AN EXPLORATORY STUDY OF COGNITIVE STYLE AS A VEHICLE FOR PERSONALIZING THE INSTRUCTION OF VOCATIONAL STUDENTS WITHIN A SELECTED OCCUPATIONAL CURRICULUM

By

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ABSTRACT

AN EXPLORATORY STUDY OF COGNITIVE STYLE AS A VEHICLE FOR PERSONALIZING THE INSTRUCTION OF VOCATIONAL STUDENTS WITHIN A SELECTED OCCUPATIONAL CURRICULUM

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One of the most significant problems in American education is the need to deal with individual differences of students. Many vocational schools are attempting to do this with increased use of media, student aids, tutorial programs, and a host of other devices. They are using what might more aptly be called the shotgun approach and hope that they will accomplish the most good. The use of cognitive style mapping would enable these approaches to be considerably more directed. This study was not specifically designed as a hypothesis-testing effort, but was intended to provide answers to questions that may result in hypotheses for future studies.

The motivating concern of this study was the identification of cognitive styles of students who fit into certain subsets of vocational student achievement. Another concern was to determine what relationships might exist between vocational student achievement subsets and the collective cognitive styles associated with them. The six objectives of the study were:

1. To identify the cognitive styles of the students in the Engineering Design class at the Southwest Oakland Vocational Center in Wixom, Michigan.
2. To identify the variables that exist between the cognitive style of the vocational student and the instructional mode, to obtain clues for personalizing instruction.
3. To determine if it is possible to identify a collective cognitive style and to see if there is a relationship between categories of vocational students' achievement and the associated collective cognitive style.
4. To discern whether there is a relationship between the number of qualitative codes and success in the Engineering Design class.
5. To determine how well a vocational student understands his/her own cognitive style.
6. To verify empirically the validity of the vocational students' cognitive style maps.

The two classes of the Engineering Design and Illustration program (40 students) from the Southwest Oakland Vocational Education Center served as the subjects for the study.

The researcher used two instruments to procure data to analyze the variables. These instruments were: Oakland Intermediate School District's Prescriptive Analysis for Curriculum Evaluation and Review (PACER) and Oakland Community College's Cognitive Style Interest Inventory (CSII). The PACER test was used to measure vocational student achievement. The CSII was used to measure preferred learning styles of the students. This instrument produces, through computer scoring, a cognitive style map of each individual's learning style.

To determine the possible relationships between vocational student achievement and the collective cognitive styles associated with them, the following approach was used.

1. Students were grouped by subsets into low, high, and middle quartiles.
2. The cognitive style elements for each subset of student achievement were tallied.
3. The percentage of occurrence was calculated using the frequency of occurrence of each element.
4. Frequency charts of major and minor cognitive style elements were constructed for each subset of student achievement.
5. Profiles of similarity were constructed.

The following conclusions were drawn:

1. The students showed a preference for individual cultural determinants.
2. The greater the deviation of the student's elements from the elements of the instructional mode, the less likely the student will be to achieve any success with that particular instructional mode.
3. It is possible to identify collective cognitive style profiles of vocational students.

Some recommendations for further study, stated in the form of hypotheses, are:

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1. A successful instructional mode will have a small number of variances between the cognitive style elements of the student and the format of style elements in the instructional mode.
2. Successful vocational students can be identified by certain theoretical symbolic orientation code elements in their cognitive style.

DEDICATION

TO JOY ANN

My Wife and Love.

It was her encouragement that lit the passageway for the attainment of this degree. And it is our life together that makes it all of value. With all my love I say:

So may thy destiny be mine.
Together we, resplendent--
Twin stars revolving, I on thee
  eternally attendant
In truth and loyal steadfastness,
Our virtue still ascendant--
Thou art my fate, I am thy mate.*

*The closing lines of "Wedded," by Mary C. Monroe.

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Many others, both friends and family, gave me encouragement and assistance. To all of these people I would like to express my thanks.

The final and most important acknowledgment goes, of course, to my wife and partner, Joy Ann. Without her continued support, encouragement, and sacrifice this dissertation would not have been possible.

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LIST OF SYMBOLS

<u>Symbolic Mediation</u>

T(AL)	Theoretical Auditory Linquistics
T(AQ)	Theoretical Auditory Quantitative
T(VL)	Theoretical Visual Linguistics
T(VQ)	Theoretical Visual Quantitative
Q(A)	Qualitative Auditory
Q(V)	Qualitative Visual
Q(P)	Qualitative Proprioceptive
Q(CEM)	Qualitative Code Empathetic
Q(CES)	Qualitative Code Esthetic
Q(CET)	Qualitative Code Ethic
Q(CH)	Qualitative Code Histrionic
Q(CK)	Qualitative Code Kinesics
Q(CKH)	Qualitative Code Kinesthetics
Q(CP)	Qualitative Code Proxemics
Q(CS)	Qualitative Code Synnoetics
Q(CT)	Qualitative Code Transactional
Q(CTM)	Qualitative Code Temporal

<u>Cultural Determinant</u>

I	Individuality
A	Associates
F	Family

<u>Modalities of Inference</u>

M	Magnitude
D	Difference
R	Relationship
L	Appraisal
(K)	Deductive

CHAPTER I

STATEMENT OF THE PROBLEM

Introduction

For the past century and a half, America has struggled to provide free public education for its young people. Quantitative considerations have been given the primary attention of society in its quest to bring to fruition America's dream of a fully educated constituency. For many years America has sought equal educational opportunities for all and has worked to adapt our schools to meet human needs, clarify values, and enlighten social realities in a diverse society. Currently, the chief concern has been to assure appropriate dissemination of education to each of America's youths. Qualitative considerations have now achieved a preeminent position in the allocation of educational pedagogy.

Despite the recognition afforded the improvement of the quality of education for the individual student by educators and politicians, there still exists a large degree of disparity over the implementation of qualitative educational programs for all students. The literature is replete with statements from various societal areas that indicate basic dissatisfaction with the public school system. It is both a truism and a crisis of significant proportion that our schools are apparently not credible.

Broudy speculated that:

> The pressure for formal accountability for "results," the resistance to tax levies and bond referenda, the flight of pupils to private schools, the increase in mandated programs--all are symptoms of a diminished credibility in the public schools.[1]

Goodlad stressed that dissatisfaction with the schools is not a new phenomenon.[2] He also stated that dissatisfaction with the schools was so widespread that it drew serious attention to the idea of deschooling society. Although Goodlad did not mention Illich, who wrote the book Deschooling Society, he was, in all probability, referring to Illich's concepts.[3]

The problem with present educational programs is not so much that they are not good, right, or effective, but that they are incomplete, fragmented, and uncoordinated. America's schools are, in large part, the reflection of tradition and the needs of vested-interest groups. Woodring explained that part of this problem has come about because the educational philosophy of the school "vacillates," and it does so because parents are confused about what they want.[4] This is reflected in the decisions of school boards. It is apparent that the opportunity to improve education is always present, whether it is a constant problem or a constant challenge. Perkins believed that the problems of education and the growing disillusionment of the public can be attributed largely to the fact that schools have too often sought to force students into narrow academic molds without regard to their abilities, interests, or even their forthcoming roles in adult life.[5] He also believed that, at the same time, the general public has awakened to the potential of vocational education to motivate and train students of all ages and abilities.

Traditionally, vocational education has been concerned with preparing the individual for a specific occupation identified with a specific industry. The concept of developing salable skills for an existing labor market has been basic to the vocational education philosophy. Vocational education can, indeed, contribute to guiding students into occupational areas that will enhance their life roles and break the academic molds that restrict individual growth and development.

Background

In her book Accent on Learning, Cross stressed that with the movement toward educational opportunity came the need to individualize education.[6] The educational establishment was faced with a diverse constituency, and, to meet the demands of society, many educators envisioned individualized instruction as the panacea for their problems.

The mobility of the American population has also created the necessity for individualizing or personalizing instruction. In his book, Future Shock, Toffler directed attention to the multiplicity of problems related to the impermanence or transience of society today.[7] Not only is there the social shock of geographical migration, but there is also the internal shock of individuals in a constant state of impermanence. This internal or psychological shock is particularly devastating to today's youths. Society has not only created a geographically mobile population, but it has added the problems of a rapidly changing society based on the "economics of transience."[8]

Yet another force has contributed to the necessity of personalizing education. Years ago, the Russians launched a space program that caused considerable concern about the scientific prowess of the American culture. The public demanded that our schools become more scientific, teach more mathematics, and indirectly become more elitist by encouraging the gifted student. In The Identification of the Gifted and Talented, Martinson stated that this importance to society is largely due to the accomplishments of its most capable members; the society that fails to nurture the talents of gifted youths fails in its obligations to them and itself.[9]

However, in a democratic society, the idea of one of its institutions becoming elitist strikes a discordant note. The United States has always affirmed that every individual should be afforded the opportunity to develop to his/her fullest potential. Therefore, in addition to nurturing the gifted without offending the average, educational institutions must help students who have special problems. Many constructs have to be considered and dealt with effectively: mentally retarded students, the learning disabled, and "mainstreaming,"[10] to mention just a few. These dichotomous extremes exemplify the extent of the problem with which educational institutions have to deal in effecting a democratic structure within society.

Individualizing or personalizing instruction for all students is apparently a solution to the dilemma of either applying disproportionate amounts of pedagogy to students to optimize their potential or subscribing to the principles of a democratic society that innately feels treating all students equally would mean giving them all the same type of education. Individualized instruction is not synonymous with "self-study" or "individual study units." Rather, it refers to a method of course organization in which each pupil works individually on an assignment according to his/her interests, needs, and abilities, and proceeds through it at his/her own pace. The student is mainly responsible for his/her own learning. During class time, the teacher is available to answer questions and provide needed assistance, which may be in the form of lecturing, demonstrating, or leading small- or large group discussions. The subject matter may be learned through textbooks, individual study units, or teacher-assigned projects, with the help of teaching machines, computers, slides, film transparencies, charts, audio and/or video tapes, laboratory, or on-the-job work experiences.

Although the personalization of instruction is an obvious force that contends with the heterogeneity of today's diverse society, educators still do not sufficiently stress learning processes and styles of learning, apparently preferring motivational categories instead. In his article, "Students' Learning Styles," Riessman wrote, "The task of the educator is to try to determine how the strengths of the individual's learning style can be utilized and the weaknesses reduced or controlled."[11]

The question that presents itself now is whether the learning behavior of individual students can be studied effectively. Can individual or group behavior effectively be studied? Is there an appropriate science of education? Conant sought answers to these questions in his book, The Education of American Teachers. He stated that it is actually a matter of whether the natural sciences are fundamentally different from the social sciences.[12] If, indeed, there is no fundamental difference between the natural and social sciences, as Conant argued, then the establishment of a conceptual framework for the applied field of education is important as a natural construct that could have a significant influence on the education of today's students. It is also reasonable to assume that a single, all-embracing science of education did not exist at the time Conant wrote his book. He went on to state:

> Teachers, like physicians, think in terms of predictive generalizations as well as arguments derived from general principles. Some people would like to combine these two modes of thought and speak of a single, all-embracing science of education. The question is whether it is useful to try to cover with the word "science" a vast field of human activity directed toward practical ends. I have come to the conclusion that it is not. Perhaps it is only a question of terminology. However, I prefer not to speak of the science of engineering but of the engineering sciences. I doubt that there is or ever will be a science of medicine, yet I am sure enormous strides forward have been made in the medical sciences. Therefore, I think it would be better to discuss the academic disciplines, that base relevance for the labors of the teacher than to try to talk in terms of a developing science of education. In other words, I shall examine academic disciplines which might be called educational sciences or educational disciplines rather than the science or the discipline of education.[13]

Before developing a framework of the educational sciences, it is important to consider the purpose, objectives, and other aspects of the present study. The topic of the educational sciences is discussed just before the section defining key terms used in the dissertation.

Purpose of the Study

A broad range of differences in cognitive manipulation has been demonstrated in research by Thurston, Guilford and others, which indicates that over one hundred cognitive styles exist.[14] Psychologists such as Kagan, Moss, and Sigel have referred to this range of differences in cognition as cognitive style.[15] Cognitive style is wholistic in focus; it includes notions of personality, intelligence, attitude, perception, and learning.

With mandates from the Michigan State Department of Education pertaining to setting goals and implementing competency-based education, as well as the impetus from other areas such as special needs legislation, it has become all the more apparent that a systematized method of personalizing vocational education is needed. Goodlad called attention to the unavoidable need to diagnose the deficiencies of each individual learner.[16] "Individualized instruction, Holtzman argues, might serve both the social and economic needs, the former need by expanding and diversifying program options to better match the diversity and pluralism of the student population."[17]

Cognitive style mapping, as used in the educational sciences, has the potential to become an effective instrument to facilitate the personalization of vocational education and, therefore, merits the attention of a thoughtful study.

One of the predominant purposes that motivated this study was to identify cognitive styles of students who fit into certain subsets of vocational student achievement. A second purpose was to determine what possible relationships, if any, might exist between vocational student achievement subsets and the collective cognitive styles associated with them. The major objectives of the study were as follows:

1. To identify the cognitive styles of the students in the Engineering Design class at the Southwest Oakland Vocational Center in Wixom, Michigan.
2. To identify the variables that exist between the cognitive style of the vocational student and the instructional mode, to obtain clues for personalizing instruction.
3. To determine if it is possible to identify a collective cognitive style and to see if there is a relationship between categories of vocational students' achievement and the associated collective cognitive style.
4. To discern whether there is a relationship between the number of qualitative codes and success in the Engineering Design class.
5. To determine how well a vocational student understands his/her own cognitive style.
6. To verify empirically the validity of the vocational students' cognitive style maps.

As a result of investigating the areas identified in the preceding objectives, the writer hopes to arrive at some recommendations that will contribute to the personalizing of instruction for vocational education students.

General Questions to Be Answered

The present study was exploratory in nature; it was _not_ designed to test hypotheses. Instead, to realize the purposes of the project, answers to the questions listed in the following paragraph were sought.

For the students in the Engineering Design class at the Southwest Oakland Vocational Education Center, and in terms of available data:

1. What is the nature of the students' cognitive styles?
2. What variables exist between the cognitive style of the vocational student and the instructional mode?
3. Is it possible to identify a relationship, if any, between vocational student achievement and collective cognitive style associated with categories of achievement?
4. What relationship exists between the number of qualitative codes and success in the Engineering Design program?
5. How well does the vocational student understand his/her own cognitive style?
6. Can the cognitive style map of the vocational student be empirically verified?

Need for the Study

If cognitive styles can be identified with categories of vocational student achievement, such an identification could have important implications for vocational education. For instance, the identification of cognitive styles could be used to predict the final grade that vocational students are apt to earn in their courses.

According to Nunney, augmentation of cognitive styles is not only well accepted but necessary if the student is to achieve his/her maximum growth.[18] Findings from the present study might generate hypotheses for experimental studies that could be used to augment and modify vocational styles so as to prepare vocational students for the optimal enjoyment of their selected life roles and occupations. Counselors, teachers, or administrators could prescribe experiences that might promote the student's success, given his elements of "style" and how they might become associated with success in the study of various occupational choices.

Vocational student preparation programs can be more effective than they currently are if it is possible to identify an individual's cognitive style in terms of the educational sciences and relate the individual's style to specific occupational areas.

The sociological and technological problems of the transient society referred to earlier also indicate the necessity of matching learning styles and instructional techniques for optimal execution of vocational tasks.

The United States is currently engaged in an economic struggle with competing countries. A large portion of the population has generally accepted the necessity of the principle of a maintenance population (zero growth) as opposed to the antiquated ideas of an ever-increasing population and economy. A maintenance population does not have to be stagnant; however, it cannot afford the inefficiency that a growth population can. Because of the necessity of economizing, it must be more efficient in its economic production. Vocational education can contribute to the country's efficiency by furnishing effective workers with the desire to take a position of productivity alongside their fellow Americans.

Matching an individual's style of learning with a style-specific instructional package promises economic as well as personal gains for the individual student. These implications are of increasing importance for the personalization of vocational education in all fields, as well as the particular applied field of engineering design.

The relationship between cognitive styles and categories of student achievement can also be used to examine student performance in a variety of dimensions. In particular, cognitive styles could be used to prescribe specific programs to enhance a student's probability of success in a given occupational area.

Cognitive style mapping is of particular importance for improving accountability, particularly in the vocational school setting. Mapping produces a Cartesian product of the individual's style that can be used for specific personalization programs. It reduces the necessity of using a teacher or administrator's opinion of a student's needs and all the concomitant legal problems with which that approach is fraught. Carried out under the approach of cognitive style mapping, curriculum development should be more objective and considerate of the individual.

The information from this study could lead to subsequent studies of a hypothesis-testing nature or further hypothesis-generating character. Therefore, as part of the conclusions, the writer generates and presents a series of possible hypotheses for consideration by future researchers in vocational education.

Finally, the study was intended to add to the body of information and knowledge about the educational sciences as the universe of discourse for the educational establishment and particularly vocational education.

Methodology of the Study

This study was considered exploratory because it was directed at seeking trends and defining information concerned with various approaches to the problem of individual differences of students that could lead to the generation of hypotheses to be studied in subsequent research undertakings. The writer was concerned with two major topics: (1) the assessment of the cognitive styles of vocational students who fit into specific subsets of vocational student achievement and (2) the relationships that might exist between vocational student achievement and the students' collective cognitive styles.

The instruments used to gather the necessary data were (1) Oakland Intermediate School District's Prescriptive Analysis for Curriculum Evaluation and Review (PACER) and (2) Oakland Community College's Cognitive Style Interest Inventory (CSII). These instruments were administered at the Southwest Oakland Vocational Education Center in Wixom, Michigan. The results of these tests were sent to the respective institutions for computer scoring.

To answer the questions listed in the previous section and to furnish insights into the development of new questions, the researcher devised cognitive style profiles and collective cognitive style profiles. As an additional aid in answering the research questions, an anecdotal data log was kept and is included in the appendix.

Basic Assumptions

It was assumed that:

1. Tests administered to the subjects of this study produced certain information that could be interpreted in terms of the subjects' symbolic orientations, modes of perception, and modalities of inference.
2. All subjects were able to read and understand the tests administered.
3. The subjects gave frank and unbiased replies to the instruments.
4. A combined class of 40 students was adequate for a study intended to lead to hypothesis generating or testing.
5. The Cognitive Style Interest Inventory (CSII) was an appropriate tool to use in accomplishing the purposes of the study.
6. The Prescriptive Analysis for Curriculum Evaluation and Review (PACER) developed by Oakland Intermediate School District was an appropriate tool to use in accomplishing the purposes of the study.

7. The reliability and validity of the instruments used were sufficient for meeting the purposes of the study.

Limitations of the Study

The following factors were considered to be limitations of the study:

1. The population of the study was limited to vocational students in the Engineering Design and Illustration class at the Southwest Oakland Vocational Education Center.
2. Financial limitations made it impossible to evaluate all the vocational students at the Center.
3. A study focusing on a selected occupational curriculum will not be as informative as a longitudinal study.
4. Cognitive style was examined in the context of the educational sciences and not in the more general context of other available psychological literature.
5. The time factor was not constant, because students attended classes at the Center during two time blocks, either in the morning or in the afternoon.

Developed in the following section is a conceptual framework that envelops an individual's cognitive mode, from which the educational sciences were to be expressed.

The Educational Sciences

The educational sciences are not oriented specifically to vocational education or any other field of expertise. Their usefulness, particularly in the prescriptive stage, will readily become evident in later chapters. The educational sciences are a humanistic approach to a form of the educational sciences that Conant alluded to, though not the "new expert" to whom Krech referred in the following passage:

> There will be a great change made in the first and foremost and continuing business of society: the education and training of the young. The development of the mind of the child will come to rest in the knowledge and skills of the biochemist, the pharmacologist, and neurologist, and psychologist, and educator. And there will be a new expert abroad in the land--the psychoneurobiochemeducator.[19]

As absurd as this omnifarious "new expert" whom Krech referred to may sound, advances have been made in developing a more scientific but nonetheless humanistic framework for education.

The most notable efforts and advances in providing a conceptual framework and scientific language for the applied field of knowledge called education have been made by the American Educational Sciences Association and its founder, the late Joseph Hill. Hill's rationale for the development of the educational sciences was:

> Without a framework and "language", the vast field of human activity called "education" does not readily lend itself to meaningful description or definition. At the present time, the universe of discourse associated with education lacks precision beyond that found at the levels of common sense and daily journalism. The difficulty with such language is not that it fails to provide a form of communication but that the possibilities of misinterpretation and misunderstanding are great and the probability of relatively precise discriminations and predictions is small.[20]

Other writers have referred to this lack of clarity in education. Van Dalen concurred with Hill when he wrote:

> Many educational terms do not have clearly assigned and commonly understood meanings; when words such as "democracy", "education", "curriculum", and "discipline" are used by

> different workers in the field, they may stand for slightly or radically different things. In contrast, the technical terms in the exact sciences such as meter, ampere, light year, and calorie are instruments of great exactitude.[21]

The exact sciences Van Dalen mentioned are what Hill referred to in the following statement as "fundamental disciplines":

> Fundamental disciplines are bodies of knowledge generated by communities of scholars that produce pure and distinctive forms of information about phenomena which they study. Biology, history, art, psychology, and mathematics are examples of fundamental disciplines. Complementing the fundamental disciplines are the applied or derivative fields of knowledge. These bodies of information are generated by practitioners who deal with practical considerations of the human condition. Medicine, pharmacy, engineering, and law are examples of applied fields of knowledge.[22]

Education is an applied or derivative field and not a fundamental discipline. The educational sciences manifest an attempt to specify a conceptual framework for education that is accorded a precision and specificity found in other applied fields. According to Hill:

> With the development of the Educational Sciences, the solutions of problems and explanations of phenomena are facilitated, and educational problems accruing to inadequate communication, misinterpretation of information, and fragmentation of effort are alleviated.[23]

There are now seven educational sciences. Each of these bodies of information includes its own facutal description, conceptualizations, principles, and generalizations, and is properly considered a separate science. According to Hill, these seven sciences are:

1. Symbols and their meanings (Symbologosics).
2. Cultural determinants of the meanings of symbols (Determinants).
3. Modalities of inference (Inferensics).

4. Biochemical and electrophysiological aspects of memory concern.
5. Cognitive styles of individuals.
6. Teaching styles, administration styles, counseling styles, and student styles.
7. Systemic analysis decision-making.[24]

The conceptual framework of the educational sciences is grounded in the following four assumptions:

1. Education is the process of searching for meaning.
2. Thought is different from language.
3. Man is a social creature with a capacity for deriving meaning out of his environment and personal experiences.
4. Not content with biological satisfactions alone, man uses symbols in his search for meaning.[25]

This study was concerned with aspects of all seven of the sciences, except for the fourth and the seventh. The emphasis was on the fifth--cognitive style of individuals. Hill and Setz described cognitive style as follows:

> Cognitive style is a unique concept for describing an individual's mode of behavior in searching for meaning. It is identified by an individual's disposition to use certain types of symbolic forms versus others: the derivations of meaning of symbols from roles the individual has found most satisfying; the manner in which he reasons. A map of an individual's cognitive style provides meaning from his environment based upon his symbolic orientations, personal experiences, and ways of reasoning, i.e., drawing conclusions.[26]

Cognitive style is a unification of the following four sciences: (1) symbols and their meanings; (2) cultural determinants of the meanings of symbols; (3) modalities of inference; and (4) electrophysiological and biochemical aspects of memory. The last science, the electrophysiological and biochemical aspects of memory, was developed most recently and is still being verified. Eaton developed a model based on educational memory in her investigation entitled "A Model for Educational Cognitive Style Based Upon a Paradigm for Psychohistorical Inquiry, With Emphasis on Educational Memory."[27]

Hill conceptualized cognitive style in terms of the educational sciences:

> The concept of cognitive style employed as an educational science is somewhat different from those described and defined in the discipline of psychology. The construct of cognitive style as defined in terms of the educational sciences is a Cartesian product, G, composed of three sets, S, E, and H, where S denotes the set of elements defining symbolic orientations, E indicates the set of cultural determinants of the meaning of symbols, and H designates the set of modalities of inference.[28]

An individual's strength in each of the three sets encompassing educational cognitive style is determined as follows:

> 1. If the percentile rank of an individual's score in a given element is in the spread of values ranging from the fiftieth through the ninety-ninth percentile (inclusively) of a population of these scores, the individual is assigned a major orientation, written as a capital letter.
> 2. If the percentile rank of an individual's score in a given element is in the spread of values ranging from the twenty-sixth through the forty-ninth percentile (inclusively) of a population of these scores, the individual is assigned a minor orientation, written as a small letter.
> 3. If the percentile rank of an individual's score in a given element is in the spread of values ranging from the zero percentile through the twenty-fifth percentile (inclusively) of a population of these scores, then the individual is assigned neither a major nor a minor orientation, and the element is not entered as a part of the cognitive style.[29]

Definitions of Key Terms

The articulation of the fundamental disciplines, such as mathematics or physics, is possible because of the exactitude of their language. It is, therefore, important to note that describing the language of the educational sciences required redefining concepts from the fundamental disciplines. Terminology from the writings of scholars in the American Educational Sciences Association, most notably its founder, Joseph Hill, has produced these redefinitions. It is extremely important that all terminology resulting from the study of the educational sciences have identical meanings to all concerned.

Van Dalen noted that "When a researcher uses a word that is familiar but whose meaning is not a matter of universal agreement, he stipulates the sense in which he will use it."[30] As the context in which terminology is employed elicits explicit definitions for precise understanding, an attempt was made to employ this concept in the derivation of terms and meanings presented herein. Paraphrasing any of the concepts or definitions could be detrimental to comprehension and inhibit understanding. To prevent misconceptions and to improve the understanding of the educational sciences, the concepts and definitions presented here are essentially those proposed by Hill and others in publications of the American Educational Sciences Association.[31]

Applied fields are composed of terms and methods of inquiry borrowed from the fundamental disciplines. Their practitioners are not concerned with producing pure and distinctive forms of information. In this context, the applied fields are composed of both sciences and arts that are designed to explain phenomena and solve problems in the practical aspects of the human situation. For example, the applied field of knowledge called medicine is composed of the medical sciences and the medical arts; engineering is composed of the engineering sciences and the engineering arts.

A cognitive style map provides a picture of the diverse ways in which an individual derives meaning. Results of a battery of tests and inventories are processed through a computer system to produce a printout in the form of a Cartesian product.

Collective cognitive style is the composite style that is expressed by a particular quartile determined by the PACER test.

Contextualism enters into the testing framework of cognitive style mapping in much the same way a physical diagnosis does in the medical field. For example, a 55-year-old man is described by his doctor as being in good health in comparison to the norms of other 55-year-old men and in the context of the activities usually undertaken by that population. That person's physical evaluation would not be the same if his condition were compared to the "good health" label given to a 19-to-20-year-old man, who could very easily engage in such activities as skiing, handball, or tennis. In that "contextualism," the 55-year-old man could not be described as being in as good health.

Derivative fields of knowledge are bodies of information generated by practitioners who deal with practical considerations of the human condition. Medicine, pharmacy, engineering, and law are examples. The derivative fields are composed of terms and methods of inquiry borrowed from the fundamental disciplines and other cognate fields.

Empirical mapping is the process of augmenting the findings of the computer-derived cognitive style map of an individual. This is done by teacher, parent, or counselor observation of the student who is being mapped. The experiences of each observer may serve to produce changes in the mathematical map and give a more exact diagnosis of the strengths or weaknesses of the student within the context of the examination.

Fundamental disciplines are bodies of knowledge generated by communities of scholars who produce pure and distinctive forms of information about phenomena they study, such as biology, history, art, and psychology.

Major orientation is noted by capital letters, and refers to an element of a cognitive style map that occurs in the 50th to 99th percentile range of a distribution of that element at a given developmental level.

Mathematical mapping is the process of deriving information from the administration of standardized test batteries and inventories and producing a computerized cognitive map. The data indicated on the map can be analyzed in the same manner as a physician analyzes the results of x-rays, blood tests, urine analysis, temperature, and other standard medical tests. These data are not conclusive in determining the ailment; rather, the information must be reinforced or augmented by personal observation and previous experience (empirical mapping).

Minor orientation is identified by the insertion of a prime factor (') mark that indicates an individual realized a score for this particular element in the 26th to 49th percentile range of a distribution of scores for that element at a given level of educational development.

Negligible orientation is a score value of a particular element of a distribution of scores at a given level of educational development that occurred at the 25th percentile or below. The negligibly oriented element would not appear on the cognitive style map.

Personalized or individualized education: A student's cognitive map presents a picture of the variety of styles he uses in his education, i.e., in his search for meaning. Mapping an individual's cognitive style enables the educator to consider the individual in terms he might not have employed without the map. The diagnosis of an individual's cognitive style and the modes of understanding required by an educational task can be used to match the student to the task. Through this approach, it is possible to prescribe educational activities that provide a better probability of successful accomplishment by the individual than otherwise might be possible.

A set is a carefully defined collection of discrete elements; these may be symbols, ideas, or physical objects. A set may contain an infinite number of elements, a finite number of elements, or no elements. The last is described as a null or empty set.

Symbolic mediation is the ability to transform the complex meanings of the symbols that represent the elements of a cognitive style map into the proper modes of instruction that are best suited to the individual student so that he can attain success in his educational endeavors. Mediation of instruction means choosing the optimum mix of communication vehicles, such as audio-visual equipment, programmed instruction manuals, transparencies, video tapes, and other teaching media, so each student receives instruction according to the interpretation of his cognitive style map.

A <u>system</u> is a defined collection of elements with their interconnections considered over a period of time.

The remaining portion of the definitions section is organized according to the seven educational sciences referred to earlier in this chapter:

1. Symbols and their meanings
2. Cultural determinants of the meanings of symbols
3. Modalities of inference
4. Educational memory
5. Cognitive style of individuals
6. Teaching styles, administrative styles, counseling styles, and student styles
7. Systemic analysis decision-making

<u>First Educational Science</u>

<u>Theoretical symbols</u> present to the nervous system, and then represent to it, something different from what those symbols are. For example, the spoken word, "school," is an auditory sensation that represents to the listener the physical object, school. The auditory sensation, "school," presents to the nervous system something different from what the symbol itself is; it is called a theoretical auditory linguistic symbol T(AL).

There are two types of theoretical symbols, namely visual and auditory. Each of these symbols can be divided into linguistic and quantitative elements.

<u>Theoretical Visual Linguistics T(VL)</u>: The ability to find meaning from words one sees. A major orientation in this

area usually indicates one who reads with a better-than-average degree of comprehension.

Theoretical Auditory Linguistics T(AL): The ability to acquire meaning through hearing the spoken word.

Theoretical Visual Quantitative T(VQ): The ability to acquire meaning in terms of numerical symbols, relationships, and measurements that are seen.

Theoretical Auditory Quantitative T(AQ): The ability to find meaning in terms of numerical symbols, relationships, and measurements that are spoken.

Qualitative symbols present and then represent to an individual's nervous system that which the symbols themselves are to that individual. Meanings for qualitative symbols are derived from three sources: (1) sensory stimuli; (2) cultural codes (games); and (3) programmatic effects of objects that convey an almost automatic impression of a definite series of images, scenes, events, or operations. At present, 20 qualitative symbols are included in the "symbolic" set; 5 of them are associated with sensory stimuli, 5 are programmatic in nature, and 10 are associated with cultural codes.

The following five qualitative symbols are associated with sensory stimuli:

Qualitative Auditory Q(A): Ability to perceive meaning through the sense of hearing. A major orientation in this area indicates ability to distinguish between sounds, musical tones, and other purely sonic sensations.

Qualitative Olfactory Q(O): Ability to perceive meaning through the sense of smell.

Qualitative Savory Q(S): Ability to perceive meaning through the sense of taste. Chefs should have highly developed qualitative olfactory and savory abilities.

Qualitative Tactile Q(T): Ability to perceive meaning through the sense of touch, temperature, and pain.

Qualitative Visual Q(V): Ability to perceive meaning through sight.

The qualitative symbols that are programmatic in nature are:

Qualitative Proprioceptive (Fine) Q(PF): Ability to synthesize a number of symbolic mediations into a performance that demands monitoring of a complex task involving small or fine musculature (e.g., playing a musical instrument, typewriting), or into an immediate awareness of a possible set of interrelationships between symbolic mediations, i.e., dealing with "signs." Although qualitative proprioceptive fine symbolic intelligence is most readily observable in seemingly automatic motor responses such as reading and playing music, certain types of theoretical symbolic mediation also require qualitative proprioceptive activity. For example, the synthesis of a number of symbolic mediations is evident when an individual, upon seeing a sign of smoke, immediately interprets it as evidence of fire and experiences an interplay of many sensations, including smell and taste of smoke and sensation of heat. In this instance, a network of previous experiences and related associations, along with the other qualitative aspects, produces the theoretical mediation of fire.

