in opposition to the processes of self-actualization. The comments of C. Argyris are cited. Employees are given minimum control over their work environment, they are expected to be passive, dependent, subordinate, they are induced to perfect and value the frequent use of a few superficial abilities, and they are expected to produce under conditions leading to psychological failure. These conditions lead to counterproductive conflict.

Argenti (1968) pointed out that almost every organization that has structure has a hierarchical one. The strength of this type is its command and control advantages, but it is unsuited to six modern developments. The hierarchical command structure is inadequate. Command and control are essential processes, but it does not follow that this structure is the sole alternative.

The command structure of organizations raises questions about assumptions on the purpose of organizational life. What is the purpose?

From the perspective of managers, the purpose is obvious and necessary, but what is the purpose from the perspective of employees whose mission is not fulfilled by command and control? If the controlling principle is conflict and the processes are command and control, then it is possible that some managers may lose sight of the line that distinguishes legitimate from autocratic control. Then both the manager and the employee may perceive the nature of life as personal conflict and the purpose of life for the manager is to subdue the employee. But some employees may object to being subdued in conflict and feel hostile and rebellious against those who attempt it. Problems may ensue in employee relations. In the exacerbated competitive milieu, it is too simple to assume that American workers will accept the conflict principle as the basis of purpose for organizational life. In practice, of course, this is disguised. But there would be no need for disguise if the conflict principle was an adequate basis for interpersonal relationships.

It has been assumed that managers and employees will think and work together rationally upon tasks that are assigned by managers in consequence of their legitimate use of authority. Cook (1968), e.g., defined management science as rational decision-making. But not even management science can be fully rational if the basis of organizational life is the conflict principle. The assumption is undependable (Ohm, 1968). There are irrational interpersonal interaction mechanisms that intervene to hinder or prevent rational relationships. Carson (1969) reviewed factor analytic and circumplicial studies and concluded that interpersonal relationships can be understood in terms of a two-factor

circumplex model of love and hate, and dominance and submission. A command structure fosters rather than limits the deficiences that arise in this empirical model of relationships.

A model of social interaction is given that reduces to eight observational categories. These categories are adequate to code interpersonal behavior, according to Carson (1969).

To illustrate the model and its explanation of the generation of hostility and ineffectiveness of employees and organizations, it may be helpful to summarize part of the presentation. Each of the eight categories is called an "octant" after Leary, who first used the term. Behavior on one side of an octant tends to invite complementary behaviors on the other side. A collaborative social context is assumed with correspondence of goals among parties to social interaction. Under the octant heading of Managerial-Autocratic Behavior, it is said that behavior of the manager is assertive, tends to be autocratic, conveying the message, "I am a strong, competent, knowledgable person on whom you can rely for effective guidance and leadership." It invites complementary behaviors in the self-effacing and docile range (rather than creative). If the complementary behavior is not given readily by the employee, punishment and conflict may be initiated by the manager. Under the heading of Competitive-Narcissistic Behavior, it is said that dominance goes even further than it does under the managerial-autocratic, assuming an aggressive component and implicitly devaluating the other person. The message is communicated by the manager "I am superior to you and you being a lesser person are hardly worthy of my serious consideration." Such behavior is said

to invite others to be submissively hostile and inferior in response, to react in the range of rebillious and self-effacing behaviors.

Since there are no rational reasons why employees in general should accept inferiority, docility and self-effacement, reliance upon the in-conflict principle can generate hostility and antagonism. It bears the assumption that the purpose of the manager is to subdue the employee into a servile relationship. Little or no checks or restraints are provided upon excessive egotism (narcissism) or autocratic behavior; unlike the more professionalized occupation of medicine. Medicine removes the physician from service where there is obivious emotional involvement, e.g., surgery on a loved person. The in-conflict principle can elicit defective kinds of emotional involvement of the manager in the "rewards" of management.

Managers are involved at the level of their individual personality structure in everything they do in an organization. England (1969) used the Personal Values Questionnaire, based upon Osgood's semantic differential, to measure personal value systems of 3,042 American managers. Results indicated there are characteristic patterns of manager's values. These operate at the levels of corporate strategy and of daily decisions. Differences in personal value systems help to explain the nature of conflict between individuals and similarities are probably responsible for much accommodation among individuals.

There is a defective assumption that decisions of managers are normative. Jackson (1964) conceives only two types of power (sic),

one based upon attributes of an individual, the other based on the legitimacy of a position. "Authoritative behavior resting on either base will be normative regulated." Any social system is normatively regulated patterns of interaction he holds. A model is given for norms about authoritative behavior (Jackson, 1964). But concepts of supreme control and ultimate authority are an illusion, outmoded survivals of former days. There is a better alternative that is already in use: process (Follett, 1969).

There is an assumption that managers are better or "superior" individuals who deserve special (aristocratic) treatment and who guarantee success. This assumption is supported and amplified by narcissistic managers as described by Carson (1969). But no single individual can assure the success of a large company or enterprise and it is irrational to expect one "superior" individual to do so. This expectation denies the realization in business and economic organizations of the democratic principle upon which American political organization depends.

Managers who take a "hard" look at their role (England, 1969) may elicit conflict with employes who do not share the manager's narcissistic view. Conflict can be dysfunctional (Litterer, 1969). Morale, effectiveness and creativity may be affected adversely under the conflict principle.

The conflict principle limits the kinds of roles that managers and employees can assume. It raises the question whether any adequate role is possible under governance of this principle. Bernthal (1969) analyzed several types of organizations and possible roles of leaders: charismatic, traditional, etc. His recommendation did not accept any of these alternatives. He suggested that the leadership role should be found in another alternative involving system-type activities. When the principle of management is conflict and competition, roles of leaders may be restricted to defective alternatives.

There is place and need for the conflict and competition view of organizational life. Command and control are essential processes both in individual and in organizational life. But difficulties arise when these processes become the principal ones. Managers may lose sight of the always vague line that separates tough-minded courageous leadership from autocratic foolishness. Autocracy can ensue. Then a subtle change may occur in the in-conflict principle and its application in an organization. Conflict may occur to reduce the autocracy, thus changing the productivity of the organization from its avowed ends to unproductive ends deriving from uncontrolled egotism of one or more managers.

Another principle is needed to maintain productivity of the organization and to give meaning and purpose to employees whose direct tasks are not fulfilled by command and control activities: the majority of employees.

NASA discovered this essential principle as it experienced the contrast that is under discussion. When work began, it is told of the

first months of work that little progress was possible because there was conflict as workers fought each other for positions of advantage for their own views and contributions. Not until another principle took hold and plans and team-work were successfully structured was real progress possible. Even then there was a variety of unsuitable normative assumptions, i.e., principles that interfered.

Like many American workers, NASA workers began by assuming that the product of their work would be a single "best" (normative) design for spacecraft. NASA officially condemned this principle as irrational.

The first principle of the systems approaches was discovered by NASA as part of the essential contrast. This principle is to create and rely upon developmental processes that are designed for and administered for continual improvement. There is a variety of assumptions and direct implications for the structure of organizations, the purpose of organizational life, interpersonal relationships, role alternatives, and decision-making.

Structural changes are needed in organizations to create system-based structures and processes. Organizers should distinguish between executives who are part of the command structure and advisors who are not and form advisors into a ladder structure. Project managers should be organized into the matrix. Both the ladder and the matrix are essential to modern management (Argenti, 1968). The change creates pluralistic structures that are consonant with functions.

There is a change in the nature of authority as well. "An order, a command, is a step in a process....and we should guard against thinking this step a larger part of the whole process than it really is." The most basic idea in business organization today is that of process or function, and authority derives from process. More than one man's experience goes into the making of a decision and authority belongs to process or function, rather than to individuals (Follett, 1969).

The process principle of management can contribute much. The central purpose of organizational life can be changed to cooperation for the creation and improvement of processes or systems. The focus of attention can be upon creative processes. This introduces a developmental organization.

The change to a developmental organization removes normative sanctions from the manger's role and makes the manager responsible to the system rather than vice versa. Like other employees, the sole basis for his role is his professional contributions he can make to the processes of the organization. Thus professionalism in management is fostered by the process principle.

The irrational, emotional interpersonal interactions can be replaced with professional processes. The products of interactions can then become more conscious, more balanced, more rational than is possible under the conflict principle taken alone.

Goals can be introduced along with developmental processes with which they are created. If people participate in setting goals for the

organization and in finding better ways to achieve them, it has been found that they can contribute far in excess of usual expectations and are willing and anxious to do so. Management by Objectives can be used. MBO is a bottom-up process with top-down direction, which means simply that the development of objectives begins at the lowest level and proceeds under direction of top management (Glaspey, 1969). This idea of involving employees in central goal-setting processes of an organization is a salutary, motivating alternative to autocratic processes under the conflict principle. Like Carson's therapeutic suggestion to involve people in processes as a means of changing defective interpersonal relationships, this alternative can be therapeutic in organizational life.

An additional principle or assumption is needed to guide the process approach to management. What kinds of investigative processes shall be used? There are available normative or heuristic alternatives. But the normative assumption was explicitly rejected by NASA when the concept of producing a single "best" design was excluded in favor of developing and assessing many alternative designs. This is essentially a heuristic approach to the use of models, structures of activities, evaluating and decision-making. NASA specifically rejected normative approaches to decision-making in favor of heuristic ones.

Definitions of heuristics vary according to the particular dictionary that is used, but most definitions convey the idea that a heuristic is a nonabsolute method or means with which to investigate a problem. It is the use of strategies and their embodiments, e.g., computer programs. This requires considerable changes in conventional

habits of thinking. Most of us think in normative and analytical terms. We analyze in terms of some general law or rule that is thought of in absolute, unalterable terms as the sole basis of some problem or reality. The velocity of light is thought by some to be a constant (sic). The square of the hypotenuse of a right triangle equals the sum of the squares of the two sides. By this normative view, the task of investigation is to discover the rule that governs nature or the problem and then apply the rule. But this epistemological method is based upon a defective ontology, that the nature of the reality is governed by one single invariant rule. The systems approach uses a better ontology and is irrevocably heuristic in the uses of models, structures of activities, strategies, decision-making, etc.

The deliberation between normative and heuristic alternatives is philosophic, and both alternatives are philosophic choices.

A heuristic approach is a practical strategy with which to deal with a problem. It limits the range of possibilities and the sample of hypotheses and strategically relates them to outcomes. Indeed, the basic human nature is irrevocably heuristic. Man is not a normative animal. On the contrary, he uses heuristic strategies to guide all his learning and responding, groups strategies into plans and uses these to control all his global behaviors. Most of man's attempts to understand his environment are necessarily heuristic ones. Man is necessarily a heuristically-functioning species (Miller and others, 1960).

All the principles and activites that are used by management should be understood in heuristic perspective. Roles of managers and

employees should be understood heuristically. This perspective furnishes needed correctives to possible self-centered egotism (narcissism). The administrator's role should be seen in heuristic terms. He is only one individual of many essential individuals that are engaged on system processes. If he gets emotionally involved in "rewards" of command and control, he can be retrained, relieved and reassigned, or dismissed. It is the system processes that are essential to effectiveness of an organization, not any individual. Reliance (excessively) upon any one individual is to be avoided, and individuals should be monitored for emotional involvement in prerogatives of management.

The heuristic approach is fundamentally reliance upon processes. This is the basis of management science. The reliance upon process can be illustrated helpfully by reference to a more highly professionalized area: medicine. Modern medicine does not rely upon any one individual or any one specialist to serve most patients. On the contrary, a series of agreed processes is initiated by, e.g., a nurse who may collect a medical history on a patient. This is part of processes of observation and analysis, the purposes of which are to identify the characteristics of, e.g., a disease process, i.e., sympotoms. A physician may examine the patient and order laboratory procedures. A variety of reports is collected and some or all may be submitted to one or more consultants. Consultants make their evaluations and reports. When all such reports are processed and submitted to a responsible physician, he evaluates - compares for one to one correspondence - the list of patient symptoms with lists of

characteristic symptoms of an illness and synthesizes several decisions on diagnosis and treatment. The reliance in all this work is not upon the "genius" of one "superior" individual; it is reliance upon a known sequence of processes in which scores of individuals may participate.

The reliance upon processes is a vital alternative to reliance upon the elitist (aristocratic) principle. None of the people in the medical processes holds all the truth or is relied upon for this purpose. Each functions professionally within his limits, each contributing his particular service to a larger whole in a structure of observations, analyses, evaluations and syntheses that are known and utilized by all. Each individual who functions within this structure depends upon each other individual to perform his service effectively. So professional people create and depend upon processes. Similarly, professional people in education can create and rely upon heuristic processes.

Bernthal (1969) recommended a new role for leadership of system-type activities: assessing environmental constraints, articulating the mission, securing resources, providing internal coordination, etc. Leadership, he held, should be neither authoritarian nor democratic, but flexible and adaptive, an integral part of a complex social system in which the leader's primary mission is to integrate human and non-human resources into an organization that moves to a common goal.

Heuristic processes can assure, measure and monitor success in a complex enterprise. Here lies the immeasurable value of heuristic processes. Without them, complex enterprises like a voyage to the moon or developmental instructional systems are impossible. With them, it

is possible to resolve interrelated complex unknowns and initiate the project. When an emergency occurs as in crippling damage to a space-craft, there is unexpected flexibility and capabilities in the systems. Computer simulators were used intensively to create means with which to rescue the spacemen from certain death. Heuristic processes are essential to all large enterprises that comprise civilization itself.

Heuristic methods are used to relate inputs and outputs. Immegart & Pilecki (1970) organized and evaluated heuristic theories relating them, and concluded that four dimensions are essential to an adequate theory: productivity, organizational health, integration and feedback. Criteria and categories are given with which to assess organizational outputs on a four-point scale.

Heuristic processes and perspectives are essential to creative development. Operations research is essential unless we are willing to settle for a medicore information system (Arnoff, 1970). These are heuristic experimental methods of which somewhat more will be said.

Scientific decision-making is essentially a creative activity (Wilson, 1962). There are problems that interfere with generating an environment in which creative processes can function. There are problems of freedom, how best to use a group and of developing permissiveness and positive attitudes. To cope with these problems, to enhance creativity, users need to limit their freedom, use groups for mutual stimulation and encouragement and for synthesis of experience, cope with fear of failure by developing better attitudes and by making defensive attitudes work for creative groups instead of against them.

Heuristic methods and processes should be used with pluralistic concepts of administration and organization.