<u>Qualitative Proprioceptive (Gross) Q(PG)</u>: Ability to synthesize a number of symbolic mediations into a performance that demands monitoring of a complex task involving large or gross musculature (e.g., throwing a baseball, skiing).

<u>Qualitative Proprioceptive Dextral (Fine) Q(PDF)</u>: A predominance of right-eyed, right-handed, and right-footed tendencies (a typically right-handed persion) while synthesizing a number of symbolic mediations into a performance demanding monitoring of a complex task involving small or fine musculature (e.g., writing right-handed).

<u>Qualitative Proprioceptive Dextral (Gross) Q(PDG)</u>: A predominance of right-eyed, right-handed, and right-footed tendencies (a typically right-handed person) while synthesizing a number of symbolic mediations into a performance demanding monitoring of a complex task involving large or gross musculature (e.g., throwing a baseball with the right hand).

<u>Qualitative Proprioceptive Kinematics (Fine) Q(PKF)</u>: Ability to synthesize a number of symbolic mediations into a performance demanding the use of fine musculature while monitoring a complex physical activity involving motion.

<u>Qualitative Proprioceptive Kinematics (Gross) Q(PKG)</u>: Ability to synthesize a number of symbolic mediations into a performance

demanding the use of gross musculature while monitoring a complex physical activity involving motion.

Qualitative Proprioceptive Sinistral (Fine) Q(PSF): A predominance of left-eyed, left-handed, and left-footed tendencies (a typically left-handed person) while synthesizing a number of symbolic mediations into a performance demanding monitoring of a complex task involving small or fine musculature (e.g., writing left-handed).

Qualitative Proprioceptive Sinistral (Gross) Q(PSG): A predominance of left-eyed, left-handed, and left-footed tendencies (a typically left-handed person) while synthesizing a number of symbolic mediations into a performance demanding monitoring of a complex task involving large or gross musculature (e.g., throwing a baseball with the left hand).

Qualitative Proprioceptive Temporal (Fine) Q(PTF): Ability to synthesize a number of symbolic mediations into a performance demanding the use of fine musculature while monitoring a complex physical activity involving timing.

Qualitative Proprioceptive Temporal (Gross) Q(PTG): Ability to synthesize a number of symbolic mediations into a performance demanding the use of gross musculature while monitoring a complex physical activity involving timing.

The remaining ten qualitative symbols associated with cultural codes are defined as follows:

Qualitative Code Empathetic Q(CEM): Sensitivity to the feelings of others; ability to put oneself in another person's place and to see things from his/her point of view.

Qualitative Code Esthetic Q(CES): Ability to enjoy the beauty of an object or an idea. Beauty in surroundings and/or a well-turned phrase are appreciated by a person possessing a major strength in this area.

Qualitative Code Ethic Q(CET): Commitment to a set of values, a group of principles, obligations, and/or duties. This commitment need not imply morality. Both a priest and a criminal may be committed to a set of values, although those values may be decidedly different.

Qualitative Code Histrionic Q(CH): Ability to exhibit a deliberate behavior, or play a role to produce some particular effect on others. This type of person knows how to fulfill role expectations.

Qualitative Code Kinesics Q(CK): Ability to understand and to communicate by nonlinguistic functions such as facial expressions and motions of the body (e.g., smiles and gestures).

Qualitative Code Kinesthetics Q(CKH): Ability to perform motor skills, or effect muscular coordination according to a recommended or acceptable form (e.g., bowling according to form, or golfing).

Qualitative Code Proxemics Q(CP): Ability to judge the physical and social distance that another person would permit, between oneself and that other person.

Qualitative Code Synnoetics Q(CS): Personal knowledge of oneself.

Qualitative Code Transactional Q(CT): Ability to maintain a positive communicative interaction that significantly influences the goals of the persons involved in that interaction (e.g., salesmanship).

Qualitative Code Temporal Q(CTM): Ability to respond or behave according to time expectations imposed on an activity by members in the role-set associated with that activity.

Second Educational Science

Cultural Determinants: There are three cultural determinants of the meaning of symbols: individuality (I), associates (A), and family (F). Through these determinants, cultural influences are brought to bear by the individual on the meanings of symbols. The "individuality" influence is frequently reflected by a person's need to quote definitions, or explain situations, in his/her own words. The "associates" influence is frequently evidenced by an individual who understands what is under consideration, but explains or discusses these matters mainly in the words of associates who are involved with him/her in the situation. The "family" determinant is frequently portrayed by the individual who uses examples in explaining a situation or solving a problem (e.g., parents, children, wife, husband, sibling, or cousin are used to illustrate a situation analogous to the one under consideration).

Third Educational Science

Modalities of inference is the third set of the Cartesian product indicating cognitive style, i.e., the form of inference one tends to use. It comprises the following modalities.

Magnitude (M): A form of "categorical reasoning" that uses norms or categorical classifications as the basis for accepting or rejecting an advanced hypothesis. People who need to define things in order to understand them reflect this modality.

Difference (D): Suggests a tendency to reason in terms of one-to-one contrasts or comparisons of selected characteristics or measurements. Artists often possess this modality, as do creative writers and musicians.

Relationship (R): Indicates the ability to synthesize a number of dimensions or incidents into a unified meaning, or through analysis of a situation to discover its component parts. Psychiatrists frequently employ the modality of relationship in psychoanalyzing a client.

Appraisal (L): The modality of inference employed by an individual who uses all three of the modalities noted above (M, D, and R), giving each one equal weight in his/her reasoning process. Individuals who employ this modality tend to analyze, question, or, in effect, appraise what is under consideration in the process of drawing a probability conclusion.

Deductive (K): Indicates deductive reasoning, or the form of logical proof used in geometry or in syllogistic reasoning.

Fourth Educational Science

Educational memory is a Cartesian product of three sets of information pertaining to: (1) the memory function, (2) concern components (persons, processes, properties), and (3) conditions. The elements of the condition set of information are: assimilation (AS), accommodation (AC), attendance (AT), and repression (RS). This set is still under development and is not yet being used in cognitive style mapping.

Fifth Educational Science

Educational cognitive style combines the information of the first four sciences by means of a Cartesian product of those four sets, to provide a picture of the profiles distributed over the four sets the individual employs in seeking meaning. These profiles reflect the cognitive strengths of the individual and are vehicles for determining educational prescriptions to help him in the educative process.

Sixth Educational Science

Counseling, administrative, teaching, and student styles are represented by a Cartesian product of three sets of information pertaining to: (1) demeanor, (2) emphasis, and (3) symbolic modes of presentation or communication, as follows:

Counseling style: The cognitive style of indivuals involved in counseling situations, as in the case of teaching and administrative styles, is important but does not provide a total explanation of the behavior of counselors. The demeanor elements of counseling style, expressed in terms of major and minor orientations involving (1) directive (V,v), (2) situational (U,u), or (3) nondirective (O,o) actions are determined on the basis of the counselor's attitude toward who should set the goals and determine the approaches to the goals in the counseling situation. The counselor who reflects "my goals my way," regardless of the counseling situation, is given a major orientation in the directive element in the demeanor set. Counselors who are at times directive and at other times nondirective, depending on the situation, are accorded major orientations in the situational element. Counselors who tend not to direct behavior, regardless of the counseling situation, are accorded major orientations in the nondirective element. The total counseling style of an individual is expressed in terms of profiles showing major and minor orientations distributed over the three sets of demeanor, emphasis, and symbolic mode.

Administrative style is defined as major and minor orientations in four elements of demeanor: (1) dominant (N,n), (2) adjustive (J,j), (3) cooperative (C,c), and (4) passive custodial (X,x). Major and minor orientations are combined in the "emphasis elements"--persons (PN), processes (PS), and properties (PT)--along with major and minor orientations in the elements of symbolic mode (QP, RP, TP), for profiles that portray the administrative style of an individual. The dominant (N) administrator reflects a "my goals my way" approach; the adjustive (J) type reflects a "my goals your way" or "your goals my way" approach; the cooperative (C) person employs an "our goals our way" attitude; whereas the passive custodial (X) demeanor is one resulting from a "your goals your way" approach to administration.

Teaching style is defined as follows. The demeanor set of teaching style includes three elements: (1) predominant (P_{ap}), (2) adjustive or "switcher" (S_{ap}), and (3) flexible (B_{ap}). These three demeanor classifications can occur as either a major orientation in one element with minor orientations in the other two, or two major orientations with a minor in the remaining element. Each of these elements is subscripted as authoritarian (a) or permissive (p). An authoritarian type is an individual who respects the wishes and decisions of those in superordinate positions relative to his/her own, and expects his/her wishes and decisions to be respected when he/she assumes the superordinate role. A permissive individual is one who does not exercise this "respect," and does not expect it to be exercised by others regarding his/her role. The orientations in the demeanor set are combined with those of the emphasis and the "symbolic mode" set (qualitative predominant [QP], reciprocity [RP], theoretical predominant [TP]) to form profiles indicating a person's teaching style.

Seventh Educational Science

Systemic analysis decision-making. A system is a defined collection of elements with their interconnections considered over a period of time. Any aspect of education may be considered a system.

The basic purpose of systemic analysis is decision making resulting in a choice of options available to the decision maker.

Analysis of a system is conducted in terms of determining how well the goals of the system are being met within the constraints of its inputs, combined with considerations of its mission and the main functions (design criteria) around which it is designed.

Performance goals must be stated in terms of the tasks to be accomplished, the conditions surrounding the tasks, and the minimum performance needed for successful accomplishment of the tasks.

Overview

The need for individualizing or personalizing the instructional setting was discussed in this chapter. The background of the study was delineated; the purpose, objectives, and questions to be answered were discussed; the methodology, need, assumptions, and limitations were specified; and the establishment of the educational sciences was discussed and explored. Last, the conceptual framework of the applied field of education was specified, along with its attendant language and definitions of key terms.

Chapter II is a review of related literature. Cognitive styles and human variability are discussed, and a fuller explanation of the educational sciences is provided.

The research design is presented in Chapter III; included is a full explanation of the instrumentation and data-collection procedures employed.

Results of the study and a complete analysis of obtained data are reported and discussed in Chapter IV.

The conclusions, implications, and recommendations are presented in detail in Chapter V.

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CHAPTER II

REVIEW OF RELATED LITERATURE

Introduction

The present study was designed to identify and analyze cognitive styles of students who fit into certain subsets of vocational student achievement. An ancillary purpose was to determine what possible relationships might exist between vocational student achievement subsets and the collective cognitive styles associated with them. To orient the reader to the focus of the present study, the following areas of literature are reviewed: (1) vocational choice, (2) cognition, (3) human variability, (4) cognitive style, (5) educational science, (6) mode of instruction, and (7) personalized instruction. Besides formulating a review of literature for purposes of illuminating the reader, a related goal was to provide a background of research that has been conducted on problems related to the present study.

Vocational Choice

Crites defined vocational choice as what the individual prefers to do.[1] He assumed that the individual had surveyed alternative vocations and decided upon or expressed his/her preferences for one over the others.

Vocational choice is relevant to a study of this orientation because an individual's selection of an occupation has an obvious bearing on the achievement aspect of the study and because, after all, the study is concerned with vocational students.

A natural organizational framework for this section was suggested by Osipow.[2] He delineated four distinct categories of thinking about career theory:

1. Trait-factor theories. This system assumes that a straight matching of an individual's abilities and interests with the world's vocational opportunities can be accomplished.
2. Sociology and career choice. This approach has as its central point the notion that circumstances beyond the control of the individual contribute significantly to the career choice he or she makes.
3. Self-concept theory. The approach has as its central thesis that (1) individuals develop more clearly defined self-concepts as they grow older; (2) people develop images of the occupational world which they compare with their self-image in trying to make career decisions; and (3) the adequacy of the eventual career decision is based on the similarity between an individual's self-concept and the vocational concept of the career he/she eventually chooses.
4. Vocational choice and personality theories. The general hypothesis underlying these studies is that workers select their jobs because they see potential satisfaction of their needs. A corollary hypothesis is that exposure to a job modifies the personality characteristics of the worker so that, for example, accountants eventually become like one another, if indeed, they were not similar in personality to begin with.[3]

Trait-Factor Theory

The trait-factor theory dates back to Parsons' conception of vocational choice. He characterized an individual's selection of an occupation as his/her "greatest decision," which occurs at that time of life when he/she is about to enter the work force. This viewpoint supports the philosophy that vocational choice is a problem-solving, conscious, cognitive process. The individual purposefully and analytically decides his/her vocational assets and liabilities, accumulates information concerning occupations, and arrives at a decision.[4]

The elements found in the educational science of cognitive style are recognized in Parsons' theory, thereby establishing the relevance of that theory to cognitive style as a determiner of vocational choice.

Thus, it is found that this oldest of theoretical approaches to vocational choice undergirds each of the theories of vocational choice that is currently in vogue. Each of the other three theories that will be considered goes beyond the general idea that people are different and concentrates on the manner in which people express and take advantage of these differences.

Sociology and Career Choice

As a category for career choice, sociology and career choice has as its main proponent August Hollingshead, who wrote:

> The pattern of vocational choices corresponds roughly with the job patterns associated with each class in the adult's work world. Therefore, we believe that the adolescent's ideas of desirable jobs are reflections of their experiences in the class and family culture complexes.[5]

Lipset, Bendix, and Malm also concluded that:

> The importance of family background for the education and careers of [young people] is seen in the characteristic cumulation of advantages and disadvantages. Vocational advice from many sources is more often given to those individuals whose families can afford to keep them in school. It also seems to be more realistic and helpful than such advice as is given the children of working class parents. The effect of these and other background factors may be discerned in an individual's choice of his first job.[6]

This study has as a basic concern the effect of enculturation on the individual. Enculturation is reflected in the educational science of cognitive style in the second set--cultural determinants. As indicated in Chapter I, the symbols that represent cultural determinants are: (I) individuality, (A) associates, and (F) family. Therefore, the studies of Hollingshead and of Lipset, Bendix, and Malm are directly related to the present study because they all deal directly with the influence of the family, associates, peers, and culture on the individual's choice of a vocation.

Miller and Form specified the following ways in which schools establish good work habits in their students:

1. The pupil is trained to stay on the job and learn his lesson.
2. The pupil is trained to obey authority.
3. The pupil is encouraged to develop initiative and to rise socially.
4. The pupil is trained to develop character.
5. The pupil is trained to get along with his teachers and his schoolmates.[7]

They further established three periods of choice that occur in the selection of an occupation: (1) the preparatory work period, (2) the initial work period, and (3) the trial work period. The first phase is defined as the time before the individual has any work experience. It is characterized as being influenced largely by the family and school. The initial work period is the second period and is characterized by the individual seeking his/her first job, during which education continues; this phase lasts until the individual terminates his/her education. In the final period, an individual completes his/her training and seeks the first permanent job. Miller and Form recognized this trial period as a time during which the new worker will change occupations several times before stabilizing with a particular choice.[8]

Self-Concept Theory

The self-concept theory is actually a developmental model of which Super, Ginzberg, and Tiedeman have been the leading proponents. Because this is a developmental model, it is appropriate to define vocational development in terms of Super's ten propositions, which are fundamental to the theory. They are as follows:

1. People differ in their abilities, interests, and personalities.
2. They are qualified, by virtue of these characteristics, each for a number of occupations.
3. Each of these occupations requires a characteristic of abilities, interests, and personality traits, with tolerances wide enough, however, to allow both some variety of occupations for each individual and some variety of individuals in each occupation.
4. Vocational preferences and competencies, the situations in which people live and work, and hence their self-concepts, change with time and experience (although self-concepts are generally fairly stable from late adolescence until late maturity), making choice and adjustment a continuous process.
5. This process may be summed up in a series of life stages characterized as those of growth, exploration, establishment, maintenance, and decline. These stages may in turn be subdivided into (a) the fantasy, tentative, and realistic phases of the exploratory stage and (b) the trial and stable phases of the establishment stage.
6. The nature of the career pattern (that is) the occupational level attained and the sequence, frequency, and duration of trial and stable jobs is determined by the individual's parental socio-economic level, mental ability, and personality characteristics, and by the opportunities to which he is exposed.
7. Development through life stages can be guided, partly by facilitating the process of maturation of abilities and interest, and partly by aiding in reality testing and in the development of the self-concept.

8. The process of vocational development is essentially that of developing and implementing a self-concept; it is a compromise process in which the self-concept is a product of the interaction of inherited aptitudes, neural and endocrine makeup, opportunity to play various roles, and evaluations of the extent to which the results of the role playing meet with the approval of superiors and fellows.
9. The process of compromise between individual and social factors, between self-concept and reality, is one of role playing whether the role is played in fantasy, in the counseling interview, or in real life activities such as school, classes, clubs, part-time work, and entry jobs.
10. Work satisfactions and life satisfactions depend upon the extent to which the individual finds adequate outlets for his abilities, interests, personality traits, and values; they depend upon his establishment in a type of work, a work situation, and a way of life in which he can play the kind of role which his growth and exploratory experiences have led him to consider congenial and appropriate.[9]

Buehler's writing in developmental psychology influenced the developmental model or self-concept theory of vocational choice; however, the most influential writings in this area are those of Piaget, beginning with his book, The Language and Thought of the Child, written in 1926.[10] Although his writing was not fully understood in the United States for many years, Piaget is the acknowledged leader in the field of developmental psychology and the one person most responsible for the resurgence of this field in the world today.

Super recognized the importance of developmental psychology to career education and formulated concepts of vocational choice while applying human variability to these concepts. He followed Piaget's theory of the stages of cognitive development[11] when he formulated his process of vocational development stages.[12] This is evident in Super's delineation of what he considered to be the five stages of vocational development: growth, exploration, establishment, maintenance, and decline. To be more specific about the stages of vocational development, Super also proposed that each of the two major substages has several substages. The exploratory stage has three substages: tentative exploration, transition exploration, and uncommitted trial.[13] The establishment stage comprises two substages: committed trial and advancement.

Overstreet and Super studied variables that could be associated with vocational maturity. Since part of the present study is concerned with the discovery of variables related to the personalization of vocational students' instruction, these variables are included and are as follows: biosocial factors, environmental factors, vocational factors, personality characteristics, and adolescent achievement factors.[14]

In 1951, Ginzberg, Ginsburg, Axelrad, and Herma investigated occupational decision making and established a construct that described the four essential elements of vocational choice. Those elements are as follows:

1. Occupational choice is a developmental process which typically takes place over a period of some ten years.
2. The process is largely irreversible.
3. The process of occupational choice ends in a compromise between interest, capacities, values, and opportunities.
4. There are three periods of occupational choice: Fantasy, Tentative and Realistic periods.[15]

In reality, these elements are phases of vocational choice that are similar to Piaget's in that they are distinct and readily identifiable phases. The periods are related to each other and the events are the factors contributing to the vocational selection an individual makes.

The second of Ginzberg et al.'s elements was the construct that vocational choice is irreversible. The researchers found five factors that cause this irreversible tendency:

1. Familial support for training. Because families assume the responsibility for support and education of their children for only a set period of time, changes in vocational objective are limited by the availability of their financial resources.
2. Preparation for college and work. Changes from one curriculum to another are restricted by the amount of time remaining after the shift to meet the requirements for further training or for employment.
3. Imminence of marriage. The prospect of marriage in early years of adulthood tends to inhibit alterations in vocational decisions which would lengthen the period of preparation and necessitate a postponement of occupational entry and the establishment of a family.
4. Reluctance to admit poor planning and failure. A change in one's vocational goals may mean an admission of poor planning or of failure to implement plans. Such admissions may be repugnant to the individual, and this may impel him to continue in his original course of action.
5. Advantages and disadvantages of changing goals. The disadvantages of a change in goals may outweigh the advantages.[16]

The effect of the family is an important aspect of the construct of irreversibility, and as such is intimately connected with the educational science of cognitive style of cultural determinants.

Another developmental model of significance to this study is Tiedeman's seven stages of vocational decision making, which is relevant to the problem with which the individual is faced in making a vocational choice. According to this author, decision making encompasses the following seven stages:

Exploration: This stage is marked by random exploratory consideration. It is characterized by generalized, vague concern with little or no apparent progress towards choice. Knowledge of self and of the occupational world is a need felt, but the individual has developed no strategy or plan of action for satisfying this need. There is an absence or near absence of definite negative choices (exclusions from the range of possibilities). This uncertainty is accompanied by vague anxieties and doubts about the future.

Crystallization: This stage represents progress toward but not attainment of choice. The individual recognizes alternative possible choices and at least some of the consequences of these alternatives. Conflicts are recognized; advantages and disadvantages are weighed; the bases for a decision are being developed at least implicitly. The process for narrowing down the range of possibilities through negative choices is operating. False steps and inappropriate earlier decisions are recognized and used as a basis for future decisions.

Choice: This stage represents a definite commitment with some degree of certainty to a particular goal. It is accompanied by expressions of satisfaction and relief for having made the commitment. The individual may focus on aspects or characteristics of self which are evidence to him that he has made an appropriate decision. This stage further represents a swerve from the pessimism characteristic of the exploratory stage to a kind of native optimism about the future. The individual usually expresses a singleness of purpose and an unswerving attitude of goal direction as well as an eagerness and impatience to reach the goal. Focus upon the consequences of the decision and further planning are not yet in evidence.

Clarification: This stage represents a process of closure in which the individual is involved in clarification and elaboration of the consequences of his commitment, as well as in planning the details and next steps to be taken to follow through on the commitment. (Some of these consequences of commitment may well have been considered prior to commitment in the crystallization stage; yet in this stage, these considerations are more imminent and personally relevant, whereas earlier, they were more distant and hypothetical.) In addition, the individual is usually engaged in a process of elaboration and perfection of his self-image and his image of the future, although planning the overt action itself may be delayed until the environmental conditions are appropriate for action.

Induction: This stage marks the beginning of the implementation of a decision; the point at which the individual comes into reality contact with a new environment. One begins the process of accommodation to a new group of people and a new situation in the living out of one's decision. The individual's primary mode of interaction is passive. One is hesitant and is looking for cues from others in the group to determine what the group's values and goals are, and what the group's expectations of one are. While there is a general defense of self and a giving up of aspects of self to group purpose, the individual needs to feel some level of acceptance of one's uniqueness by the group. Gradually, one identifies with the group through the assimilation of one's individual values and goals into the group's values, goals and purposes. This stage ends when a person becomes aware of being accepted by the group.

Reformation: In this stage, the individual's primary mode of interaction is assertive rather than passive. One is highly involved in the group, enjoins the group to do better, and acts upon the group in order to bring its values, goals, and purposes into greater conformance with one's own values and goals (which have become somewhat modified during induction). One also acts upon the out-group to bring their view of one's identification with the in-group into greater consistency with one's own view. There is a strong sense of self, which is somewhat lacking in objectivity. At the same time, self is abandoned to solution and group purpose. The result of this stage is a modification of the group's values, goals, and purposes.

Integration: In this stage, older group members react against the new menber's force for change, which causes the individual to compromise or modify one's intentions. This results in a greater objectivity towards self and towards the group's purposes. A synthesis is achieved which both the individual and the group strive to maintain through collaborative activity. The individual is satisfied, at least temporarily, and one has an image of self as successful, while the group also considers one successful.[17]

Tiedeman's approach to vocational development contains a view of the individual as being responsible for his/her behavior and being able to choose thoughtful action. Life environmentally causes the individual to have discontinuities of experience. These discontinuities are socially and physically experienced or anticipated. When one effectively resolves these problems, control over his/her own environment gradually increases. This increased control or responsibility for one's own behavior, in turn, creates further purposeful action.[18] As this theory suggests an orderly progression through the seven steps, it is important to realize that people do differ in their manner of making selections and decisions. This difference is important to the current study because it reflects one of the major themes of the study: the relationship of the educational science of cognitive style to the individual's decision-making style.

In 1967, Dinklage developed a system of categorizing secondary school students on the basis of their ability to make decisions in the areas of education, vocation, and personal affairs. The eight decision-making styles were as follows: planning, intuitive, complaint, fatalistic, impulsive, delaying, agonizing, and paralytic. She found differences in style on the variables of sex and type of institution the student attended. Dinklage concluded that planning style was the most effective, and that intuitive style had some effect on decision making; the remaining styles were considered ineffective.[19]

Vocational choice and personality theories grew from a series of studies by Roe, starting in 1951 and documented in several monographs.[20] She was primarily interested in the differences between scientists in terms of personality. Roe's theory has three major components. The first assumes that childhood experiences are likely to be related to vocational choice. The second component of vocational choice is related to Maslow's theory of "need."[21] The third and last component is genetic influences on vocational choice and decision making.

Holland developed a theory of vocational selection based on combining the theory of career choice as an extension of personality and the theory that people see themselves in terms of occupational titles. Holland's original idea of vocational development theory suggested a specific method of classifying people according to their personality, as shown through vocational preferences.[22] According to him, there are six personality model types and six environmental model types within which any individual or environment may be classified. Holland described this theory as "a heuristic theory of personality types and environmental situations," meaning that the theory had as its basic theme the intention of establishing the stimulation of investigation along these lines.[23] Holland's theory was grounded in the following assumptions:

> The choice of a vocation is an expression of personality. . . . Interest inventories are personality inventories. . . . Vocational stereotypes have reliable and important psychological and sociological meanings. . . . The members of a vocation have similar personalities and similar histories of personal development. . . . Because people in a vocational group have similar personalities, they will respond to many situations and problems in similar ways, and they will create characteristic interpersonal environments. . . . Vocational satisfaction, stability, and achievement depend on the congruency between one's personality and the environment (composed largely of other people) in which one works. . . . Our knowledge of vocational life is disorganized and often isolated from the main body of psychological and sociological knowledge.[24]

Holland described his theory of vocational choice in the following series of propositions:

1. In our culture, most persons can be categorized as one of six types--Realistic, Intellectual, Social, Conventional, Enterprising, and Artistic.
2. There are six kinds of environment: Realistic, Intellectual, Social, Conventional, Enterprising, and Artistic.
3. People search for environments and vocations that will permit them to exercise their skills and abilities, to take on agreeable problems and roles and to avoid disagreeable ones.
4. A person's behavior can be explained by the interaction of his personality pattern and his environment.[25]

The propositions described above constitute the base of Holland's theory. He formulated several hypotheses about personality profiles, pairing persons and environments, and environmental patterns. One hypothesis related to consistent-inconsistent codes and was based on the notion that each environmental or personality pattern consists of the following six symbols: R, I, S, C, E, and A. Each of these exists to different degrees of strength. The "primary" type is the environmental type or personality type that is the most dominant. The "secondary" type is the next most dominant, and so forth. Holland found that some combinations of primary and secondary type had better outcomes than others. A primary and secondary type are said to be "consistent" when they are compatible. If they are dissimilar, they are incompatible and termed "inconsistent." The primary-secondary combinations that are consistent and inconsistent are illustrated in Figure 1.

	Secondary					
Primary	R	I	S	C	E	A
Realistic	-	C	I	C	I	I
Intellectual	C	-	I	I	I	C
Social	I	I	-	C	C	C
Conventional	C	I	C	-	C	I
Enterprising	I	I	C	C	-	C
Artistic	I	C	C	I	C	-

Note: C = Consistent, I = Inconsistent

Figure 1.--Consistent and inconsistent codes.[26]

The magnitude by which the primary type exceeds the other profile types is termed "homogeneity." The consistency referred to in Figure 1 and the homogeneity are positively correlated but not necessarily identical. Homogeneity is a measure of degree, whereas consistency refers to the structure of the environment or to the individual personality. Vocational stability is an important product of homogenous environments and personalities. Variability between personality types and environmental types is demonstrated in Figure 2.

	Model Environments					
Personality Types	Real.	Intel.	Soc.	Conv.	Ent.	Art.
Realistic	++	+	-	-	-	--
Intellectual	+	++	-	-	--	+
Social	--	-	++	-	+	+
Conventional	-	-	+	++	+	--
Enterprising	-	--	+	-	++	+
Artistic	-	-	+	--	-	++

Note: ++ = very attractive, + = attractive
-- = very unattractive, - = unattractive

Figure 2.--The attractiveness of the model environments to different personality types.[27]

Congruent interaction of a homogenous personality with a homogenous environment results in a higher amount of predictability and a greater degree of vocational satisfaction than with an incongruent interaction of personality and environment or with varying degrees of heterogeneity.

Thus far, only the psychological factors of vocational choice have been considered. The other side of the coin is the genetic factors of career choice. Or how much of the differential in students' career interests is because of nature and how much is because of nurture? Grotevant, Scarr, and Weinberg tried to separate genetic from environmental interests by testing 870 parents and children of natural and adoptive families in Minnesota. The results of their two-year study indicated that genetic endowment contributes to differences in individuals' vocational interest. The data suggested that:

> We don't inherit genes for investigative or conventional interests, but there does seem to be a genetic influence on more broadly defined styles of interacting and coping with the world, such as sociability, activity level, and emotionality. Although genes don't dictate our occupational choices, they will probably predispose us to be more attracted to certain activities and occupations.[28]

The present study is related to the work of Grotevant et al., in that both efforts recognize the influence of the family on the individual in selecting a career.

From the literature reviewed on career choice, it is apparent that the process is complex, involving symbols and cultural determinants. Cognition is also a significant prelude to human variability; selected aspects of that subject are explored in the next section of this chapter.

Cognition

According to the dictionary, cognition is the mental process by which knowledge is acquired.[29] Or more aptly stated, cognition is the process of knowing. Cognition is an elusive process that everyone innately believes he/she understands. As Keen described it, cognition is "the currency of our conscious activity."[30] To understand and appreciate the development of growth traits of intelligence in the individual, it is necessary to review the theory of Piaget, who was mentioned earlier in this chapter (see p. 43).

Piaget's major work on intellectual development has enlightened scientists and pointed the way toward new conceptualizations of the human mind, intelligence, and cognition. Piaget is known primarily as a child psychologist and developmental psychologist, but he is also a mathematician and philosopher. He prefers to be identified as a genetic epistemologist. In this capacity, he has studied the origin of knowledge, i.e., how the individual comes to know and how this knowing progresses through developmental stages. Piaget conceived cognition as adaptation; he indicated that it has three components: content, function, and structure.[31]

<u>Content</u> is what the individual sees, hears, and generally perceives. Intellectual content varies from culture to culture, but is reasonably constant within cultures. The content aspect of cognition is the basis for the major portion of cognition from which conventional psychometric tests are derived.

<u>Function</u> is the biologically rooted, invariant part of cognition or intelligence. Function can also be defined as the way in which an individual transacts with the world. Function comprises two basic processes: organization and adaptation. Organization is the systematic pattern of interrelationships that characterize the individual's intellect. Adaptation is the process made possible by organization.

The human mind adapts to the world in two ways: it assimilates and it accommodates. In assimilation, the mind receives data from the world in terms of knowledge and familiar patterns, whereas in accommodation the mind is forced to change its internal processing in terms of the external world.

Structure, Piaget postulated, is that portion of cognition or intelligence that bridges the gap between content and the biologically based invariant function. Cognitive structure originates with functioning and manifests itself in content. Flavel asked:

> What are structures in Piaget's system? They are the organizational properties of intelligence, organizations created through functioning and inferable from the behavioral contents whose nature they determine. As such, Piaget speaks of them as mediators interposed between the invariant functions on the one hand and the variegated behavioral contents on the other.[32]

This brief review of Piaget's theory leads to the stages of cognitive development that he originated and elaborated on during more than 50 years of investigating children's development. These stages are as follows:

The Sensorimotor Stage (birth to approximately two and one-half years). Perceptions and movements or actions constitute the child's intellectual instrumentation. The child is born with basic reflexes, which become action structures (schemes). At this stage, the child does not mentally represent objects or actions. There is no language until the latter part of this stage. Egocentrism, although total at first, gradually lessens, but still remains the dominant force throughout this period. An infant's intelligence is displayed in its actions. There is no concept of space, no concept of cause-and-effect relationships, and no concept of time. Piaget referred to sensorimotor intelligence as "practical intelligence," and outlined the following six substages of sensorimotor development:

1. Reflexes (birth to about one month)--Exercises ready-made schemes based on reflexes. Becomes proficient with use of sucking, crying, swallowing, grasping, gross motor movements.

2. First differentiations (approximately one to four months)--Primary circular reactions (i.e., coordination of motor habits and perceptions through constant repetition of a behavioral pattern until the pattern is smoothed out and mastered). Now the child can adapt to new situations.

3. Reproduction (approximately four to eight months)--Secondary circular reactions (i.e., coordination of primary circular reactions to form intentional acts). Still involves repetition of simple behavior patterns to achieve mastery, but now these are used to preserve interesting sights and make experiences last. This is the rudimentary beginning of the child's experimentation and attempts to modify its world.

4. Coordination of secondary schemas (approximately 8 to 12 months)--Applies familiar, previously mastered schemes to new situations through a systematic combination of these schemes. For example, the child can move an object out of the way in order to reach another object.

5. Experimentation (approximately 12 to 18 months)--Develops tertiary circular reactions (i.e., devises new schemes as a response to novel circumstances or features of an object). Makes new discoveries,

pursues, and explores these discoveries and their consequences, thereby creating new schemes. Actively experiments.

6. Representation (approximately 18 to 24 months to 30 months)--Invents new means through mental combinations. For the first time can consider various alternative strategies without actually having to perform them. Begins symbolic representation. Language is only one form of symbolic representation (Piaget preferred to use the linguist's term "semiotic function"):

> This function is the ability to represent something by a sign or a symbol or another object. In addition to language, the semiotic function includes gestures, either idiosyncratic or, as in the case of the deaf and dumb language, systematized. It includes deferred imitation, that is, imitation that takes place when the model is no longer present. It includes drawing, painting, modeling. It includes mental imagery, which I have characterized . . . as internalized imitation. In all these cases, there is a signifier which represents that which is signified, and all these ways are used by individual children in their passage from intelligence that is acted out to intelligence that is thought. Language is but one among these many aspects of the semiotic function, even though it is in most instances the most important.[33]

The period of preoperational thought (two or three years to seven or eight years)--Within the preoperational period is the preconceptual period, in which the child can symbolize but cannot perform operations. That is, the child can differentiate words and images from the objects or events to which the thoughts, images, and representations refer. He cannot integrate his thoughts into networks of thoughts in which he can reverse his thinking (reversibility is necessary for true operational thought, according to Piaget). Actions are internalized and, therefore, represented, but thought is not liberated from perceptions. Thus, the child in this perception-bound state will make decisions based on perceptual clues when confronted with a conflict between cognitions and perceptions. The child gradually becomes less dependent on direct sensorimotor actions, and his speech develops through two major developmental periods:

1. Egocentric speech (two years to four or five years)--No communication or intent to communicate in the adult sense. Speaks in the presence of others, but without intention that others should hear his words. Speaks "according to himself" but not "for himself." When he says he speaks for others, he actually speaks from his own point of view. Piaget called nonconversations of this type collective monologues. In many cases, egocentric speech is the thinking of actions out loud.

2. Socialized speech (by ages five, six, seven)--The child begins to communicate and exchange ideas, and intends that others should hear him and listen. Since cooperation depends on socialized speech, as well as for other reasons, this development has important implications for vocational education.

The intuitive substage of preoperational thought occurs from approximately four and one-half years to about seven or eight years. Thinking has progressed to the point where the child can give reasons for beliefs and actions and can form some concepts. The child's thinking is intuitive and not logical in the operational sense; i.e., his/her thought is not reversible. The child's perception is centered, in that he/she can perceive only one aspect or feature at a time.

The period of concrete operations (7 or 8 years to about 11 or 12 years)--The child becomes capable of true thought. Operational thought makes it possible for the child to relate events to other events and the whole of which they are a part. In this period, operational thinking is limited to concrete things and situations. One of the most important aspects of this age is that the child develops the ability to conserve, i.e., to hold constant certain features and characteristics of an object or situation when some other portion of it changes.

The period of formal operations (thought to be from 11 or 12 years to about 15 or 16 years, but this is not well established)--This is the final stage of intellectual development. Before this stage, the child has been able to deal with objects but has not been able to deal with ideas not linked to these things. The name of the stage comes from its primary characteristic, the ability to consider the form of an argument rather than just its content. The child can now deal with all classes of a problem: present, past, future, verbal, imaginary. Formal operations are important for vocational as well as comprehensive education; they are a necessary condition for mature relationships between individuals. This depends on reciprocity, conservation, perspectivism, reversibility, and other aspects of human intelligence that do not fully become present until this period of cognitive development is reached.

McKinnon and Renner pointed out that "no work can be found with American children which verifies his [Piaget's] conclusions that children begin to think logically between ages 11-15."[34] In a study of the ability of college freshmen to think logically, these researchers found that 50 percent of entering freshmen students were operating at Piaget's concrete level of thought and another 25 percent had not fully attained the criteria for formal thought.[35] According to McKinnon and Renner, the responsibility for this apparent discrepancy between American students and the Swiss students used in Piaget's studies lies not with the elementary schools but with the schools of higher education. They pointed out that American teachers have been subjected to four years of mainly listening experience, and went on to say that "Teachers are, in other words, not having the kinds of experiences with inquiry which Piaget says they must have in order to allow logical thought processes to develop."[36] They continued: "Future teachers, therefore, assume that telling is teaching and when they get their first class, they tell, tell, tell! If, then, a college student develops logical thought, such development is more by accident than design."[37]

Piaget's work has important implications for the present study because of its emphasis on personalized education and the use of various modes of instruction to expand the individual's educational cognitive style.

Another view of why American students have not obtained as high a degree of formal operational functioning as would be suggested by Piaget's theory is that the tasks used to establish Piaget's theory are not necessarily the tasks that students are using in their cognitive structures. In other words, an individual's expertise may influence the manifestation of formal operations. Piaget described the situation as follows:

> They would, therefore, be capable of thinking formally in their particular field, whereas faced with our experimental situations, their lack of knowledge or the fact they have forgotten certain ideas that are particularly familiar to children still in school or college, would hinder them from reasoning in a formal way, and they would give the appearance of being at the concrete level.[38]

Elkind supported Piaget's position, but contended that:

> Piaget's suggestion that people be tested in formal operations in their area of specialization seems reasonable in principle but difficult to achieve in practice. How does a salesman, a shoe clerk, or a carpenter use formal operations? To be sure some areas of specialization may require formal operational thinking, but not all occupations do. Devising tests of formal operations for specific fields is a difficult task but one that has to be attempted if the question of the generality or universality of formal operations is to be answered.[39]

Piaget extended his idea of formal operations into adulthood and suggested that the student's aptitudes and choosing a vocation would greatly enhance the manifestation of formal operations.[40] This statement suggests that vocational education has the possibility of offering the student more than just a vocation. It appears that selecting a vocation may help the individual attain formal operations and a more complete way of thinking about the problems with which he/she is confronted.

When reflecting on the review of literature on cognition, it becomes apparent that the process of acquiring knowledge is complex, uses symbols, and is inherent in the structure of the educational sciences. Another aspect of the development of cognitive style is human variability, which is reviewed in the following section.

Human Variability

The variability among individuals is extensive and in its totality is beyond the scope of this review. Perceptual differences among students are also extensive and have an important relationship to the educational sciences, with which this study is particularly concerned. Perception is the first event in the process that leads from stimulus to action. To understand perception, it is important to find out what the individual responds to and why.

In the simplest sense, a stimulus is any sort of energy change, or event, that can set off a response. Heat or pressure on the skin, light hitting the eye, and chemical particles carried into the nose are all stimuli in the simple sense.

It is not easy to understand fully the problem of perception. Reality, the objects and events around the individual, seems so tangible, so concrete that the individual believes the world exists just as he/she perceives it. Experience mirrors what is "out there." Perception, then, is the experience of objects and events that are here now. It excludes those things that are somewhere else. Students often learn differently in the same set of circumstances because they perceive the stimuli differently.

Bruner dealt with human variability, and particularly perception, as follows:

> Perception involves an act of categorization. Put in terms of the antecedent and subsequent conditions from which we make our inferences, we stimulate an organism with some appropriate input and he responds by referring to some class of things or events. "That is an orange," he states or he presses a lever that he has been "tuned" to press when the object he "perceives"

> is an orange. On the basis of certain defining or criterial attributes in the input, which are usually called cues although they should be called clues, there is a selective placing of the input in one category of identity rather than another. . . . The use of cues in inferring the categorical identity of a perceived object, . . . is as much a feature of perception as the sensory stuff from which percepts are made.[41]

Bruner's criterial attributes or cues are selectively placed or categorized for identification. This process of selection and categorization is obviously exposed to large degrees of variability. Perceptions, therefore, are seldom the same for two or more people. The perceptual nature of the cognitive process must not and should not be ignored. Perception and cognition are individual matters and should be so considered by educators.

Cognitive Style

In recent years, an increasing amount of research attention has been given to certain constructs concerning mental performance, which are referred to as cognitive style. Messick conceptualized style as comprising the typical modes of perceiving, remembering, thinking, and problem solving.[42] These modes have been referred to as "styles" because they are thought to be an individual's typical approach to cognitive tasks. The topic of cognitive or learning style has grown out of both practical and theoretical interests. Teachers have noticed that students learn in different ways--some through manipulating concrete materials, others through applying abstract logic, and still others through trial and error. Still further, a preliminary review of recent literature indicated that investigators have considered cognitive style from different conceptual viewpoints, producing an extensive body of literature on the topic.[43]

One popular approach has viewed cognitive style variations as correlates of personality development.[44] Researchers have identified several dimensions of cognitive style--tempo, risk-taking, impulsivity/reflectivity, flexibility/inflexibility, and field-dependence/field-independence--in their work and have developed and used a number of different measurement instruments to define and quantify these dimensions for people of various ages.

Kagan considered cognitive style in his information-processing model.[45] The relationship between cognitive style variations and perceptual and physical components was the focus of recent research conducted by Gardner, Katz, and Stuart.[46] In terms of overall cognitive development, various writers have integrated the concept of cognitive style into such diverse models as Guilford's structure of intellect and Piaget's developmental stages; Holland's work has also been cited in research on the role of cognitive style variation in vocational and educational choice.[47] Many researchers, including Ausubel in 1969 and Frostig in 1971, have postulated the potential of the cognitive style dimension in educational remediation and prescription.[48]

Although the exact working of the definitions of cognitive style varies among researchers, all of them relate to individual differences in information processing. Writers in the field have also agreed on other characteristics of cognitive style. For example, it is generally accepted that an individual's learning style becomes stabilized in early adolescence.

Kagan, Moss, and Sigel defined cognitive style as "a term that refers to stable individual preferences in mode of perceptual organization and conceptual categorization of the external environment."[49] Allport conceived a concept of "style," which he defined as the structural consistency of personality, for style is intimately bound to the structure of personality and changes as the structure changes.[50] Messick explained cognitive style by saying that "Consistent individual differences in these ways of organizing and processing information and experience have come to be called cognitive styles."[51] He included the following list of the various dimensions of cognitive style:

1. Field independence versus field dependence
2. Field articulation
3. Conceptualizing styles
4. Breadth of categorization
5. Conceptual differentiation
6. Compartmentalization
7. Conceptual articulation
8. Conceptual integration
9. Cognitive complexity versus simplicity
10. Leveling versus sharpening
11. Scanning
12. Reflection versus impulsivity
13. Risk-taking versus cautiousness
14. Tolerance for unrealistic experiences
15. Constructed versus flexible control
16. Strong versus weak automatization
17. Conceptual versus perceptual-motor dominance
18. Sensory modality preferences
19. Converging versus diverging[52]

Since these cognitive styles are what might be called bipolar in nature, they tend to be independent of each other. But, in general, an individual who is ranked as "good" in a particular style will generally be rated the same in other styles. Warr stressed that the methods by which individuals organize their participation in events and activities into "coherent modes of dealing with information concerning oneself and one's environment . . . are, to a large degree, independent of the content of the information being handled."[53]

Holland did extensive research on cognitive style modes related to vocational education interests. His work on vocational choice and personality theories was discussed in a previous section of this chapter (see p. 49). However, Holland referred to his theory as personality models, when, in fact, they are models of cognitive style. It was also mentioned that Holland categorized personality (style) into six types. These types of styles are described in this section, because they were thought to be relevant to this part of the paper. They are as follows:

The realistic-style individual copes with his/her physical and social environment by selecting goals, values, and tasks that entail the objective, concrete valuation, and manipulation of things, tools, animals, and machines. He/she prefers agricultural, technical, skilled trade, and engineering vocations, but avoids supervisory and leadership roles. This person likes activities that involve motor skills, things, realism, and structure.

The intellectual-style person copes with the physical and social environment through the use of intelligence; he/she solves problems primarily by manipulating ideas, words, and symbols. He/she prefers the academic and scientific areas. Activities that involve analytic and imaginative behavior are the forte of an individual exemplifying this style.

The social-style individual copes with his/her environment by selecting goals and tasks in which he/she can use an interest in others in order to train them or change their behavior. Vocations preferred by the social individual are of an educational, religious, or therapeutic nature. He/she prefers activities involving religious, social, and esthetic expression, and is concerned with human welfare.

The conventional-style person copes with his/her environment by selecting goals, tasks, and values that are sanctioned by custom and society. This person enjoys activities involving clerical and computational tasks, and prefers occupations that are structured and role oriented, such as clerk, accountant, and appraiser.

The enterprising-style person is one who copes with his/her world by selecting goals, tasks, and values through which to express adventurous, dominant, enthusiastic, energetic, and impulsive qualities. He/she prefers business and supervisory roles, and enjoys activities in which he/she can make use of a persuasive, self-confident, extroverted nature.

The artistic-style individual copes with his/her physical and social environment by using feelings, emotions, intuitions, and imagination to create art forms or products. He/she prefers occupations that involve design and constructing skills, and activities wherein he/she can use independence of judgment and originality.[54]

Banks devised another approach to cognitive style models related to vocational education. He defined five style dimensions:

Learning Style--Consistent patterns of behavior or activity preferred and employed by the individual to effectively and efficiently acquire knowledge, skills and attitudes.

Concrete Style--A preferred learning strategy employed by the individual where optimum learning is affected by that individual in a situation that allows the learner to become personally and actively involved with an object or in direct contact with phenomena in "hands on" experience.

Symbolic Style--A preferred learning strategy employed by the individual where optimum learning is affected by that individual in a situation that allows the learner to engage in a wide variety of mediated, computational, reading or verbal interaction to achieve learning.

Structural Style--A preferred learning strategy employed by the individual where optimum learning is affected by the learner in a highly organized situation. The sequence and form of instruction are determined prior to engaging in the learning activity.

Unstructured Style--A preferred learning strategy where optimum learning is affected by the learner in an unorganized situation. The student utilizes a random pattern of personal selection and involvement in learning activities and objectives and a specific sequence are avoided.[55]

The most comprehensive system for formulating and using cognitive style is called "educational sciences," which was developed by Joseph Hill and his associates at Oakland Community College in Michigan. That system is explored in the next section.

Educational Sciences

One of the first applications of the educational sciences was made by the late Joseph Hill. He directed a training program for the Area Redevelopment Administration, through which adults were trained to mediate the symbolic requirements of their job roles.[56] This early project encouraged Hill to pursue the educational sciences, particularly in terms of cognitive style, when he became president of Oakland Community College. Hill organized and pursued the concept of cognitive style in evaluating students, prescribing personal programs, teaching, counseling, and administering educational programs. His early concept of the educational sciences was:

> If education is to be regarded as a relatively rigorous applied field of information, similar to those of medicine, engineering, and pharmacy, its conceptual framework must reflect a scientific orientation. The factual descriptions, concepts, generalizations, laws, and theories which could comprise a scientific conceptual framework for education are of many kinds. Under these circumstances, it is necessary to recognize that the conceptual framework which will probably best serve the purpose of education will be one composed of a set of disciplines which we might call the educational sciences. If this notion can be assured, then the framework can be mapped in terms of the sciences considered to be fundamental to the educative process.
>
> If education is thought of as a social system involving the generic elements of persons, processes, and properties, and their interconnections, then analysis of this system shows that there are seven aspects of it that are fundamental to its existence. These seven aspects, or strata, can be used to construct a conceptual framework unique to the applied field of education. Since each stratum includes factual descriptions, concepts, generalizations, and principles which apply to certain strata of education, it can be considered as a science in its own right. These strata may be designated as: (a) symbols and their meanings, (b) cultural determinants of the meaning of symbols, (c) modalities of inference, (d) neurological, electrochemical, and biochemical aspects of memory function, (e) cognitive styles of individuals, (f) teaching, administrative, and counseling styles, and (g) systematic analysis and decision-making.[57]

The educational sciences evolved into three major thrusts that were designed to: (1) provide a common language to facilitate the maximization of success for the individual in the instructional setting; (2) provide a foundation for individualized instruction; and (3) offer a systems approach to implementing the organizational aspects of the educational sciences in the educational process. It was Hill's opinion that if the educational sciences were, in fact, used, the aforementioned goals could be achieved.

A complete description of the educational sciences and implicit definitions were given in Chapter I; therefore, it is not necessary to review this topic further. The subject of cognitive style mapping is explored next; because the educational science of cognitive style has been involved in many studies, this area of research is also reviewed.

The earliest investigation of cognitive style maps was conducted by Trowbridge in 1913.[58] He was interested in explaining why some people are more readily confused than others about their location relative to their environment. This concept of a cognitive style map was obviously different than what Hill and his associates researched in the educational sciences. Trowbridge's concept was that of a geographical orientation, in which an individual could localize objects outside his/her immediate field of vision. Hill's concept was analogous to Trowbridge's because in Hill's conceptualization the individual's cognitive style is determined by the way the person takes note of his/her surroundings, seeks meaning, and becomes informed. Hardwick, McIntyre, and Pick wrote a monograph relevant to this subject.[59] They reviewed historical and current work in this area in great detail, and discussed the use of a triangulation task for analyzing cognitive maps.[60]

Witken suggested that the elements of a student's cognitive style might be used to profile or map his/her method of learning as a supplement to other test data on the student:

> The cognitive maps that we will in time be able to establish for individual children offer promise of providing a rich, sensitive, complex, and comprehensive way of characterizing

> children both in their cognitive functioning and their functioning as persons. Whereas unidimensional assessments like the IQ encourage us to think in terms of "more or less" and "better or worse," the cognitive map concept focuses on the ways in which they may be different. The result is to emphasize individuality and to de-emphasize labelling along a simple "better or worse" continuum.[61]

Hill suggested a system that uses the information about a student's style of learning to produce a map that can be effective in personalizing his/her instruction. According to Hill,

> [Each map] reflects each student's cognitive style. A cognitive map provides a picture of the diverse ways in which an individual acquires meaning. It identifies cognitive strengths and weaknesses. This information can be used to build a personalized program of instruction.
>
> Results from a battery of tests and inventories are processed through the college's computer system to produce a map of cognitive traits that describe the many ways each student might seek meaning. Cognitive maps are printed out in the form of a cartesian product of three sets. The first set indicates a student's tendency to use certain types of symbols, one's ability to understand words and numbers, qualitative sensory symbols, qualitative programmatic symbols, and qualitative codes. The second set indicates influences which the student brings to bear in deriving meaning from symbols. These influences are effected mainly in terms of one's own individuality (I), or one's associates (A), or those of one's family (F). The third set indicates the manner in which the individual reasons, or the way in which one infers. Whether the individual thinks in categories (M), or in terms of differences (D), or synthesizes multiple relationships (R), or uses all three (S), one's modality of inference influences, and is influenced by symbols and the cultural determinants that are employed in that person's style. These three sets of elements; i.e., symbolic mediation, cultural determinants, and modalities of inference, comprise the cognitive style of the individual. A maximum of 3,260 different profiles of these elements are possible in an individual's map at a given level of educational development.[62]

As mentioned earlier in this section, a review of the studies using the educational science of cognitive style was thought to be of value since the present study was concerned with cognitive style as a means of personalizing vocational education. Studies are available for each of the seven educational sciences. Berry and Sutton compiled an annotated bibliography of studies that have been conducted in each area. The following discussion of research on the educational sciences is based on their bibliography.

As related to the educational science of the first set, symbols and their meanings, the variation in kinds of symbols came from the work of Champlin and Villemain.[64]

The second set, cultural determinants, was derived from the work of Kelley.[65] Parsons later developed the concept of "individuality."[66] Merton[67] worked in the area of role-set theory, and Cross[68] found that the father's occupation was an important variable in determining college attendance.

The third set, modalities of inference, was conceptualized from the works of Piaget,[69] Wertheimer,[70] Bruner,[71] and Guilford.[72] These works served as the foundations of this science.

The fourth set, memory-concern, emphasizes the neurological basis of memory. Piaget's research on thinking involves two of the elements in the memory subset.[73] Piaget considered thinking to be an internal action. He conceived of thinking as adaptation, and said that it comprises three major components: content, function, and structure. Piaget contended that interiorization implies assimilation and accommodation. Assimilation is the process whereby the mind receives data from the world in terms of existing knowledge, familiar patterns, and the known. Accommodation is the complementary process by which the environment operates on the organism and forces the mind to change its internal functioning in terms of the external world.

The fifth set, cognitive style, was defined by Allport[74] as the consistency and pattern of expressed behaviors. Broverman[75] and Gardner[76] studied cognitive style in the context of personality. Hill developed educational cognitive style, which was investigated by Blosser,[77] Deloach,[78] and Dehnke[79] in regard to cognitive style and educational instruction. In an attempt to relate selected cognitive styles with student success, Hoogasian,[80] Grasser,[81] and Shuert[82] worked within selected disciplines.

In the sixth set, teaching administrative, and counseling styles, Greyson,[83] Wyett,[84] and Zussman[85] made significant research contributions.

The seventh set, systemic analysis decision making, was derived from the general systems theory of von Bertalanffy.[86] The importance of system feedback was orchestrated by Wiener.[87] Neumann and Morgenstern[88] did investigative research on choices.

Crowe[89] investigated the educational cognitive styles of twelfth grade students enrolled in selected vocational education programs, to determine the similarities among cognitive style elements of the various groups. Her study is particularly relevant to the current research, as both are related to the general field of vocational education.

Bartman's[90] study was designed to determine if people with similar types of educational cognitive styles would achieve similar or dissimilar results on a standardized inventory of vocational maturity. Two other research efforts related to the field of vocational education were conducted by Gural,[91] who developed an approach to the reconceptualization of a vocational curriculum, and by Rice,[92] who explored cognitive styles to determine success within occupational curricula. One other study that is applicable to the present effort, as both are concerned with the vocational school setting, was undertaken by Jellema.[93] His basic motivation was to determine the applicability of matching the student's cognitive style with an instructional mode based on the concept of individualized instruction. Jellema found that it was possible to assess the cognitive style of an individual using a simplified questionnaire. He also concluded that matching a learning style with an instructional mode yielded inconclusive results, but appeared to indicate that a match was of benefit to the student.[94]

From the review of literature on the educational sciences, it is apparent that extensive research has been done in this area. There has been considerably less research in the field of the educational sciences as related to vocational education. Since the mode of instruction is an important aspect of personalizing instruction, it is briefly discussed in the next section.

Modes of Instruction

The research literature reports numerous modes of instruction for teaching and learning. Among these modes are magnetically recorded teaching-learning materials, captioned filmstrips, dioramas, demonstration boards, 8mm silent and sound films, 16mm sound films, pictures, games, mock-ups, models, printed materials, programmed instruction, real objects, resource persons, simulations, simulation games, slides, slide-tape presentations, sound filmstrips, study trips, television, and transparencies.

The present study was not intended to furnish an overall review of such a complex subject as modes of instruction. Rather, the objective was to identify the variables that exist between the vocational student's cognitive style and the instructional mode, to obtain ideas for personalizing instruction, in terms of Hill's educational cognitive style. To do this, students' learning styles were compared to the style of the mode of instruction. DeNike and Strother discussed compatible cognitive style elements for the instructional modes in their book, Media Prescription and Utilization as Determined by Educational Cognitive Style.[95]

> It is the intent of this manuscript to offer a new approach to media selection. This approach takes into account learner cognitive styles as they relate to the mode of understanding required by the medium. Through this approach, we can select media that are compatible with a student's method of acquiring meaning when confronted with an educational task.[96]

In devising an instructional process for the individual student, a theoretical framework and a definitive methodology are needed. These instructional processes are discussed in the following section.

Personalized Instruction

In the book Individuality in Learning, Holtzman indicated that instructional methods used in the past are now being questioned:

> There is a call for education that is less routinized and more personalized, for education that not only imparts adopted knowledge but implants adaptive thinking, for education that does not just master belatedly the solutions of the past but that solves creatively the problems of the present and foresees realistically the issues of the future.[97]

In this context, literally dozens of approaches have been developed to organize and structure school learning and activities with the intent of perfecting personalized instruction. Two of the better-known plans for individualizing instruction are the Dalton Plan implemented in Dalton, Massachusetts, and the Winnetka Plan of Winnetka, Illinois. In the Dalton Plan, the students "contracted" to accomplish a specific amount of work in an agreed-upon time. In the Winetka Plan, testing was used to determine pupil tasks. These plans were both forerunners of mastery learning, and the major emphasis in both plans was on students working at their own speeds.

Teachers and students are sometimes incompatible. If the teacher is viewed as a constant instead of a variable, education can be assessed more realistically, as Thelen described:

> Everybody seems to realize that some pupils perform better with certain teachers than with others. Indeed, toward the end of a school year, a group of teachers will often sit down to figure out which students should be assigned to certain teachers.
>
> At the University of Chicago, it has been a long-standing custom for kindergarten teachers to recommend the first grade teacher to which every kindergartener should be assigned. Frequently, school counselors make similar recommendations. Many parents try hard to get their children with certain teachers.
>
> Surprisingly enough, although everyone recognizes that the interpersonal relationship between child and teacher is at the heart of the learning situation, most systems used for grouping children overlook this factor completely.[98]

Providing personalized instruction requires the development of a conceptual framework for the applied field of education. Most important, personalized instruction necessitates the development of an educational atmosphere in which the learning style of the individual is recognized and augmented. The cognitive style maps of individuals provide a meaningful and comprehensive way of characterizing the student's cognitive functioning.

In their article entitled "Career Mobility Through Personalized Education," Nunney and Hill described the personalized programs of Oakland Community College:

> Although educators are aware that individuals learn not only at different rates but in different ways, little has been done in traditional programs to adapt teaching methods and media to individual differences.
>
> OCC has found that mastery of essential skills and attitudes can be facilitated by the development of personalized educational sequences employing a variety of teaching media, instructional techniques, and flexible time sequences to accommodate each student's identified learning strengths and abilities. The keystone of this approach is a diagnostic testing program that measures students' abilities to acquire meaning through qualitative strengths as well as the more traditional theoretical methods.
>
> Students entering OCC spend three hours taking a battery of tests. Some tests measure subtle abstractions, some measure visual and manual coordination, some index response of senses, and some indicate personal characteristics. The scores achieved on these tests and on demonstrable performances, along with supportive data from personal interviews, are translated into elements of the student's cognitive map--a picture of the ways he derives meaning from his environment and experiences.[99]

Cognitive style was conceptualized in terms of the notion of personalized instruction as follows:

> Personalized instruction is defined as that form of presentation of a desired skill, or knowledge area, to an individual which will result in at least a 90 percent level of successful attainment of the skill or knowledge by the person. The assumptions are:
>
> (1) that each individual searches for meaning in his own unique way;
> (2) that it is possible to determine which elements of a person's educational cognitive style have enabled him to succeed in the past;
> (3) that 90 percent of all individuals can and do achieve at a 90 percent level of success in certain informal and/or formal educational settings of their choice;

(4) that it is possible to match an individual's cognitive style to a mode of understanding or form of presentation in order to produce a 90 percent achievement level; and
(5) that an educated person is one who has developed perceptual, cultural, inferential, and memory skills so that he or she is able to use theoretical and qualitative symbols to search for meaning in all experiences.[100]

Bruner followed this same of line of reasoning, and maintained that:

> We begin with the hypothesis that any subject can be taught effectively in some intellectually honest form to any child at any stage of development. It is a bold hypothesis and an essential one in thinking about the nature of curriculum. No evidence exists to contradict it; considerable evidence is being amassed that supports it.[101]

Bloom, when discussing mastery learning, indicated:

> Most students (perhaps over 90 percent) can master what we have to teach them, and it is the task of instruction to find the means which will enable our students to master the subject under consideration. Our basic task is to determine what we mean by mastery of the subject and to search for the methods and materials which will enable the largest proportion of our students to attain such mastery.[102]

Considering the problem of teacher expectation of students' performance, Bloom stated:

> Each teacher begins a new term (or course) with the expectation that about a third of his students will adequately learn what he has to teach. He expects about a third of his students to fail or to just "get by." Finally, he expects another third to learn a good deal of what he has to teach, but not enough to be regarded as "good students." This set of expectations . . . creates a self-fulfilling prophecy such that the final sorting of students through the grading process becomes approximately equivalent to the original expectations.[103]

The assumption that the majority of students can achieve at high levels led to the development and systematic use of alternative modes of instruction and prescription centers at Oakland Community College. Implementation programs have been conducted at Oakland

Community College and the East Lansing Public Schools in Michigan, and at Polk Community College in Florida. Analysis of these activities formed the basis for the following set of assumptions, which are used in designing educational systems using cognitive style mapping:

1. Educational cognitive style maps can be generated for all students.
2. Different mapping techniques will have to be used for different students, largely dependent on their level of educational development and the context in which the mapping is effected.
3. Analysis of the educational cognitive style maps must precede the design of the educational process to be followed.
4. A heterogeneous group of 30 students will need at least 5 or 6 alternative prescriptions.
5. A one-prescription system will rarely be successful for all students involved.
6. Teacher-aides, peer-tutors, and volunteers can be matched with a student's cognitive style.
7. The teacher's role varies from diagnostician to prescriptionist to educational process designer.
8. Case studies on individual students must be developed in order to assess the efficiency of the prescription and the potential need for change.
9. Augmentation of elements at any age level is possible but the amount of time needed depends upon the level of educational development, the element being augmented, the degree of motivation, and the establishment of realistic performance goals.[104]

In addition to the preceding assumptions, personalized instruction calls for the fabrication of an educational climate in which the style of the student and that of the teacher are mutually respected.

The foregoing information has illustrated that there is a method by which to organize the broadly based conceptual framework of the functions and purposes of personalized education to meet the demands of contemporary society and the American educational system. Vocational education and perhaps special education need the application of these educational sciences; this, indeed, was the main focus of the present study. The effort was undertaken with the conviction that the conceptual framework called the educational sciences provides a meaningful approach to the personalization of instruction that merits further study. The study was considered exploratory because it was directed to seeking trends and defining information concerned with various approaches to the problem of individual differences of students that could lead to the generation of hypotheses to be studied in subsequent research endeavors.

Summary

The purpose of this chapter was to review selected literature related to theories of vocational choice, cognition, human variability, cognitive style, educational sciences, modes of instruction, and personalized instruction. The review of literature, in conjunction with the information on the design of the study presented in the next chapter, provided the background necessary for the analysis of the data and findings presented in Chapter IV.

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[104]Nunney, pp. 16-17.

CHAPTER III

DESIGN OF THE STUDY

Introduction

The background of the present study and a review of the literature in related fields germane to the research were discussed in Chapters I and II. This chapter is concerned with the research methodology; source of the data; sample selected for the study, including a description of the way in which the sample was selected; and the data-collection procedures employed in the study.

It should again be noted that the study was not intended to be a hypothesis-testing effort, but rather was designed to provide answers to questions that may result in hypotheses to be tested in future studies. These questions concern the identification of cognitive styles of students who fit into certain subsets of vocational student achievement. A second purpose was to determine what relationships, if any, might exist between vocational student achievement subsets and the collective cognitive styles associated with them.

Restatement of Objectives

The major objectives of the study are restated as follows:

1. To identify the cognitive styles of the students in the Engineering Design class at the Southwest Oakland Vocational Center in Wixom, Michigan.

2. To identify the variables that exist between the cognitive style of the vocational student and the instructional mode, to obtain clues for personalizing instruction.
3. To determine if it is possible to identify a collective cognitive style and to see if there is a relationship between categories of vocational students' achievement and the associated collective cognitive style.
4. To discern whether there is a relationship between the number of qualitative codes and success in the Engineering Design class.
5. To determine how well a vocational student understands his/her own cognitive style.
6. To verify empirically the validity of the vocational students' cognitive style maps.

By investigating the areas identified in the above objectives, the writer hoped to arrive at some findings that would contribute to personalizing the instruction of vocational education students.

Setting, Program, and Sample

Setting

The setting for the study was the Southwest Oakland Vocational Education Center in Wixom, Michigan. The Center is the area vocational center for the southwest quadrant of Oakland County. Oakland County has four centers that are responsible for vocational education in their respective quadrants. Besides the Southwest Center in Wixom, centers are located in Clarkston, Pontiac, and Royal Oak. These centers provide training for students from feeder high schools located in their respective areas. The Southwest Oakland Vocational Center opened in September 1971 to 750 high school juniors and seniors, from both public and parochial students in the Clarenceville, Farmington, Huron Valley, Novi, South Lyon, Walled Lake, and West Bloomfield school districts.

Students with all levels of academic achievement attend classes at the Center for two and one-half hours each morning to learn a salable skill with which to enter the world of work. They return to their home high schools for all other classes, sports, and extracurricular activities. A second group of students attends classes at the Center in the afternoon. A graduate job placement service helps students obtain employment. Adults also take evening courses for job training or upgrading.