Morphet and others (1967) analyzed the assumptions of the pluralistic concept of administration:

1. "Leadership is not confined to those holding status positions in the power echelon." Anyone can provide leadership when he participates in helping a group formulate goals, programs or policies. Thus leadership is distributed widely and the superordinate is more effective as he develops, rather than restricts this leadership potential. Instead of losing leadership by sharing it, he increases his own potential and can prevent conflicts.
2. "Good human relations are essential to group production and to meet the needs of individual members of the group." This improves morale and aids production through meeting individual as well as group needs.
3. "Responsibility, as well as power and authority, can be shared."
4. "Those affected by a program or policy should share in decision making with respect to that program or policy." This assumption is stated in the Declaration of Independence. Traditional and emerging administrative theories differ more on this assumption than on any other. To extend democracy from the political domain to the economic one, it is essential to implement this assumption.
5. "The individual finds security in a dynamic climate in which he shares responsibility for decision making." "A free man is more secure than a vassal."
6. "Unity of purpose is secured through consensus and group loyalty."
7. "Maximum production is secured in a threat-free climate." This does not mean a problem-free situation. Work on problem-solving promotes growth and satisfaction in individual.
8. "The line-and-staff organization should be used exclusively for the purpose of dividing labor and implementing policies and programs developed by the total group affected." The emerging pluralistic structures should be used for developing goals, programs and decisions.
9. "The situation and not the position determines the right and privilege to exercise authority." Authority arises out of the situation rather than out of the position. Decisions should be made as near the scene of action as practicable.
10. "The individual in the organization is not expendable."
11. "Evaluation is a group responsibility." This is necessary to develop the competencies of the group.

Pluralistic organizations differ from bureaucratic ones. They have an open as opposed to a closed climate, are more free, less conscious of structure and status, have freer communications internally, have more democratic administrative behavior, are more innovative (Morphet and others, 1967).

Morphet and others (1967) use systems theory and concepts from the social and behavioral sciences to analyze cooperative procedures with which individuals and groups can not only survive but also promote growth beyond survival. A cooperative concept of human relations is presented. Contrasted are theories of survival of the fittest, and the Marxian class struggle. Growth is the major purpose of human behavior, and action and belonging lead to growth. Then cooperative procedures which lead to growth and belonging are valid. Cooperative procedures should be adopted for resolving human problems. This is particularly applicable to public schools. Characteristics of successful state cooperative projects were described, and general guides were given for cooperative procedures and group work.

In summary of this section, it has been said that, if the proposed contrast is not used (epistemologically), then the only practical alternative for the philosophy of management is the conflict principle. None of the assumptions is dependable that support this principle. If the contrast is used, then the defective products of the conflict principle are perceived and heuristic processes and pluralistic structures are used along with those of command and control. Where it is possible, heuristic processes are relied upon as a value (axiological) judgment.

Principle Two - Experimentation and Authority

Principle Two compares an exclusively normative approach with an experimental heuristic one with the idea of establishing the contrast as a permanent part of the epistemological method of managers. The problem is the exclusive use of normative methods of experimentation and decision-making. The contrast has utility in connection with this problem.

Some managers may make decisions on the basis of authority (bureaucratic or expert) specifically against or without use of professional standards and methods, thus short-circuiting the use of other normative methods with which decisions are made. This arbitrary decision constitutes, in effect, a rule or normative act that is enforced by the authority of the manager.

On the other hand, many managers are careful to validate the bases of decisions by means of research projects. Conventional research designs and strategies are significant embodiments of the professional methods. When applied by professionally trained researchers, it is possible to test hypotheses and obtain (sometimes) definitive answers. But the conventional research strategy that tests one or a few null hypotheses is ineffective and unfruitful. It is basically a normative method that can test only one or a few alternatives effectively and it does not ask the right question. It is not adequate alone to generate, evaluate and compare, e.g., instructional strategies and materials. Thus manager's alternatives are generally limited to normative methods of decision and experimentation. Taken alone and used exclusively, these are defective.

The choice in research strategies lies with algorithmic and heuristic alternatives. These are not exclusive. George A. Miller, President (1969) American Psychological Association, pointed out that an algorithmic strategy is defective (Miller and others, 1960). It seeks normative approaches, postulates all conceivable alternatives, tests each alternative one by one and it is impracticable. There are too many possible combinations, hypotheses, unconnected theories, parameters, unknown connections, and interactions of variables to hope to check them all one by one or a few at a time. The duration of a whole society is too short to succeed in this process. The testing of null hypotheses is a defective algorithmic research strategy.

Heuristic experimental strategies should be used to supplement and complement the deficiencies of the algorithmic strategies. Operations research is heuristic strategies and methods that are used to create and evaluate systems. Principle Two uses and relies upon heuristic experimental strategies to create new alternatives, new systems and to make all decisions relevant to creative processes.

Operations research is an essential kind of experimentation. It is systematic study of the structure, characteristics, functions and relationships (of an organization, e.g.,) in order to provide the executive with a more factual basis for decision-making. It functions by analysis of the system, constructing a model, testing the model, solving the model, controlling the model and solution, and implementing the results (Arnoff, 1970).

In addition to the use of a model to serve a decision-maker, there is also the use of modeling and simulation for the purpose of creating systems that are unknown to the experimenters, e.g., NASA's use of simulation for system building of experimental spacecraft.

Models play key roles in scientific thinking, according to Bross (1967). There are many kinds of models, each with its advantages and disadvantages: physical models, e.g., model aircraft, abstract models, e.g., a planetarium, symbolic models, e.g., model of solar system, mathematical models, e.g., for growth of cities, etc. Advantages are that a model provides a frame of reference for consideration of a problem, it clarifies the problem of abstraction, clarifies the nature of the reality under study, is manipulative and is often the cheapest way to accomplish prediction. Disadvantages include the dangers in abstraction, equating the model with the real world and problems of comparing the model with the real world. A model is neither true nor false; it is a heuristic creation, a symbolic representation of selected features of a reality that has been chosen for study.

Models serve at least four distinct functions: organizing, heuristic, predictive and mensurative (Deutsch, 1967). Each model embodies a theory asserting a structure of correspondence between the model and the thing that is modeled. It also means that the main aspects of the model are the important aspects of the thing that is modeled. The organizing function means that a model orders and relates disjointed data to show relations that have been unperceived. A model can serve as a heuristic device leading to discovery of new facts and methods. Each of the four

functions of the model is related to the evaluations that are done on the performance of the model. Three additional considerations enter into the evaluation of the model: originality, simplicity and realism. Thus models and their uses are very complex.

Computer simulation is a type of modeling that is increasingly used in large-scale system projects, e.g., NASA's space program. Simulation should be considered under three conditions, according to Anderson (1968): (1) when the real situation does not exist or would be impractical to create, (2) to test more assumptions that one could in a real situation, (3) to explore the interrelationships of variables.

Simulation is a heuristic method of evaluating a trial system model in a simplified environment, e.g., a computer program.

The construction of a computer simulator has common features in all cases. Each simulator requires the preparation of a detailed system description and system analysis, including the construction of a flow chart. The latter is an iconic device, a heuristic model of the system that is being studied. Analysts translate the flow chart into a computer program which is run on a computer to produce outputs with which to compare to the data that have been gathered previously regarding the real system. The simulator is "debugged" and revised until it conforms to reality in essential features.

Once the simulator is "validated" in this fashion, it is used for comprehensive experimentation. Often the experimental environment can be recreated within a matter of seconds or minutes, i.e., the simulator is run and rerun. Time delays and costs of repeated experiments are minimized by computer simulation.

The availability of a competent simulator opens the way to combine two kinds of research methods. Simulation experimentation and conventional research can be performed together in complementary fashion. This approach has already been used by NASA and has been suggested independently by scientists at IBM. Byerly and Fahidy (1969) concluded that simulation is useful in extending and interpreting information gained by conventional research. A judicious combination can not only monitor the experimental technique, it can also aid the design of future research. Simulation can extend experimental data into conditions that are difficult or too expensive to produce experimentally. The particular example of this point was the computer simulation of the reduction of divalent copper by carbon monoxide in two chemical steps. The actual experiment would have presented considerable difficulties, but simulation was convenient and accurate.

Research can provide the initial data with which a system model is constructed, while simulation can be used to test and evaluate the adequacy of the model in comprehensive fashion. When the two kinds of experimentation are used in this complementary manner, the research question is "What kinds of information do I need to construct a simulator?" When the simulator is used, the questions are "Is this model of the system a valid and reliable one?" "What are the characteristics and limitations of the system?"

The results of each type of experimentation feed information into the other. The research results tell what kind of model can be constructed, while the results of the simulation feed back into research

to identify possible gaps or deficiencies in the concept of the system or relations of the subsystems.

Effective and efficient creation of large-scale complex systems can be done by combining simulation experimentation with conventional experimentation. It is possible to escalate the scale and widen the limitations of spacecraft systems drastically by these means. NASA, e.g., used the experimental rocket plane X-15 to obtain data regarding pilot and aircraft systems performance at altitudes and speeds exceeding the limits of conventional real-time systems: 4000 miles per hour and altitudes above 200,000 feet. Operations researchers constructed computer simulators embodying the results. After validation, the parameters of the simulators were extended to speeds and altitudes involved in sub-orbital and orbital flights of space craft. Outputs of the simulators were obtained to specify performance characteristics of aircraft and pilots; comprehensive evaluation. Then suborbital spacecraft were constructed and flown. Results of suborbital flights were used to revise the computer programs. These were debugged and validated and then used once more for comprehensive evaluation. Using data gained from the comprehensive evaluation, orbital spacecraft were constructed and flown. Data regarding the latter were used to revise the computer simulators again. The result was computer simulators that were capable of simulating moon flight and landing, with safe return to earth. Thus large-scale spacecraft systems were constructed quickly and efficiently, while achieving adequate reliability of performances, using simulation experimentation in complementary fashion with research. In like manner, it may prove possible to construct complex instructional systems for use in schools by combined use of simulation experimentation and research.

In summary of this section, it has been said that a contrast is an essential part of the epistemological method of managers. If the contrast is not accepted and used, then the sole practical alternative that is available to managers is the exclusive use of normative methods of experimentation and decision-making. These methods are defective and interfere with creative system-making. If the contrast is accepted and used as part of epistemological method, then the conclusion is accepted that the above practices are defective. The heuristic experimentation strategies are used to supplement normative strategies as part of an incomplete model of professional management theory.

Principle Three - Strategic Thinking and Analytical Thinking

Principle Three compares strategic thinking with analytical thinking to establish a permanent contrast that can be used (epistemologically) to develop heuristic systems approaches. The problem is the improper or undue emphasis upon analytical thinking. The contrast can be useful in connection with this problem.

Analytical thinking may originate in connection with the question, "What is wrong with it (him)?" Analysis may be influenced by an assumption that something is defective about an idea, a concept, a proposal, a contribution or an individual. Then the purpose of analysis may be to identify the defect. A faulty form of analytical behavior may ensue.

Additional connections may emphasize this faulty kind of analysis. If the behavior of the manager is like that explained by Carson (1969) under the category of Competitive-Narcissistic Behavior, then the manager may have an irrational need, as described by Carson, to devaluate the

contributions and personality of an employee. In that event, the question, "What is wrong?", initiates an expectation of deficiency and the purpose of analysis is likely to be to identify some defect that can be pinned on the individual in question. In broader terms, it may be to the competitive advantage of a manager in the in-conflict life of the organization to analyze (devaluate) some matter or individual for some self-centered purpose or end. It should be obvious that balanced wisdom is not likely to ensue from this kind of analysis.

There is a more adequate form of analytical thinking; that of the cognitive Taxonomy. The cognitive processes are to breakdown a communication into its elements, into relationships between elements and parts of a communication, and to identify the organization of principles and structure that hold a communication together. This is one form of higher-level thinking, but it is only one form of many that are essential for adequate cognition of an activity. The Taxonomy lists additional behaviors in hierarchical order: knowledge, comprehension, application, synthesis and evaluation. The latter two categories exceed analysis in position in the hierarchy. Thus analysis is both narrow and shallow; narrow because it does not use all, or even the most important behaviors in the Taxonomy and shallow because it obviates questions in in the problem-solving, philosophic and moral and ethical realms.

Like athletes who face constraints of time, gravity, skills and fatigue, every manager faces cognitive constraints. These are perhaps summarized in the last clarifying question with which every manager is

confronted when a decision must be made to initiate a large-scale new program "Have I thought of everything?" If there is a single problem that lies unexplored, if there is one significant question that has not been asked and dealt with fully, if there is one question that is bypassed in ontology, axiology, epistemology, or moral and ethical matters then the large project may easily fail, the company may become bankrupt and the manager and many employees may be unemployed; their reputations blighted. Managers are compelled to think comprehensively over the entire range of philosophic and moral and ethical matters. While no single set of values or principles can be stated, managers should have specific training in thinking through the consequences of both acting and not acting (Schein, 1969).

The (epistemological) manner in which a manager inquires and gathers information is crucial; it must be fully comprehensive and fully intensive at the same time. In comprehensive terms, what thinking processes should be used? A comprehensive model of cognitive operations has already been outlined: a hierarchical structure of intellect model.[1] Briefly, it says that one cannot solve problems in an area until all knowledge in the area has been clarified, so the lowest level in the hierarchy is the clarifying behaviors of the Taxonomy. The next highest level is problem-solving. No one can think philosophically until he has mastered the problem-solving level. So the next level above problem-solving is the philosophic. Above the philosophic level is the domain of

[1] Geisinger, R. W. Mission Possible: II. New Process Curricula for Middle Schools. Unpublished paper, 1970.

the moral and ethical questions. The structure of cognitive operations then is the clarifying, problem-solving, philosophic, moral and ethical categories (religious). A manager must think through every matter for which he is responsible on each of these levels.

If anyone had to plod up the cognitive ladder from one level to another without guidance or direction, he might say that it is impossible, there is no way to climb with certainty and be productive at the same time. So many people may choose to narrow the search and make it easier by halting at some convenient level, e.g., the analytical. Fortunately, human nature has capabilities that are readily developed by those with open minds that make it relatively easy to advance in the hierarchy. This is strategic thinking using many different kinds of questions. Strategic thinking, in the form of asking questions, is philosophic activity with which one learns to learn, remembers, controls his skills and global behaviors and acts creatively.

Psychological experiments have demonstrated, e.g., that one remembers, not by simply committing data to memory, but by using strategies to construct a structure. People remember under the guidance of a strategy. Strategic thinking overarches above all levels of cognitive activities in a similar manner, to organize and structure everything that is done by a competent person.

Strategic thinking is creative; where analytical thinking breaks down a communication, strategic thinking puts it together, structuring and restructuring thinking into usable form. In fact, all the hierarchical categories of the structural model are strategic in nature; one clarifies

by means of clarifying strategies, solves problems by problem-solving strategies, philosophizes by philosophizing strategies, and acts in moral and ethical matters by moral and ethical strategies. A manager thinks strategically, and most of his thinking is strategic.

The basic essence of the systems approaches, in all its dimensions, levels, techniques and methods, lies in the fact that it is strategic thinking, i.e., philosophizing. "The essence of planning is the selection of strategic objectives in the form of specific sequences of action to be taken by the organization," (Gross, 1969).

The strategies that are used are strategies of asking questions, strategies of organizing questions into patterns and patterns into sequences and sequences into cycles and the cycles and sequences into hierarchies of strategies. The concept, "strategy" is used in its psychological sense as used by G. A. Miller, Galanter and Pribram in Plans and the Structure of Behavior, in which they contend that strategies are organized into plans and the plans are used to control all of one's global behaviors.

Strategic thinking is used by managers to construct structures of activities that focus into nodes at which decisions can be made, so strategic thinking underlies and is basic to decision-making. Strategic thinking has structure; the patterns and cycles of question-asking are organized in such a manner that activities focus at points at which decisions can be made rationally on the basis of information that has been gathered through the activities. The structured approach to space mission planning is described by Thomas and Willard (1966), who present a hierarchical structure.

At the top of the hierarchies of strategies and methods in the systems approaches are those discovered and used by NASA. Only in the achievements of the space programs can the full power and potential of these creative systems strategies be perceived. What are the general creative systems strategies?

The creative strategies thinking and methods of NASA generalized into three principal strategies and three systems that were created to implement the three general strategies.

NASA existed to create a product: man-spacecraft mission systems. Thus General Strategy One was the strategy of systems synthesis; itself consisting of substrategies and techniques. Particular methods were used to formulate mission objectives and to connect particular pieces of hardware with specific objectives. The methods included value-, utility-, and redundancy-analysis. Special computer programs were used on the results of these analyses to select alternate spacecraft designs. The primary product of this strategy was one or more designs of spacecraft that serve as input to General Strategy Three. The second vital product class of General Strategy One was a variety of models, including a computer simulator. When the latter was debugged and "validated" for its correspondence to the reality of the spacecraft mission itself, it was submitted for use in General Strategy Two.

General Strategy Two was the strategy of comprehensive evaluation.

The computer model was run and rerun many times as an experiment, to identify problems and consequences, e.g., failure of components or pilots, failure of subsystems, limits of capabilities, interrelationships of subsystems, parameters, faulty interactions of subsystems, etc. Probabilities of failures were assessed. Results of comprehensive evaluation were interpreted and returned as input to General Strategy One for revision of systems designs. Results were used to prepare operations manuals, survival techniques, etc. This strategy is one of comprehensive experimentation using a digital computer as an environment for exhaustive testing.

General Strategy Three is the strategy of production analysis and control. While a feasible design was produced in General Strategy One, it is necessary in General Strategy Three to implement this design through contracts for the construction of components, i.e., spacecraft hardware. As each company manufactured its particular component according to diverse rates of production, the project could fail due to two constraints: excessive weight and cost. Accordingly, the management information system FAME was created to implement General Strategy Three, production analysis and control. FAME is an acronym for the title of the system, Forecasts and Appraisals for Management Evaluation. FAME uses feedback regarding weight and cost of components to control the production, assembly and launch of spacecraft systems.

One significant product of General Strategy Three was the development of a library of Cost Estimating Relationships. These data serve as as input to General Strategy One.

Significant techniques were used to guide managers in Strategy Three. One is statistical decision techniques, and another is probabilistic planning for estimation of cost and personnel requirements.

The full creative potential of the systems approaches is realized, not by application of any one or a few methods, tools, techniques, principles or strategies; it is realized by using the three principles that have been discussed and by using the three creative systems strategies together in complementary and supplementary fashion. It is possible to create fully-functioning new systems that embody balanced wisdom through the use of systems approaches.

Summary

What are the contributions of the system approaches to management and administrators? Highest in the hierarchy of contributions are philosophic rationales and methods that make it possible to deal effectively with intangibles and complex unknowns that are difficult or impossible to quantify by conventional methods. The basic contributions are all philosophic. They deal with main areas of philosophy, goals and values of organizations and programs (axiology), the nature of the reality of a product or structure of organization (ontology), and the methods of investigation and of gaining knowledge (epistemology). The systems approaches contribute principles and methods and strategies that, taken together, constitute a part of a systems model of professionalism. Using a contrast method of presentation, it is suggested that there are at least three essential principles of the systems approches: (1) the process principle vs. the in-conflict principle as the basis of philosophy of management, (2) the heuristic experimentation principle vs. authority,

and (3) strategic thinking vs. analytical thinking. These contrasts are presented, not to discredit either side, but to suggest that, if the system approaches are not used, then the practical alternatives for managers are the use of the in-conflict principle as the basis of the philosophic of management, the use of authority and other normative methods of experiment and decision, and excessive reliance upon analytical thinking as opposed to creative kinds of thinking. All poles of the contrasts are philosophic in nature. If the systems approaches are used, then other alternatives can be introduced. Taken together, these contrasts, principles, strategies,rationales and methods constitute a part of a systems model of professionalism.

The systems approaches, as they have been characterized in this report possess incomparably greater creative potential than conventional alternatives. They furnish means with which to put things together, thus countering effectively the centrifugal kind of analytical thinking that is common today. Among the defects for which more balanced alternatives are available are the following:

Conventional Alternatives	System Approaches
Hierarchical structure of organizations	Varied, flexible structures
No purpose in life for majority of employees except earn a living	Cooperation to create and improve systems
Irrational interpersonal relations	Participate in and rely on processes
Generates hostility and rebellion	Generates cooperation
Normative role for managers	Heuristic role for managers
Normative methods of decision-making	Heuristic scientific methods
Normative methods of research	Combined normative and heuristic methods
Normative assumptions limit creativity	Normative experiments identify systems; expand creativity
Limits institutional development to tolerable modifications	Can expand and extend systems drastically
Limits human development to existing processes, modifications	
Emphasizes faulty analytical thinking	

Implicit elitist assumptions, creates aristocracy	Emphasizes strategic thinking and many levels; balanced thought
Poor controls excessive egotism	Creates equality of roles in dependence on processes
Poor controls emotional involvement	Emphasizes professionalism and defines it
Depends on vague unknowns for success	Monitors emotional involvement
Authority depends variously on legitimacy, norms, a "superior" individual	Processes assure success
	Authority depends on processes

These contrasts have been discussed briefly in the report.

The systems approaches have the power and potential to yield success in attempts to make education more professional, if they are used with these proposed contrasts in mind.

Application to Education

Knezevich (1969) has provided suggestions for applications of the system approaches in the book entitled Administrative Technology and the School Executive. This has been distributed to all school administrators in Pennsylvania. The entire book is helpful, and chapter six could be studied. Included in the discussion are; computerized school lunch planning, bus scheduling, utility cost resource allocation, student scheduling, PERT, warehouse inventory, game theory and queuing theory.

But the problem is the general development of systems comprehension and capabilities among the faculty and staff members of schools and other educational institutions. To deal with this problem and to disseminate systems comprehension, simpler applications are needed. The purpose of this section of the report is to suggest several heuristic strategies for relatively simple systems applications. The following suggestions are made: (1) involve personnel in processes, i.e., strategies and their embodiments, (2) change organizational structures and salary policies,

(3) begin system-type experimentation, and (4) implement instructional management systems.

Applying the Process Principle

A course, e.g., English, can be conceived as an instructional system. If evaluation is done, the results can be used as feedback to improve the system and then we have a cybernetic system. Then the problems are to identify and quantify the inputs, processes and outputs of the system, connecting each to the other and to the whole, and to use the results of these studies to construct new means of evaluation and of instruction.

To implement the system concept at a simple (incomplete) level, a faculty can undertake development of two processes and their products: (1) testing and evaluation system, (2) system-based Learning Activity Packages and units. Neither of these systems needs a development de novo. The Association for Supervision and Curriculum Development has published the results of a tryout of a practicable approach to evaluation, and systems-based instructional packages have been tried out at several locations (Kapfer, 1968).

NASA's recommendations for applying systems approachers to education emphasized the need for new kinds of tests and new approaches to evaluation in the schools (Applications, 1968). Standardized tests and objective-type tests are inadequate. Tests are needed which take into account the overall effects of an instructional program. These should measure not only skills and basic knowledge acquired, but also the "more important changes in motivation and attitude which are results of educational programs and which affect future learning." Curriculum-makers and

evaluators support this emphasis, and call for measures of concept formation rather than measures of knowledge retention (Chase, 1969). Testing and evaluation must be changed to perceive courses as instructional systems.

The ASCD's proposal (Wilhelms, 1967) for reform of evaluation can be helpful. It is still an experimental program, but it is relatively simple, easy to use and can improve evaluation while saving the time of pupils and faculty. This plan can be initiated in a school district on an experimental basis or a school district could use selected components and develop other components as necessary.

The evaluation program deals with educational development rather than classification with respect to national norms. It is intended to answer the question "How much does the average student in an average class grow in one year toward any objective that teachers regard as important?" "Which of four different instructional programs yield a higher growth than others?" "What are students learning in particular in a particular course?" It brings to light a teaching problem if one exists. It identifies both problems and related elements, suggests several methods of finding a solution. It can give evident how appropriate is the selected alternative. It provides means with which to deal with teachers who do not know how to evaluate.

A cooperative evaluation program is described which has been pilot tested in three junior high schools. This cooperative program answers the above questions. It replaces course grades with measures of status and growth with respect to major objectives—about five in each field of study.

To initiate the cooperative evaluation program, two organizational changes are needed. An Evaluation Committee is organized districtwide to direct the program, and advisors are appointed to groups of students (20-30), to receive reports for the record, file them in record holders and transmit copies to parents.

Guidance, English and social studies were involved in the first year with science, mathematics and foreign languages added the second year.

There is a division of labor. Guidance counsellors and assistant principals in charge of discipline assume responsibility for collection of data on interests, values and sociometric measures, as well as vocational and scholastic aptitudes. Mathematics and science teachers collect data on critical thinking and scientific attitudes. The social studies faculty is responsible for data on awareness of social problems, attitudes and democratic behavior. English teachers and library personnel will secure data on study and independent reading. Fine Arts develops and uses instruments for measures of appreciation and practical competence. Vocational faculty collect data on work habits and physical education on health and physical development. The primary goals to be evaluated by each department are the primary goals of instruction in that department.

The use of report cards continues until parents receive so much better data from the innovative system that they ask, "Why do we need these report cards?" The estimate for this event is about five years.

The Evaluation Committee directs the enterprise. It consists of heads of departments and special services, guidance and library, e.g., and it is led by a Coordinator of Secondary Education, assisted by an outside consultant on evaluation.

Advisors are selected by students who record their first three choices because an advisor should first be a friend of the student. The advisor should also be a teacher with whom the student will have contact regularly. No teacher should be excluded from the role of advisor if he seems unsuited for it. The role can transform teachers.

Advisors maintain record folders for each student. This is a plain manila folder which is divided into twelve sections by the insertion of labeled cardboard dividers: (1) biographical information, (2) academic record, (3) guidance, (4) mathematics, (5) science, (6) social studies, (7) English, (8) foreign language, (9) fine and practical arts, (10) vocational education, (11) physical education and sports and (12) predictions. Many specifics are listed under each category to elicit creative effort by faculty.

Each department prepares its own measures of educational development. Most departments will average six scheduled occasions to accomplish this task. The use of formal standardized tests is not necessary or recommended. Many kinds of informal methods of evaluation can be devised, and the authors are confident that no teacher or advisor will be confronted wih too much work.

There is a difference between instructional evaluation and measurement for the record. A teacher may do the former as he pleases; he may give whatever tests or measures he likes and grade and interpret the results as he pleases, if he does not intend to report the results to advisors for inclusion in the permanent records of students. The Evaluation Committee agreed to start the pilot program with just six goals; writing competence, independent reading, critical thinking, interests, work habits and acceptance of and by peers. The requirements for getting measures into the record are several. First, the measure assesses an approved objective. Second, the measure itself must be approved by the department head or representative on the Evaluation Committee. Third, no measure can enter the permanent record unless it is the independent judgment of more than one individual. Permanent results are cooperatively obtained. Departments produce their own measures cooperatively, score administration products cooperatively, with due regard to problems of validity, reliability and bias. The Evaluation Committee reviews yearly the measurement programs of the departments.

The ASCD has significant suggestions to make regarding instruments and statistical techniques. The Interest Index of John French was adapted to the program and it yields information on interests in twelve fields of study. To measure the objective of independent reading, 3 x 5 inch book cards are used. These are filled out in the library and English classes as soon as a student has finished a book, or given it up.

Personal-social values of groups are measured with an instrument that is published in full. Sociometric ratings are secured with a set of nine "Descriptions of Classmates." The assistant principals use an instrument entitled, "Record of Behavior Problems." There is a "Record of Incomplete and Unsatisfactory Work." Together, these four instruments can reveal the problem student. The latter is he who has low interests across the board, does not like or trust his classmates, and vice versa, who continually gets into trouble and who habitually fails to get his work done. Three instruments are used to identify strengths and weaknesses in the English program. These are the Test Essay, the Shadow Test and the Pesky Errors Test. There are instruments for use in music and visual arts. Evaluation in Social Studies, edited by Harry D. Berg, is cited as an excellent resource for evaluation in that area.

The product of the evaluation system is called ratings by fifths of the standing of each student in his grade, e.g., curriculum and his annual gain in writing. There is first the student's standing in the total population of grades, next is the standing in his own curriculum, and finally there is his growth from last year (among students who started at the same level). The second scale score corresponds most closely to a grade in writing. A clerk prepares these ratings from a distribution of cumulative ratings prepared by teachers of performance on tests, etc.

The size of this task has been found to be manageable for teachers. Few of the latter will have more than 150 test papers to rate, and most can rate that many in about five or six hours. A clerk finishes the task. Teachers report that it is easier and quicker, and more helpful,

to rate test papers in this manner than it is to grade, correct and annotate homework papers. Grades on the latter are obviated with reduction in student's tension.

The ratings that are the product of this system are easier, quicker and more reliable to obtain than are conventional grades. They cannot be altered by student's anxious arguments, and it puts evaluation on a cooperative and impersonal basis.

The fruits of the cooperative effort of evaluation are freedom to teach for the teacher, freedom to learn for the learner and comprehensive and better information with which the public schools can communicate with colleges in regard to admissions matters. Schools do not have to settle for an educationally deficient system of evaluation. The burden of endless judgmental grading is lifted from students and teachers. Yet colleges and universities have more and better information than is provided by the present means of evaluation.

A school district could develop curricular systems packages in selected fields of study. If a three-phased program was used for each field of study (planning, construction, tryout), and all fields of academic study were successively included in the plan, then a school district could exhibit a greater degree of success than may be the case prior to the attempt.

Kapfer (1968) reported that nontextbook media, e.g., Learning Activity Packages are providing honest alternatives to the use of a textbook. Packages are constructed by rewriting lesson plans for student rather than for teacher use. A study guide is included which

tells the student what step to undertake next in the sequence of his studies. Behavioral objectives are stated in the guide for the use of the student. To use the LAP, a student takes a pretest, selects and uses a package on the basis of the results of the test, uses a self-test to determine if he is ready for the posttest and finally uses the posttest. On the basis of the results of the posttest, the student uses either, "Quest" activities or selects another LAP for study. Several packages comprise a unit of instruction and packages are provided for several difficulty levels, degress of depth and breadth and points of view. Thus LAP's are intended to provide for individualized instruction in terms of rate, style and sequences of learning activities.