Covering 56,498 square feet of floor space, the skills center has four wings joined by a centrum, which houses the administrative office and student commons.

Career opportunities at the school include architectural drafting, auto mechanics, data processing, dental office assisting, diesel power mechanics, display, engineering drafting, food services, graphic arts, greenhouse and nursery occupations, industrial electronics, machine shop, medical office assisting, office procedures, retail plant and floral sales, and welding. Students completing the one- and two-year courses are capable of taking such diverse positions as secretary, repairman, mechanic, cook, and medical or dental assistant.

A federal- and state-funded special needs program provides 80 physically, mentally, or emotionally handicapped students from all of the feeder schools with a salable skill with which they can enter the working world. Although the students are integrated into the regular program, the specific course content for each area differs from the course of study offered to more able students. A coordinator, a counselor, and five trade teachers are specially assigned to the program. Special needs students may end their formal training and be placed on the job when they reach their highest potential; this may take anywhere from three months to two years.

Financed through county, state, and federal funds, the Center is operated by the Walled Lake Consolidated School District. Voters in Oakland County authorized up to .5 mill in property taxes to finance the Center; other funds come from state and federal sources through the Michigan Department of Education.

As the Center is administered by the Walled Lake school system, a short description of that district is in order. The Walled Lake Consolidated School District, located in southwestern Oakland County, encompasses nine governmental units, including all or parts of Commerce, Novi, West Bloomfield, and White Lake Townships, and the cities of Farmington, Novi, Orchard Lake, Walled Lake, and Wixom.

The district is the seventh largest of the 28 school districts in Oakland County, with a student enrollment of 11,434 and a professional staff of 621. More than 390 other support personnel assist in meeting the needs of K-12 students. Twelve elementary schools, two junior high schools, and two senior high schools are located in the district. In addition, the district operates a special education school, a vocational high school, and an outdoor education center.

Program

Because the present study was exploratory in nature, it was desirable to select as a source of data a program that possessed the necessary flexibility to allow for innovation and to assure cooperation in data collection. The Engineering Design curriculum offered at the Southwest Oakland Vocational Education Center is such a program. The total cooperation of the director of the Center, John C. Xenos, was assured, because of his dedication to the advancement of vocational education and his interest in the educational sciences.

Sample

The sample of students from the Engineering Design and Illustration course was selected on the basis of a judgment-purposive sampling technique, described by Deming as follows:

> The results from a judgment-sample are obtained by procedures which depend to some appreciable portion on (1) a judgment selection of "typical" or "representative" counties, cities, road segment blocks, individual people, households, firms, articles or packages concerning which information is to be obtained; or (2) weighing factors that are prescribed arbitrarily.[2]

According to Hill and Kerber, sample selection based on this technique is "determined on the basis of what the research worker might consider from his experience to be typical, or representative, sampling units."[3] Hill and Kerber also stated that when sample selection is based on human judgment, it is called "purposive" or "judgment" selection. Selection of this type is based on what a researcher might consider from his past experience to be representative of the sampling unit.[4]

Tatsuoka[5] and Deming[6] also supported judgment selection as being representative of the subjects relative to the purpose of a study.

Random and/or probability sampling was found to be unnecessary since the purpose of the study was to be achieved by formulating answers to questions raised about the cognitive styles of individual students in vocational education and the existing variables related to the instructional mode. Therefore, the use of nonprobability sampling was considered to be acceptable because the intended thrust of the study was an in-depth analysis of the individual's cognitive style and the determination of the variables related to that style for the purpose of personalizing the individual's instruction. Hill and Kerber stated that general questions to be answered can provide the same function as hypothesized research in that they can direct, frame, bind, and limit the description or exploration of the study.[7]

Sample Size Adequacy

Perhaps the most famous of educational psychological studies and writings were those of Jean Piaget, who conducted many studies using small numbers of Swiss school students. These studies were instrumental in the development of Piaget's theory of the cognitive development of children.[9] McKinnon and Renner, and many others, have pointed out that Piaget's research is not cross-cultural and, therefore, not totally applicable to American students.[10] However, the true value of studies like Piaget's is that they promote intellectual stimulation and new ideas for further research. Einstein developed his theory of relativity when he was in his early twenties and then spent much of his later life trying to refute his own theory.[11] This is another example of research that did not depend upon extensive sampling to test a hypothesis; it did, in fact, generate much new thinking and research from other investigators.

In the field of cognitive style research, Dehnke,[12] DeLoach,[13] Van Ast,[14] Wasser,[15] and many others have conducted studies using small samples to provide the necessary data. In view of the stated design objectives of the present study and the foregoing discussion of the merits of the use of a small sample size for this type of study, the selection of two sections of the Engineering Design and Technical Illustration class was deemed appropriate for the study. These classes consisted of 20 subjects each, or a total sample size of 40 subjects.

Data Collection

Instrumentation

The researcher used two instruments to procure data to analyze the existing variables. These instruments were: Oakland Intermediate School District's Prescriptive Analysis for Curriculum Evaluation and Review (PACER); and Oakland Community College's Cognitive Style Interest Inventory (CSII).[16] A description of these two instruments follows.

PACER is a content-oriented test developed specifically for students in the Engineering Design and Technical Illustration program. In testing for categories of vocational student achievement, it is expedient to use the PACER test. This instrument has been used in the Southwest Oakland Vocational Education Center for six years and is an excellent evaluative tool, particularly for occupational content of specific programs. The test is also equipped and set up for computerized scoring, using optically scanned answer sheets.

Joos described the underlying philosophy of the PACER system of testing as follows:

> Oakland Schools (an intermediate school district in the Michigan educational system) has developed and is marketing a computer-based system which provides analytic and prescriptive processing of testing data in a manner which is designed to facilitate the evaluation or assessment of school programs at the classroom level. The system involves specially written tests used with optically-scanned answer sheets. By use of the system, which is known as PACER, it is possible to prescribe improvements or changes in school programs. The methodology can be applied to comparisons between programs, to measurement and description of individual, class, or district curricular progress as well as to the assessment of experimental treatments. The methodology of the system is adaptable to clinical evaluation, developmental program evaluation, or special program evaluation. Its methodology is designed for use in dynamic mode as a means of assessment of quality and quantity concurrently with the events of education.
>
> While the PACER system of program evaluation could be used with any test, it departs radically from the norming strategy of standardized tests. The system does not require control groups or matched pairs, though it can be used with either. In the PACER system of program evaluation, there are no assumptions of normality of distribution, and no usage is made of parametric statistics such as standard deviation or coefficients of correlation.
>
> In this system, instead of measuring pupil achievement against items, item achievement is measured against pupils. Programs of education are measurable in terms of numbers or percentage of pupils who achieve each test item. Ordinary test analyses are performed upon measurement numbers no smaller or

> less complex than a pupil score, which is defined as the sum of all items for a pupil. PACER analysis begins with the smallest and least complex unit possible: the single item achievement of a single pupil. It maintains and reports all of these pupil-item units together with meaningful combinations of them. Whenever output reports a summed score, it also reports each part of all the parts summed.
>
> As a result, any value reported by the system does not need to be interpreted by an accompanying statement of probable accuracy, since every value is accompanied by the complete list of added parts. In such a context, measurement error is a relatively meaningless idea.
>
> PACER utilizes item analysis, not for the purpose of test development, but for curriculum evaluation. In this sense, PACER is an old method for a new purpose. PACER is made possible by modern computer technology and by specially designed tests which can make use of this technology for diagnostic evaluation of school programs.[17]

Item analysis of the PACER instrument was furnished by Dr. William Veitch, Assistant Director of Systematic Studies of the Oakland Intermediate School District. Kuder-Richardson Formula 20 (KR-20) reliability coefficients were shown to be .9521. Veitch also employed a split-half approach to estimating the reliability of the PACER instrument; corrected odd-even correlation was computed to be .9552. The PACER test was designed specifically for students at the high school reading and comprehension level. A description of the test follows.

The PACER is a multiple-choice test consisting of 150 questions, which are divided into 14 categories: (1) general drafting skills; (2) applied geometry and mathematics; (3) fasteners and hardware; (4) materials and characteristics--metals; (5) materials and characteristics--plastics; (6) manufacturing processes--machining; (7) manufacturing processes--heat treatment; (8) cams and gears; (9) electrical drafting; (10) technical illustration; (11) reference materials and standards; (12) details, layouts, and assemblies; (13) print making and micro-filming; and (14) tool and fixture design. The students have as much time as necessary to complete the test. An example of a test item follows:

15. The rule-of-thumb for determining the minimum depth of a tapped hole is:

    a. equal to the radius.
    b. 1-1/2 times the diameter.
    c. 4 times the circumference.
    d. 7 times the diameter.
    e. 1/2 the radius.

Cognitive Style Interest Inventory

The Cognitive Style Interest Inventory (CSII) battery comprises a series of tests designed to produce the student's learning profile. The instruments cover students with a wide range of abilities, from the eighth grade to the twelfth grade; they are also set up to be computer scored, which produces a cognitive style map. Test responses are processed by the computer center at Oakland Community College. A description of the battery of tests follows:

Verbal Reasoning Test.--In this test, composed of 25 sentences, the first and last words of each sentence are omitted. The student is asked to select from a list of five pairs of words, the combination of two words that makes the sentence true. Students use IBM answer cards and are allowed 15 minutes in which to complete the test.

Example:

. . . . is to pacifist as religion is to . . . .

a. atlantis............minister
b. object..............minister
c. atlantis............sacred
d. war.................atheist
e. conscience..........minister

Listening Comprehension Test.--A brief story, entitled "Coke and Chips in the Caribbean," is presented to the students on a tape recording. Students are asked eight questions to determine their comprehension of the story.

Visual Numerical Test.--Students are given 15 minutes to answer 20 problems on addition, subtraction, multiplication, division, percentages, fractions, and money values. Again, answers are recorded on IBM answer cards.

Example:

$$\begin{array}{r} 5473 \\ -\underline{2987} \end{array}$$

ANSWER:
a. 2485
b. 2486
c. 2496
d. 3486
e. None of these

Reading Comprehension Test.--The students are instructed to read 8 stories and answer 36 questions about those stories. The test has a time limit of 20 minutes; answers are recorded on IBM cards.

Oral Numerical Test.--In this test, the students are asked to listen to a mathematical problem on a tape recording and then write down the answer on an answer sheet. They have about 20 seconds to compute each answer.

Example:
How many hours will it take to drive 300 miles at 60 miles per hour?

Language Structure and Usage Test.--In this test, the student is given 40 minutes to answer multiple-choice questions on IBM cards. There are 50 items on the test, and the main intention is to ascertain how well the student understands the structure of the English language. Students are instructed to answer to the best of their ability and to proceed immediately to the next questions.

Example:

Select the one topic which could be handled best in one paragraph of about 100 words, assuming that you have sufficient information on all topics.

a. Traveling through America
b. My trip west
c. Visiting Chicago
d. Arriving at the hotel
e. Walking through the zoo on the 4th of July

Qualitative Codes Test.--The questions on this test deal with the student's interests, beliefs, attitudes, values, and other aspects of personal behavior. The test comprises 40 statements, and the student is asked to rate each statement according to how similar it is to him/her. The choices are: usually, sometimes, seldom, and never. This test has no time limit, but each student is directed to give the first answer that comes to mind.

Example:

I can understand how others feel.

a. Usually
b. Sometimes
c. Seldom
d. Never

Visual Test: A slide projector and screen are used to present several pictures with patterns on them. A piece is removed from each pattern and placed at the bottom of the screen, along with several other similar pieces. The student is to select the proper piece that fits the picture.

Auditory Test: In this test, a series of sound patterns is presented, using a tape recorder. The student is to complete the pattern on an answer sheet within 30 seconds.

Qualitative Life Choice Test.--This test is made up of 32 items covering topics similar to those in the Qualitative Codes Test. The procedure for this test is the same as that for the Qualitative Codes Test.

Example:

I compete effectively in amateur sports.

a. Usually
b. Sometimes
c. Seldom
d. Never

Test of Cultural Effects.--This test consists of 10 incidents or stories that involve people. The student has three possible solutions from which to choose. One of the choices is to be ranked "most like me," another "least like me," and the third is to be left blank. As before, answers are recorded on IBM cards, and there is no time limit.

Example:

Mrs. Jones, a widow with three children at home, is about to be evicted from the flat that she has rented for the past ten years. In order to help her solve her problem, she should:

1. Ask her married children (or sisters or brothers) for help.

   a. MOST   b. LEAST

2. Ask the ladies in her church group to give her some advice and help.

   a. MOST   b. LEAST

3. Realize that no one can really help her and decide to solve it on her own.

   a. MOST   b. LEAST

Test of Inferential Patterns.--The student is presented with ten situations in which he/she is supposed to imagine him/herself. The student is supposed to rank order the choices in order of preference.

Example:

If you were asked to recommend a "very good" restaurant to your best friend's family, what would you do?

1. Determine if the restaurant has the high standards of very good restaurants you have visited in the past.

   a. First choice c. Third choice
   b. Second choice d. Fourth choice

2. Find out if its standards are in keeping with older traditions as well as modern ones, and the extent to which it is like or different from other good restaurants and eating places.

   a. First choice c. Third choice
   b. Second choice d. Fourth choice

3. Discover in what ways the restaurant resembles and duplicates other fine eating places.

   a. First choice c. Third choice
   b. Second choice d. Fourth choice

4. Determine in what ways the restaurant's reputation is different from currently accepted standards of excellence.

   a. First choice c. Third choice
   b. Second choice d. Fourth choice

Besides the described instruments developed by Oakland Community College and Oakland Schools, the judgments of the teacher and counselor who had been in close contact with the student were also considered in determining individual cognitive style.

Mechanics of Gathering Data

The previously mentioned instruments were the major items used in gathering the necessary data. After conferring with the school principal, it was decided that the Engineering Design class would be the sample for the study. The class roster was number coded to preserve the students' anonymity.

The Oakland Community College Cognitive Test Battery was administered at the Southwest Oakland Vocational Education Center. Test responses were then sent to Oakland Community College for computer scoring and the production of cognitive style maps. The teacher and students subsequently discussed the test results and the cognitive style maps.

The PACER test was administered at the Vocational Education Center to the identical sample of students. Test responses were then sent to Oakland Schools for computer scoring and production of computer print-outs. These results were also discussed with all of the students.

Treatment of the Data

One of the predominant purposes of this study was to identify cognitive styles of students who fit into certain subsets of vocational student achievement. A second purpose was to determine what relationships, if any, might exist between vocational student achievement subsets and the collective cognitive styles associated with them.

To achieve the aforementioned purposes, the following procedure was employed:

Collective Cognitive Style Profiles

1. Students were grouped by subsets into low, high, and middle quartiles, as defined by PACER methodology.
2. The cognitive style elements for each subset of student achievement were tallied.
3. The percentage of occurrence was calculated using each element's frequency of occurrence.
4. Frequency charts of major and minor cognitive style elements were constructed for each subset of student achievement.
5. Profiles of similarity were constructed, as formulated by Nunnally in Psychometric Theory.[18]

Methodology Used in Achieving Objectives

This study had six major objectives, which were stated in Chapter I and again near the beginning of this chapter. These objectives are now restated, followed by the methodology employed to achieve the objectives in the present study (abbreviated objectives are included, rather than the full statements):

Objective 1.	Cognitive style identification
Methodology	Identifying the cognitive style of the students in the Engineering Design class was achieved by producing cognitive style maps, generated by the computer at Oakland Community College.

Objective 2 — Relationship of cognitive style and instructional mode

Methodology — This relationship was established by comparing frequency charts and collective cognitive style profiles of the students to media selection charts prepared by Denike and Strother in their book, Media Prescription and Utilization as Determined by Educational Cognitive Style.[19]

Matching the student's cognitive style to the appropriate instructional mode is a matter of both kind and degree. The general formats for the instructional mode style, as described by Hill and Nunney[20] and Denike and Strother,[21] are shown in Figure 3.

Objective 3 — Identification of collective cognitive styles related to categories of achievement

Methodology — This objective was achieved by inspecting the frequency chart and table of concentration of major and minor cognitive style elements for each subset of student achievement. Profiles of similarity and distance measures were also analyzed. A systematic examination of this information was carried out using the content analysis technique, described by Berelson in Content Analysis in Communication Research.[22]

Objective 4 — Number of qualitative codes

Methodology — The relationship between the number of qualitative codes and success in vocational education was

Programmed Text	T(VL) Q(CET) Q(CS) Q(CEM)	x	I a	x	M R r or m d d
Audiotape recording in the learning laboratory	T(AL) Q(CS) Q(CET)	x	I	x	M R
Faculty-led seminar or tutor	T(AL) Q(CEM)	x	F a	x	R or L
Youth tutor/ youth peer tutor	T(AL) Q(CEM)	x	I or A	x	M or R
Independent study	T(AL) T(VL) Q(CS) Q(CET)	x	I	x	M or R
Captioned filmstrip	T(VL) T(VQ) Q(V) Q(CEM) Q(CES) Q(CET) Q(CH) Q(CK) Q(CP)	x	A or F or I	x	M D R L or K
8 mm silent films	T(VL) T(VQ) Q(V) Q(CT) Q(CTM)	x	I a	x	M D R L
8 mm sound film	T(AL) T(AQ) Q(A) Q(V) Q(CT)	x	I a	x	M D R L
Flat pictures	T(VL) T(VQ) Q(V) Q(CEM)	x	I a	x	M D R L

Figure 3.--General format for the instructional mode style.

Models

$$\begin{bmatrix} T(VL) \\ T(VQ) \\ Q(T) \\ Q(V) \\ Q(CES) \\ Q(CET) \end{bmatrix} \times \begin{bmatrix} I \\ f \\ a \end{bmatrix} \times \begin{bmatrix} M \end{bmatrix}$$

Printed materials

$$\begin{bmatrix} T(VL) \\ T(VQ) \\ Q(T) \\ Q(V) \\ Q(CEM) \\ Q(CES) \\ Q(CES) \\ Q(CET) \\ Q(CH) \\ Q(CS) \\ Q(CTM) \end{bmatrix} \times \begin{bmatrix} A \\ I \end{bmatrix} \times \begin{bmatrix} M \\ D \\ R \\ L \end{bmatrix}$$

Real things
(realia)

$$\begin{bmatrix} T(AL) \\ T(VL) \\ T(VQ) \\ T(AQ) \\ Q(A) \\ Q(O) \\ Q(CP) \\ Q(T) \\ Q(V) \end{bmatrix} \times \begin{bmatrix} Q(P) \\ Q(CEM) \\ Q(CES) \\ Q(CET) \\ Q(CH) \\ Q(CK) \\ Q(CP) \\ Q(CS) \\ Q(CTM) \end{bmatrix} \times \begin{bmatrix} I \\ f \\ a \end{bmatrix} \times \begin{bmatrix} M \\ D \\ R \\ L \end{bmatrix}$$

Slides

$$\begin{bmatrix} T(VL) \\ T(VQ) \\ Q(V) \\ Q(CEM) \\ Q(CES) \\ Q(CET) \\ Q(CH) \\ Q(CK) \\ Q(CS) \\ Q(CTM) \end{bmatrix} \times \begin{bmatrix} A \\ F \\ I \end{bmatrix} \times \begin{bmatrix} M \\ D \\ R \\ L \end{bmatrix}$$

Slide-tape
presentations

$$\begin{bmatrix} T(AL) \\ T'(vl) \\ T(AQ) \\ T'(vq) \\ Q(A) \\ Q(V) \\ Q(CEM) \end{bmatrix} \times \begin{bmatrix} Q(CES) \\ Q(CET) \\ Q(CH) \\ Q(CK) \\ Q(CP) \\ Q(CS) \\ Q(CTM) \end{bmatrix} \times \begin{bmatrix} A \\ F \\ I \end{bmatrix} \times \begin{bmatrix} M \\ D \\ R \\ L \\ K \end{bmatrix}$$

Figure 3.--Continued.

determined by systematically examining the frequency charts and the table showing the percentage of occurrence of cognitive traits.

Objective 5	Cognitive style self-awareness
Methodology	One of the questions alluded to the degree to which a student understood his/her own cognitive style. If students have sufficient understanding of their own cognitive style map, they might be able to select their own mode of instruction and learning experiences. To effect this particular phase of the study, it was necessary to train the students in recognizing cognitive style elements. An educational scientist trained by Oakland Community College conducted a course for both classes of the Engineering Design program to familiarize the students with their cognitive styles and train them in recognizing cognitive style elements. These students were then given five cognitive style maps, produced by the Oakland Community's College's computer, one of which was their own; they were asked to rank the maps on a scale from 1 to 5, from most like themselves to least like themselves.
Objective 6	Empirical verification
Methodology	Verification was accomplished by comparing anecdotal data about each student with his/her own cognitive

style map to determine if, in fact, the maps were representative of observed information. The instructor kept a daily anecdotal data log of the student population as it related to key elements of the student's cognitive style. An observation worksheet was used to record pertinent remarks concerning the mode of instruction and observed correlations between the student's behavior and cognitive style elements and symbols. The anecdotal logs are included in Appendix A.

Summary

Discussed in this chapter were the design of the study, the source of the sample, its adequacy, and its selection. The data-collection instruments were discussed, and the mechanics for gathering and treating the data were explained.

Chapter IV contains an analysis of the data gathered in the study; the findings are also set forth.

Footnotes--Chapter III

[1]D. B. Van Dalen, Understanding Educational Research (New York: McGraw-Hill, 1966), pp. 204-206.

[2]William Edward Deming, Some Theory of Sampling (New York: John Wiley and Sons, 1950).

[3]Joseph E. Hill and August Kerber, Models, Methods and Analytical Procedures in Education Research (Detroit: Wayne State University Press, 1967), p. 43.

[4]Ibid., pp. 43-44.

[5]Maurice M. Tatsuoka, "Sampling," Encyclopedia of Educational Research, 4th ed. (1969), pp. 479-81.

[6]Deming, pp. 10-13.

[7]Hill and Kerber, pp. 35-36.

[8]Tatsuoka, pp. 479-80.

[9]Jean Piaget, The Origins of Intelligence in Children (New York: International University Press, 1952).

[10]Joe W. McKinnon and John W. Renner, "Are Colleges Concerned with Intellectual Development?" American Journal of Psychology 39 (September 1971): 1047.

[11]Albert Einstein, Out of My Later Years (New York: Philosophical Library, Inc., 1950).

[12]R. E. Dehnke, "An Exploration of the Possible Isomorphism of Cognitive Style and Successful Teaching of Secondary School English" (Ph.D. dissertation, Wayne State University, 1966).

[13]J. F. DeLoach, "An Analysis of Cognitive Style Disparity as an Antecedent of Cognitive Dissonance in Instructional Evaluation: An Exploratory Study in the Educational Sciences" (Ph.D. dissertation, Wayne State University, 1969).

[14]John Von Ast, "Cognitive Style Mapping: Its Use in Vocational Instructor Selection and Guidance" (Ph.D. dissertation, University of Minnesota, 1975).

[15]Laurence Wasser, "An Investigation into the Cognitive Style as a Facet of Teachers' Systems of Student Appraisal" (Ph.D. dissertation, Wayne State University, 1969).

[16]Because of the length of these tests, they are not included as appendices within this dissertation. A copy of the CSII test may be obtained from Oakland Community College, 2480 Opdyke Road, Bloomfield Hills, MI 48013. A copy of the PACER test may be obtained from Oakland Schools, 2100 Pontiac Lake Road, Pontiac, MI 48054.

[17]Oakland Schools, A Methodology for Program Evaluation in School Systems: PACER (Pontiac, Michigan: Oakland Schools Press, 1970).

[18]Jum C. Nunnally, Psychometric Theory (New York: McGraw-Hill Book Company, 1967), pp. 176-78.

[19]Lee DeNike and Seldon Strother, Media Prescription and Utilization (Ohio: Line and Color Publishers, 1976), pp. 24-122.

[20]Joseph E. Hill and D. N. Nunney, "Personalizing Educational Programs Utilizing Cognitive Style Mapping" (Oakland Community College, 1971).

[21]DeNike and Strother, Media Prescription and Utilization.

[22]Bernard Berelson, Content Analysis in Communication Research (Glencoe, Illinois: The Free Press, 1952).

CHAPTER IV

FINDINGS OF THE STUDY

Introduction

The major purpose of this study was to identify the cognitive styles of students who fit into certain subsets of vocational student achievement. A second purpose was to determine what relationships, if any, might exist between vocational student achievement subsets and the collective cognitive styles associated with them. For example, the collective cognitive style of students comprising the first quartile of the PACER test might be different than the collective cognitive style of students comprising the fourth quartile of that test.

Before identifying these collective cognitive styles, the following procedures were followed: (1) the Oakland Community College Cognitive Test Battery was administered at the Southwest Oakland Vocational Education Center; (2) test responses were sent to Oakland Community College for computer scoring and the production of cognitive style maps; (3) the Oakland Schools' Prescriptive Analysis for Curriculum Evaluation and Review was administered at the Southwest Oakland Vocational Education Center; (4) test responses were sent to Oakland Schools for computer scoring and production of computer printouts.

The data required for the construction of collective cognitive style profiles were gathered and analyzed according to the procedures outlined in Chapter III.

Because of the exploratory nature of this study, no attempt was made to test hypotheses. The main emphasis was on seeking answers to general questions. This type of approach gives the study a hypothesis-generating demeanor, and adds importance to the final outcome of the study.

Coding of Individuals

A total of 40 students participated in the study. For purposes of identification, and to ensure confidentiality, each student was given a code number from 001 through 040. Students were then ranked from highest to lowest, according to the score they received on the PACER test. The students who ranked from 1 to 10 were referred to as being in the first quartile; students who ranked from 11 to 20 were considered to be in the second quartile; students who ranked from 21 to 30 were referred to as being in the third quartile; and students who ranked from 31 to 40 were considered to be in the fourth quartile. Table 1 shows the students' coded numbers, their scores on the PACER test, and their rank in relation to the rest of the students in the study.

Findings Concerning Cognitive Style Profiles

The findings of this investigation are reported below, in terms of cognitive style of the 40 students in the sample group.

Table 1.--Ranking of students, based on score from Prescriptive Analysis for Curriculum Evaluation and Review (PACER) test.

Rank	Student Number	Score	Rank	Student Number	Score
1	019	140	21	015	91
2	010	133	22	039	89
3	026	128	23	013	88
4	030	124	24	031	87
5	011	124	25	001	86
6	016	120	26	018	83
7	037	116	27	027	83
8	022	109	28	002	82
9	032	108	29	025	80
10	005	108	30	014	76
11	007	107	31	021	74
12	029	106	32	040	73
13	012	103	33	006	71
14	008	103	34	024	71
15	020	103	35	038	70
16	028	103	36	036	69
17	033	101	37	004	68
18	003	101	38	023	66
19	035	100	39	017	65
20	034	94	40	009	45

Definitions pertaining to cognitive style and mapping appeared in Chapter I, a discussion of cognitive style profiles appeared in Chapter II, and reviews of cognitive style and empirical mapping are included in Appendix B.

The findings of the present study comprise the information generated to answer the general questions posed in Chapter I. They are as follows:

Question 1. What is the nature of the students' cognitive styles?

Findings: Refer to cognitive style maps, Table 2 (pp. 116-129). Table 2 consists of the cognitive style maps of all 40 students in the sample. Preliminary analysis of these maps indicates that the students had a variety of learning styles, which could, indeed, be mapped to illustrate their cognitive styles.

Question 2. What variables exist between the cognitive style of the vocational student and the instructional mode?

Findings: Refer to Table 3, frequency of occurrence (p. 131); individual student maps, Table 2 (pp. 116-129); and collective cognitive style profiles, Table 6 (p. 135). The obvious variables that exist between the cognitive styles of the student and the instructional mode were identified as (1) motivation of the student and (2) content of the instructional materials.

In the context of the educational sciences, the variables that exist between the cognitive style of the vocational student and the instructional mode are any variances in the cognitive style elements of the individual student as compared to the format of the cognitive style elements of the instructional mode.

In addition to the existing variables, question 2 also alluded to the relationship between the individual student's cognitive style and the format of the instructional mode. To answer this portion of the question, it was necessary to compare the cognitive style elements of each individual student with the various formats of the instructional modes. The individual students' cognitive styles are presented on pages 116-129, and the formats of the instructional modes were presented on pages 105-106. Inspection of these maps showed that it was, indeed, possible to identify and match the individual student with the most appropriate instructional mode.

Question 3. Is it possible to identify a relationship, if any, between vocational student achievement and collective cognitive style associated with categories of achievement?

Findings: Refer to frequency of occurrence and concentration of cognitive traits, Tables 3 and 5 (pp. 131 and 134) and profile scores, Charts 1-12 (pp. 139-149). Also see measures of distance (pp. 150-152). To describe collective cognitive style profiles, the frequency of occurrence of each element was calculated for each quartile of the PACER test. If an element occurred in 70 percent of the students under study, it was included in the collective cognitive style profile being constructed. Seventy percent was chosen as the percentage of occurrence because Hoogasian[1] used that percentage in a similar study and Zussman[2] used 65 percent, also under similar

Table 2.--Cognitive style maps of Engineering Design students.*

Symbolic Orientation				Cultural Determinants		Modalities of Inference	
			Student 001				
T(AL)	T(AQ)	T(VL)	T(VQ)				
Q(A)	"	"	"				
Q(V)	"	"	"				
Q(P)	"	"	"				
Q(CES)	"	"	"	A	F		L
Q(CH)	"	"	"				(K)
Q'(CK)	"	"	"				
Q(CKH)	"	"	"				
Q(CP)	"	"	"				
Q(CS)	"	"	"				
Q(CT)	"	"	"				
			Student 002				
T'(AL)	T'(AQ)	T'(VL)	T(VQ)				
Q(A)	"	"	"				
Q(V)	"	"	"				
Q'(P)	"	"	"				
Q'(CEM)	"	"	"				
Q'(CES)	"	"	"	F	I	M	L
Q(CH)	"	"	"				
Q(CK)	"	"	"	A'	A'		
Q(CKH)	"	"	"				
Q'(CP)	"	"	"				
Q(CS)	"	"	"				
Q'(CT)	"	"	"				
Q'(CTM)	"	"	"				
			Student 003				
T(AL)	T(AQ)	T(VL)	T(VQ)				
Q(A)	"	"	"				
Q(V)	"	"	"				
Q(P)	"	"	"				
Q(CEM)	"	"	"	I	I	L	M
Q'(CES)	"	"	"	A'	F'		
Q(CET)	"	"	"				
Q(CH)	"	"	"				
Q(CK)	"	"	"				
Q'(CKH)	"	"	"				
Q(CP)	"	"	"				
Q(CS)	"	"	"				
Q(CT)	"	"	"				
Q(CTM)	"	"	"				

Table 2.--Continued.

Symbolic Orientation				Cultural Determinants		Modalities of Inference	
			Student 004				
T(AL)	T'(AQ)	T'(VL)	T'(VQ)				
Q(A)	"	"	"				
Q'(V)	"	"	"				
Q(P)	"	"	"				
Q(CEM)	"	"	"	F	I	D	M
Q(CES)	"	"	"	A'	A'		
Q'(CET)	"	"	"			R'	R'
Q'(CH)	"	"	"				
Q'(CK)	"	"	"				
Q'(CKH)	"	"	"				
Q(CP)	"	"	"				
Q(CS)	"	"	"				
Q'(CT)	"	"	"				
			Student 005				
T(AL)	T(AQ)	T(VL)	T(VQ)'				
Q'(A)	"	"	"				
Q(V)	"	"	"				
Q'(P)	"	"	"				
Q'(CEM)	"	"	"	A	F	L	M
Q(CES)	"	"	"				
Q(CET)	"	"	"				
Q(CH)	"	"	"	I'	I'		
Q(CK)	"	"	"				
Q'(CKH)	"	"	"				
Q(CP)	"	"	"				
Q(CS)	"	"	"				
Q(CT)	"	"	"				
Q(CTM)							
			Student 006				
T'(AL)	T'(AQ)	T(VL)	T(VQ)				
Q(A)	"	"	"				
Q(V)	"	"	"				
Q(P)	"	"	"				
Q'(CEM)	"	"	"	I	I	R	R
Q'(CES)	"	"	"				
Q'(CET)	"	"	"	A'	A'	D'	M'
Q'(CH)	"	"	"				
Q(CK)	"	"	"				
Q'CKH)	"	"	"				
Q(CP)	"	"	"				
Q(CS)	"	"	"				
Q'(CT)	"	"	"				

Table 2.--Continued.