Multimedia activities can be used with LAP's. When technology is used, then the use of systems approaches is mandatory. Many authors are cited in the references whose contributions might guide the development of LAP's. Canfield (1967), Briggs (1967) and Banathy (1967) can be mentioned, partly to illustrate the fact that there is no normative systems approach, so individual school districts can develop and use their own, within professional limitations.

Faculties can develop new courses of study in business education data processing and the sciences using the systems approaches as the content of study. Many concepts and processes in these academic areas can be taught and understood most effectively in these terms. Nature itself appears to be organized as interrelated systems. Accordingly, teachers can learn about systems approaches in their area of competence by preparing and teaching courses of instruction incorporating systems concepts.

To learn the new methods of strategic thinking, of perceiving entities as a whole, faculties could add new courses to the curriculum in academic studies that focus upon seeing things as a whole; ecology, astronomy, anthropology, psychology (humanistic and developmental), geology, etc. Teachers can learn the new kinds of thinking by preparing and teaching courses that use the new kinds of thought.

The systems approach is clearly a tool by which education can be made both a science and a profession (English, 1968). Therefore, the education and training of teachers should include large amounts of time and effort that are devoted to acquiring systems comprehensions and capabilities. Every educator's primary basis of professional competence should be seen as the systems approaches. So preservice and in-service training should be intensive and prolonged upon the systems approaches.

Another way to initiate participation in processes in a school district would be to ask faculty members for their opinion of the one or two contributions that would help them the most to improve their own effectiveness (or the effectiveness of the school program). Rather than having an administrator stifle such comments by unilateral action, means could be provided to obtain responses of faculty members. Then a system could be developed to select, develop and plan for project development, similar to Hettinger's (1967) for planning of research projects.

A school district or research could establish a board or committee of individuals that are especially selected for competence in educational research and/or systems approaches to solicit and evaluate creative ideas, develop the values and objectives of a project, and plan the activities with which they are realized. A research organization could generate an

active backlog of ten well-developed projects that await action. Planning is thus made concrete. Other benefits are cited by Brogan (1970): (1) develop personnel, (2) accelerate process of improving operations, (3) increase the value content of projects, (4) improve the competitive posture (of a business), (5) engage the enthusiasm and commitment of employees. This is a quasi-system approach to project selection, development and approval, thus distributing these functions more widely and utilizing professional skills in the processes of selection, development and approval.

The purpose of involving people in system-type processes is to help the entire staff to learn to see things whole; to learn to use heuristic methods. The systems approaches are this kind of thinking. This is their essence, rather than sophisticated computerized information systems and the like. The hardware is correctly seen as only mechanical aids. This is the reason that the informal means of evaluation of the ASCD proposal have been mentioned. They constitute part of a simple, if incomplete, system approach, a way to get started in the school district. Systems approaches perceive and measure all things as systems; inputs, processes and outputs. This can be done at first in relatively simple, informal terms. Then strategic thinking can begin to relate these subsystems, and their inputs, processes and outputs together. In due time, after the staff has learned to run a system-based school rather than being run by it, computer models can be developed and used. When this step can be taken, the door is open to see the full power and effectiveness of the systems approaches realized.

Changes in Organization, Control and Administration

School districts can choose the kind of organizational structure they want for their own use. Morphet and others (1967) described two school systems of approximately 36,000 pupils, 1,200 teachers and 90 separate schools. One system was organized entirely in hierarchical line-staff structure, with ten areas of nine schools each. There was a supervising principal for each area, and a building principal for each building. The ten supervising principals met monthly with the superintendent and the building principals met monthly with their supervising principal. But there were many complaints by building principals of slow service from the central office and there were other problems. Another school district was reported to have no supervising principals. Each building principal dealt directly with a central staff member and obtained prompt service in accord with policies established by the board. Other matters were presented to the superintendent. Principals met monthly as a group, and the superintendent and his central staff met monthly with a committee of principals and teachers. Building principals were highly appreciative of the service they received under this system and felt they had a part in policy making. It is possible to function effectively in administration of a large school district when it is organized differently than a strict line-staff policy would direct.

Morphet and others (1967) report that there is evidence that teachers and college professors are more productive in pluralistic, collegial organizations than they are in monocratic organizations. The ladder and matrix concepts might be advantageously adapted to educational institutions, with consequent advances in creativity and flexibility in programs and productivity of personnel.

Educational research institutions might benefit from the experience of Westinghouse Research Laboratories and industrial research organizations. These institutions established dual ladders of advancement and promotions for research personnel and for administrators. The ladder for the professional researcher is parallel to that for administrators, recognizing and recompensing the contributions of the professional equally with those of the administrator. The system is effective at the Westinghouse Research Laboratories and it has gained wide recognition among the professional personnel. It has done much to retain continuity of the staff and to maintain quality. Criteria are given for hiring and promotion. A "senate" of professional peers is used to make personnel decisions for advanced professional positions. Separate promotional ladders should be provided for professional educators and administrators.

What kind of organizational structure is suited for the organization of school districts and other educational institutions? Is the autocratic hierarchical command structure that is used to organize armies actually the best for educating students? Is there room for tyring out pluralistic collegial structures?

System-Type Experimentation

The system approach can be fruitful in multiple ways in the schools, e.g., in input-output analysis of instructional programs. If the English program of a school is conceived as a system, then it is possible to obtain cost data for the program. Koenig (1967) reported such an analysis for Gunn Senior High School. The purpose was to state the cost per student per school year for each instructional program. For English, the cost was $222; for foreign language, the figure was $226; for mathematics, the cost was $209; for Boy's Physical Education, the cost was $238. If costs are

computed in this fashion for existing and for proposed instructional programs, then it is possible to compare costs of different programs and to begin to use constutility studies.

Utility and value studies rate the contributions of programs to desired ends. Knezevich (1969) has a description of the procedure. Three major factors have to be determined: (1) actual and desired educational outputs, (2) programs, activities and elements associated with educational functions, and (3) utilities and costs associated with programs, activities elements, etc., that are relevant to educational goals.

In this application lies the importance of improved testing and evaluation programs. Better and more comprehensive information is needed on the products of educational programs, so that adequate data can be obtained on the value and utility of the programs; the products in each essential dimension. The products of the procedures are utility-cost ratios that can be used to make decisions on the selection of alternate programs. Comparative costs and utilities can be developed for indiviudal programs and for the entire program that is in use.

Still conceiving of the instructional programs as systems, it is possible to begin to measure classroom processes that are related to cognitive achievements of students. Ned Flanders and Dwight Allen are among researchers who hypothesized that teachers would be more effective (in terms of measured learnings of pupils) if they used less direct talk and more indirect methods of verbal behavior in the classroom. Flanders developed his famous instrument for Interaction Analysis, taught student teachers the indirect talk rationale, and then observed the achievements of pupils that were taught by teachers using the indirect rationale. The results were positive support of the hypothesis. The indirect verbal processes of some teachers in the classroom

are related to the amounts of and kinds of learnings (products) observed in pupils. Now the Far West Laboratory for Educational Research and Development is developing twenty minicourses (Borg, 1968), to make this capability of process analysis and control in the classroom available to teachers. There is one minicourse that teaches teachers to use the Flanders' Interaction Analysis. There are others that teach teachers to create a questioning environment in the classroom (Minicourse #1), and to use the cognition-clarifying questions of Sanders (Sanders, 1966) based upon the use of the cognitive Taxonomy.

Thus in-service training projects can be organized to teach teachers to observe and direct their own use of verbal processes in the classrooms. If new concept-measuring tests are used, then teachers could begin to monitor the results in student learnings of their own classroom verbal processes.

NASA (Applications, 1968) pointed out that large school districts could test the effects of proposed programs in two ways; by adding more instruction and services to the system and/or removing existing instruction and services. To determine the cost-effective mix of controllable variables - programs, qualities of teachers, books, design and use of classrooms, different bases of grouping students (affective, socioeconomic levels and other) different combinations of these variables could be selected and tried out, controlling for nonschool influences.

Data are needed on the motivational and psychological influences in learning as they are related to educational development of individual students. This means a transition is involved toward a developmental approach to school programs.

Instructional Management Systems

The communications with which a student is instructed, tested, evaluated, etc. can be conceived as an instructional management system. Teachers can be helped greatly by having access to an instructional management system. Teachers are helped by turning over to the system the tasks of collecting and recording data on individual students, monitoring student progress and the place of the student in the program, and by information regarding lesson alternatives.

Accordingly, instructional management systems have been developed by several institutions.

Cooley and Glaser (1968) reported the development of a computerized information and management system for use with a program of individually prescribed instruction for elementary grades. The system is computerized and it is designed to provide prescriptions for individual study.

Hedges and Kane (1968) reported a system for primary-level pupils. The System Development Corporation has developed an instructional management system for public schools (Coulson, 1967). The system has been in operation since 1967 in the Los Angeles School District in the first four grades. It is computerized and can be used in a time-sharing mode to reduce costs. The system provides for self-pacing, assignment of children to ability groups, self-tutoring and assignment of remedial materials selected by the system.

Project PLAN (Program for Learning in Accordance with Needs) provides both instructional programs for the age range 6-18, and a computerized instructional management system. PLAN provides individualized instruction in which a student may decide his own course of study in conference with a

teacher, using the computer as an aid and a resource. Components of PLAN include: (1) educational objectives, (2) teaching-learning units as guides to achieve objectives, (3) tests that indicate whether objectives are achieved, (4) guidance and individual planning of instruction and (5) evaluation using an IBM 360/50 computer (Flanagan, 1968).

PLAN is a production of the American Institutes of Research and the Westinghouse Learning Corporation. Tryouts were reported in 14 school districts in 1967 (Flanagan, 1967), and have continued. By September 1970, four major programs will be in use through the entire grade range one through twelve; mathematics, language arts, social studies and science (Deep, 1970).

Limitations of Systems Approaches

Hartley (1969) pointed out that most literature on the systems approaches is descriptive rather than critical. It is easy to exaggerate the degree to which systems concepts can aid education. Systems approaches are a means, not an end, for achieving quality in education. Present limitations can probably be overcome. But the success of systems approaches still depends upon the artistry of the user, according to Hartley. Limitations include the following:

confusion over terminology
problems in adapting models
a wisdom lag
illusions of adequacy by model builders
inadequate impetus from the states
centralizing bias
unexpected costs
goal distortion
measuring difficulties
cult of testing
cult of efficiency
political barriers
shortage of trained personnel
teacher resistance

Limitations are far outweighted by the potential advantages in the system approaches (Hartley, 1969).

There are significant limitations in the heuristic strategies and systems capabilities of personnel of school districts. The four heuristic strategies that have been suggested are at most only limited tactical applications of NASA's creative General Strategies One and Three. No modeling is done, so evaluation of systems is deficient. The full power of the systems approaches cannot be known so long as the scope and nature of the work and the personnel is left at these levels. A distinctly amateurish quality can be anticipated in the systems work that is contributed by the school district personnel. The latter are not trained for and are not expected to be professional systems men.

The purpose of the limited heuristic strategies that have been suggested is only to make a beginning for the systems approaches in the training and daily work of the school district personnel and educators that serve them. If this beginning is achieved then school districts may be better prepared for the advent of the system-based Evaluation Centers that have been proposed in an earlier report. In the system-based regional Evaluation Centers that are staffed by systems professionals lies the hope for system-based public schools.

Chapter 3

New Process Curricula For Middle Schools

Progress in our democracy and in education must be measured by a different standard than in oriental despotisms or aristocracies. It is measured there by results gained for the "superior" people who hold social and political advantage, in terms of the degree of control of the rulers over the ruled. But it was the poor, the disadvantaged, the "people of no account" that were summoned to migrate to America. Their advance is our progress. The measure of schools should be the growth and development of all our children and youth. Aristocracies fulfill the potentialities of a few, but our democracy was founded to fulfill the potentialities of the common people.

But our progress has been largely confined to short-range material, rather than human goals. Like a primitive society, we have assigned greater value to things than to people, with increased anxiety (Lindgren, 1956). We have evidenced an urge to fulfillment, but the trend is not to wholeness. Man compartmentalizes his life and so becomes a menace to himself and to his society (Alford, 1969).

If we should think of the lot of our child in our schools, what do we find? Does the middle class child find opportunities for self-fulfillment? No, the child finds intense demands made upon him for proximate goals. Only 2 of 47 societies studied by anthropologists are more severe than our own in the demands placed upon children by their parents. From birth the child is prepared for the rivalrous society. A university degree, awards, scholarships and grades are required. If a child fares

Note: The opinions expressed here do not necessarily reflect opinion or policy of the Pennsylvania Department of Education.

badly in the race he is scorned by his own parents. If he is unsuccessful, he is regarded with contempt. Thus many good people have been broken and made into debris by society's insistence upon success. This race does not create human worth, but an empire of things, remote, cold, comfortless (Tennenbaum, 1969).

The situation is even worse with disadvantaged pupils. We should ask ourselves why Negro students are so full of pain that they have strong destructive feelings. Could it be that the source of their pain is grief over the death of their potential as individuals? "Successful" middle class people can settle for financial security in often luxurious surroundings and be reasonably content. But disadvantaged pupils often have only their pain and grief and a conviction that somehow the nation itself has gone astray from its true aim, represented validly if partially in themselves.

From the perspective of the majority of pupils, the view upward in our schools is often opaque. Ciampa (1969) said that students lose sight of their aim in higher education when they go through the maze of tests and examinations. This "way" of education caused at least 41 student suicides in New Jersey between September 1960 and June 1963 and possibly 738 suicide attempts. Students need to know more clearly their own individual goal in growth and development.

Curriculum makers have asked repeatedly for better definition of goals, but to no avail. What is the course of strategic development of fully functioning children? Are behaviorists correct in their insistence upon formulating thousands of precisely stated goals? Is it better practice

to formulate a few objectives for curriculum, especially in elementary education? Until we have an agreed strategy of human development, however, there is no good way to order long lists of objectives or the curricular activities with which they are implemented.

Progress in education must be measured by the degree to which the potential is fulfilled in each individual. But what is this potential that resides in a human being? What kind of character and personality does a person have when potential is fulfilled? What does one do when he is fully functioning, instead of compartmentalized? What can man become?

We need to restructure our concept of man and his potential. We need to rediscover Nature's plan for fulfillment and then restructure education to fulfill this maximum potential (Alford, 1969). We should provide our children and curriculum makers with a clear rationale about the nature of the meanings they can experience, the kind of man they can become and the processes with which this is done. We need a strategic view of man's becoming.