Symbolic Orientation				Cultural Determinants		Modalities Inference	
			Student 007				
T'(AL)	T(AQ)	T(VL)	T(VQ)				
Q(A)	"	"	"				
Q(V)	"	"	"				
Q(P)	"	"	"				
Q(CEM)	"	"	"	I	I	M	R
Q'(CES)	"	"	"	F'	F'		
Q(CET)	"	"	"				
Q(CH)	"	"	"				
Q'(CK)	"	"	"				
Q'(CKH)	"	"	"				
Q)CP)	"	"	"				
Q(CS)	"	"	"				
Q(CT)	"	"	"				
Q(CTM)	"	"	"				
			Student 008				
T(AL)	T'(AQ)	T(VL)	T'(VQ)				
Q(A)	"	"	"				
Q(V)	"	"	"				
Q'(P)	"	"	"				
Q(CEM)	"	"	"	I	I	L	
Q(CES)	"	"	"				
Q'(CET)	"	"	"	A'	F'		
Q'(CH)	"	"	"				
Q(CK)	"	"	"				
Q'(CKH)	"	"	"				
Q(CP)	"	"	"				
Q(CS)	"	"	"				
Q'(CT)	"	"	"				
Q(CTM)	"	"	"				
			Student 009				
T'(AL)	T'(AQ)	T'(VL)	T'(VQ)				
Q(A)	"	"	"				
Q(P)	"	"	"	A	A	M	M
Q(CET)	"	"	"	F'	I'	D'	L'
Q'(CH)	"	"	"				
Q'(CKH)	"	"	"				
Q(CP)	"	"	"				
Q(CS)	"	"	"				
Q(CT)	"	"	"				

Table 2.--Continued.

Symbolic Orientation				Cultural Determinants		Modalities of Inference	
			Student 010				
T(AL)	T(AQ)	T(VL)	T(VQ)				
Q(A)	"	"	"				
Q(V)	"	"	"				
Q(P)	"	"	"				
Q(CEM)	"	"	"	F	I	L	(K)
Q'(CES)	"	"	"				
Q'(CET)	"	"	"	A'	A'		
Q(CH)	"	"	"				
Q(CKH)	"	"	"				
Q'(CP)	"	"	"				
Q'(CS)	"	"	"				
Q(CT)	"	"	"				
Q(CTM)	"	"	"				
			Student 011				
T(AL)	T(AQ)	T'(VL)	T'(VQ)				
Q(A)	"	"	"				
Q(V)	"	"	"				
Q(P)	"	"	"				
Q'(CEM)	"	"	"	A	F	L	(R)
Q'(CES)	"	"	"				
Q(CET)	"	"	"	I'	I'		
Q(CH)	"	"	"				
Q(CK)	"	"	"				
Q'(CKH)	"	"	"				
Q'(CP)	"	"	"				
Q(CS)	"	"	"				
Q'(CT)	"	"	"				
Q(CTM)	"	"	"				
			Student 012				
T'(AL)	T(AQ)	T(VL)	T'(VQ)				
Q(A)	"	"	"				
Q(V)	"	"	"				
Q(P)	"	"	"				
Q(CEM)	"	"	"	I	I	L	
Q(CH)	"	"	"	A'	F'		
Q'(CK)	"	"	"				
Q(CKH)	"	"	"				
Q(CP)	"	"	"				
Q(CS)	"	"	"				

Table 2.--Continued.

Symbolic Orientation				Cultural Determinants	Modalities of Inference
			Student 013		
T(AL)	T'(AQ)	T(VL)	T(VQ)		
Q(A)	"	"	"		
Q(V)	"	"	"		
Q(P)	"	"	"		
Q(CEM)	"	"	"	I I	M R
Q(CES)	"	"	"		
Q(CET)	"	"	"	A' F'	
Q(CH)	"	"	"		
Q(CK)	"	"	"		
Q(CKH)	"	"	"		
Q(CP)	"	"	"		
Q(CS)	"	"	"		
Q'(CT)	"	"	"		
Q'(CTM)	"	"	"		
			Student 014		
T'(AL)	T'(AQ)	T(VL)	T'(VQ)		
Q'(A)	"	"	"		
Q(V)	"	"	"		
Q(P)	"	"	"		
Q(CEM)	"	"	"	A I	L M R
Q'(CES)	"	"	"		
Q(CET)	"	"	"	F' F'	
Q'(CH)	"	"	"		D' D'
Q'(CK)	"	"	"		
Q(CKH)	"	"	"		
Q(CP)	"	"	"		
Q(CS)	"	"	"		
Q(CT)	"	"	"		
			Student 015		
	T'(AQ)	T(VL)	T(VQ)		
Q'(A)	"	"	"		
Q'(V)	"	"	"		
Q(P)	"	"	"		
Q'(CEM)	"	"	"	I I	M
Q'(CES)	"	"	"		
Q(CET)	"	"	"	F' F'	D'
Q'(CH)	"	"	"		
Q'(CKH)	"	"	"		
Q(CP)	"	"	"		
Q(CS)	"	"	"		
Q'(CT)	"	"	"		

Table 2.--Continued.

Symbolic Orientation				Cultural Determinants		Modalities of Inference	
				Student 016			
T(AL)	T'(AQ)	T'(VL)	T(VQ)				
Q(A)	"	"	"				
Q(V)	"	"	"				
Q'(P)	"	"	"				
Q(CEM)	"	"	"	F	I	L	(K)
Q(CES)	"	"	"				
Q(CET)	"	"	"	A'	A'		
Q'(CH)	"	"	"				
Q(CK)	"	"	"				
Q(CKH)	"	"	"				
Q(CP)	"	"	"				
Q'(CS)	"	"	"				
Q(CT)	"	"	"				
Q(CTM)	"	"	"				
				Student 017			
T'(AL)							
Q'(A)							
Q'(V)							
Q'(CEM)				F'			
Q'(CES)							
Q'(CKH)							
Q'(CP)							
				Student 018			
T(AL)	T'(AQ)	T'(VL)	T'(VQ)				
Q'(A)	"	"	"				
Q(V)	"	"	"				
Q'(P)	"	"	"	I	A	D	M
Q'(CEM)	"	"	"				
Q'(CES)	"	"	"				
Q'(CET)	"	"	"	F'	F'		
Q'(CH)	"	"	"				
Q'(CK)	"	"	"				
Q'(CKH)	"	"	"				
Q'(CP)	"	"	"				
Q(CS)	"	"	"				
Q'(CT)	"	"	"				
Q'(CTM)	"	"	"				

Table 2.--Continued.

Symbolic Orientation				Cultural Determinants	Modalities of Inference
			Student 019		
T(AL)	T'(AQ)	T(VL)	T(VQ)		
Q(A)	"	"	"		
Q'(V)	"	"	"		
Q(P)	"	"	"		
Q(CEM)	"	"	"	I F	L (K)
Q'(CES)	"	"	"		
Q(CET)	"	"	"	A' A'	
Q(CH)	"	"	"		
Q(CKH)	"	"	"		
Q(CP)	"	"	"		
Q(CS)	"	"	"		
Q(CT)	"	"	"		
Q(CTM)	"	"	"		
			Student 020		
T(AL)	T(AQ)	T(VL)	T'(VQ)		
Q(A)	"	"	"		
Q(V)	"	"	"		
Q'(P)	"	"	"		
Q(CEM)	"	"	"	A F I	M
Q(CH)	"	"	"		
Q(CK)	"	"	"		
Q(CKH)	"	"	"		
Q(CP)	"	"	"		
Q(CS)	"	"	"		
Q(CT)	"	"	"		
			Student 021		
T(AL)	T(AQ)	T'(VL)	T'(VQ)		
Q'(A)	"	"	"		
Q'(V)	"	"	"		
Q'(P)	"	"	"		
Q'(CEM)	"	"	"	F F	D
Q'(CES)	"	"	"		
Q(CET)	"	"	"	A' I'	
Q'(CH)	"	"	"		
Q'(CK)	"	"	"		
Q'(CKH)	"	"	"		
Q'(CP)	"	"	"		
Q'(CS)	"	"	"		
Q(CT)	"	"	"		
Q'(CTM)	"	"	"		

Table 2.--Continued.

Symbolic Orientation				Cultural Determinants		Modalities of Inference		
			Student 022					
T'(AL)	T'(AQ)	T(VL)	T(VQ)					
Q(A)	"	"	"					
Q'(V)	"	"	"					
Q(P)	"	"	"					
Q'(CEM)	"	"	"	I	I	M	M	
Q'(CES)	"	"	"					
Q(CET)	"	"	"	A'	F'	D'	R'	
Q'(CH)	"	"	"					
Q'(CK)	"	"	"					
Q(CKH)	"	"	"					
Q(CP)	"	"	"					
Q(CS)	"	"	"					
Q'(CT)	"	"	"					
Q(CTM)	"	"	"					
			Student 023					
T'(AL)	T'(AQ)	T'(VL)	T'(VQ)					
Q(A)	"	"	"					
Q(V)	"	"	"					
Q'(P)	"	"	"					
Q'(CEM)	"	"	"	F	I	M	M	
Q'(CES)	"	"	"					
Q(CET)	"	"	"	A'	A'	D'	R'	
Q'(CH)	"	"	"					
Q(CK)	"	"	"					
Q(CKH)	"	"	"					
Q(CP)	"	"	"					
Q'(CS)	"	"	"					
Q'(CT)	"	"	"					
Q(CTM)	"	"	"					
			Student 024					
T'(AL)	T'(AQ)	T'(VL)						
Q(A)	"	"						
Q'(V)	"	"						
Q'(P)	"	"		A	A	R'	M'	D'
Q(CES)	"	"						
Q'(CET)	"	"		F'	I'			
Q'(CH)	"	"						
Q'(CK)	"	"						
Q(CKH)	"	"						
Q'(CP)	"	"						
Q'(CS)	"	"						
Q'(CT)	"	"						
Q'(CTM)	"	"						

Table 2.--Continued.

Symbolic Orientation				Cultural Determinants	Modalities of Inference
			Student 025		
T(AL)	T'(AQ)	T(VL)	T'(VQ)		
Q(A)	"	"	"		
Q'(V)	"	"	"		
Q(P)	"	"	"	I I	M M
Q(CEM)	"	"	"		
Q'(CES)	"	"	"		
Q'(CET)	"	"	"	A' F'	D' R'
Q(CH)	"	"	"		
Q'(CK)	"	"	"		
Q'(CKH)	"	"	"		
Q'(CP)	"	"	"		
Q'(CTM)	"	"	"		
			Student 026		
T'(AL)	T(AQ)	T(VL)	T(VQ)		
Q(A)	"	"	"		
Q(V)	"	"	"		
Q(P)	"	"	"	I	D L
Q(CEM)	"	"	"		
Q(CES)	"	"	"	A'	
Q'(CET)	"	"	"		(K)
Q'(CH)	"	"	"		
Q(CK)	"	"	"		
Q(CKH)	"	"	"		
Q'(CP)	"	"	"		
Q(CS)	"	"	"		
Q(CT)	"	"	"		
Q'(CTM)	"	"	"		
			Student 027		
T'(AL)	T'(AQ)	T'(VQ)			
Q(A)	"	"			
Q(V)	"	"			
Q(P)	"	"			
Q(CEM)	"	"		I A	L
Q(CES)	"	"			
Q(CH)	"	"			
Q(CK)	"	"			
Q(CKH)	"	"			
Q(CP)	"	"			
Q(CS)	"	"			
Q(CT)	"	"			
Q'(CTM)	"	"			

Table 2.--Continued.

Symbolic Orientation				Cultural Determinants	Modalities of Inference
		Student 028			
T(AL)	T'(AQ)	T'(VL)	T'(VQ)		
Q(A)	"	"	"		
Q'(V)	"	"	"		
Q'(P)	"	"	"		
Q(CEM)	"	"	"		
Q(CES)	"	"	"	A F I	R R
Q(CET)	"	"	"		
Q(CH)	"	"	"		D' M'
Q(CK)	"	"	"		
Q'(CKH)	"	"	"		
Q(CP)	"	"	"		
Q(CS)	"	"	"		
Q(CT)	"	"	"		
Q'(CTM)	"	"	"		
		Student 029			
T(AL)	T(AQ)	T'(VL)	T'(VQ)		
Q(A)	"	"	"		
Q'(V)	"	"	"		
Q(P)	"	"	"		
Q'(CEM)	"	"	"	A F	L
Q'(CES)	"	"	"		
Q(CET)	"	"	"		
Q(CH)	"	"	"		
Q'(CK)	"	"	"		
Q)CKH)	"	"	"		
Q(CP)	"	"	"		
Q(CS)	"	"	"		
Q(CT)	"	"	"		
Q(CTM)	"	"	"		

Table 2.--Continued.

Symbolic Orientation				Cultural Determinants	Modalities of Inference
			Student 030		
T'(AL)	T(AQ)	T(VL)	T(VQ)		
Q(A)	"	"	"		
Q(V)	"	"	"		
Q(P)	"	"	"		
Q(CEM)	"	"	"		
Q(CES)	"	"	"	A F I	L
Q(CET)	"	"	"		
Q(CH)	"	"	"		(K)
Q(CK)	"	"	"		
Q'(CKH)	"	"	"		
Q(CP)	"	"	"		
Q'(CS)	"	"	"		
Q(CT)	"	"	"		
Q(CTM)	"	"	"		
			Student 031		
T(AL)	T'(AQ)	T'(VL)	T'(VQ)		
Q(A)	"	"	"		
Q(V)	"	"	"		
Q'(P)	"	"	"		
Q'(CEM)	"	"	"	A A	D L
Q(CES)	"	"	"		
Q'(CET)	"	"	"	F' I'	
Q(CH)	"	"	"		
Q(CK)	"	"	"		
Q'(CKH)	"	"	"		
Q(CP)	"	"	"		
Q(CS)	"	"	"		
Q'(CT)	"	"	"		
Q(CTM)	"	"	"		
			Student 032		
T'(AL)	T(AQ)	T(VL)	T(VQ)		
Q(A)	"	"	"		
Q(V)	"	"	"		
Q(CEM)	"	"	"	A F I	
Q(CES)	"	"	"		L
Q(CET)	"	"	"		
Q(CH)	"	"	"		
Q'(CKH)	"	"	"		
Q(CP)	"	"	"		
Q'(CS)	"	"	"		
Q(CT)	"	"	"		
Q(CTM)	"	"	"		

Table 2.--Continued.

Symbolic Orientation				Cultural Determinants		Modalities of Inference	
			Student 033				
T'(AL)	T'(AQ)	T'(VQ)					
Q'(A)	"	"					
Q(V)	"	"					
Q'(P)	"	"					
Q'(CEM)	"	"		I	F		L'
Q'(CES)	"	"					
Q'(CET)	"	"		A'	A'		
Q'(CH)	"	"					
Q'(CK)	"	"					
Q'(CKH)	"	"					
Q'(CP)	"	"					
Q'(CS)	"	"					
Q'(CT)	"	"					
Q'(CTM)	"	"					
			Student 034				
T(AL)	T(AQ)	T'(VL)	T'(VQ)				
Q(A)	"	"	"				
Q'(V)	"	"	"				
Q'(P)	"	"	"				
Q(CEM)	"	"	"	I	F	D	L
Q'(CES)	"	"	"				
Q(CET)	"	"	"	A'	A'		
Q(CH)	"	"	"				
Q'(CK)	"	"	"				
Q'(CKH)	"	"	"				
Q(CP)	"	"	"				
Q(CS)	"	"	"				
Q'(CT)	"	"	"				
Q'(CTM)	"	"	"				
			Student 035				
T'(AL)	T'(AQ)	T'(VL)	T'(VQ)				
Q(A)	"	"	"				
Q(V)	"	"	"				
Q'(P)	"	"	"	I	F		L
Q(CEM)	"	"	"				
Q'(CES)	"	"	"				
Q(CET)	"	"	"	A'	A'		
Q(CH)	"	"	"				
Q'(CK)	"	"	"				
Q(CKH)	"	"	"				
Q(CP)	"	"	"				
Q(CS)	"	"	"				
Q(CT)	"	"	"				

Table 2.--Continued.

Symbolic Orientation				Cultural Determinants		Modalities of Inference	
			Student 036				
T(AL)	T'(AQ)	T'(VL)	T(VQ)				
Q(A)	"	"	"				
Q(V)	"	"	"				
Q'(P)	"	"	"				
Q(CEM)	"	"	"	I	I	D	R
Q(CES)	"	"	"	A'	F'	M'	M'
Q'(CET)	"	"	"				
Q(CH)	"	"	"				
Q'(CK)	"	"	"				
Q(CKH)	"	"	"				
Q'(CP)	"	"	"				
Q(CS)	"	"	"				
Q'(CT)	"	"	"				
Q'(CTM)	"	"	"				
			Student 037				
T(AL)	T(AQ)	T(VL)	T(VQ)				
Q(A)	"	"	"				
Q(V)	"	"	"				
Q(P)	"	"	"				
Q(CEM)	"	"	"	I	F	L	(K)
Q(CES)	"	"	"				
Q(CET)	"	"	"	A'	A"		
Q(CH)	"	"	"				
Q'(CK)	"	"	"				
Q(CKH)	"	"	"				
Q(CP)	"	"	"				
Q(CS)	"	"	"				
Q(CT)	"	"	"				
Q(CTM)	"	"	"				
			Student 038				
T(AL)	T'(AQ)"	T'(VL)	T'(VQ)				
Q(A)	"	"	"				
Q(V)	"	"	"				
Q(P)	"	"	"				
Q(CEM)	"	"	"	I	I		
Q(CES)	"	"	"				L
Q(CET)	"	"	"				
Q(CH)	"	"	"	A'	F'		
Q(CK)	"	"	"				
Q'(CKH)	"	"	"				
Q(CP)	"	"	"				
Q(CS)	"	"	"				
Q'(CT)	"	"	"				
Q(CTM)	"	"	"				

Table 2.--Continued.

Symbolic Orientation				Cultural Determinants		Modalities of Inference
			Student 039			
T(AL)	T'(AQ)	T(VL)	T(VQ)			
Q(A)	"	"	"			
Q(V)	"	"	"			
Q(P)	"	"	"	A	A	
Q(CEM)	"	"	"			L
Q(CES)	"	"	"	F'	I'	
Q(CET)	"	"	"			
Q(CH)	"	"	"			
Q'(CK)	"	"	"			
Q'(CKH)	"	"	"			
Q(CP)	"	"	"			
Q(CS)	"	"	"			
Q'(CT)	"	"	"			
			Student 040			
T(AL)	T'(AQ)	T'(VL)	T(VQ)			
Q'(A)	"	"	"			
Q(V)	"	"	"			
Q'(P)	"	"	"	F	F	L'
Q'(CEM)	"	"	"			
Q'(CES)	"	"	"	A'	I'	
Q(CET)	"	"	"			
Q(CH)	"	"	"			
Q'(CK)	"	"	"			
Q(CKH)	"	"	"			
Q(CP)	"	"	"			
Q'(CS)	"	"	"			
Q'(CT)	"	"	"			
Q(CTM)	"	"	"			

*A key to symbols used in this table may be found on page x of this dissertation.

circumstances. The writer decided to be conservative and use the higher figure of 70 percent.

Table 3 shows the frequency of occurrence of the major and minor cognitive traits in the four quartiles of the Prescriptive Analysis for Curriculum Evaluation and Review (PACER) test. It was necessary to calculate this information because the frequencies were used to compute the percentages of occurrence illustrated in Table 4 and, more important, these frequencies were needed to construct the collective cognitive style profiles and the measures of profile similarity. The noteworthy aspect of Table 3 is that it illustrates what symbols were being mediated by the students and to what degree. Within the symbolic mediations, it is interesting that, when comparing the first quartile to the fourth quartile, the frequencies of the majors and minors were almost reversed. This illustrates that the high achievers were using more major modes of understanding than were the low achievers.

Table 4 shows the percentage of occurrence of the major, minor, and negligible cognitive traits of the entire CSII test These percentages were calculated from the frequency of occurrence of the traits listed in Table 3. This table was included because it illustrates the strengths of the entire population being studied, and the reader can readily ascertain that the students had many more major traits than they did negligible traits. The students also showed a preference for individual cultural determinants, as evidenced by the fact that 72.5 percent had a major cognitive trait in

Table 3.--Frequency of occurrence of major and minor cognitive traits in all four quartiles of the PACER test.*

	First Quartile		Second Quartile		Third Quartile		Fourth Quartile	
	Maj.	Min.	Maj.	Min.	Maj.	Min.	Maj.	Min.
Symbolic Mediation								
T(AL)	6	4	6	4	6	3	5	5
T(AQ)	8	2	6	4	1	9	1	8
T(VL)	8	2	5	4	5	4	1	8
T(VQ)	8	2	2	8	5	5	3	5
Q(A)	9	1	9	1	7	3	7	3
Q(V)	8	2	7	3	8	2	5	4
Q(P)	7	2	4	6	7	3	4	5
Q(CEM)	7	3	8	2	5	4	3	5
Q(CES)	6	4	2	6	5	5	4	5
Q(CET)	8	2	6	2	4	3	5	4
Q(CH)	7	3	8	2	7	3	3	6
Q(CK)	5	2	4	6	4	5	3	5
Q(CKH)	6	4	4	6	6	4	4	5
Q(CP)	7	3	9	1	6	3	6	4
Q(CS)	6	4	9	1	9	0	5	4
Q(CT)	8	2	6	3	5	5	2	7
Q(CTM)	9	1	4	3	1	5	3	3
Cultural Determinant								
I	8	2	9	0	7	1	5	4
A	4	6	3	6	5	3	2	7
F	8	1	6	4	2	6	4	5
Modalities of Inference								
M	1	0	3	1	7	0	3	3
D	1	1	1	1	1	3	3	4
R	0	1	2	0	2	1	2	3
L	8	0	7	1	5	0	1	2
(K)	7	0	0	0	1	0	0	0

*A key to symbols used in this table may be found on page x of this dissertation.

Table 4.--Percentage of occurrence of major, minor, and negligible cognitive traits in the total CSII test.*

Cognitive Trait	Major %	Minor %	Negligible %
T(AL)	57.5	40.0	2.5
T(AQ)	40.0	57.5	2.5
T(VL)	47.5	45.0	7.5
T(VQ)	45.0	50.0	5.0
Q(A)	80.0	20.0	0.0
Q(V)	70.0	27.5	2.5
Q(P)	55.0	40.0	5.0
Q(CEM)	57.5	35.0	7.5
Q(CES)	42.5	50.0	7.5
Q(CET)	57.5	27.5	15.0
Q(CH)	62.5	35.0	2.5
Q(CK)	40.0	45.0	15.0
Q(CKH)	50.0	47.5	2.5
Q(CP)	70.0	27.5	2.5
Q(CS)	72.5	22.5	5.0
Q(CT)	52.5	42.5	5.0
Q(CTM)	42.5	30.0	27.5
I	72.5	17.5	10.0
A	35.0	55.0	10.0
F	50.0	40.0	10.0
M	35.0	10.0	55.0
D	15.0	22.5	62.5
R	15.0	12.5	72.5
L	52.5	7.5	40.0
(K)	20.0	0.0	80.0

*A key to symbols used in this table may be found on page x of this dissertation.

this area. This was the second highest major percentage of any total cognitive trait exhibited by the students (Qualitative Auditory was the highest, at 80 percent).

Table 5 was constructed to illustrate the concentration of major and minor cognitive traits in the four quartiles of the PACER test. This information was already illustrated in Table 3, but it was thought that including a table that only indicated majors and minors and did not include specific numbers would be of interest to those readers whose own cognitive styles do not include T(VQ)--Theoretical Visual Quantitative.

Table 6 depicts the collective cognitive style profiles of each quartile of the PACER test. These profiles indicate the learning style of the various groups of students, categorized by student achievement. A cursory inspection indicates that students who had more symbolic orientations were grouped higher in terms of achievement. It is also of interest that Modality of Inference (K) only appeared as a major orientation for students in the top quartile. In an Engineering Design class this result is not surprising, because this modality of inference uses deductive reasoning or the form of proof used in geometry.

Measures of Profile Similarity

In his book, Psychometric Theory, Nunnally[3] formulated the distance measure D as indicative of the similarity of the profiles of two groups, A and B. The distance, D, is obtained as follows:

Table 5.--Concentration of major and minor orientation of cognitive traits in all four quartiles of the PACER test.*

	First Quartile		Second Quartile		Third Quartile		Fourth Quartile	
	Maj.	Min.	Maj.	Min.	Maj.	Min.	Maj.	Min.
Symbolic Mediation								
T(AL)**								
T(AQ)	X					X		X
T(VL)	X							X
T(VQ)	X			X				
Q(A)	X		X		X		X	
Q(V)	X		X		X			
Q(P)	X				X			
Q(CEM)	X		X					
Q(CES)								
Q(CET)	X							
Q(CH)	X		X		X			
Q(CK)								
Q(CKH)								
Q(CP)	X		X					
Q(CS)			X		X			
Q(CT)	X							X
Q(CTM)	X							
Cultural Determinant								
I	X		X		X			
A							X	
F	X							
Modalities of Inference								
M					M			
D								
R								
L	X		X					
(K)	X							

*X placed in the column titled Maj. indicates that the specific cognitive trait in the corresponding row has a major orientation (50th-99th percentile) for that designated quartile of the PACER test. An orientation for that population indicates that 70 percent or more of the individuals in that group had a major orientation of that cognitive trait. X placed in the column titled Min. indicates that the specific trait in the corresponding row had a minor orientation (26th-49th percentile) for that quartile of the PACER test. An orientation for that population indicates that 70 percent or more of the individuals in that group had a minor orientation of that cognitive trait. The absence of an X indicates that the trait was negligible.

**A key to symbols used in this table may be found on page x of this dissertation.

Table 6.--Collective cognitive style profiles.

Symbolic Orientation				Cultural Determinants	Modalities of Inference
			Top Quartile		
	T(AQ)	T(VL)	T(VQ)		
Q(A)	"	"	"		
Q(V)	"	"	"		
Q(P)	"	"	"		
Q(CEM)	"	"	"	I F	L (K)
Q(CET)	"	"	"		
Q(CH)	"	"	"		
Q(CP)	"	"	"		
Q(CT)	"	"	"		
Q(CTM)	"	"	"		
			Second Quartile		
	T'(VQ)				
Q(A)	"				
Q(V)	"				
Q(CEM)				I	L
Q(CH)	"				
Q(CP)	"				
Q(CS)	"				
			Third Quartile		
	T'(AQ)				
Q(A)	"				
Q(V)	"				
Q(P)	"			I	M
Q(CH)	"				
Q(CS)	"				
			Bottom Quartile		
	T'(AQ)	T'(VL)			
Q(A)	"	"		A	
Q'(CT)	"	"			

*A key to symbols used in this table may be found on page x of this dissertation.

$Dab^2 = (Xa_1 - Xb_1)^2 + (X^{a2} - X^{b2})^2$, where the square root of the above expression is the distance between points a and b. For any number of variables (k), the distance is as follows:

$$Dab^2 = (Xa_1 - Xb_1)^2 + (Xa_2 - Xb_2)^2 + \ldots + (Xak - Xak - Xbk)^2$$

$$= \Sigma(Xaj - Xbj)^2.$$

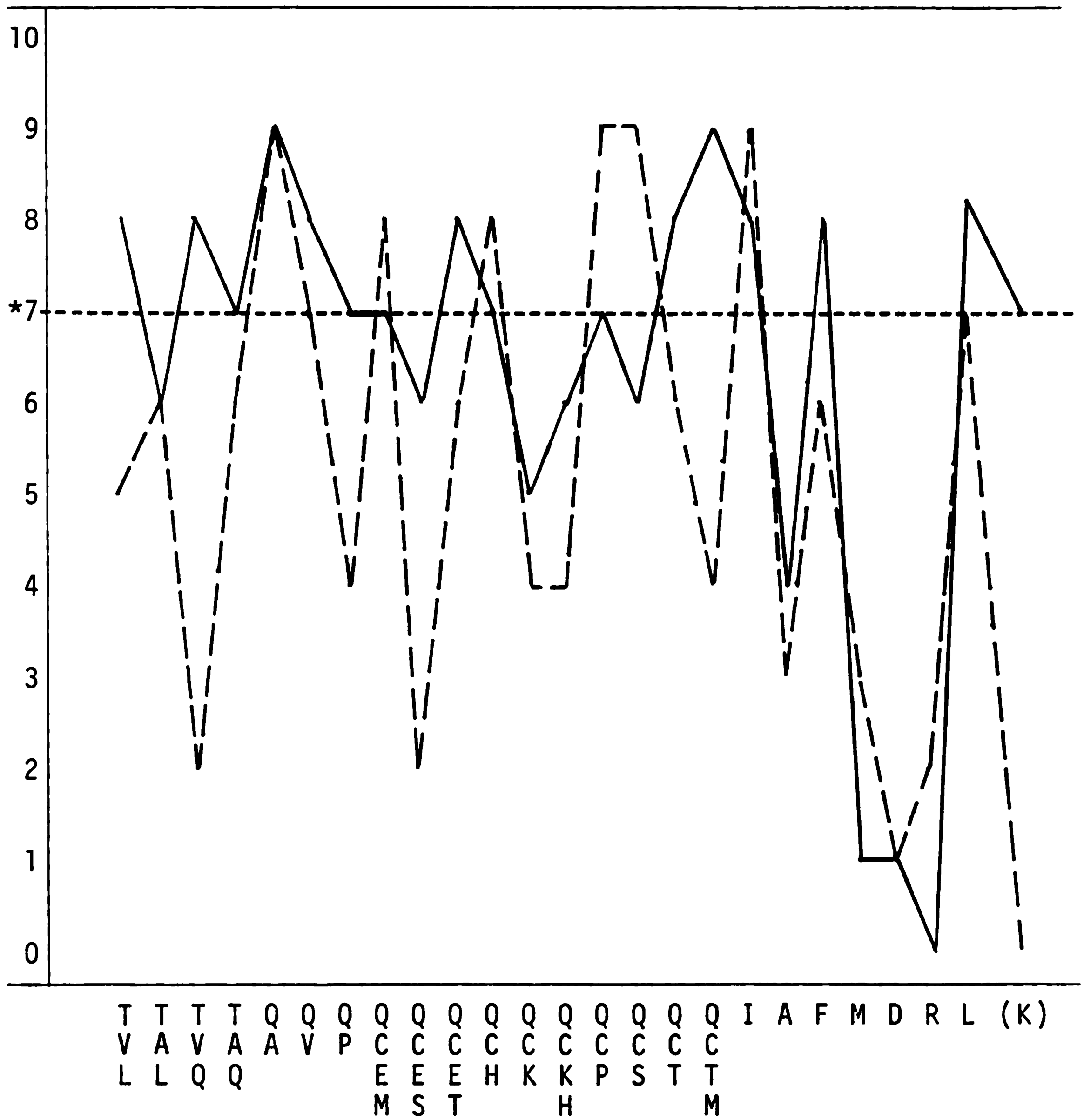
Similar profiles that have small D's have similar profiles, whereas groups with large D's have dissimilar profiles. Nunnally stated,

> The most appealing measure of profile similarity is the distance measure "D" which was proposed by Osgood and Suci (1952) and by Cronbach and Gleser (1953). "D" is simply the generalized Pythagorean theorem for the distance between two points in Euclidean space. In the case of two persons and two variables, this is the length of the hypotenuse of a right triangle.[4]

As the present study was exploratory in nature, the most comprehensive approach that could be formulated to reveal possible relationships was to compare each quartile of achievement of cognitive traits with every other quartile. This necessitated the comparison of six combinations of quartiles. As the cognitive traits were divided into major, minor, and negligible degrees of strength, it was necessary to formulate profiles for both the major and minor traits. No profiles were constructed for negligible cognitive style traits. Distance measures of profile similarity were used to analyze the data in Charts 1-12. The following profiles were analyzed:

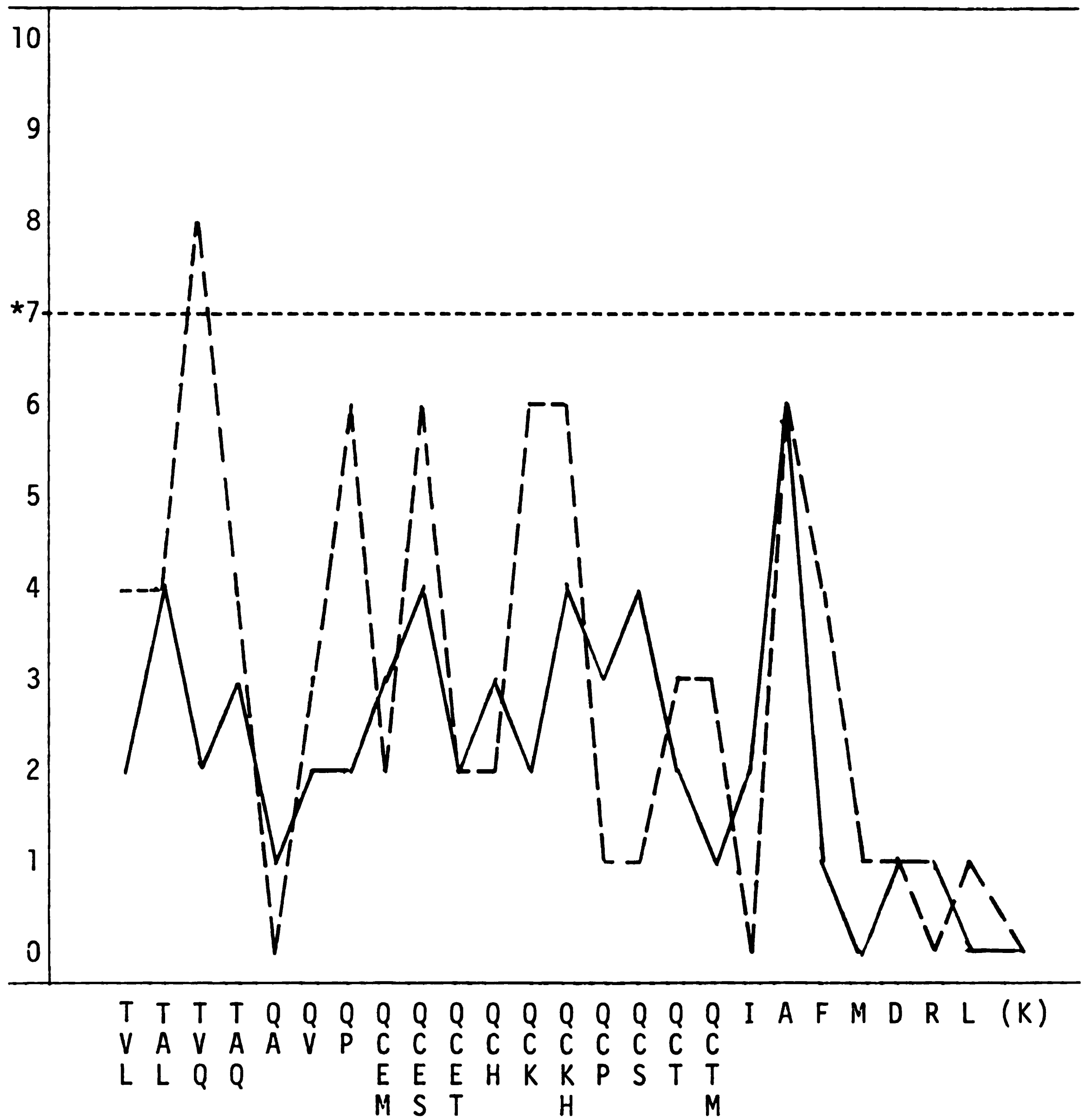
The individual profiles are presented graphically in Charts 1-12 on the following pages. The graphic presentations are included for those readers who possess a major cognitive trait in Qualitative Visual Q(V), the ability to perceive meaning through sight.