The available alternatives do not seem promising. Waller (1969) reviewed major approaches to the development of intellect. She said there are three: (1) factor analytic, Thurstone's primary mental abilities, e.g., (2) developmental, Piaget's theories, e.g., (3) learning theory, S - R paradigm in programmed instruction, e.g. Attempts have been made to implement each in the classroom. The Eastern Regional Institute for Education analyzed more than 350 process curricula and segments and is implementing a few in schools. ERIE utilizes an information processing paradigm for curriculum development.

None of these approaches attempts to give comfort or insight to pupils in our schools in the form of a rationale upon the nature of meaning or the nature of their own growth and development.

The problem is that there has not been proposed any true alternative. Curricula and evaluation are still based upon the same defective rationale that has formed the basis of organized education for centuries. If this statement provokes an emotional reaction it should make educators consider the following defects.

Process curricula are defective in their present conception. Processes are derived by logical analysis of the curriculum. The curriculum is the standard or reference that determines the nature of the processes that are selected. We make a normative use of curriculum and an instrumental use of a student, moving him through the curriculum or the list of objectives.

Objectives are derived logically from the curriculum. They are curriculum-centered.

Evaluation is defective. It is one-sided. It is focused upon the curriculum and this focus never changes regardless of the kind of tests that are used: diagnostic, norm-referenced or criterion-referenced. Even educational development tests do not really perceive the development of the student; they perceive his development with respect to the curriculum. Existing tests are curriculum-referenced. Evaluation is focused primarily upon the curriculum and only instrumentally upon the student.

The existing rationale of curriculum and evaluation is defective. It makes normative use of curriculum and instrumental use of students.

This approach should be reversed. We should develop a normative psychology and make instrumental use of curriculum to elicit the personal processes that ensue in self-actualization persons.

Objectives of this kind of approach are the processes that experimentation tells us a human being does when he learns and advances to his full potential.

Evaluation is process-referenced, i.e., students must be given opportunities to engage in the actual processes with which they interact with their environment. Features of these processes are measured by interaction analysis, e.g. Then new kinds of tests - process-referenced - must be developed.

There is another alternative that can be developed by experimentation. It has bases in psychology and the philosophy of curriculum. These bases and an essential kind of experimentation are discussed briefly.

Process curricula should be developed for middle schools based on the nature of man, the philosophy of curriculum and experimentation. No claim is made that a complete basis is given in the following comments. It is proposed rather to make curriculum the product of experimentation based upon these strategic views of the nature of man and curriculum.

Psychological Bases

The following suggestions are made as hypotheses, to stimulate thought and research and in the hope that some kind of strategic view can be provided to students and curriculum makers.

The proposed alternative can be summarized as follows. Man does have a basic Freudian nature, but his potential does not lie with that. He has another basic nature of which the principal feature at first is an appetite for exploration. What man becomes depends upon his interaction with the environment. Adequate opportunities for exploration lead to question and answer learning, decreased anxiety, increased motivation, and readiness for action, i.e., the beginnings of personality development. The process of learning is questioning, and the use of questioning strategies. Children learn to use an intensive internal dialectic, which consists of a child asking himself questions and then formulating data gathering questions which he asks orally. Man forms strategies and groups strategies into plans. There is a hierarchy of strategic behaviors that subsumes all of life. Man can become a strategy-bearing and strategy-living person, a learning system that is fully open to the environment, a person that has created new personality structures from the primitive id, ego and superego and has transferred control of his desires and impulses to the higher level cognitive functions of this new, fully functioning person.

To be an adequate, fully functioning person in our world, each individual must learn to ask a great many kinds of questions. To take an elementary example, one must ask the right questions in order to get a new roof upon his home or have his automobile repaired without being cheated. In the former example, speaking from experience, the key question is something like this one, directed to the roofing

contractor "Are you putting tarpaper under the shingles?" or "What is the real roof - the shingles?" If this key question is not considered, the homemaker is likely to buy a cheap but defective roof covering.

Man's Basic Nature

Sigmund Freud deserves credit for the first strategic breakthrough on the nature of man. He discerned rightly not only the structure, but also the processes with which it functions.

The central feature of Freud's insight is an internal dialectic of the id, ego and superego. The id is the true psychic reality in this dialectic (Hall, 1954). The focus of attention of the individual begins with the demands of the id rather than the environment. From the first occasion of experience of tension or need, through the period of exploration to find the object or conditions that satisfy the need, through the time of instrumental activity in which use is made of the object, to the experience of need reduction, the focus of attention remains fixed upon one's inner state instead of upon the environment. The result is a self-centered, pressured, spectator-type, stimulus-controlled individual who is largely unconscious of his environment.

The internal dialectic of the id, ego and superego is defective. Its purpose is not to deal with the environment, but to deal with the demands of the id, and the transactions of the internal dialectic. Accordingly, consciousness is limited in degree and kind. True, the primary process forms an image of the desired object and the secondary process attempts some degree of reality testing, but the representation

of reality is far from correspondence with the environment. Piaget (1952) has shown how far from reality these representations are and suggested cognitive operations by which one can be brought closer to reality, but that is a different story. By the Fruedian account, man's consciousness is a tempest in a teapot, largely out of touch with the environment.

The control of operations and decisions is one-sided. To recount the widely known story, the ego is activated by identification and the superego by parental prohibitions and identification. The tyrannical demands of the id are either discharged or they are controlled by the ego or superego. The id and superego attack the ego producing feelings of frustration and anxiety. To defend itself, the ego developes defenses: identification, introjection, aggression, deceit, etc. None of these mechanisms comes into existence to deal with the environment; the purpose of each is to deal with the internal dialectic. So behavior is controlled by the side of personality which usurps control. If personality is id-controlled, behavior is likely to be impulsive, irrational, selfish. If it is superego controlled, the result may be the rigid, authoritarian personality. If it is ego controlled, the result is likely to be aggressive behavior. Personality develops into sterotypes, the Hunter, the Sioux (Erickson, 1950), Economic Man, or some other kind of compartmentalized man. Personality develops from the results of the internal dialectic into some kind of one-sided compartmentalized individual, rather than a fully functioning person.

The basic failure of schools is that children are forced to settle for the Freudian nature because they have no other alternative. Values are introjected by students as a result of the exercise of authority that is part of any educational institution rather than working them out by valuing processes (Pilder, 1970). Process curricula are needed to provide alternatives.

Need-primacy theory has been criticized by Woodworth (1958) and White (1959).

Freudian views upon human nature are an essential beginning of a strategic understanding upon the nature of man, but they are not as adequate end of the matter. Man's potential as a fully-functioning person does not lie with inner adjustments of his Freudian nature; it requires release from its control.

An Alternative

There is an alternative human nature that lies along side the Freudian and only awaits adequate experiences of exploration to become a significant factor in development. Much human behavior, both playful and serious, is directed toward the environment without any intra-organic goal. The best evidence of this is children's exploratory behavior. The curiosity-investigatory motive is universally present in children. It is not motivated by an organic need like hunger, thirst or a desire for pleasurable bodily sensations. The immediate reward for exploration is acquaintance with the environment, freedom from anxiety and readiness for action (Woodworth, 1958).

How does one learn the environment? Exploratory behavior leads directly to question and answer behavior. The question and answer procedure for learning subsumes all the learning with which man deals effectively with the environment: perceptions, discriminations, sequences, place, cue, thing, concept problem solving and higher order insights and inventions. In sequence learning, e.g.:

> Our theory is that "question and answer are the key" to the problem: S_1 puts the question and S_2 gives the answer. S_1 arouses a questioning set, a readiness for some unknown S_2. Consequently, when S_2 comes, it is more than merely contiguous to S_1; it belongs to it as an answer belongs to its question. ...According to our familiar formula, $S_1R_1S_2R_2$,...the R_1 elicited by S_1 is an investigatory questioning response, and the answer is given by S_2 which supplies the incentive (Woodworth, 1958, pp 240, 258).

Typically the first thing that is learned in a sequence is the incentive.

Question and answer learning are the key to the understanding of learning and the development of personality.

Transformation of the Inner Dialectic

Freud showed us that the essential feature of the nature of man is an internal dialectic. Personality developes from the processes and results of this dialectic. If man is to be transformed so that he has alternative structures and processes, functions of the inner dialectic must be transformed.

Of what kind of dialectic is man capable? How can the self-centered Freudian dialectic be transformed?

The answer to this question was foreseen by Woodworth and has been used by many psychologists: Robert White, Jerome Bruner, e.g., Woodworth suggested that a human being can create or invent a search model. The model is used to control and organize the exploratory

behavior, the questions and answers utilized by the human being for insightful action.

Tenth graders and even younger children learn to play the experimental game "Twenty Questions" (Geisinger, 1964). This game requires the player to identify the object that is animal, vegetable or mineral by asking data gathering questions and to ask connected, related questions. With practice, the players learn that some questions are more significant that others; they are key or constraint-seeking questions, in Bruner's words. That is, if the object to be identified is in fact a robin, it is necessary for the player to ask "Is it a bird?" If this key question is asked, success is probable. If it is not asked, success is unlikely. Success in inquiry depends upon use of a constraint-seeking strategy.

Children learn to use a strategy to guide their formulation of questions. The strategy is key questions that a child asks himself. The strategy is used as an internal standard to analyze the information gathered from each question, evaluate the kind of additional data that are needed, and then form the basis with which the child formulates additional data gathering questions orally. Children can learn to use an internal dialectic of key questions (Geisinger, 1968). This is a search plan or model of investigation of the environment. The question and answer dialectic can engage the motivation and abilities of children wholly, transforming the Freudian dialectic to question and answer learning that is directed toward the environment.

The Freudian dialectic can be changed into a question and answer, strategy-using dialectic.

Some evidence clarifies the concept of the internal dialectic. Baker (1968) e.g., attempted to construct a computer model of concept attainment, using all the experimental evidence that is available. He found that the facile assumption of many people is incorrect, i.e., that most of the information that is processed comes from perceptions of the environment. Most of the information that is processed by a human being during the course of concept attainment is created internally by the subject. Baker pointed out that the psychological task is to determine what internal information is created and how it is processed.

Geisinger (1968) attempted to measure the internal dialectic with which tenth graders play the experimental game "Twenty Questions" using a Test of Constraint-Seeking Strategy.

The Strategic Nature of Man

Acknowledging their debt to Woodworth, Galanter, Miller and Pribram took a year out of their busy professional lives to prepare Plans and The Structure of Behavior. They wrote that man is a strategic animal. Man forms strategies and plans with which he directs and controls all his global behaviors. To bridge the gap between the "image" and behavior, to make "subjective behaviorism" possible, it is justifiable in experimental evidence to conceive of man as a creature of strategic operations. Considerable research has been stimulated by the proposal.

The "image" is the accumulated organized knowledge than an organism has about its world. A "plan" is any hierarchical process that has control of the order in which a sequence of operations is performed.

Where do plans come from? These come from values, intentions, skills and habits. They come from learning to remember, speak, solve problems and seek information. They come from "metaplans," plans that generate plans. They come from heuristic rules and procedures, and all these must be studied, for most of man's searches are conducted according to heuristic plans, as contrasted to algorithmic rules.

How are plans formed? Strategies and plans are formed by grouping TOTE units. A TOTE unit is a cybernetic Test-Operate-Test-Exit unit which serves as a feedback unit. Therefore, man is to be understood as a behavioral system that is open to the environment. Man's nature is potentially strategic. This concludes the summary of Plans and the Structure of Behavior.

It is suggested in the spirit of an hypothesis that there are at least four levels, or taxonomies of strategic behaviors. Each level is hierarchically organized and the abilities to perform at the higher levels depend upon abilities to perform at lower levels. Each level consists of asking questions that are characteristic and distinctive for that level. The hierarchies of strategic behaviors are listed in Table 1.

TABLE 1

Hierarchies of Strategic Behaviors

Religious
Philosophic
Problem-Solving
Clarifying

To realize our basic humanness, each of us must live fully upon all of these strategic levels.

The lowest level of strategic processes is the clarifying. The nature of cognition-clarifying questions has been illustrated by Sanders (1966), who discussed the use of questions to induce students to engage in the processes of the Bloom Taxonomy. When the teacher uses cognition-clarifying questions, the student will learn at the higher levels of the cognitive taxonomy: comprehension, application, analysis, synthesis and evaluation. The Bloom Taxonomy is a necessary but not sufficient condition for fulfillment of the clarifying level of strategic operations.

On a horizontal level, the use of cognition-clarifying questions should extend to all distinct realms of meaning (Phenix, 1964). These are the content of clarification. Phenix described six, of which more will be said subsequently.

Only recently has it been appreciated that children need to think out their values for themselves and this process of value clarification is essential to the healthy development of every child.

If human beings are to have a workable alternative to learning their values by introjection, an unconscious process of the Freudian dialectic, they need opportunities to learn by valuing processess. Man is a valuing animal.

In the fast pace of work and play, television and travel, and in the confusing value conflicts that are rife in our nation, children may find it difficult and need help in thinking out their values. On one end of a value continuum are children who are confused, inconsistent, apathetic, irrational, overconforming, etc. These may be subject to a common "malady" of confusion in values. Many underachievers are included in this group. On the opposite end of the continuum are those who are

clear in their values and standards. These individuals are positive, purposeful, enthusiastic and proud. Children can be moved to the positive end of the continuum by valuing processes (Raths and others, 1966).

As children experience valuing processes, they move toward value clarity and advance toward psychological and ethical maturity. Attitudes toward learning, perserverance, active participation, practices of raising questions and self-direction of activity improve (Raths and others, 1966).

Value-clarifying questions are the same types of questions with which inquiry is done in other activities. Raths and others discussed choosing, prizing and acting questions. If one analyzes the action type clarifying questions used by teachers, it appears to this writer that most of them, if not all, engage students in the categories of the Bloom Taxonomy, i.e., the action type questions can be classified as those inducing the processes of the taxonomy: knowledge, comprehension, application, etc.

Above the clarified learnings are the problem-solving strategies. Included in these processes are all those activities that include definition and formulation of a problem, development of a hypothesis, testing of a hypothesis and evaluating the hypothesis. Again the content upon which these processes are used is the realms of meaning of human experience, all those relevant activities upon a horizontal level, not just confined to one science, or to science alone, or to any single intellectual endeavor.

Knowledge that has been clarified and has been successfully used in problem-solving activities can be evaluated at the philosophic level. The taxonomy of philosophic activities is unknown in precise terms to this

writer, probably due to the writer's lack of acquaintance with the literature in the field. To this writer, the philosophic processes include the domains of the philosophies of science, religion, ethic, morality and law. They also include the immense domain of heuristic strategies and methods that comprise the system approaches and the kinds of thinking that executives and managers use to conduct the affairs of great institutions.

More specifically, it is philosophic activity with which one generates the needs, procedures, programs, results, value and consequences of alternative strategies and compares the alternatives. It is philosophic thinking when one considers several strategies and asks oneself, if I do so and so, then. . . .

Choosing, prizing and deciding upon values and organized systems of values are philosophic activities. Combs and Meux (1971) pointed out that the development of activities for value analysis is an integral aspect of ego development. The capabilities for value analysis depend upon the stage of development and fully rational value judgment is achieved only at the highest stage of ego development.