The distance measure, D, was shown to indicate the similarity of the profiles of two groups. Preliminary inspection of the distance measure for the profiles of similarity indicated that the further the quartiles were apart, the larger the D measurement was;



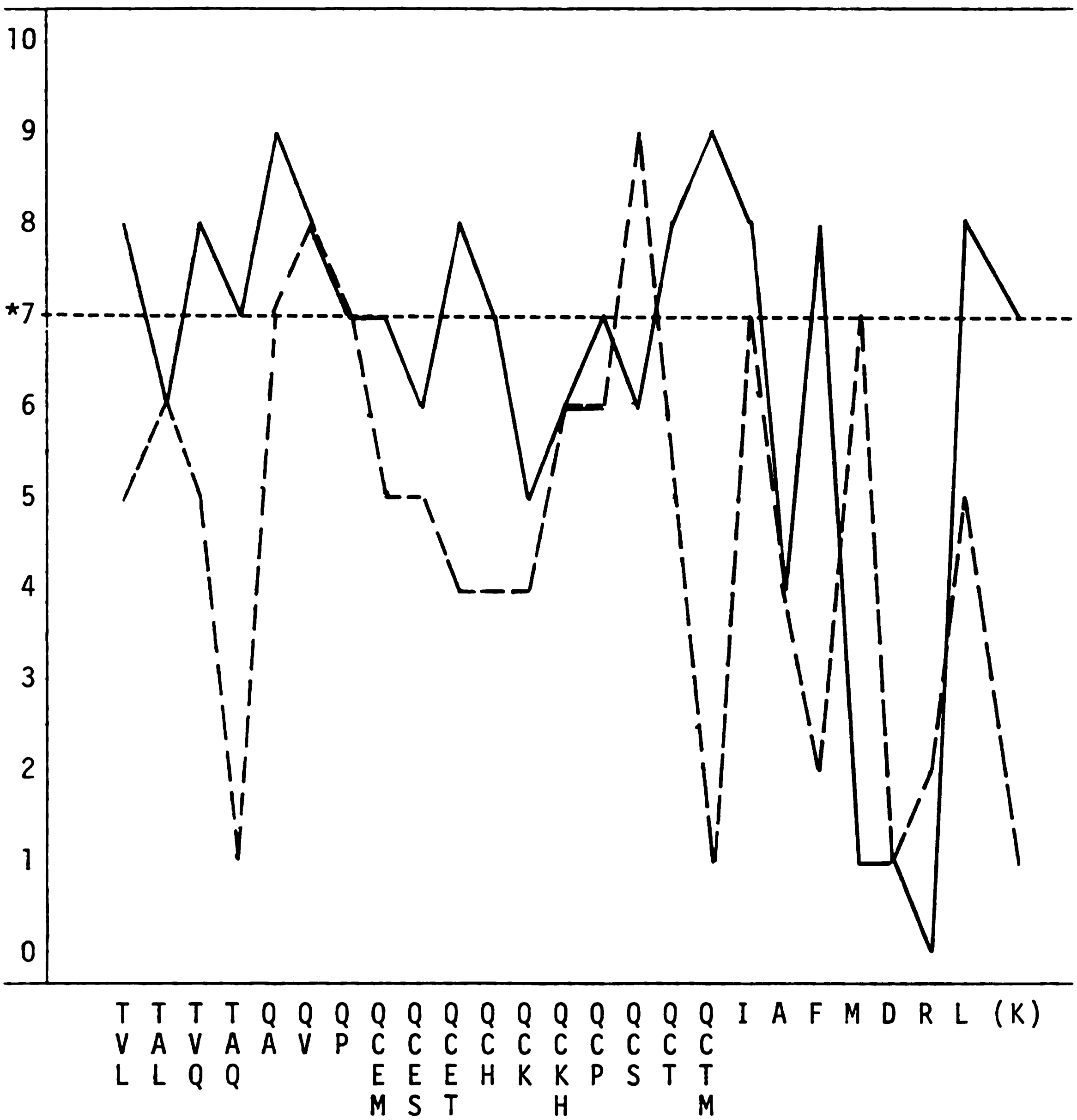
―――――― = First quartile students.
---------- = Second quartile students.
* = 7 or 70% is an orientation for population represented.

Chart 1.--Profile score of orientation of major cognitive traits of PACER first quartile students and orientation of major cognitive traits of PACER second quartile students.



———— = First quartile students.
- - - - - = Second quartile students.
* = 7 or 70% is an orientation for population represented.

Chart 2.--Profile score of orientation of minor cognitive traits of PACER first quartile students and orientation of minor cognitive traits of PACER second quartile students.



———————— = First quartile students.
--------- = Third quartile students.
* = 7 or 70% is an orientation for population represented.

Chart 3.--Profile score of orientation of major cognitive traits of PACER first quartile students and orientation of major cognitive traits of PACER third quartile students.

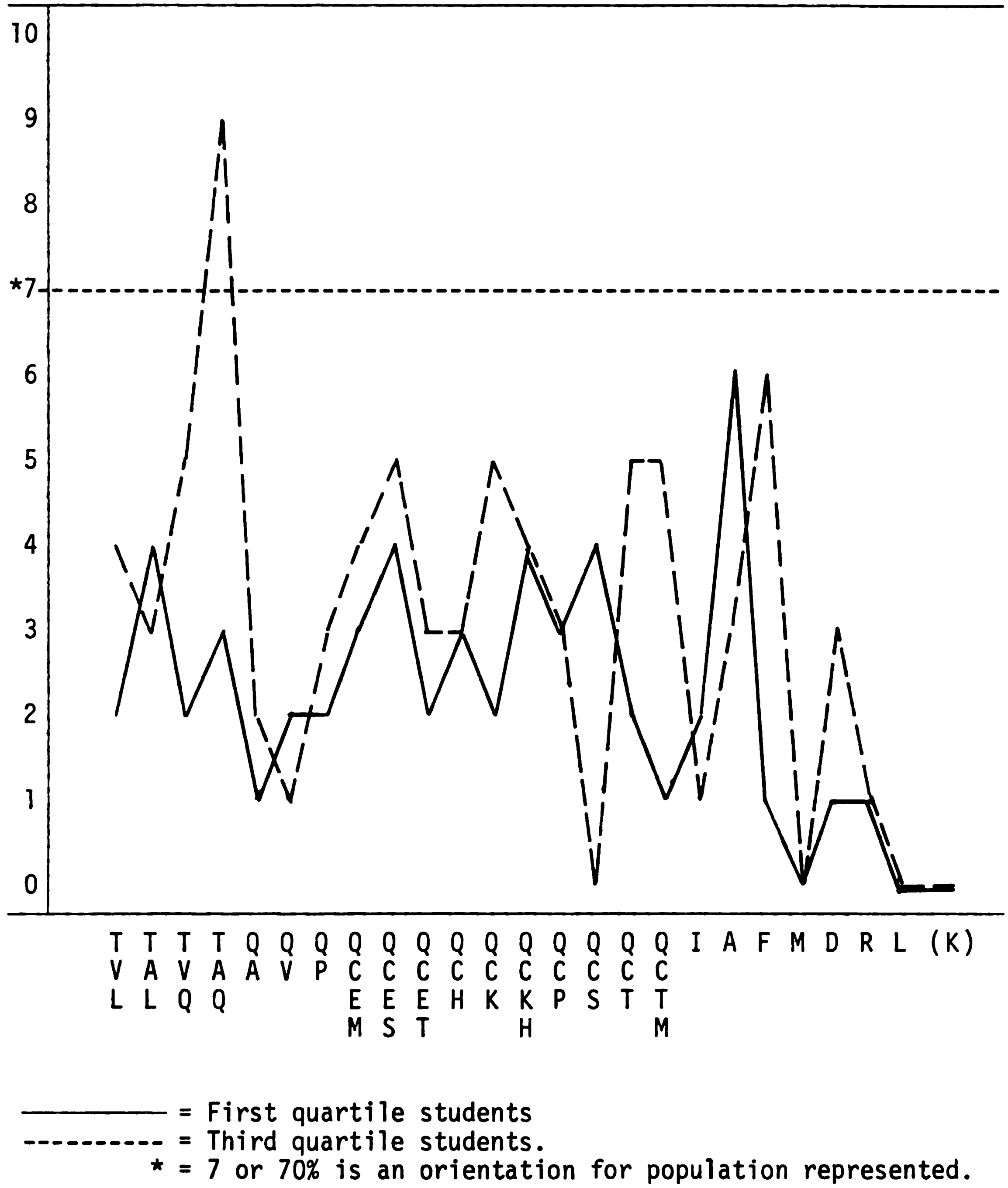
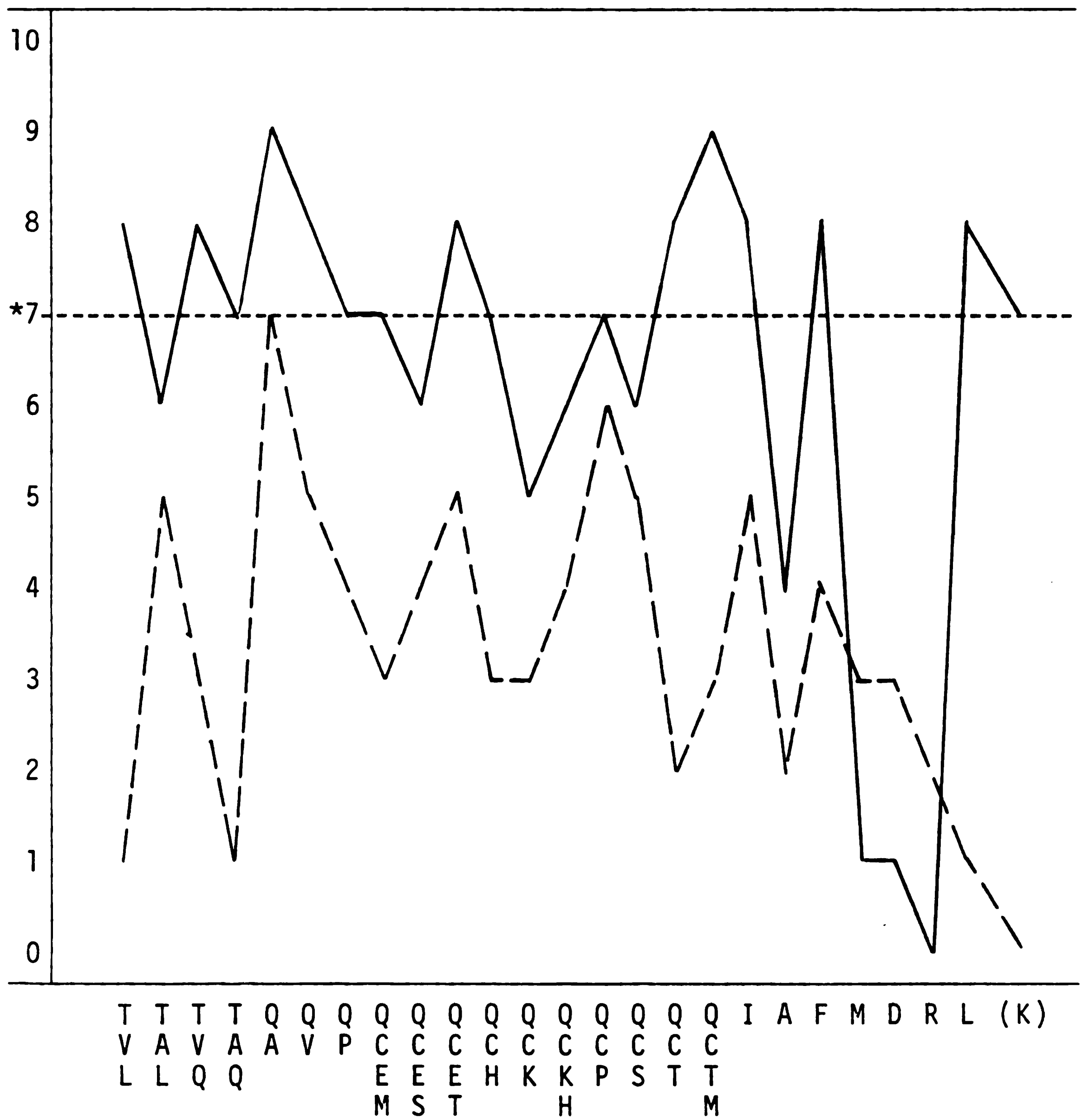
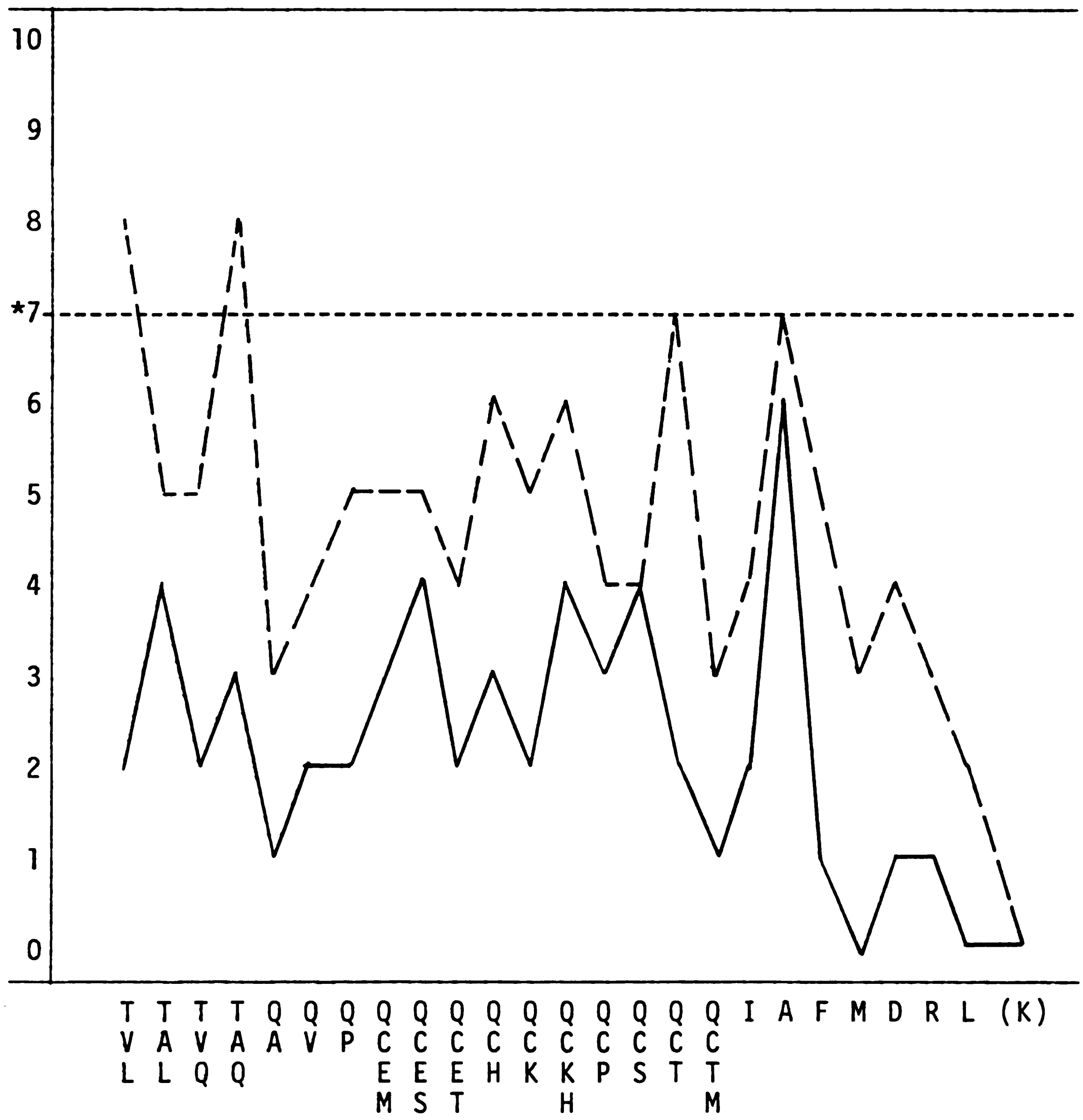


Chart 4.--Profile score of orientation of minor cognitive traits of PACER first quartile students and orientation of minor cognitive traits of PACER third quartile students.



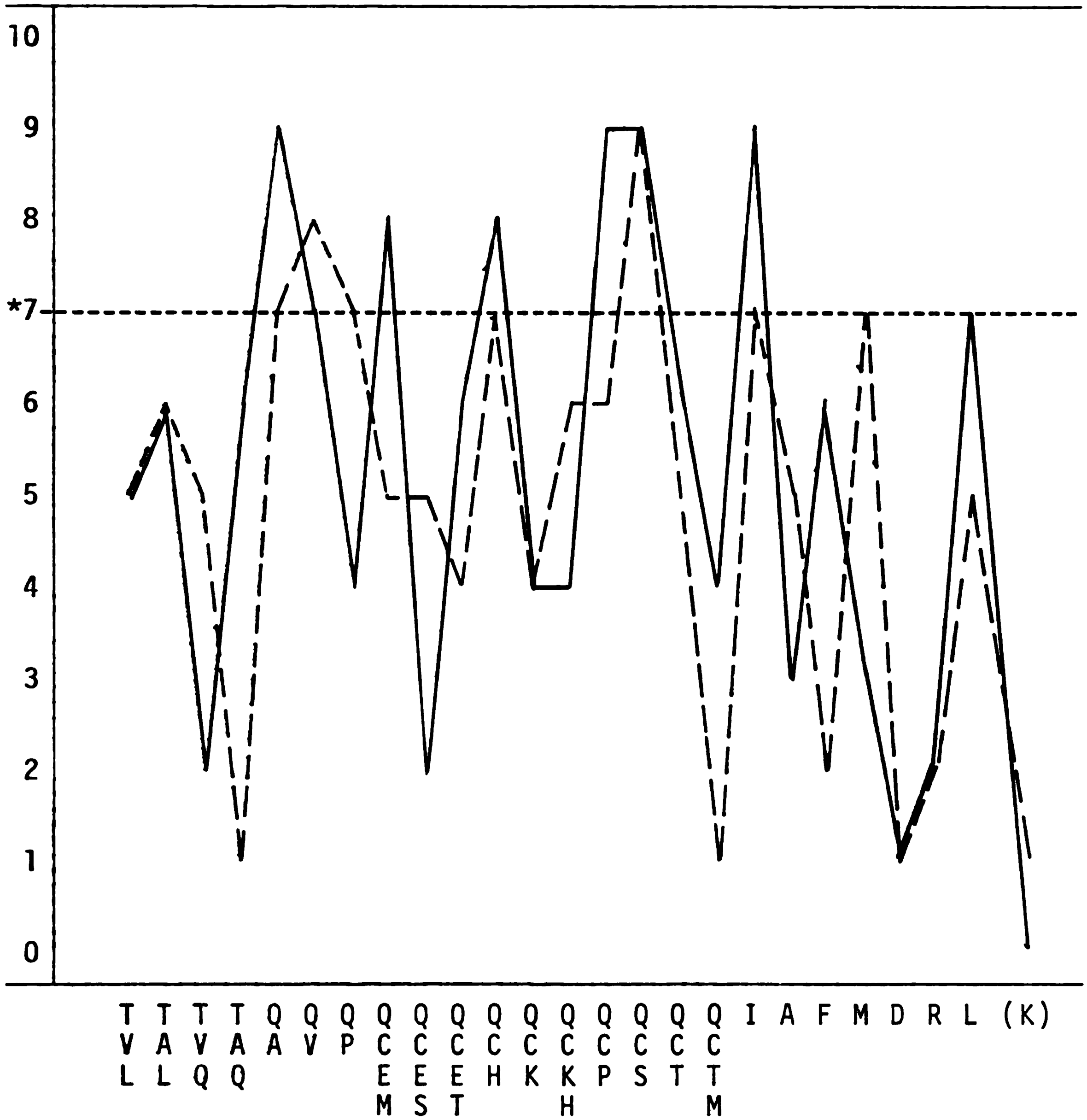
———————— = First quartile students.
---------- = Fourth quartile students.
* = 7 or 70% is an orientation for population represented.

Chart 5.--Profile score of orientation of major cognitive traits of PACER first quartile students and orientation of major cognitive traits of PACER fourth quartile students.



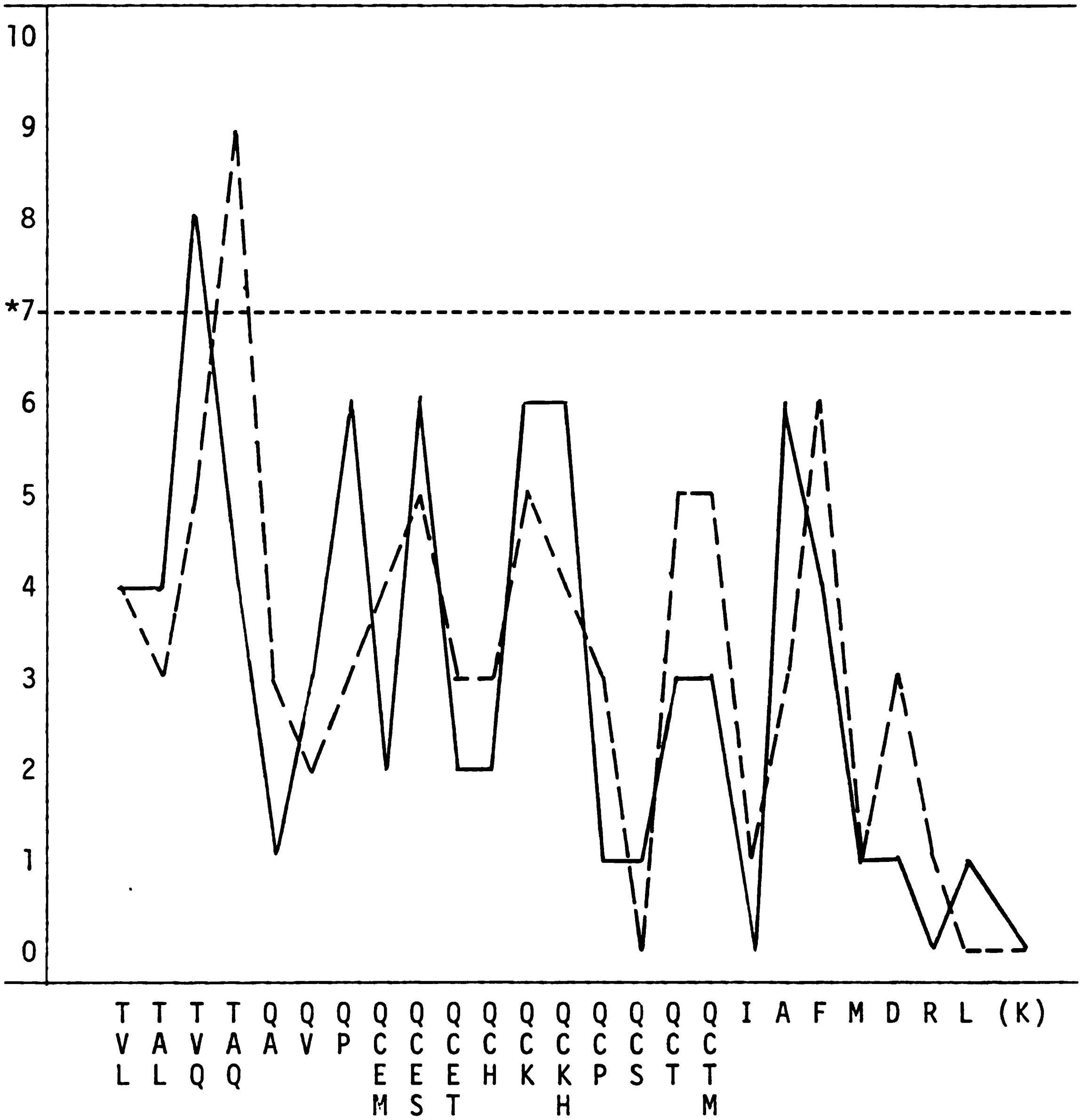
———————— = First quartile students.
---------- = Fourth quartile students.
* = 7 or 70% is an orientation for population represented.

Chart 6.--Profile score of orientation of minor cognitive traits of PACER first quartile students and orientation of minor cognitive traits of PACER fourth quartile students.



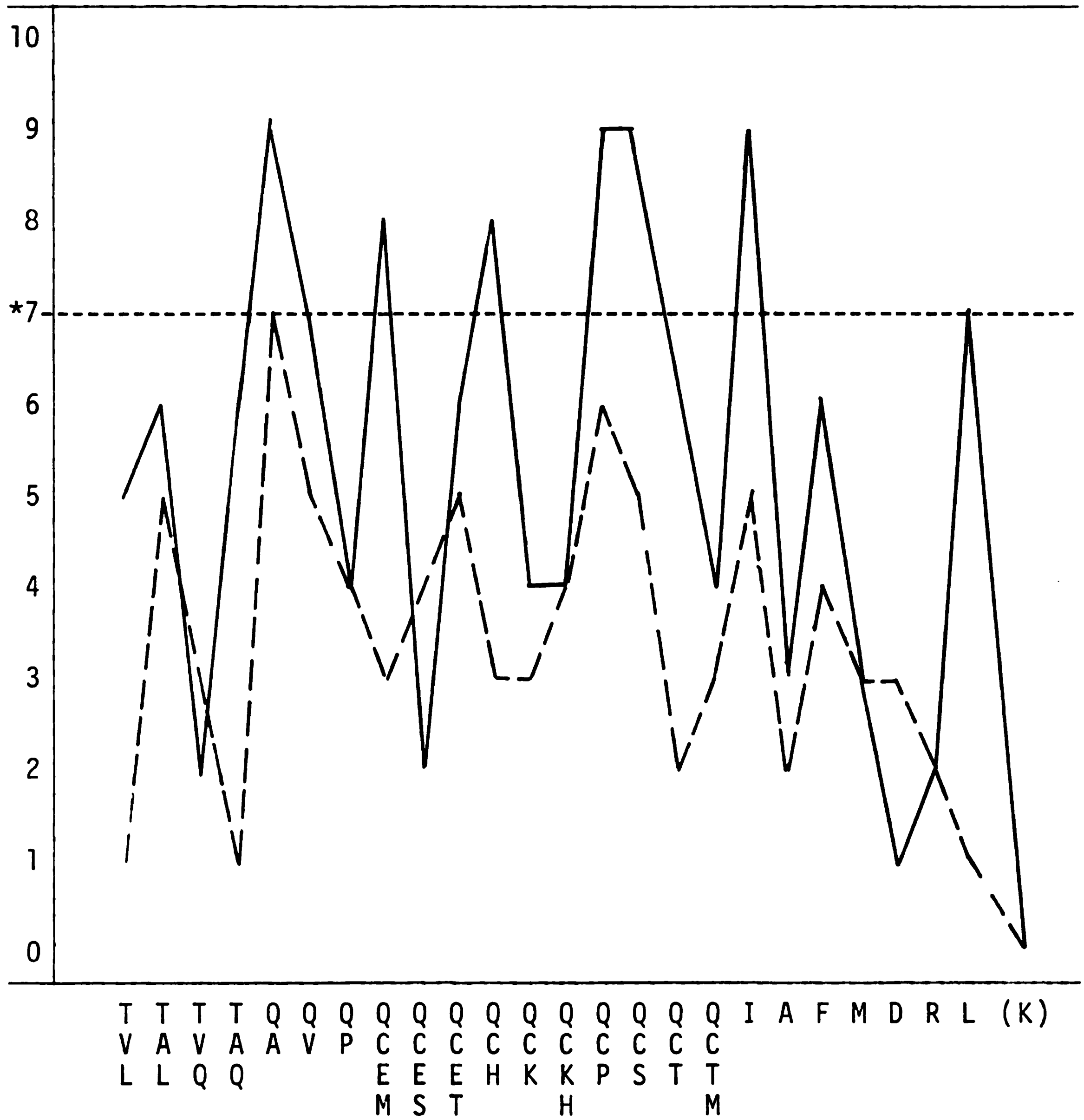
——————— = Second quartile students.
---------- = Third quartile students.
* = 7 or 70% is an orientation for population represented.

Chart 7.--Profile score of orientation of major cognitive traits of PACER second quartile students and orientation of major cognitive traits of PACER third quartile students.