At lower stages of ego development, a teacher can expect students to have difficulties in performing the tasks of value analysis. At the concrete stage students have difficulties in using abstract criteria and principles.

If America wants its children to develop into citizens that value democracy, lawfulness and the rule of law, moral and ethical behavior and real social community, then America must provide educational experiences in which most students in the schools become fully functioning persons that

have achieved something near their fullest development of personality. Any stage of development of a child that is less than this results in a child that has serious difficulties in valuing processes and in moral and ethical development. Every man and woman has to be an effective philosopher every day. Therefore, the main task of the public schools must be personality development, rather than salable skills on the job market.

Children need opportunities for working out moral dilemmas. Kohlberg has a useful six stage scheme of moral development that is based upon the way value is placed upon the concept of human life. This set of constructs should be used and evaluated with the development of each child so that individuals are placed at their particular stage of development and experiences are selected to help them advance in and through the stages of development.

It is philosophic thinking that every one must do to consider alternative strategies of making a living, choosing a vocation, getting along with people, making moral and ethical decisions, and selecting and committing oneself to one particular set of values. After prolonged and effective strategic thinking of these kinds, an individual can formulate a reasonably mature philosophy of life.

A philosophy of life is an internal (or internalized) standard of values and goals that one uses daily to anlyze and evaluate his choices. It is the central basis of the internal strategic dialectic.

It is a mistake to think, if anyone does, that a mature person is primarily one with salable skills, e.g., command and control over people. Even when this skill is highly developed, the individual is an unprincipled

autocrat who remains compartmented, an individual who exploits others primarily to feed his egotistic self-love. Under these assumptions, the societal result would be an autocracy, controlled by specialists in specific skills.

It is a mistake to think, if anyone does, that only the leaders of life need to develop into fully functioning strategic persons. If that were accomplished and all our leaders were such persons, they would be unable to communicate with the mass of people who would have difficulties thinking about values and moral and ethical principles. The societal result, under these assumptions, would be another aristocracy developed in America which was founded as an alternative to aristocracy.

To make a democracy secure, every individual must have adequate opportunities to develop his strategic abilities and his personality structure to some stage that is near each person's maximum potentialities. Thus each individual needs opportunities to work out for himself the values and ideology with which the nation was founded, not through direct influence, but through comprehensive questioning and comparison of strategies of alternative ways of life until each individual chooses the democratic values for himself.

This strategic view of man says that meaning is a very personal achievement. It is gained by and is related to the strategies that are used to construct these meanings. Take the experience of playing "Twenty Questions." The result, the object is a robin, e.g., embodies all the data and meanings gained in the course of inquiry. If one doubts the validity of the conclusions and accosts the student with doubts about the validity of his perceptions and logic, the student can

review the significant questions and the associated answers. There is the class question, the question on distinctive characteristics, the question on attributes, the question on instances and the question of deduction. The object was a bird, it has a red breast, gray wings and flew north in the spring. Now what bird has a red breast, gray wings, flies north in the spring? Why that is a robin. Now just try to argue with the student about the relativity of his processes. If an outsider is skeptical, the student will ask himself the question, "Have I asked myself all the significant questions that I must ask?" Then he reviews the strategy he has used and concludes that he has followed the strategy effectively, so that the meaning he has found is valid. So meaning is a personal achievement that is related to the strategies one uses as he learns.

This strategic view of man can impart wholeness and integration to the individual and to social life. It can produce an integrated, fully-functioning personality and overall strategic plans that society must have to function and build civilized life. Just as an individual achieves certainty through evaluation of his strategies, so does a society agree together upon an ideology, a set of strategies with which they perceive and confront the world.

The strategic view of man can fulfill the urge to self-actualization. The goal of learning and development can be achieved by means of strategic processes of question and answer learning. If students have adequate opportunities to ask questions, if they can deal effectively with certain moral, ethical and religious problems, if they can create a viable conscience that serves as an internal standard in the manner already

mentioned, then new personality structures and processes are created; something like the self-concept, the ideal self-concept and the creative-self of Adler, in contrast with the ego, the superego and the id, respectively. With their processes, these new structures form a new, more conscious, more balanced, better integrated entity called selfhood. Youth should be urged to live for their own best self (Rogers, 1972).

The struggle for selfhood is a quest for being. It involves advances through levels of meaning, so it is a struggle for increased consciousness. It requires decentration from the internal dialectic of the id, ego and superego and it is a conflict against the continuous danger that one side of personality may gain control. It is a struggle for balance and completeness of structure and function. It requires coordination of the three general system strategies and the use of related strategies in an unfamiliar context of adjustment. If secondary school students can achieve selfhood by the time of their graduation, they are probably doing well. The goal of secondary education is selfhood for each student.

Selfhood can advance to personhood. If students can succeed in transferring control of their decisions and purposes from the Freudian dialectic to the questioning dialectic, if they can succeed in certain moral, ethical and religious problems, then the new entity can be created: personhood. Personhood is a quest for self-actualization; it is a continuous becoming. It is the rule of the self by the creative self in processes of becoming. The selfish self is transformed by the emergence of the creative self to a self that deals effectively with the environment; that is created specifically for that purpose.

The creative self assumes control in personhood of both the standards of conscience and of one's unique self-actualizing style of life. Personhood is each individual's uniqueness and selflessness. If a student can achieve personhood by the time he completes university training, he is probably doing all that can be expected of him. Personhood is the goal of higher education for each individual.

The Stages of Personality Development

What do these ideas mean for selection of curricula?

The answer to this question lies in the strategy that man develops in stages.

In Freudian terms, Erikson has said that a healthy personality develops in terms of stages of ego crisis. If the individual resolves the crisis at each stage he advances to a higher stage of development. The first two stages deal with very young children, and the third stage deals with children 4 and 5 years of age. The fourth stage describes essential features of the problems confronting elementary children and the fifth stage keynotes development through adolescence. The last three stages deal with persons who are adults in age.

Tests exist and have been used with which individuals can be identified and placed in the stage of development that is characteristic of them.

These stage constructs or theories of Erikson are useful approximations that have received partial construct validation and do represent something real or correspond in some manner to features of real development in human beings. Apparently, the sequence is invariant for people of many nationalities and it does appear to represent development of personality

from an affective point of view. This writer therefore interprets the Eriksonian stages as the primary foundations that are essential to the development of strategic operations.

Associated with the healthy development of our Freudian nature is the taxonomy of motivation that was first described by White in his construct of competence. Wherry and Waters (1968) announced partial construct validation of this approach. Similarly, Kellerman and Plutchik (1968) attempted to validate a construct of eight primary emotions that can form lasting personality traits. Welsh (1971), Holland and others have reported circular relationships of certain personality traits and vocational interests. The exact relationships of these theories to the Freudian and other stages of development have not been worked out.

What the writer is suggesting is an extension of that which has already been proposed. Children develop in stages and within the stages they develop in taxonomies. It is essential to identify the stages and the taxonomies with which they develop. Then the programs of the schools can be designed to help children develop in and through their individual stages of development.

The second essential foundation to the strategic operations is the Piagetian stages of intellectual development.

Before a child can learn strategic operations, he must be able to perform Piagetian-type formal operations. The abilities to do formal operations depend upon intellectual operations learned at lower stages in the Piagetian constructs.

Like the Freudian and strategic operations, the Piagetian constructs are an interactional theory of development. A child learns by interaction

with his environment, his peers, family and teachers, rather than by direct learning of external structure or by innate patterning. Some experimental programs have made a mistake in attempting to use the IQ as a criterion measure and use instructional treatments to increase the IQ. The interactional concept of stages is a better approach because the sequence of stages is invariant and richer stimulation can lead to faster advances through the stages (Kohlberg, 1968).

Elkind (1971), who has done distinguished work with the Piagetian constructs, interpreted the intellectual tasks of the child in the light of Piaget in the following manner: from birth to 2 years of age, the child creates objects; from age 3 to 5, the child creates symbols; from age 6 to 11, the child creates rules, logical rules in the personal, social and school domains; from age 12 to 15, the child creates the formal logical operations. The latter constitutes what Elkind called a second order symbol system. These comments may help to interpret the meaning and application of Piagetian constructs to the schools.

Rowland and Maguire (1968) described the Piagetian stages of development. These are the sensori-motor, the preoperational, the concrete operations and the formal operations.

Piagetian-type development is prior to and essential to the development of certain skills, like skills in reading, writing and mathematics. There is difficulty in teaching a child to perform certain types of algebraic operations, e.g., before the child has achieved conservation of the concept of number.

The purpose of the schools is to help all children to develop into fully functioning persons on all essential dimensions that make a

responsible, mature, moral and ethical person. Little or any of the programs of the schools that aim at development of salable skills is relevant to this purpose or to the children in the schools.

The meaning of relevance for the schools lies in the strategies that children develop in stages and in taxonomies within the stages. These stages are the Freudian stages of development, the Piagetian-type stages of intellectual development and the stages of strategic development. Instruction is relevant that helps a child at his stage of development.

The theory of stage development should be used as a guide to select experiences so a child can grow through the stages. Buell (1967) said this of the Piagetian theory. It should also be used as a strategy for application to the Freudian stages of development that are conjoint or perhaps prior to the Piagetian and also for the strategic stages that are subsequent to the other two stage theories.

Could it be that we have made a mistake in educating children and youth primarily for salable skills in the labor market? The fully functioning individual is much more rare, much more difficult to produce, much more valuable than the individual who is highly skilled in some specialized sense. The latter is likely to be compartmented, stunted in significant strategic processes; the development of a conscience, the transfer of control from primitive Freudian desires to the more conscious structures of personhood, advanced religious achievement and civilized character. It is these achievements that are precious beyond measure, of the highest value. It is suggested as a hypothesis that the worth of an individual, and his income from society, should not be determined by his excellence for instrumental use to please or serve us; it lies

rather in his unique personhood and his further processes of becoming. And the value of a civilization is not proportional to the roads, buildings and cities that it constructs, but in the quality of people it produces.

Philosophy of Curriculum

In the quest for better education, the new school in the middle finds its real opportunity and challenge. New kinds of practices can be tested, modified and used in modified form in the lower and upper levels of schools. The middle school should be seen as a testing ground for new programs and practices (Alexander, 1969). It could become a landmark development (Atkins, 1968). If we change schools, we should change them in the direction we want them to be tomorrow. Therefore in defining the middle school, attention should be focused not on grade levels, but on individuals, on their psychological and social maturity (Brandt, 1968). "The middle school must be defined on the bases of educational philosophy and psychology," (Gastwirth, 1966).

There is danger that the college preparatory function may be imposed upon the middle school, that the middle school will become another junior high school. The middle school has its own concept that differs from the concept of the junior high and the elementary schools. Teaching basic skills of the three R's could be terminated at grade 4 to free the middle school to develop its own concept (Brimm, 1969). Innovation can bring about only inconsequential changes so long as educators and citizens think that education must be obviously practical, immediately useful, oriented to vocations and ordinary problems of living (Johnson, 1967).

There has been much emphasis upon objectives dealing with disciplines of knowledge. While some features of the emphases are good, educators must not

lose sight of the fact that basic deficiencies still remain in the discipline centered approach to curriculum. The deficiency is a central one, because normative use is made of the curriculum and its objectives, and students are evaluated, not in terms of their own growth and development, but in respect to the curriculum, which is the standard. Thus normative use is made of curricula in our schools, while instrumental use is made of students.

Process curricula have been proposed, ERIE, e.g., to obviate this particular difficulty. Skills are emphasized that a learner uses to acquire information, content and generalization to cope with his world. But the objectives of this approach are still derived from the curriculum, and the processes the learner uses are not those that the learner actually uses to interact with this world. Processes are imposed as a logical means to learn the curriculum. Process curricula still make normative use of curricula and instrumental use of students.

The primary goal of this proposal is to elicit processes of knowing valuing and conating. Because the goal of these horizontal levels of strategic processes is clarification, the second goal of process curricula is to create the clarifying educational environment. Because the first learning that one does is the incentive value of what is learned, perhaps the primary domain of learning in which to begin is the domain of values. Long-range goals are selfhood and personhood for each learner. Curriculum activities are selected through normative use of the learning model of the learner already mentioned.

To teach teachers to create a cognition-clarifying environment, the Far West Laboratory has developed a minicourse model (Borg, 1968).

Preliminary results with the model indicate that teacher behaviors can be trained effectively in 75 minutes a day for 15 days. The minicourse model is effective.

To create the clarifying educational environment, extensive use should be made of the minicourse model. Twenty are under development by the Far West Laboratory. Teachers can be trained effectively and at minimum cost by means of minicourses. The minicourse technology should be extended to the valuing and conating processes.

Children and youth need opportunities for extended exploration of our world. To guide exploration and the search for meaning, the approach of Phenix (1964) seems quite well suited to the question asking nature of man. It is tentatively accepted in its main outlines subject to experimental confirmation and some revisions.

Phenix (1964) said that it is our essential nature to experience meanings and education is the process of engendering meanings. If all possible modes of human understanding are analyzed, it is clear there are at least six realms of meaning. To be fully human, each individual should live concurrently in each realm. A complete person is skilled and fully functioning in all realms. Through concurrent development in each, an individual would perceive and live in terms of the wholeness of life and continue in the same terms. Thus learning turns from compartmentalization to wholeness of meaning.

Meaning does not appear automatically in a human life. Man is threatened by meaninglessness in all realms. Anxiety is then intensified. The antidote to anxiety is attainment of meanings.

When the realms of meaning are identified, they include the following:

(1) symbolic, (2) esthetic, (3) empirical, (4) synnoetic (personal meanings), (5) ethical, (6) synoptic. Each realm has its distinctive ideas and methods of inquiry. The disciplines are classified as examples of the realms.

The realms of meaning serve as the logical basis for planning and executing a program of general education. Materials should be selected to provide experiences concurrently in all realms. Selection principles are stated. These comments complete the summary of Phenix's philosophy. Those who desire more complete discussion should consult the book.

Several revisions are envisaged. First the realms of meaning must be augmented by at least one realm. Place must be made for the realm of system approaches. The term "system" is a construct that is very useful in all realms of meaning, for problem-solving and for decision-making. System approaches attempt to see an entity whole, a child as an open behavioral system, e.g. Included in the realm would be studies of heuristic strategies of all kinds.

The methods of selecting goals and objectives of education should be changed. Goals of education should be selected in terms of stages of development, beginning with the Freudian and the Piagetian stages. When there is evidence gained that progress through these stages has been sufficient to provide the individual child with the abilities to learn certain basic skills, then goals can be formulated for achievement of particular basic skills that fit with the Freudian and Piagetian stage development. The skill goals should be formulated subsequent to and contingent upon achievement of the stage developments.

There will be separate and distinct sets of goals for each stage of

development and for each sex. Women are different from men and they need opportunity to develop their distinctive differences.