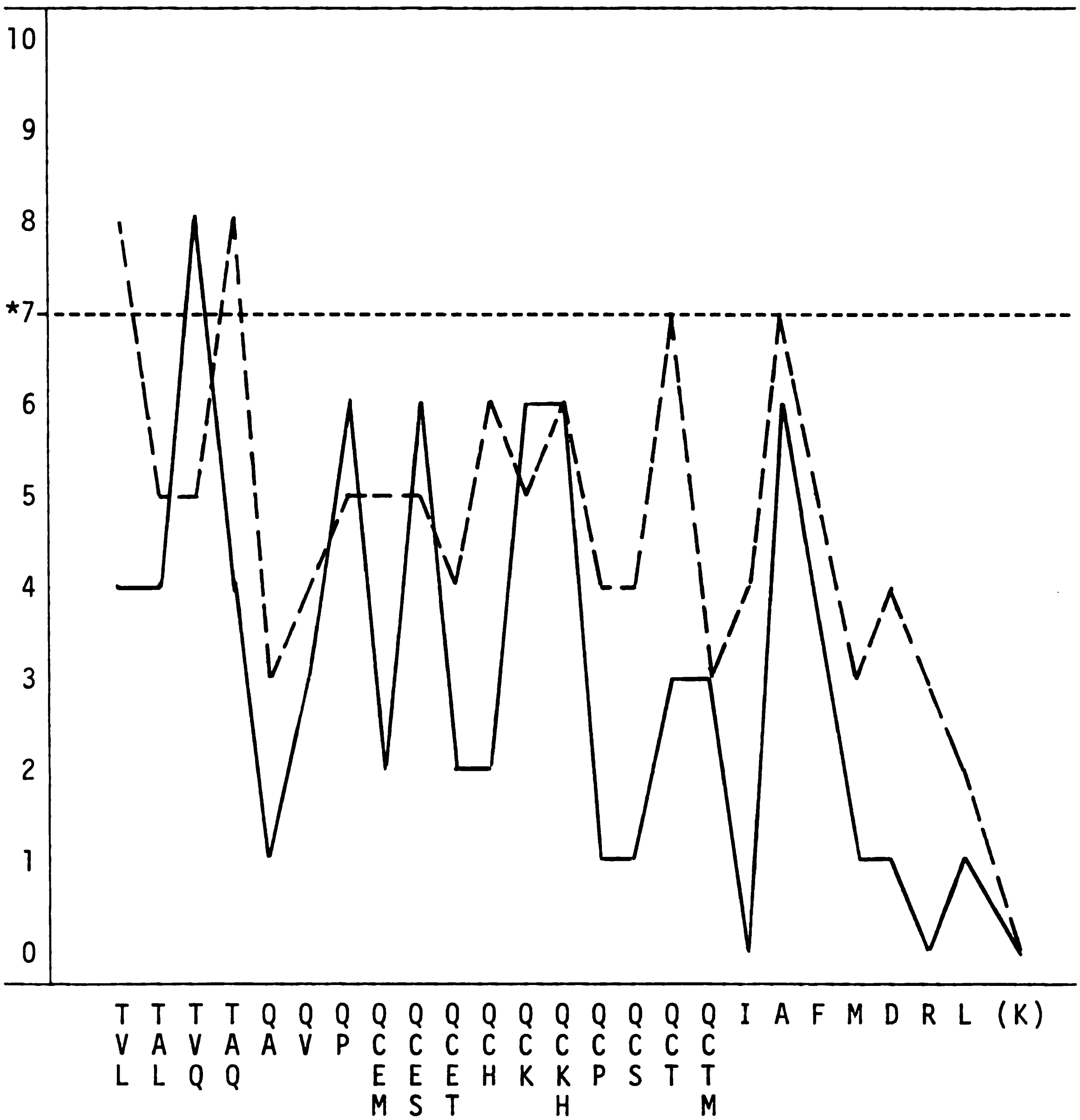
———————— = Second quartile students.
---------- = Third quartile students.
* = 7 or 70% is an orientation for population represented.

Chart 8.--Profile score of orientation of minor cognitive traits of PACER second quartile students and orientation of minor cognitive traits of PACER third quartile students.



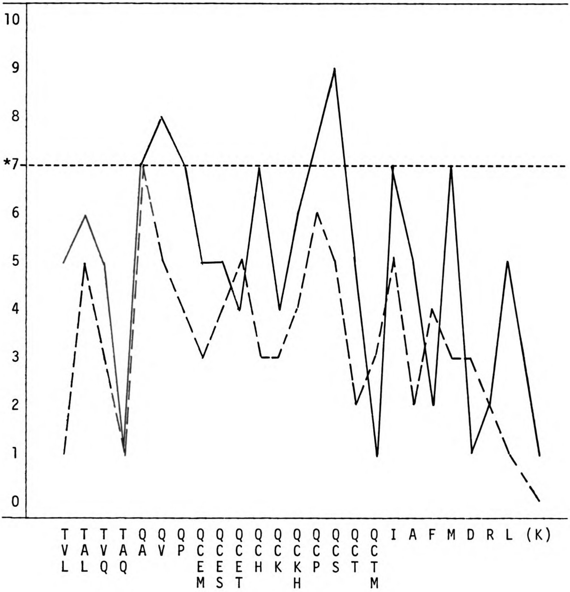
———————— = Second quartile students.
---------- = Fourth quartile students.
* = 7 or 70% is an orientation for population represented.

Chart 9.--Profile score of orientation of major cognitive traits of PACER second quartile students and orientation of major cognitive traits of PACER fourth quartile students.



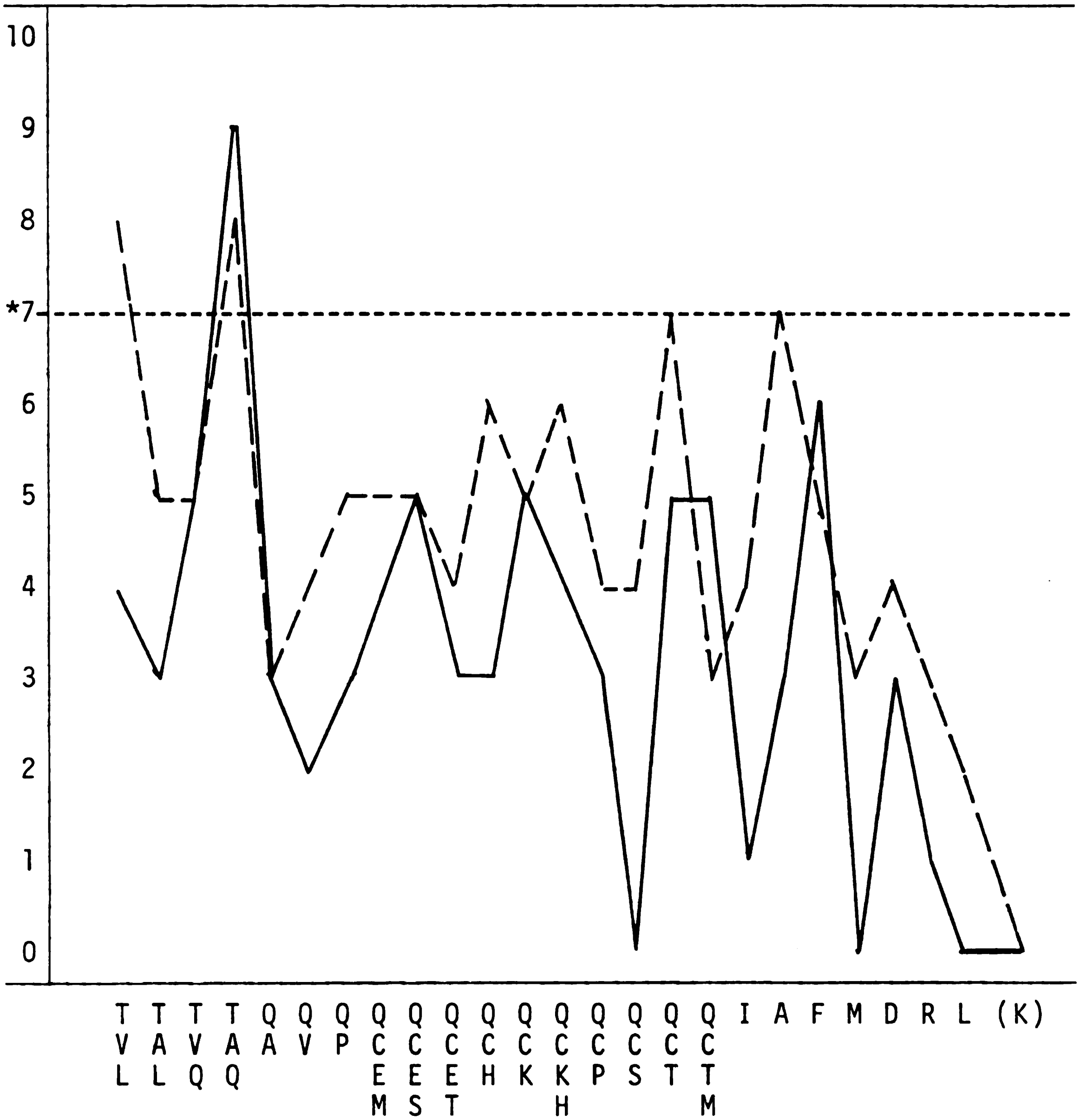
———————— = Second quartile students.
---------- = Fourth quartile students.
* = 7 or 70% is an orientation for population represented.

Chart 10.--Profile score of orientation of minor cognitive traits of PACER second quartile students and orientation of minor cognitive traits of PACER fourth quartile students.



———————— = Third quartile students.
---------- = Fourth quartile students.
* = 7 or 70% is an orientation for population represented.

Chart 11.--Profile score of orientation of major cognitive traits of PACER third quartile students and orientation of major cognitive traits of PACER fourth quartile students.



——————— = Third quartile students.
---------- = Fourth quartile students.
* = 7 or 70% is an orientation for population represented.

Chart 12.--Profile score of orientation of minor cognitive traits of PACER third quartile students and orientation of minor cognitive traits of PACER fourth quartile students.

the closer the quartiles were together, the smaller the D measurement was. Therefore, these measurements indicated that what had been expected was indeed true.

The distance measures of the profiles of similarity in Charts 1-12 are as follows:

Chart 1. Major cognitive traits of PACER first-quartile students and orientation of major cognitive traits of PACER second-quartile students were:

$Dab^2 = 189$

$D = 189^{\frac{1}{2}} = 13.75$

Chart 2. Minor cognitive traits of PACER first-quartile students and orientation of minor cognitive traits of PACER second-quartile students were:

$Dab^2 = 119$

$D = 119^{\frac{1}{2}} = 10.91$

Chart 3. Major cognitive traits of PACER first-quartile students and orientation of major cognitive traits of PACER third-quartile students were:

$Dab^2 = 295$

$D = 295^{\frac{1}{2}} = 17.18$

Chart 4. Minor cognitive traits of PACER first-quartile students and orientation of minor cognitive traits of PACER third-quartile students were:

$Dab^2 = 145$

$D = 145^{\frac{1}{2}} = 12.04$

Chart 5. Major cognitive traits of PACER first-quartile students and orientation of major cognitive traits of PACER fourth-quartile students were:

$Dab^2 = 399$

$D = 399^{\frac{1}{2}} = 19.97$

Chart 6. Minor cognitive traits of PACER first-quartile students and orientation of minor cognitive traits of PACER fourth-quartile students were:

$Dab^2 = 196$

$D = 196^{\frac{1}{2}} = 14.00$

Chart 7. Major cognitive traits of PACER second-quartile students and orientation of major cognitive traits of PACER third-quartile students were:

$Dab^2 = 139$

$D = 139^{\frac{1}{2}} = 11.79$

Chart 8. Minor cognitive traits of PACER second-quartile students and orientation of minor cognitive traits of PACER third-quartile students were:

$Dab^2 = 95$

$D = 95^{\frac{1}{2}} = 9.75$

Chart 9. Major cognitive traits of PACER second-quartile students and orientation of major cognitive traits of PACER fourth-quartile students were:

$Dab^2 = 210$

$D = 210^{\frac{1}{2}} = 14.49$

Chart 10. Minor cognitive traits of PACER second-quartile students and orientation of minor cognitive traits of PACER fourth-quartile students were:

$Dab^2 = 154$

$D = 154^{\frac{1}{2}} = 12.41$

Chart 11. Major cognitive traits of PACER third-quartile students and orientation of major cognitive traits of PACER fourth-quartile students were:

$Dab^2 = 149$

$D = 149^{\frac{1}{2}} = 12.21$

Chart 12. Minor cognitive traits of PACER third-quartile students and orientation of minor cognitive traits of PACER fourth-quartile students were:

$Dab^2 = 113$

$D = 113^{\frac{1}{2}} = 10.63$

Question 4. What relationship exists between the number of qualitative codes and success in the Engineering Design program?

Findings: Refer to frequency of occurrence and concentration of cognitive traits, Tables 3-5 (pp. 131, 132, and 134), and Table 6 (p. 135). For the Engineering Design Students at the Southwest Oakland Vocational Education Center, and in terms of this study, the more cognitive trait elements a student had in his/her cognitive style, the greater was that student's chance for success.

Question 5. How well does the vocational student understand his/her own cognitive style?

Findings: Inspection of students' cognitive style map selection, Table 7 (p. 153) indicated that the students' self-awareness figures approached the theoretical distribution; therefore there was no evidence that they could identify their own cognitive style maps.

The Kalmogorov-Smirnov One Sample Test[5] was used to determine whether students could determine their own cognitive style. Table 7 shows the cumulative distribution of the observed choices, as compared to the theoretical cumulative distribution. The choices were ranked 1 through 5, with 1 being most like the student and 5 being least like the student. A maximum deviation occurs in column 4, in which the amount is .05. Deviations also occur in columns 1 and 2, in which the deviations in both cases are .025. As this was not an experimental study, these figures were thought to approach the theoretical distribution, and therefore indicated there was no evidence that the students could identify their own cognitive styles.

Table 7.--Students' cognitive style map selection (N = 40).

	(1)	(2)	(3)	(4)	(5)
Theoretical distribution	1/5	2/5	3/5	4/5	5/5
Number of students making selection	7	8	9	6	10
Cumulative distribution	7/40	15/40	24/40	30/40	40/40
Deviations	1/40	1/40	0/40	2/40	0/40

Question 6. Can the cognitive style map of the vocational student be empirically verified?

Findings: The cognitive style map of the vocational student can be empirically verified. This was accomplished by comparing the anecdotal data on each student with the elements of that individual's cognitive style map. (Refer to the anecdotal observation worksheets in Appendix A.)

Clues for Personalizing Instruction

Question 2 broached the issue of obtaining clues for personalizing instruction. By its very nature, Engineering Design has a theoretical symbolic orientation. The use of mathematics of design is based on theoretical symbolic orientation and inference. Designing and drawing machinery employs codifying data and drawing inferences from them. Therefore, educators providing personalized instruction must use that information. Some clues for personalizing instruction follow:

1. The first clue provided in the study was that the most successful students in the first quartile of the PACER test had a strong major element T(VQ) (better than average ability to acquire meaning in terms of numerical symbols, relationships, and measurements).

2. The second clue was that most students in the first three quartiles of achievement used a major T(VL) (ability to find meaning from words seen) in learning.

3. All students except one used either a major or minor T(AQ) (ability to acquire meaning in terms of numerical symbols, relationships, and measurements that are spoken) orientation in obtaining meaning from numbers.

4. The findings indicated there was an almost even balance across all four quartiles of the PACER achievement test in the T(AL) element (ability to acquire meaning through hearing spoken words).

5. The fifth clue provided by the cognitive style constructs was that all students used either a major or minor in the element Q(V) (the ability to perceive meaning through sight). This is not surprising, considering that the class deals primarily with translating ideas by using drawings and other visual displays.

6. A sixth clue provided by the present study was that students in all categories of achievement used a major I (individual) orientation style in obtaining meaning from their surroundings. A total of 29 students in the study had a major in this category, whereas only 7 had a minor in the category.

7. One of the elements that was rather mixed in terms of the number of students subscribing to it was element A (associates). This is surprising, because in actual observations the students depended a great deal on the approval of their peers.

8. Another clue for personalizing vocational students' instruction was mentioned in the answer to question 1. The observed diversity of individual cognitive styles was indicated in the study.

9. The last clue and probably the most obvious is that seven of the ten students in the first quartile had the element K (deductive

reasoning, or the form of logical proof used in geometry) in their cognitive style maps. In the second, third, and fourth quartiles there was only one other major; it was in the third quartile. There were no minors in any of the four quartiles.

Summary

In this chapter the findings of the study were presented in answer to the six questions posed in Chapter I. Within these findings, individual student cognitive style maps were presented, along with tables of frequency, percentage, and concentration. Collective cognitive style profiles were given for the four quartiles of the PACER test. Profiles of similarity were also presented for the same divisions of achievement; following these profiles the measures of distance were recorded. A table showing the students' degree of self-awareness was also presented. In the next chapter, the conclusions emanating from these findings are discussed, along with implications of the study and recommendations for further research.

Footnotes--Chapter IV

[1]Vaughn Hoogasian, "An Examination of Cognitive Style Profiles as Indicators of Performance Associated with a Selected Discipline" (Ph.D. dissertation, Wayne State University, 1970).

[2]P. S. Zussman, "A Pilot Study Exploration of Cognitive Style and Administrative Style as Defined in the Educational Sciences" (Ph.D. dissertation, Wayne State University, 1973).

[3]Jum C. Nunnally, Psychometric Theory (New York: McGraw-Hill Book Company, 1967).

[4]Ibid.

[5]S. Siegel, Nonparametric Statistics for the Behavioral Sciences (New York: McGraw-Hill, 1956).

CHAPTER V

SUMMARY AND SYNTHESIS

Summary

The present study was an exploratory one; it was not designed to test hypotheses, but rather to lead to new avenues of exploration to personalize better the instruction of vocational students. The predominant purpose of the study was to identify cognitive styles of students who fit into certain subsets of achievement. A second purpose was to determine what relationships might exist between vocational student achievement subsets and the collective cognitive styles associated with them.

The study comprised five chapters. Contained in Chapter I were the statement of the problem and its importance. The following six major objectives of the study were identified:

1. To identify the cognitive styles of the students in the Engineering Design class at the Southwest Oakland Vocational Center in Wixom, Michigan.
2. To identify the variables that exist between the cognitive style of the vocational student and the instructional mode, to obtain clues for personalizing instruction.
3. To determine if it is possible to identify a collective cognitive style and to see if there is a relationship

between categories of vocational students' achievement and the associated collective cognitive style.

4. To discern whether there is a relationship between the number of qualitative codes and success in the Engineering Design class.
5. To determine how well a vocational student understands his/her own cognitive style.
6. To verify empirically the validity of the vocational students' cognitive style maps.

Selected literature related to theories of cognition, human variability, cognitive style, educational sciences, modes of instruction, personalizing instruction, and vocational choice was reviewed in Chapter II. In Chapter III, the source of the data, the sample employed in the study, and the survey methodology were discussed. Presented in Chapter IV were the findings of the study, including individual cognitive style maps, collective cognitive style profiles, and measures of similarity of the occurrence of the elements in various quartiles of vocational student achievement. The measures of distance for the profiles of similarity were also computed and displayed in that chapter.

Chapter V is presented in five sections: (1) Summary, (2) Conclusions, (3) Implications and Clues for Personalizing Instruction, (4) Limitations, and (5) Recommendations.

Conclusions

The conclusions of the study are the answers to the general questions posed in Chapter I. These questions were formulated in an attempt to accomplish the objectives of the study. Answers to those questions were based on the findings reported in Chapter IV. It should be noted that all conclusions are tentative and subject to further examination and verification in studies of a hypothesis-testing nature. For the students in the Engineering Design class at the Southwest Oakland Vocational Education Center and in terms of available data, the following results were evident:

Question 1. What is the nature of the students' cognitive styles?

Findings: Refer to cognitive style maps, Table 2 (pp. 116-129). Table 2 consists of the cognitive style maps of all 40 students in the sample. Preliminary analysis of these maps indicates that the students had a variety of learning styles, which could, indeed, be mapped to illustrate their cognitive styles.

Relation: The above findings are pertinent to the question as they illustrate the diversity of the students' cognitive styles.

Conclusion: The instrument used to identify the students' cognitive styles was the Cognitive Style Interest Inventory, developed by Oakland Community College. The cognitive map is the result of a computer printout which, in effect, produces a picture of the student's learning style. The combination of elements and statements can produce more than 2,300 potential profiles. The following conclusions were based on an assessment of the learning styles of the vocational students in the sample:

1. Producing cognitive style maps did provide a visual display of the students' learning styles (see pp. 116-129). The maps provided insight into the cognitive styles of the individual students.

2. The students tested had a variety of cognitive styles.

3. Regarding the percentage of occurrence of major cognitive traits, students showed a preference for individual cultural determinants, as evidenced by the fact that 72.5 percent of the students had a major cognitive trait in this area. This was the second highest percentage of any total cognitive trait exhibited by the students (Qualitative Auditory was the highest, at 80 percent).

Inference: From these conclusions, Hypothesis 1, 2, 4, 5, and 6 (to follow) can be inferred.

Question 2. What variables exist between the cognitive style of the vocational student and the instructional mode?

Findings: Refer to Table 3, frequency of occurrence (p. 131); individual student maps, Table 2 (pp. 116-129); and collective cognitive style profiles, Table 6 (p. 135). The obvious variables that exist between the cognitive styles of the student and the instructional mode were identified as (1) motivation of the student and (2) content of the instructional materials.

In the context of the educational sciences, the variables that exist between the cognitive style of the vocational student and the instructional mode are any variances in the cognitive style elements of the individual student as compared to the format of the cognitive style elements of the instructional mode.

In addition to the existing variables, question 2 also alluded to the relationship between the individual student's cognitive style and the format of the instructional mode. To answer this portion of the question, it was necessary to compare the cognitive style elements of each individual student with the various formats of the instructional modes. The individual students' cognitive styles were presented on pages 116-129, and the formats of the instructional modes were presented on pages 105-106. Inspection of these maps showed that it was, indeed, possible to identify and match the individual student with the most appropriate instructional mode.
Relation: The above findings are pertinent to the question because they illustrate the complexity of the answer, which must consider so many variances in cognitive style.
Conclusion: The obvious variables that exist between the cognitive styles of the student and the instructional mode were identified as (1) motivation of the student and (2) content of the instructional materials.

In the context of the educational sciences, the variables that exist between the cognitive style of the vocational student and the instructional mode are any variances in the cognitive style elements of the individual student as compared to the format of the cognitive style elements of the instructional mode. The greater the deviation of the student's elements from the elements of the instructional mode, the less likely that student will be to achieve any success with that particular instructional mode. An example of an extreme case is student 017, whose cognitive style map was as follows:

Symbolic Orientation	Cultural Determinants	Modalities of Inference
T'(AL)		
Q'(A)		
A'(V)		
Q'(CEM)	F'	
Q'(CES)		
Q'(CKH)		
Q'(CP)		

When student 017's cognitive style was compared to the elements necessary for the instructional mode of Printed Materials, it became apparent that this student would be at a total loss in any attempt to gain understanding from that instructional mode. The general format for Printed Materials is as follows:

Symbolic Orientation	Cultural Determinants	Modalities of Inference
T(VL)		
T(VQ)		
Q(T)		
Q(V)		M
Q(CEM)	A	D
Q(CES)	I	R
Q(CET)		L
Q(CH)		
Q(CS)		
Q(CTM)		

In addition to the existing variables, question 2 also alluded to the relationship between the individual student's cognitive style and the format of the instructional mode. To answer this portion of the question, it was necessary to compare the cognitive style elements of each individual student with the various formats of the instructional modes. The individual students' cognitive styles were presented on pages 116-129, and the formats of the instructional modes were presented on pages 105-106. Inspection of these maps showed that it was, indeed, possible to identify and match the individual student with the most appropriate instructional mode. Of course it is important to recognize that matching a student with the appropriate instructional mode is not proof that this is, indeed, the best possible match. Further studies are needed to verify this type of matching.

Inference: From these conclusions, Hypothesis 3 (to follow) can be inferred.

Question 3. Is it possible to identify a relationship, if any, between vocational student achievement and collective cognitive style associated with categories of achievement?

Findings: Refer to frequency of occurrence and concentration of cognitive traits, Tables 3 and 5 (pp. 131 and 134) and profile scores, Charts 1-12 (pp. 138-149). Also see measures of distance (pp. 150-152).

Within the symbolic mediations, it is interesting that, when comparing the first quartile to the fourth quartile, the frequencies of the majors and minors were almost reversed. This illustrates that the high achievers were using more major modes of understanding than were the low achievers. The students had many more major traits than they did negligible traits. The students also showed a preference for individual cultural determinants, as evidenced by the fact that 72.5 percent had a major cognitive trait in this area. This was the second highest major percentage of any total cognitive trait exhibited by the students (Qualitative Auditory was the highest, at 80 percent).

An inspection of Table 6 indicates that students who had more symbolic orientations were grouped higher in terms of achievement. It is also of interest that Modality of Inference (K) only appeared as a major orientation for students in the top quartile. In an Engineering Design class this result is not surprising, because this modality of inference uses deductive reasoning or the form of proof used in geometry.

Relation: The above findings are pertinent to the question as they identify the relation between achievement and collective cognitive style.

Conclusion: The identification of vocational students' collective cognitive styles related to categories of achievement was achieved by inspecting the frequency chart of Table 3 on page 131. Table 5, showing the concentration of cognitive traits, was also examined in conjunction with the categories of achievement (p. 134). The writer concluded that it was possible to identify collective cognitive style profiles of vocational students in the Engineering Design class at the Southwest Oakland Vocational Education Center. Collective cognitive style profiles for each of the four quartiles of student achievement on the PACER test are shown on page 135.

Inspection of the profiles of similarity shown in Charts 1-12 on pages 138-149 and the measures of distance of the profiles of similarity for these charts, on pages 150-152, indicated that more successful students collectively used more cognitive style elements than did less successful students.

The total frequency of occurrence of major cognitive traits of students in the first quartile of the PACER test was 160 elements; in the second quartile, 130 elements; in the third quartile, 121 elements; and in the fourth quartile, 84 elements. At the same time, the frequency of occurrence of minor cognitive traits of students in the first quartile of the PACER test was 54; in the second quartile, 75 elements; in the third quartile, 80 elements; and in the fourth quartile, 114 elements. As might be expected, as the major cognitive trait elements decreased from the first through the fourth quartiles, the minor cognitive trait elements increased. This suggests that the more ways students have to find meaning from their environment, the better will be their chances for success in the Engineering Design program at the Southwest Oakland Vocational Education Center. As was indicated in the last part of the previous answer, the more successful students had the modality of inference of the element (K) (deductive reasoning) in their cognitive style maps. One might infer that these students were more successful because they had that element in their cognitive style, but this inference should be verified in the context of further hypothesis-testing studies.

Inference: From the above conclusions, Hypothesis 7 (to follow) can be inferred.

Question 4. What relationship exists between the number of qualitative codes and success in the Engineering Design program?

Findings: Refer to frequency of occurrence and concentration of cognitive traits, Tables 3-5 (pp. 131, 132, and 134). For the

Engineering Design students at the Southwest Oakland Vocational Education Center, and in terms of this study, the more cognitive trait elements a student had in his/her cognitive style, the greater was that student's chance for success.

Relation: The above finding is pertinent to the question because of its specificity.

Conclusion: This question was answered, in part, by the response to the previous question. For the Engineering Design students at the Southwest Oakland Vocational Education Center, and in terms of this study, the more cognitive trait elements a student had in his/her cognitive style, the greater was that student's chance for success.

Inference: From this conclusion, Hypothesis 8 (to follow) can be inferred.

Question 5. How well does the vocational student understand his/her own cognitive style?

Findings: Inspection of students' cognitive style map selection, Table 7 (p. 153) indicated that the students' self-awareness figures approached the theoretical distribution; therefore there was no evidence that they could identify their own cognitive style maps.

Relation: The above finding is pertinent to the question as it determines that there is no relation and is positive enough not to allow for any possible relations.

Conclusion: There was no conclusive evidence that students should be left to their own choice regarding the selection of instructional modes. This does not mean that a student may not "know" what he/she prefers as an instructional mode. What it does suggest is that an inexperienced student will not intuitively select the mode of instruction that is best for him/herself. For example, a student might be unable to understand why he/she is having difficulty with the instructional mode Printed Materials, when, in fact, he/she might have a minor or even negligible T(VL) element (ability to find meaning from the printed word). Hence institutions that offer numerous instructional modes, as well as those that offer very few, should be concerned with the assessment of their students' cognitive styles.

Inference: From this conclusion, Hypothesis 9 (to follow) can be inferred.

Question 6. Can the cognitive style map of the vocational student be empirically verified?

Findings: The cognitive style map of the vocational student can be empirically verified. This was accomplished by comparing the anecdotal data on each student with the elements of that individual's cognitive style map. (Refer to the anecdotal observation worksheets in Appendix A.)

Relation: The above finding is pertinent to the question, but it is a judgmental finding.

Conclusion: The cognitive style map of the individual vocational student can be empirically verified. Individuals' cognitive style maps were verified by comparing the anecdotal data on each student with the elements of that individual's cognitive style map. The instructor had kept a daily anecdotal data log of the students as it related to key elements in their cognitive styles. An observation worksheet was used to enter pertinent remarks about the mode of instruction and the observed correlations between the student's behavior and the cognitive style elements and symbols. It must be pointed out that not all of the elements in a particular student's cognitive style were necessarily observed. Empirical mapping and verification is an observation technique, and in this writer's judgment there is adequate evidence that the cognitive style of the vocational student can be empirically verified.

On the basis of these results, it was concluded that the computer-generated cognitive style maps of the vocational students were valid.

Inference: From this conclusion, Hypothesis 10 (to follow) can be inferred.

Implications and Clues for Personalizing Instruction

Question 2 broached the issue of obtaining clues for personalizing instruction. By its very nature, Engineering Design has a theoretical symbolic orientation. The use of mathematics of design is based on theoretical symbolic orientation and inference. Designing and drawing machinery employs codifying data and drawing inferences from them. Therefore, educators providing personalized instruction must use that information. Some clues for personalizing instruction follow:

1. The first clue provided in the study was that the most successful students in the first quartile of the PACER test had a

strong major element T(VQ) (better than average ability to acquire meaning in terms of numerical symbols, relationships, and measurements). It would be beneficial to students displaying this element if the instructor would write the quantitative symbols being used. It has been said that all engineers and draftsmen talk with a pencil. This statement becomes all the more important when recognized in its true context.

2. The second clue was that most students in the first three quartiles of achievement used a major T(VL) (ability to find meaning from words seen) in learning. This suggests that reading assignments and programmed learning devices would be of benefit to these students.

3. All students except one used either a major or minor T(AQ) (ability to acquire meaning in terms of numerical symbols, relationships, and measurements that are spoken) orientation in obtaining meaning from numbers. This suggests that, for the majority of students in the Engineering Design class, number concepts may be introduced by teacher demonstrations, group discussions, and media using recorded messages.

4. The findings indicated there was an almost even balance across all four quartiles of the PACER achievement test in the T(AL) element (ability to acquire meaning through hearing spoken words). An attempt should be made to strengthen this element in the students' cognitive style.

5. The fifth clue provided by the cognitive style constructs was that all students used either a major or minor in the element Q(V) (the ability to perceive meaning through sight). This is not

surprising, considering that the class deals primarily with translating ideas by using drawings and other visual displays. Therefore, it is suggested that the instructor should use many visual display methods to help illustrate a point and to augment other reading activities.

6. A sixth clue provided by the present study was that students in all categories of achievement used a major I (individual) orientation style in obtaining meaning from their surroundings. A total of 29 students in the study had a major in this category, whereas only 7 had a minor in the category. Hence individual study may be appropriate for students in this type of vocational class.

7. One of the elements that was rather mixed in terms of the number of students subscribing to it was element A (associates). This is surprising, because in actual observations the students depended a great deal on the approval of their peers. Nevertheless, this clue does suggest that class discussion and/or class interaction may be helpful to those students who possess this element of cognitive style.

8. Another clue for personalizing vocational students' instruction was mentioned in the answer to question 1. The observed diversity of individual cognitive styles was indicated in the study. The suggestion here is that a large range of prescriptive modes of instruction is probably necessary.

9. The last clue and probably the most obvious is that seven of the ten students in the first quartile had the element K (deductive reasoning, or the form of logical proof used in geometry) in their

cognitive style maps. In the second, third, and fourth quartiles, there was only one other major; it was in the third quartile. There were no minors in any of the four quartiles. The implication is that successful students, at least in this type of vocational program, have this type of deductive reasoning ability. These students are the type who go on to engineering school. Another implication of a student having the element (K) in his/her cognitive style is that it might be possible to predict that the student would be a high achiever in a vocational program such as Engineering Design.

Limitations

An exploratory study does not have the inherent limitations an experimental study might possess. However, this is not to say that an exploratory study is devoid of limitations.

It was noted several times throughout this paper that the study was not designed to be a hypothesis-testing effort, but rather that it was intended to provide answers to questions that might generate hypotheses to be tested in future studies. This is not to be construed as an apology for the present study's not being an experimental effort, but to call attention to the importance and necessity of conducting a study that generates hypotheses rather than one that is totally experimental.

Before discussing the recommendations of the study, three limitations should be considered, which are an addition to those presented in Chapter I. These limitations became evident during the course of the study and are, therefore, presented now:

1. The accuracy of matching the student's cognitive style to the format of an instructional mode could not be assessed. Future studies should be addressed to this subject.

2. Not all of the elements of a student's cognitive style could be verified, because of the monumental amount of work necessary to accomplish this task and also because it was beyond the scope of the study. This limitation is also left for future researchers to address.

3, In the literature review, many other areas of cognitive style were discussed. The writer did not intend to imply that the cognitive styles contained in the context of the educational sciences are the only ones worthy of study. Because of the complexity of the human mind, many variables and styles are interrelated. The study of these characteristics is also left to future studies.

Recommendations for Further Study

The questions that were initially raised in Chapter I have been answered. However, a number of conclusions of the study lend themselves to the generation of hypotheses that might be relevant to future research. Some hypotheses for further study follow:

Hypothesis 1. (Question 1) Successful vocational-technical students can be identified by certain cultural determinant code elements in their cognitive styles.