After large or general goals have been selected, objectives of instruction should be selected for development of the taxonomies of behaviors that are characteristic of development within each stage.

Piagetian-type curricula should be constructed for preschool, grades K-4 and grades 5-8. These would aim to form in each child the abilities to function fully in all the stages of Piagetian development, including formal operations. Curricula that are designed for skill development in reading, writing and mathematics in grades K-4 should be developed as adjuncts to prior achievement in Piagetian curricula and affective curricula and should be designed for 90 per cent of students to achieve 90 per cent of objectives as in many programmed curricula. School programs, rather than students, should be evaluated for their effectiveness in creating skills of reading, writing and mathematics with essentially all students by the end of the 4th grade. Ineffective programs and schools would be either revised or terminated.

Another revision would abolish the distinction between formal and informal curricula. In many elementary schools, the teachers do 90 per cent or more of the talking. The curriculum is what the teacher does and the students are expective to be passive, receptive and do what the teacher tells them. This concept should be changed so that the curriculum is what the student does and the teacher serves as a consultant, facilitator and clarifier for the students. A wide variety of informal, semiformal and self-instructional media packages can be developed.

If as many communications as possible were consigned to media and the teacher was taken "off-line," then costs of instruction should decrease through severing the direct connection between the number of pupils to be instructed and the number of teachers that are required, i.e., the pupil-teacher ratio.

The first new curricula to be developed should be designed for affective learnings. Glasser (1969) and Bessell and Palomares (1969) have proposed a new type of semiformal method of instruction that appears to have much promise for affective, clarifying and other types of learnings.

Glasser (1969) suggested gathering students in a tight circle for social problem-solving meetings, open-ended meetings and educational-diagnostic meetings. These meetings can be used to create opportunities for children to ask and to consider many kinds of questions in many areas. The relevance of particular things the students study can be thought out. The discussions promote children's involvement, help them to feel that their opinions and feelings are important, help children to become more conscious of their thoughts, feelings and opinions, to clarify their values, etc.

The circle approach of Glasser has much to commend it. It may also have some limitations in that it seems based upon a counseling model and seems to aim at treatment, requiring skills in psychology that many teachers may not possess or be able readily to acquire.

Bessell and Palomares (1969) also use the tight classroom circle for affective development. The approach is also based upon a particular psychological model which may or may not be adequate. Considerable progress seems to have been made to convert from a counseling approach

to an instructional one. "Magic circle" programs are now available for preschool, Kindergarten and grades 1, 2 and 3. Guidelines and training are available for teachers and for working with parents and the community. There are instructions how to deal with the rest of the class that are not included in the instructional circles.

This "magic circle" method of instruction varies from informal to semiformal in nature and it has great promise for dealing with higher level objectives in the cognitive taxonomy, values, many interactional objectives, and of course the primary purpose for which it was first proposed, affective development.

Many more circle programs should be prepared and evaluated. Other models than that of Palomares may prove helpful, but Palomares' courses seem full of value. Circle programs should be developed for value clarification, as has been suggested by several workers, e.g., Sid Simon and Richard Davis.

Circle programs should be developed for the middle school to help students establish relevance of their lives to the world, to vocation, to help students to learn their roles in life as peers, family members, health identity, self-concept, and the beginnings of a philosophy of life.

Of particular importance in the middle school is the Eriksonian stage of identity crisis. Students will remain confronted with this crisis in many forms until it is resolved more or less effectively in or after college years. The circle approach can be used effectively to deal with this many faceted crisis, to resolve drug, alcohol and other excesses or abuses. Circle programs should be developed and used extensively in the middle school.

CHAPTER 4

SUMMING UP: CONSTRUCT VALIDATION OF THE NATURE AND POTENTIALITIES OF HUMAN NATURE

Major breakthroughs have occurred since 1958 in scientific discoveries regarding human nature, evaluation and testing. While none of these discoveries can be viewed in normative terms or as final answers to key problems, there is some reason to believe that they just might be utilized together as heuristic principles and methods that might achieve construct validation of the nature and potential of human nature.

The combination of heuristic system approaches has reached new heights in the successes of the National Aeronautics and Space Administration. Beginning with the X-15 rocket plane, experimental data were collected and incorporated into computer simulators. To extrapolate the known data to its limits, these simulators were used at the limits of their parameters to obtain engineering data with which to upgrade the X-15 to a suborbital craft. Then the suborbital spacecraft were constructed, flown and observed, the computer simulators were modified and run again at their maximum limits to obtain data with which suborbital spacecraft could be upgraded into orbital spacecraft and finally spacecraft that could land on the moon and return. In this fashion, the system approaches furnish heuristic principles and methods for rapid upgrading of complex man-machine systems.

If the major breakthroughs in science regarding human nature, evaluation and testing were used for a NASA type institutional research program of construct validation of the nature and potential of human nature and the results were incorporated into computer simulators of individual humans, then it is conceivable that we could develop Americans that would function near their maximum potentialities.

Comprehensive construct validation R and D projects can now be

envisaged using new breakthroughs in science with system approaches.

This prospect became technically possible when partial validation was reported with constructs of Freudian and logical stages of human development and with constructs of hierarchical taxonomies of educational objectives. Since construct validation is validation of a theory, the methods of evaluation and the tests that are used, the implications of these reports are that comprehensive construct validation research and development just might succeed in construction of a comprehensive view of human potentialities with the instructional systems to realize them.

It is possible to fit all these constructs, scientific methods and tests together in a way that has these possibilities.

Significant advances occurred recently when partial construct validation was reported for Erikson's (1950, 1968) stages of Freudian development (Boyd and Koskels, 1970; Constantinople, 1969). This model envisages six critical stages of ego development for an individual. The more successful an individual is at resolving the crisis at each stage, the greater his degree of psychosocial maturity.

Partial construct validation was reported by Wherry and Waters (1968) for White's hierarchical construct of motivation. Similarly, Kellerman and Plutchik (1968) reported partial construct validation of the nature of human emotions. Using the radex theory of Guttman (1954), Plutchik proposed a model which says there are eight primary emotions. Personality traits are formed when two or more of the primary emotions are mixed and the mixture persists in time. Characteristics of the model are perceived in circumplex structure.

Partial construct validation has been reported for the constructs

of the id, ego and superego by Signori and Schwartzentruber (1969). Response test items were devised for life situations that were characteristic of the actions of the id, ego and superego in a variety of moral situations.

Kropp and Stoker (1971) reported partial construct validation of the Bloom taxonomy using the radex theory of Guttman. Thus it is reasonable to inquire whether man does indeed develop in stages and in taxonomies and what is the nature of man when he functions fully in these terms.

The modern breakthrough in this area probably began with the fine work of the psychologist, Robert S. Woodworth. He said there is another nature in man that lies fallow, waiting for development. The principal feature at first is an urge to explore, which is not based on drives, our elemental nature. Exploratory behavior leads directly to question and answer behavior. Question and answer learning, he said, subsumes all learning with which man deals with the environment: perceptions, discriminations, sequences, place, cue, thing, concept, problem-solving, higher order insights and inventions, etc. What man becomes depends upon his interaction (question and answer learning) with his environment. In sequence learning, e.g.:

> Our theory is that "question and answer are the key" to the problem: S_1 puts the question and S_2 gives the answer.
> (Woodworth, 1958, p. 240)

Question and answer learning are the key to the understanding of learning and the development of personality (Woodworth, 1958).

Adequate opportunities for exploration, for question and answer learning, lead to development of a search model and to transformation of our elemental human nature (Woodworth, 1958).

Freud showed us that the essential feature of the nature of man is an internal dialectic. Personality develops with the processes and results of the dialectic of the id, ego and superego. Since the purpose is to deal with the demands of the id, this structure of man is self-centered, limited in consciousness of the environment. If man is to be transformed and become fully conscious, fully functioning, this Freudian dialectic must be transformed.

How can this dialectic be transformed? Of what kind is man capable?

The answer to this question was provided by Woodworth who suggested that a child can create or invent a search model which is used to control and organize the exploratory behavior. Acknowledging their debt to Woodworth, Galanter, Miller and Pribram suggested that man forms strategies and plans with which he directs and controls all his global behaviors. Man can be conceived as a creature of strategic operations. These strategic operations are sequences of key questions. Success in inquiry depends upon the use of question-asking strategies (Geisinger, 1964, 1968). Thus, the Freudian dialectic of the id, ego and superego can be transformed into internal dialectics of questioning strategies (Geisinger, 1972).

What is the connection between this construct of the strategic nature of man and the Freudian construct? Man's potential does not lie with adjustments of his Freudian nature. It lies with development of his strategic potentialities.

Transformation of the dialectic into strategic operations is hypothesized to lead toward development of new, more balanced and conscious structures and processes of personality; something like the self-concept,

the ideal self-concept and the creative self of Adler. If this development proceeds far enough to transfer internal control from the Freudian dialectic to the strategic operations and certain problems of ethical, moral, religious and social nature are resolved, then some authors believe new entities of personality can appear: selfhood and personhood.

What is the relation of the construct of strategic operations to the Piagetian constructs of logical thinking? While all the difficulties are not resolved, partial construct validation of the Piagetian stages of development has been reported (e.g. Siegelman and Block, 1969). Piaget's developmental theory when "liberalized" and interpreted in functional semantic-pragmatic terms can account for data that neither the non-Piagetian cognitive approaches nor the neo-behaviorist theories can explain (Pascual-Leone and Smith, 1969). The Piagetian constructs are suggested to be essential stages of development prior and essential to the development of strategic operations. Overarching above Piagetian-type formal operations are the stages of strategic operations.

What are the stages of development of the strategic operations? While these cannot be viewed in normative terms, it does appear possible to hypothesize four hierarchical levels of strategic operations:

1. Clarifying
2. Problem-solving
3. Philosophic
4. Religious

(Geisinger, 1972)

The goal of the lowest level of strategic behavior is fully clarified knowledge in all realms of meaning and value, fully clarified affective and motivational structures. This is achieved by adequate experiences within the Bloom cognitive taxonomy and the Krathwohl affective taxonomy.

These are essential but possibly not sufficient to achievement of clarification.

Qualitatively different are the problem-solving behaviors. Essential, but possibly not sufficient behaviors are the hypothesis formation and testing activities.

Philosophic strategic operations are used to evaluate the strategies one is using for clarification and problem-solving and to test for meanings in the relationships of these strategies. By philosophic activity, moral and ethical meanings and strategies are formulated and grouped into plans. A philosophy of life is formed and an ideology of group life is formed. Just as an individual achieves certainty and integration by evaluation of the adequacy of his strategies, so does a society achieve certainty and integration through achievements of an agreed ideology on the meaning and purpose of group life.

The ability to reason in moral and ethical matters appears to require upper level logical and strategic abilities. Hardeman (1972) reported that 142 first grade middle class children were tested for Piagetian conservation abilities and for moral reasoning. Nonconservers tended to make lower moral reasoning scores. The data showed that cognitive operational structures play a role in moral concept development. Stuart (1967) reported that the ability to decenter (a Piagetian term) and particularly the ability to decenter social relations is positively correlated with the ability to render moral and causal judgments for children in grades 2-8. Kohlberg (1958, 1969) proposed a stage theory of moral development. His data showed that the sequence is invariant with individuals in the United States. Progression through

the stages depends upon the way in which value is placed on the concept of human life. Adulthood sees movement toward integration in the use of moral structures and thought in their application. To this writer, the achievement of competence in moral and ethical matters is evidence for competence in philosophic strategic processes.

While partial construct validation has not yet been reported for the strategic stages of development, there are breakthroughs reported in evaluation and testing that may result in success.

The purpose of secular education may be to aid each citizen in a democracy to develop his strategic nature through the level of philosophic strategies so he is able to participate fully as a moral individual in a moral and ethical society. These constructs might be validated in terms of the goal of secondary education as attainment of selfhood and the goal of higher education as attainment of personhood.

The goals of Christian education can be seen in similar terms as development in and through stages of religious development (Geisinger, 1969). Opportunities for these achievements might be provided by churches.

In summary of the breakthroughs on the nature of human nature, it has been said that partial construct validation has been achieved on the constructs that man develops in stages and in taxonomies. These results include stages and taxonomies of Freudian and Piagetian type development and are proposed to include levels of strategic operations.

BREAKTHROUGHS IN EVALUATION

Children and youth develop in terms of stages and within the stages they develop taxonomically. It is possible to test groups of children

and evaluate the stage and the taxonomic levels for each child.

When this is done in terms of the stage of Freudian development, e.g. the placement of a child at a particular stage has the effect of informing an evaluator where the child has progressed in his genetic development, i.e., what problems or crises he has resolved and which ones he still must encounter. If combined with process measures of the id, ego and superego and with measures of moral and social development, the evaluator should also be able to estimate the relative control over the personality exercised by the id, ego or superego, the degree of self-centeredness, the probabilities of psychosis, narcissistic egotism and delinquency. Freudian-type evaluation should be comprehensive enough to diagnose emerging extremes of behavior, i.e., the kind of person that is being produced in the total environment of each child.

Similarly, the stages of cognitive and strategic development should be assessed and each individual in the schools should be placed at his particular stage of development. Since human beings develop in many realms of meaning (Phenis, 1964), the means of evaluating human development (taxonomies?) should be constructed for each realm.

Secondly, hierarchical cluster analysis can be used to partition a global criterion or predictor variable domain instead of factor analysis (Campbell, 1969). Conventional methods of factor analysis cannot be depended upon to recover the real structure of a set of variables (e.g. Tryon, 1935, 1958; Guttman, 1954, 1958; Bentler, 1970).

What kind of hierarchical cluster analysis yields the most information and is most helpful?

The clustering method of B. C. TRY (a set of computer programs) by

Tryon (1958) does what factor analysis purports to do but may not succeed in doing; it clusters variables on the basis of empirical relationships between them. Excellent test item statistics are provided with which the minimum number of test items can be selected to accomplish measurement of a cluster at specified levels of reliability and validity and the exact contributions of each test item to reliability and validity measurement of a cluster are computed.

While B.C. TRY appears to this writer to be a significant advance over popular methods of factor analysis, it does not have the capability of detecting hierarchical structures of taxonomic variables.

How can hierarchical taxonomies be statistically analyzed? Taxonomic goals of education can be formulated and evaluated as radexes using Guttman's (1954) radex theory and the smallest space analysis computer programs. These can be used for construct validation of hierarchical taxonomies.

The SSA programs use order factor analysis instead of common factor analysis. Only ordinal data are required instead of the higher level data that are assumed by factor analytic methods.

The radex theory says that a radex is a circumplex and a simplex varying at the same time. A circumplex varies in a dimension of process, like tests of verbal, numerical and reasoning abilities. A simplex varies in a dimension of complexity like tests of addition, subtraction, multiplication and division.

SSA computer programs use a computational breakthrough provided by Shepard (1962).

Third, strategic behavior can be induced and evaluated in classroom

verbal discussion. This is in accord with Kohlberg's (1968) suggestion that an interactional theory of developmental process must be used to explain a child's ontogeny. A child learns by interaction with his parents, peers and teachers, rather than by innate patterning or learning of external stimuli. An interactional concept of stages differs from a maturational concept of stages in that experience is necessary for the stages to take the shape they do and richer stimulation leads to faster advances through the interactional stages involved.

If development of formal curricula must wait for successful construct validation of every cell in the above model of human operations, this piece-meal approach may never be concluded. But children learn their higher level taxonomic objectives readily by verbal interactions. These can be provided by emphasis upon informal instruction in which teachers use skills of verbal interaction.

Children give verbal cues which can tell a trained teacher exactly what learning objective a child is ready for. Cues have been provided by various researchers (e.g., Raths and others, 1966; Gantt, 1969; Sanders, 1966).

Teachers could be taught to use at least four strategies of verbal interaction in the classroom to help students use clarifying strategies of thought:

1. The pupil is a learner,
2. The pupil is a value,
3. The pupil is a thinker,
4. The pupil is a thinker in classroom topic discussion.

Effectiveness in using these strategies of verbal interaction could be assessed by teachers with appropriate instruments of interaction analysis. The Far West Laboratory has already created a minicourse model

that is effective for self-instruction. Additional courses could be constructed by this same laboratory to help teachers acquire skills for informal verbal interaction.

Fourth, data obtained by video taped multidimensional interaction analysis could be used for construct validation research. These data should be considered as measures of the global criterion domain of education. The variables should be cluster analyzed and also taxonomically analyzed.

Results could then be evaluated in terms of the meaning of the clusters and taxonomies that are obtained. The evaluator can ask himself, this construct is what I thought I was doing, but this set of clusters is what I got. What construct might explain these clusters better? The same question should be asked of taxonomic clusters. Thus the statistical analysis can help the evaluator to improve his constructs and the tests with which they are observed.

Then predictor tests of stage development and taxonomic development could be constructed. After being administered, the data should be cluster and taxonomically analyzed. The resulting clusters and taxonomies (radexes) of the predictor tests should be validated against the cluster and taxonomic (radexes) structures of the criterion measures. Thus we can devise cluster-referenced evaluation and tests. This is a possible new approach to construct validation of cluster and taxonomic variables.

When construct validation research has refined our constructs and improved our tests, quality assessment tests for schools could be constructed as predictor tests of the criterion domain. Teachers would

use improved measures of verbal interaction as approximate measures of the degree to which they are effective in using strategies of instruction.

Thus the global criterion domain of the activities of instruction in the classroom would be partitioned both by strategies and by statistical cluster analysis.

BREAKTHROUGHS IN TESTING

Following the genesis of the evaluative concept that people develop by stages, workers began to develop tests that can assess stage developments.

Freudian Stage Development

Erikson's paradigm of the stages of ego development furnished the constructs on which test development has been based. Boyd and Koskela (1970) used a special kind of test item in each of five fields: physical, societal, interpersonal, familial and self and asked subjects to categorize three attributes in each field. Items (160) were divided equally between positive and negative aspects of eight ego stages. The answer form has a six-point scale varying from Like-Unlike. This is the Self-Description Questionnaire which deals with solution of ego crises. Constantinople (1969) prepared his Inventory of Psychosocial Development which has 60 rating scale items, five positive and five negative for each of six bipolar continua: Basic Trust vs. Mistrust; Autonomy vs. Shame and Doubt; Industry vs. Inferiority; Identity vs. Identiy Confusion; Initiative vs. Guilt and Intimacy vs. Isolation. These Eriksonian continua are used to infer the student's level of maturity from the difference between the positive and negative items that a subject endorsed as characteristic of him. Waterman (1972) reported favorably on the use of this test with

college freshman.

Piagetian Stage Development

Research on test development in this area has its problems. Miller, Cohen and Hill (1970) tried to test for ordinality the ordinal scale of Uzgiris and Hunt (1956) for the object concept development and the sensory-motor stage, but failed to confirm it. They did change the handling of tasks by the subject, it was reported, to require much more motor coordination. An alternative methodology was proposed. The Concept Assessment Kit-Conservation of Goldschmidt and Bentler was reported by reviewers DeVries and Kohlberg as inadequate but useful for assessing retardates.

Lambert and others (1970) concluded that evidence provided by a number of investigators indicates that it is feasible to develop an ordinal scale of intellectual development based on the stages outlined by Piaget but it would cover rather wide ranges of age in contrast to the six month intervals of the Binet.

Strategic Stage Development

A number of workers have made similar suggestions that appear to have promise for test item development. Payette (1967) suggested the cognitive preference test item. While he used it with the Bloom taxonomy, this writer believes it can also be adapted to assessing stages of strategic development. The test item presents an introductory stem and four alternative responses below. All four options are correct and the student is told in the directions this is so. Test directions ask the student to indicate which of the four options he prefers. Actually Payette presented in each of the four options a different level of the

Bloom taxonomy using the rationale that the student would select the highest level response with which he usually functions. It seems logical, therefore, to adopt this cognitive levels test to assignment of stages of strategic development by presenting correct options at clarifying, problem-solving and philosophic levels.

Philosophic Stage Development

Kohlberg (1958, 1969) has used a Moral Judgment Inventory to arrive at a construct of six stages of moral development. The test consists of ten hypothetical moral dilemnas which are presented to the child with questions that are intended to place the child at a particular stage of moral development.

Taxonomic Testing

Within each stage of development the construct of taxonomic structure should be tested.

There are at least three different kinds of taxonomic tests: circumplex, simplex and radex.

The circumplex varies along a dimension of kinds of processes. This kind of variation can probably be assessed by the kind of test that varies each dimension of a construct exhaustively. Gorton and Noll (1967) described development of such a test to assess values of college students. Since there were eight types of people represented in their construct of value, 56 triplets were generated, which is all the possible combinations of eight dimensions taken three at a time (each dimension was represented by one statement in a triplet). Each of the eight value orientations appeared 21 times in the 56 triplets. By assigning weights of plus one to the highest item in a triplet, zero to the middle item

and minus one to the lowest item, scores could range from minus to plus 21 for each dimension or value type. The writer is developing a test of this kind for the ten state goals of education. In this case there are 120 possible combinations of ten dimensions taken three at a time, so there are 120 triplets, each phrase of which is a critical incident for a different goal. Each scale for a goal has nine positive and nine negative instances and each goal appears 36 times in a triplet. Tests like these call for a respondent to respond to all possible combinations of behaviors. When analyzed by appropriate Guttman-Lingoes computer programs on the basis of empirical item relationships, the computer will plot positive and negative kinds of behavior on opposite sides of a circumplex.

Each of the circumplexes that represent essential dimensions of human development should be determined experimentally for each stage of development. There is a considerable literature available on this point, i.e., circumplexes have been reported for many behaviors.

The second kind of test that is needed for taxonomic testing is the test for a simplex. This test battery like the tests of addition, subtraction, multiplication and division varies the respondent's behavior along a dimension of increasing complexity.

Payette's (1967) cognitive levels test should be considered for testing for simplexes. As already described, all options in the multiple choice test item are correct and the respondent is told this is so. Each option represents a different cognitive level and the respondent is asked to select the option he prefers. Normally a subject selects the option representing the highest level at which

he is able to function effectively.

Batteries of multiple-choice tests can be constructed to assess a simplex. Guttman and Schlesenger (1967) recently contributed much to the methodology for multiple-choice tests with the former's facet theory of selection of distractors. Each facet is presented in the distractors in every possible combination and both correct and error responses of subjects are plotted by Guttman-Lingoes' computer program in a way that preserves order relationships of both correct and error responses. This technology provides the evaluator with data that has meaning for every correct and error responses for every subject. Tests can be of shorter length with increased diagnostic and remedial capabilities. Feldman and Markwolder (1971) used this recommendation to construct a map test to measure reasoning state levels. While noting reasons for caution, they recommended the approach for its heuristic advantages.

All developmental simplexes should be identified. The third type of test is the taxonomic-type test battery which attempts to assess an entire radex or variations both of kind and of complexity, i.e., both a circumplex and a simplex varying together. An example of this kind of test battery was developed by Kropp and Stoker (1966) who attempted to construct a battery of tests that would assess children's abilities to think according to the Bloom cognitive taxonomy. Multiple-choice test items were used for knowledge, comprehension, application and analysis, but the investigators were forced to obviate the multiple-choice format for synthesis and evaluation. Test item construction was reported as very difficult. To attempt construct validation of the hierarchical structure of the Bloom taxonomy, Kropp and Stoker (1971) reasoned that

a radex structure should be plotted by the smallest space analyses computer program as a circular expansion of process and complexity. Using data for grades 9-12 and for all grades with the Guttman-Lingoes program #2, all five graphs plotted by the computer gave some evidence for a radex.

All developmental radexes should be identified for each stage and area of human development and goals of education should be formulated separately for each stage as radexes, specifying componential circumplexes and simplexes.

Freudian Taxonomic Testing

An example of an essential circumplex may be that reported by Kellerman and Plutchik (1969). These workers used a construct of eight primary emotions which could form personality traits when any two formed a lasting combination. Items were paired in all possible combinations to form the Emotions Profile Index with a test-retest reliability above 0.90 on all dimensions.

An example of a taxonomy was reported by Wherry and Waters (1968) who attempted construct validation of Robert White's construct of motivation. Five positive and five negative synonyms were obtained for a 150-item pool of motivational states with 21 subtests. Data from 235 college students were analyzed using Wherry's hierarchical method and two separate hierarchies of competence and satisfaction were reported. Results were said to support White's concept of competence.

Piagetian Testing

Siegelman and Block (1969) subjected data of Smedlund for concrete reasoning to scalogram analysis. After dropping one item, the remaining

eight items constitued two parallel sets of Piagetian tasks for concrete reasoning. These were reported as satisfactory as assessed by two scalogram indices.

Kugelman and Breznitz (1967) believe that only one of two methods of scalogram analyses should be used to test Praget's theory of development.

Work is underway at Purdue University to develop Piagetian-type measures of concept formation (Wheatley, 1972) and logical thinking (Towler, 1972). With support from the Office of Education, teams are developing tests that are intended to be unbiased for socioeconomic or ethnic groups, i.e., that will not penalize subjects on these bases.

Tests of Piagetian taxonomies are much needed and should be construct validated as soon as possible.

Strategic Taxonomic Testing

Tests of the clarifying stage are rare. Already cited were the taxonomic-type tests of Kropp and Stoker. Needed are taxonomic tests of the developmental dimensions of human beings. Included would be psychomotor, perceptual, personality constructs and processes, etc. Also needed is a new approach to the ways in which children learn meanings and become cultured and civilized. Disciplinary distinctions may not be the actual areas of development of meaning. Perhaps Phenix (1964) construct of realms of meaning can be validated. To do so would require development of tests that could identify the circumplexes. simplexes and radexes that are essential to the construct.

Research is underway at several institutions that aims to develop curricula and/or instruments to assess problem-solving abilities of

children. The productive thinking program at Berkeley, California is developing a battery of such tests. Tests conceptualize creative thinking as a complex problem-solving process (e.g., Wardrop and others, 1969).

Feldhusen and others (1971) identified four classes of problem-solving tasks: puzzle-insight problems, process, component and real life. For each class, illustrative tasks were identified and described and the rationale was described for the Purdue Elementary Problem-Solving Inventory (Feldhusen, 1972).

Rickborn and Lundsteen (1968) reported reliability data for a test of qualitative levels in creative problem-solving. This is one of several tests of problem-solving reported by Lundsteen.

Philosophic Tests

Smith and others (1967) reported a multiple-choice test that was intended to assess metaphoric, empirical and rationale aspects of an individual's epistemological hierarchy.

The Personal Orientation Inventory has been used for some years in the attempt to assess a construct of self-actualization (e.g. Damm, 1969). In recent years other approaches have been conceived and tests have been reported. The Comparative Life Outlook Inventory (Nowlon, 1968) was constructed to assess progress toward actualization with high school students. Scores are significantly related to participation in extra curricular school activities and scores on the California Test of Mental Maturity. Test-retest reliability was reported at 0.858.

The Expanded Sociometric Device was offered (Wright and Dunn, 1970)

as a more omnibus measure than Duncan's Personality Integration Reputation Tests. Factor analysis was reported to yield four factors: task and perceptual effectiveness, antonomy and self-realization, commitment and openness.

Felker (1966) reported a scale of 84 items to measure philosophic mindedness using a four-sided construct of flexibility.

Several approaches have been taken to assess one's philosophy of life. Crumbaugh (1968) reported reliable and valid assessment of Frankl's construct of the meaning and purpose in life with 1151 students. Dempsey and Dukes (1966) used a revised form of Morris' Paths of Life. Respondents ranked the 13 paths of life in order of preference using a Q-sort. Test-retest reliability of the short form was reported at 0.80.

The purpose in citing particular tests in this paper was neither to endorse any particular test nor to suggest the use of a test for any purpose. These tests were constructed for a wide variety of purposes and respondents. They simply illustrate that some research projects have taken courses that are not incompatible with the particular way in which constructs have been grouped together in this paper. The tests fit into a larger picture of meaning. When the technology of testing has been extended and computer assisted testing is used, it should be heuristically beneficial to test for the stages and taxonomies of human development.

SUMMARY

Major breakthroughs have occurred since 1958 in science regarding human nature, evaluation and testing. The breakthroughs in human nature include the discovery of the strategic nature of man. When knowledge of the strategic nature is compared to that of the Freudian and logical development, the second breakthrough is the constructs that children develop in stages and within stages they develop in hierarchical taxonomies. The breakthrough in evaluation include the principle of evaluating individuals and criterion groups in terms of their developmental stages and taxonomies: Freudian, Piagetian and strategic. Another breakthrough in evaluation is to use hierarchical statistical analyses to evaluate hierarchical taxonomies rather than conventional factor analysis, which cannot be depended upon. Tryon's B. C. TRY is helpful. The third breakthrough is Guttman's radex theory and the smallest space analysis programs which can be used for construct validation of hierarchical taxonomies. Goals of education should be formulated and construct validated as radexes at each stage of development. Another breakthrough in evaluation lies with a new process methodology for construct criterion validation and quality assessment predictor validation. Breakthroughs in testing include tests of Freudian stages of development, Plagetian stages and possible methodologies of testing strategic stages of development. Examples of tests are given and new types of tests are described for construct validation of the stages and taxonomies of human development. The implications of these breakthroughs are that a comprehensive NASA-type construct validation R & D program could be conceived to discover the

the nature and potentialities of human nature, using the concept that man's potentialities lie with maximizing the development of his strategic nature. When research is successful at each stage, quality assessment tests of schools and instructional programs could be developed.

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Chapter 2

The System Approaches in Education:
A Model of Professionalism

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Chapter 3

New Process Curricula For Middle Schools

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Chapter 4

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