Hypothesis 2. (Question 1) Successful vocational-technical students can be identified by certain code elements of modalities of inference in their cognitive styles.

Hypothesis 3. (Question 2) A successful instructional mode for a vocational-technical student will have a small number of variances between the cognitive style elements of the student and the format of style elements in the instructional mode.

Hypothesis 4. (Question 1) Successful vocational-technical students can be identified by certain theoretical symbolic orientation code elements in their cognitive styles.

Hypothesis 5. (Question 1) The presence of a major qualitative code Visual will predispose a vocational student to be successful in the Engineering Design curriculum.

Hypothesis 6. (Question 1) The presence of a major cultural determinant code Individual will predispose a vocational student to be successful in the Engineering Design curriculum.

Hypothesis 7. (Question 3) The presence of a major modality of inference code in deductive reasoning will predispose a vocational student to be successful in the Engineering Design curriculum.

Hypothesis 8. (Question 4) The greater the presence of cognitive style elements in a vocational student's cognitive style, the more that individual will be predisposed toward being a successful vocational student.

Hypothesis 9. (Question 5) When knowledgeable students are required to rank five cognitive style maps on a scale of "most like me" to "least like me" (one of which is their own), their selection will indicate a noticeable bias toward their own map.

Hypothesis 10. (Question 6) When the elements of the vocational student's cognitive style map are compared to the individual's cognitive style elements contained in his/her anecdotal evaluation, the correctness of the cognitive style map will be empirically verified.

The following hypotheses were formulated from implications that arose during the course of the study. The review of related literature was particularly responsible for suggesting some of these hypotheses:

Hypothesis 11. Considered in the context of the collective cognitive styles of groups of students in terms of performance, grade point averages are adequate to differentiate cognitive styles of students in vocational education programs.

Hypothesis 12. There are significant differences between the instructor determinations of superior students and nonsuperior students as they relate to their cognitive styles.

Hypothesis 13. Vocational students intuitively sense the cognitive styles of their peers and instructor, and make interpersonal decisions based on their intuitive understanding of the cognitive styles of others.

Hypothesis 14. Considered in the context of the collective cognitive styles of groups of employees, the system or institution determines to a large extent the cognitive style it wishes to have its successful employees reflect.

Hypothesis 15. When groups of vocational students are given instruction in their chosen occupational field based on their educational cognitive style, they will have significantly different group means on the PACER test for their occupational field than students who were not instructed according to their cognitive style.

Hypothesis 16. When a group of vocational students is given the PACER test, there will be no significant difference in scores between students whose cognitive styles were matched to an instructional mode and those whose cognitive styles were mismatched to the instructional mode.

Some ideas and topics for further research in the area of cognitive style mapping and the educational sciences are as follows:

1. Research in developing a program to implement clues provided by cognitive style mapping for the personalization of vocational education instruction needs to be undertaken.

2. Research in developing a program to devise methods and techniques for augmenting cognitive style for vocational students needs to be completed.

3. Research efforts should be designed to examine the affective and motivational behavior of cognitive style of the vocational student.

4. The present study should be replicated using a larger sample from other institutions, to establish a larger group measure of profiles of similarity in Engineering Design and in other areas of vocational education.

5. A specific battery of instruments should be identified, with which to determine potentailly successful vocational students.

6. A pilot program should be instituted to measure the relative effectiveness of different, identified cognitive and vocational styles among vocational students in diverse economic and cultural settings.

7. An investigation comparing students enrolled in vocational area skill centers to those in comprehensive high schools should be undertaken. Such a study should determine whether there is a correlation between students' cognitive styles and their results on one of the vocational inventories, such as the Crites Inventory.

APPENDICES

APPENDIX A

ANECDOTAL OBSERVATION WORKSHEETS

APPENDIX A

ANECDOTAL OBSERVATION WORKSHEET

001	ENGINEERING DESIGN	CARL C. MONROE
STUDENT	COURSE	INSTRUCTOR

DATE	COMMENTS	SYMBOLS
9/13/78	Noticed the student reads aloud to himself.	T(AL)
9/27/78	Student worked on project requiring the interpretation of an unfamiliar machine layout. Did this with ease.	Q(V)
10/3/78	Student has trouble selecting a project of his own to do.	L
10/18/78	During the showing of a silent film the student was observed sleeping.	T(AL)
11/2/78	Student dislikes playing competitive sports.	Q'(CKH)
11/14/78	Student enjoyed working on a project with another student. He was very helpful toward the other student and assumed the role of teacher.	A Q(CP) Q(CH)
11/14/78	Student always goes on break with other students rather than alone.	A
11/20/78	Student was given project for the welding teacher. This project had a strict time limit on it and the student seemed to enjoy the responsibility and the pressure of getting the job done within a time frame.	Q(CTM)

T(VL)	T(AL) ++
T(VQ)	T(AQ)

Q(CEM)	Q(CES)	Q(CET)	A ++	M
Q(CH) +	Q(CK)	Q(CKH) -	F	D
Q(CP) +	Q(CS)	Q(CT)	I	R
Q(V) +	Q(T)	Q(S)		L
Q(P)	Q(O)	Q(A)		(K)

ANECDOTAL OBSERVATION WORKSHEET

002	ENGINEERING DESIGN	CARL C. MONROE
STUDENT	COURSE	INSTRUCTOR

DATE	COMMENTS	SYMBOLS
9/8/78	Student's parents visited the classroom today. Apparently they were invited by the student.	F
10/9/78	Student insists on treating faculty as though they are "one of the boys."	A
10/27/78	Have had some problems with the student doing math homework in class. Have given student more projects requiring mathematics.	T(VQ)
11/3/78	Student complained about the music that is being played over the intercom.	Q(A)
11/15/78	Student insists that all of the students in the class should follow the rules of the school.	Q(CET)
11/29/78	Student refused opportunity to do a group project.	I

T(VL)	T(AL)
T(VQ) +	T(AQ)

Q(CEM)	Q(CES)	Q(CET) +	A +	M
Q(CH)	Q(CK)	Q(CKH)	F +	D
Q(CP)	Q(CS)	Q(CT)	I +	R
Q(V)	Q(T)	Q(S)		L
Q(P)	Q(O)	Q(A) +		(K)

ANECDOTAL OBSERVATION WORKSHEET

003	ENGINEERING DESIGN	CARL C. MONROE
STUDENT	COURSE	INSTRUCTOR

DATE	COMMENTS	SYMBOLS
9/6/78	In conversation with me, the student indicated to me that he likes to play games.	T(AL) T(VL) T(AQ) T(VQ)
10/5/78	Student was observed drawing pictures rather than working on his project.	Q(CES)
10/26/78	Student got very frustrated when the part he was drawing was lost. Does not like having the rules changed.	Q(CET)
11/1/78	Student must take whatever we are talking about at the time and hold it in his hands.	Q(T)
11/2/78	Student had difficult time making up his mind about what project he wanted to do next when I gave him the choice.	L

T(VL) +	T(AL) +			
T(VQ) +	T(AQ) +			
Q(CEM)	Q(CES) +	Q(CET)	A	M
Q(CH)	Q(CK)	Q(CKH)	F	D
Q(CP)	Q(CS)	Q(CT)	I	R
Q(V)	Q(T)	Q(S)		L +
Q(P)	Q(O)	Q(A)		(K)

ANECDOTAL OBSERVATION WORKSHEET

004	ENGINEERING DESIGN	CARL C. MONROE
STUDENT	COURSE	INSTRUCTOR

DATE	COMMENTS	SYMBOLS
9/8/78	The student voiced his displeasure over having to do regular lettering sheets and work sheets the same as the rest of the students.	Lack of Q(CET)
10/23/78	The student has stated that he likes to use the sound page with ear phones. Does not know why but insists that he prefers to use the ear phones.	T(AL)
10/31/78	Student prefers to work in the library by himself when he uses the sound page.	Q(A) Q(CP) I Q(CS)
11/13/78	Keeps his drawer in perfect order. Has a place for all his drawing equipment.	R
11/21/78	The student has shown considerable interest in how an intricate mechanical assembly goes together and how it functions.	R
11/22/78	The student stated that he does not like to watch silent picture strips.	T(AL) T(AQ) Q(A) Q(CS)
11/22/78	Student has had considerable trouble in being on time when returning from break.	Lack of Q(CTM)

T(VL)	T(AL) ++			
T(VQ)	T(AQ) +			
Q(CEM)	Q(CES)	Q(CET) -	A	M
Q(CH)	Q(CK)	Q(CKH)	F	D
Q(CP) +	Q(CS) ++	Q(CT)	I +	R ++
Q(V)	Q(T)	Q(S)		L
Q(P)	Q(O)	Q(A) ++		(K)

ANECDOTAL OBSERVATION WORKSHEET

005	ENGINEERING DESIGN	CARL C. MONROE
STUDENT	COURSE	INSTRUCTOR

DATE	COMMENTS	SYMBOLS
9/8/78	Student enjoys kidding around with the instructor. Likes a buddy relationship.	A
9/15/78	Student has to have verbal instructions repeated many times. He will write it down and bring it back to me to make sure it is correct.	T(VL) T(VQ) Q(V)
9/9/78	Student has told me that he is on the track team.	Q(CKH)
10/2/78	Student had problem with another student which ended in a fight. He came to me for understanding and support. May be a problem with Q(CS) or Q(CP).	F
10/26/78	Student was given the option of working from a complex layout or from a real part. He chose the real part.	Q(CT)
11/8/78	Student has been picked on lately by members of the class.	Q'(CT)
11/29/78	Student has had an excellent record of attendance and is always on time after the break period.	Q(CTM)

T(VL)	+	T(AL)					
Q(VQ)	+	T(AQ)					

Q(CEM)		Q(CES)	W(CET)		A	+	M
Q(CH)		Q(CK)	Q(CKH)	+	F	+	D
Q(CP)	-	Q(CS)	Q(CT)	-	I		R
Q(V)	+	Q(T)	Q(S)				L
Q(P)		Q(O)	Q(A)				(K)
Q(CTM)	+						

ANECDOTAL OBSERVATION WORKSHEET

006	ENGINEERING DESIGN	CARL C. MONROE
STUDENT	COURSE	INSTRUCTOR

DATE	COMMENTS	SYMBOLS
9/11/78	Student has shown high degree of commitment to being on time to class.	Q(CTM)
9/15/78	Was given an assignment to complete but was talked into working on a government project for one of the students instead of what he was supposed to be working on.	A
10/18/78	Other students have indicated to me that it is important to them what this student thinks of their actions.	Q(CT) Q(CEM) Q(CH) Q(CP)
10/26/78	Student came to me for help on visualizing an assignment. This seems to be a consistent problem with him.	Q(A) Q'(V)
11/22/78	Student likes to touch people he is talking to.	Q(T) Q(CP) Q(CS)

T(VL) T(AL)
T(VQ) T(AQ)

Q(CEM) +	Q(CES)	Q(CET)	A ++	M
Q(CH) +	Q(CK)	Q(CKH)	F	D
Q(CP) ++	Q(CS) +	Q(CT) +	I	R
Q(V)	Q(T) +	Q(S)		L
Q(P)	Q(O)	Q(A)		(K)
Q(CTM) +				

ANECDOTAL OBSERVATION WORKSHEET

007	ENGINEERING DESIGN	CARL C. MONROE
STUDENT	COURSE	INSTRUCTOR

DATE	COMMENTS	SYMBOLS
9/7/78	Student is second-year student and required to select his own project. Student cannot make decision on what he wants to work on.	L
10/5/78	Student is constantly socializing with his peers.	A
10/25/78	Student wants to work with other students but always ends up in a hassle. Does work well with other students.	I Q'(CP)
11/8/78	Student was caught turning in someone else's work for his own.	A'(CET)
11/15/78	Student had argument with his classmates today about--he thought that beauty was so much nonsense.	Q(CES) Q'(CET)

T(VL)	T(AL)
T(VQ)	T(AQ)

Q(CEM)	Q(CES) +	Q(CET) --	A +	M
Q(CH)	Q(CK)	Q(CKH)	F	D
Q(CP) -	Q(CS)	Q(CT)	U +	R
Q(V)	Q(T)	Q(S)		L +
Q(P)	Q(O)	Q(A)		(K)

ANECDOTAL OBSERVATION WORKSHEET

008	ENGINEERING DESIGN	CARL C. MONROE
STUDENT	COURSE	INSTRUCTOR

DATE	COMMENTS	SYMBOLS
9/12/78	Student reads every time the opportunity is present. Student was reading a novel in class--very quiet, studious type.	T(VL) T(VL) T(CES)
9/26/78	Student has completed several work sheets on own volition--they are all reading work sheets.	T(VL) Q(CET)
10/10/78	Student wanted to talk to me--confided that she disliked her father, as he is an alcoholic.	I Q(CT)
11/10/78	Student is always on time.	Q(CTM)
10/17/78	Student has indicated that she is leaving her home and moving into an apartment with her boyfriend.	A
10/26/78	Student refused to work on a project with another student--prefers to work alone.	I Q(CP)
11/1/78	Student stays in class during break time--always by herself.	I

T(VL) +++	T(AL)
T(VQ)	T(AQ)

Q(CEM)	Q(CES) +	Q(CET) +	A +	M
Q(CH)	Q(CK)	Q(CKH)	F	D
Q(CP) +	Q(CS)	Q(CT)	I +++	R
Q(V)	Q(T)	Q(S)		L
Q(P)	Q(O)	Q(A)		(K)

ANECDOTAL OBSERVATION WORKSHEET

009	ENGINEERING DESIGN	CARL C. MONROE
STUDENT	COURSE	INSTRUCTOR

DATE	COMMENTS	SYMBOLS
9/13/78	Student has a very difficult time staying on the job--is almost hyperkinetic.	Q'(CET)
9/22/78	Student stated that he won the swimming meet in his division.	Q(CKH) Q(P)
10/3/78	Student went out during break to the parking lot (they are not allowed in the parking lot). When I asked the student why he went with the other students, he said, "because they asked me to."	A
10/18/78	Student was assigned the project. When I checked on him later on, he was working on something else. Could not understand why he could not work on whatever he wished to.	Q'(CET)
10/25/78	Student confided in me that he was arrested for stealing motorcycles while involved in a gang.	Q(CH) Q(CET)
11/1/78	Student is constantly late after break and quite often late to class.	Q'(CTM)
11/3/78	Student spends too much time talking to other students.	A
11/6/78	Student dislikes reading assignments.	T'(VL) T'(VQ) Q'(V)
11/15/78	Student never finishes assignments on time.	Q'(CTM)
11/20/78	Student tries hard to please authority figures. Does not follow through as soon as they are not present.	F

T(VL) -	T(AL)			
T(VQ) -	T(AQ)			
Q(CEM)	Q(CES)	Q(CET) --+	A ++	M
Q(CH) +	Q(CK)	Q(CKH) +	F +	D
Q(CP)	Q(CS)	Q(CT)	I	R
Q(V) -	Q(T)	Q(S)		L
Q(P) +	Q(O)	Q(A)		(K)
Q(CTM) --				

ANECDOTAL OBSERVATION WORKSHEET

010	ENGINEERING DESIGN	CARL C. MONROE
STUDENT	COURSE	INSTRUCTOR

DATE	COMMENTS	SYMBOLS
9/8/78	Student has asked for drawing problems that involve mathematics.	(K)
9/20/78	Student was assigned the project of picking his own project. He agonized over this for some time then once he decided he moved rapidly to a conclusion.	L
9/27/78	Student volunteered to help a new student that was having problems.	Q(CEM)
10/10/78	Noticed today that other students have begun to ask this student's approval over peer problems that they are having.	Q(CEM) Q(CT) Q(CP) Q(CH)
11/8/78	Student is always on time.	Q(CTM)
11/14/78	Student does exceptionally well on all types of tests.	T(AL) T(AQ) T(VL) T(VQ)

T(VL)	T(AL) +
T(VQ)	T(AQ) +

Q(CEM) ++	Q(CES)	Q(CET)	A	M
Q(CH) +	Q(CK)	Q(CKH)	F	D
Q(CP) +	Q(CS)	Q(CT) +	I	R
Q(V)	Q(T)	Q(S)		L +
Q(P)	Q(O)	Q(A)		(K) +
Q(CTM)				

ANECDOTAL OBSERVATION WORKSHEET

011	ENGINEERING DESIGN	CARL C. MONROE
STUDENT	COURSE	INSTRUCTOR

DATE	COMMENTS	SYMBOLS
9/7/78	Student was given the responsibility of picking his own project. Had no problem at all, and in fact, helped other students with the problem of selecting their own project.	L Q(CET) Q(CS)
9/27/78	Student always goes on break with other students.	A
10/9/78	Student pays close attention to lecture types of discussions.	T(AL)
10/24/78	Student seems comfortable talking to visitors who are touring the classroom.	Q(CH) Q(CP) Q(CS)
11/6/78	Student has good command of his psychomotor skills. Does very good line work and lettering.	Q(P) Q(CES) Q(CET)
11/24/78	Student is very willing to help other students.	Q(CEM) Q(CH)

T(VL)	T(AL) +			
T(VQ)	T(AQ)			
Q(CEM) +	Q(CES) +	Q(CET) ++	A +	M
Q(CH) +	Q(CK)	Q(CKH)	F	D
Q(CP)	Q(CS) +	Q(CT)	I	R
Q(V)	Q(T)	Q(S)		L +
Q(P) +	Q(O)	Q(A)		(K)
Q(CH) +				

ANECDOTAL OBSERVATION WORKSHEET

012	ENGINEERING DESIGN	CARL C. MONROE
STUDENT	COURSE	INSTRUCTOR

DATE	COMMENTS	SYMBOLS
9/14/78	Student is having trouble getting along with his peers.	Q'(CEM) I
9/21/78	Student usually goes on his break alone.	I
10/4/78	Student has problems making up his mind when confronted with a problem that consists of various alternatives.	L
10/23/78	Student was reading in class for pleasure; seems to prefer the written word to listening to lectures or discussions.	T(VL)
11/6/78	Student had a fight during break time with another student.	I Q'(CP) Q'(CS)
11/13/78	Student argued with me today--why he had to do an assignment (the rest of the class was doing it with no problems).	I F Q'(CEM) Q'(CT)
11/27/78	Student is constantly absent or late to class.	Q'(CTM)

T(VL) +	T(AL)
T(VQ)	T(AQ)

Q(CEM) --	Q(CES)	Q(CET)	A	M
Q(CH)	Q(CK)	Q(CKH)	F +	D
Q(CP) -	Q(CS) -	Q(CT) -	I ++++	R
Q(V)	Q(T)	Q(S)		L +
Q(P)	Q(O)	Q(A)		(K)
Q(CTM) -				

ANECDOTAL OBSERVATION WORKSHEET

013	ENGINEERING DESIGN	CARL C. MONROE
STUDENT	COURSE	INSTRUCTOR

DATE	COMMENTS	SYMBOLS
9/25/78	Student has problems completing assignments on time.	Q'(CTM)
9/26/78	Student likes to stay in classroom and remains aloof from his classmates.	I
10/20/78	Student is having difficulty in learning how to letter properly.	Q'(P)
10/31/78	When the student and I are talking about an assignment and numbers are mentioned, he must immediately write them down.	T'(AQ) T(VQ) Q(V)
11/22/78	Student has had complaints from student that shares his desk in the other class that the student always writes numbers down on the drawing board cover.	T(VQ) M

T(VL)	T(AL)
T(VQ) ++	T(AQ) -

Q(CEM)	Q(CES)	Q(CET)	A	M +
Q(CH)	Q(CK)	Q(CKH)	F	D
Q(CP)	Q(CS)	Q(CT)	I +	R
Q(V) +	Q(T)	Q(S)		L
Q(P) -	Q(O)	Q(A)		(K)
Q(CTM) -				

ANECDOTAL OBSERVATION WORKSHEET

014	ENGINEERING DESIGN	CARL C. MONROE
STUDENT	COURSE	INSTRUCTOR

DATE	COMMENTS	SYMBOLS
9/8/78	Student has had considerable trouble in being on time to class.	Q'(CTM)
9/28/78	Student is very careful in doing his drawing assignments. After he has done an assignment, he completely retraces the drawing as he says that he wants it as perfect as he can get it.	D Q(CET) M
10/17/78	When given an assignment that is complex in visualization, the student has no problems in grasping the assignment very quickly.	Q(V)
11/17/78	Student is always with other students when they go on break.	A Q(CT) Q(CP) Q(CEM)

T(VL)	T(AL)
T(VQ)	T(AQ)

Q(CEM) +	Q(CES)	Q(CET) +	A +	M +
Q(CH)	Q(CK)	Q(CKH)	F	D +
Q(CP +	Q(CS)	Q(CT) +	I	R
Q(V) +	Q(T)	Q(S)		L
Q(P)	Q(O)	Q(A)		(K)
Q(CTM) -				

ANECDOTAL OBSERVATION WORKSHEET

015	ENGINEERING DESIGN	CARL C. MONROE
STUDENT	COURSE	INSTRUCTOR

DATE	COMMENTS	SYMBOLS
9/21/78	Student is constantly argumentative with other students, teachers, other staff (everyone).	I Q'(CP) Q'(CS) Q'(CT) Q'(CEM)
10/11/78	Had the student in to inform him of his grade in class today. He was very argumentative, but when he realized that he was in a weak position he completely changed his tactics and his role and tried to con me.	Q(CH) F
10/14/78	Student is late on an extreme basis to class. Has tried to blame his problems on his mother.	F'
11/16/78	Student does excellent drawings.	Q(CKH)

T(VL) T(AL)
TIVQ) T(AQ)

Q(CEM) -	Q(CES)	Q(CET)	A	M
Q(CH) +	Q(CK)	Q(CKH) +	F +-	D
Q(CP) -	Q(CS) -	Q(CT) -	I +	R
Q(V)	Q(T)	Q(S)		L
Q(P)	Q(O)	Q(A)		(K)

ANECDOTAL OBSERVATION WORKSHEET

016	ENGINEERING DESIGN	CARL C. MONROE
STUDENT	COURSE	INSTRUCTOR

DATE	COMMENTS	SYMBOLS
10/2/78	Student asked me about what college to go to. He is interested in an engineering school and I discovered that he is highly qualified in mathematics.	T(VQ) F Q(CS)
10/18/78	Student voluntarily reads extra projects for extra credit.	T(AL) Q(CET)
10/24/78	Student had difficulty working with another student on a group project.	I
11/6/78	Student is constantly coming in to my office for help and reassuring on whatever job that he has.	F
11/20/78	Student asked to take home work so that he could get caught up in an assignment that he has fallen behind on.	Q(CET)
11/28/78	Student stays in class a great deal by himself.	I

T(VL)	T(AL) +
T(VQ) +	T(AQ)

Q(CEM)	Q(CES)	Q(CET) ++	A	M
Q(CH)	Q(CK)	Q(CKH)	F ++	D
Q(CP)	Q(CS) +	Q(CT)	I ++	R
Q(V)	Q(T)	Q(S)		L
Q(P)	Q(O)	Q(A)		(K)

ANECDOTAL OBSERVATION WORKSHEET

017	ENGINEERING DESIGN	CARL C. MONROE
STUDENT	COURSE	INSTRUCTOR

DATE	COMMENTS	SYMBOLS
9/15/78	Noticed that this student reads aloud to himself.	T(AL)
9/19/78	In checking a drawing by this student he had many spelling mistakes.	T'(VL)
9/26/78	Student has most of the dimensions on his drawings wrong.	T'(VQ) M'
10/6/78	Student cannot work with other students on projects.	A' Q'(CP)
10/31/78	Observed this student cheating during a test.	Q'(CET)
11/2/78	Student is always late after break.	Q'(CET) Q'(CTM)
11/14/78	Student is absent a great deal.	Q'(CET) Q'(CTM)
11/16/78	Today some of the students came to me and complained about this student because of his body odor.	Q'(CP) Q'(CS)

T(VL) -	T(AL) +
T(VQ) -	T(AQ)

Q(CEM)	Q(CES)	Q(CET) ---	A -	M -
Q(CH)	Q(CK)	Q(CKH)	F	D
Q(CP) --	Q(CS) -	Q(CT) -	I	R
Q(V)	Q(T)	Q(S)		L
Q(P)	Q(O)	Q(A)		(K)
Q(CTM) --				

ANECDOTAL OBSERVATION WORKSHEET

018	ENGINEERING DESIGN	CARL C. MONROE
STUDENT	COURSE	INSTRUCTOR

DATE	COMMENTS	SYMBOLS
9/8/78	Student stays by himself most of the time.	I
9/20/78	Student pays close attention during lectures.	T(AL)
10/11/78	Student has started to go on break with other students.	A
10/24/78	Student likes to cite definitions of terms when discussing things with other students.	M
11/13/78	Student tends to exaggerate contrasts when drawing projects.	R
11/14/78	Student is generally on time.	Q'(CTM)

T(VL)	T(AL) +			
T(VQ)	T(AQ)			
Q(CEM)	Q(CES)	Q(CET)	A +	M +
Q(CH)	Q(CK)	Q(CKH)	F	D
Q(CP)	Q(CS)	Q(CT)	I +	R +
Q(V)	Q(T)	Q(S)		L
Q(P)	Q(O)	Q(A)		(K)
Q(CTM) -				

ANECDOTAL OBSERVATION WORKSHEET

019	ENGINEERING DESIGN	CARL C. MONROE
STUDENT	COURSE	INSTRUCTOR

DATE	COMMENTS	SYMBOLS
9/15/78	Student was assigned task of developing his own project to work on. After much agonizing over the problem he finally decided on what his project would be. From there on the project progressed very rapidly.	L
9/18/78	Student has shown considerable interest in doing drawings that require considerable difficulty and problem-solving ability.	(K)
9/18/78	When I asked for volunteers to act as class guides, the student in question agreed.	Q(CEM)
10/10/78	Student is always punctual.	Q(CTM)
10/24/78	Student does exceptionally well on all types of tests and test situations.	T(AL) T(AQ) T(VL) T(VQ)

T(VL) +	T(AL) +			
T(VQ) +	T(AQ) +			
Q(CEM) +	Q(CES)	Q(CET)	A	M
Q(CH)	Q(CK)	Q(CKH)	F	D
Q(CP)	Q(CS)	Q(CT)	I	R
Q(V)	Q(T)	Q(S)		L +
Q(P)	Q(O)	Q(A)		(K) +
Q(CTM) +				

ANECDOTAL OBSERVATION WORKSHEET

020	ENGINEERING DESIGN	CARL C. MONROE
STUDENT	COURSE	INSTRUCTOR

DATE	COMMENTS	SYMBOLS
9/25/78	On reviewing student's records, I found that this student is consistently late with completing his projects or does not turn them in at all.	Q'(CTM) Q'(CET)
10/9/78	Student is very loud and boisterous in class, tries to dominate other students.	A Q(CH)
10/17/78	Student is always late on returning from break.	Q'(CTM)
10/23/78	Student insists on treating faculty as though they are one of the boys.	A
11/6/78	Student looks for school rules to break as though he must do this to prove himself to his peers.	Q'(CET) A

T(VL)	T(AL)
T(VQ)	T(AQ)

Q(CEM)	Q(CES)	Q(CET) --	A +++	M
Q(CH) +	Q(CK)	Q(CKH)	F	D
Q(CP)	Q(CS)	Q(CT)	I	R
Q(V)	Q(T)	Q(S)		L
Q(P)	Q(O)	Q(A)		(K)
Q(CTM) --				

ANECDOTAL OBSERVATION WORKSHEET

021	ENGINEERING DESIGN	CARL C. MONROE
STUDENT	COURSE	INSTRUCTOR

DATE	COMMENTS	SYMBOLS
9/8/78	Student wishes to please everyone he comes in contact with.	A
9/21/78	Student seems uninterested with movie presentations.	T'(AL) Q'(V)
10/23/78	In talk with student, the student indicated he did not like lecture style of discussions.	T'(AL)
11/3/78	Student enjoys working on projects that involve real things.	Q(T)
11/27/78	Student has everything arranged in his drawer in terms of categories. This stresses contrasts.	D

T(VL) -	T(AL) -
T(VQ)	T(AQ)

Q(CEM)	Q(CES)	Q(CET)	A +	M
Q(CH)	Q(CK)	Q(CKH)	F +	D +
Q(CP)	Q(CS)	Q(CT)	I	R
Q(V)	Q(T) +	Q(S)		L
Q(P)	Q(O)	Q(A)		(K)

ANECDOTAL OBSERVATION WORKSHEET

022	ENGINEERING DESIGN	CARL C. MONROE
STUDENT	COURSE	INSTRUCTOR

DATE	COMMENTS	SYMBOLS
10/10/78	Student would rather talk with faculty than with his peers. Seeks out conversations with teachers, particularly his instructor.	F Q(CH) Q(CT)
10/16/78	In discussion with student it was revealed that he has plans made for his future well in advance for the next several years.	Q(CS)
10/19/78	The student is generally on time to class and after break time.	Q(CTM)
10/30/78	Reviewed a complex layout assembly with the student. He could grasp visual problems with a large degree of accuracy.	Q(V)
11/15/78	Student does exceptionally well on tests that require reading and the classification differences and relationships of things.	M D R

T(VL)	T(AL)			
T(VQ)	T(AQ)			
Q(CEM)	Q(CES)	Q(CET)	A	M +
Q(CH) +	Q(CK)	Q(CKH)	F +	D +
Q(CP)	Q(CS) +	Q(CT) +	I	R +
Q(V) +	Q(T)	Q(S)		L
Q(P)	Q(O)	Q(A)		(K)
Q(CTM) +				

ANECDOTAL OBSERVATION WORKSHEET

023	ENGINEERING DESIGN	CARL C. MONROE
STUDENT	COURSE	INSTRUCTOR

DATE	COMMENTS	SYMBOLS
9/13/78	Student's parents came in for visit. Student seemed pleased that they were here.	F
9/27/78	Student stayed in class during break and worked on his project.	I
10/3/78	Student has extremely neat equipment drawer.	M R
10/18/78	Student comes to me an average of five times a day for clarification of what he is working on or just reinforcement of his projects.	A'(CS)
11/14/78	Student is improving with his abilities to visualize industrial layouts.	Q(V)

T(VL)	T(AL)
T(VQ)	T(AQ)

Q(CEM)	Q(CES)	Q(CET)	A	M +
Q(CH)	Q(CK)	Q(CKH)	F +	D
Q(CP)	Q(CS) -	Q(CT)	I +	R +
Q(V) +	Q(T)	Q(S)		L
Q(P)	Q(O)	Q(A)		(K)

ANECDOTAL OBSERVATION WORKSHEET

024	ENGINEERING DESIGN	CARL C. MONROE
STUDENT	COURSE	INSTRUCTOR

DATE	COMMENTS	SYMBOLS
9/8/78	Student came in late today. His excuse was that he was late at wrestling practice.	Q(P) Q(CKH)
10/9/78	Student is very aggressive with his peers and could be considered by his peers as the class bully.	Q(P) Q'(CEM) Q'(CP) Q'(CT) Q'(CS)
10/27/78	Student's equipment drawer is very messy.	R' M' D'
11/3/78	Student is having difficulty in visualization.	Q'(V)
11/15/78	Student complained about the quality of the music that the other students selected.	Q(A) Q(CES) Q(CH) Q'(CEM)
11/29/78	Student started fight with another student in one of the other classes.	A'(CEM) Q'(P) Q(CET) Q(CH) Q(CK) Q(CKH)

T(VL)		T(AL)					
T(VQ)		T(AQ)					
Q(CEM)	---	Q(CES)	+	Q(CET)	+	A	M -
Q(CH)	++	Q(CK)	+	Q(CKH)	++	F	D -
Q(CP)	-	Q(CS)	-	Q(CT)	-	I	R -
Q(V)	-	Q(T)		Q(S)			L
Q(P)	++-	Q(O)		Q(A)	+		(K)

ANECDOTAL OBSERVATION WORKSHEET

025	ENGINEERING DESIGN	CARL C. MONROE
STUDENT	COURSE	INSTRUCTOR

DATE	COMMENTS	SYMBOLS
9/6/78	Student is having considerable difficulty in learning how to do mechanical lettering.	Q'(P) Q'(CKH)
9/27/78	Student's drawings are almost child-like in line quality, as well as appearance.	Q'(P) Q'(CKH)
10/3/78	Student likes other people to do things or activities according to the letter of the law.	M
10/10/78	Student enjoys using the sound page.	T(AL) Q(A)

T(VL)	T(AL) +
T(VQ)	Q(AQ)

Q(CEM)	Q(CES)	Q(CET)	A	M +
Q(CH)	Q(CK)	Q(CKH) --	F	D
Q(CP)	Q(CS)	Q(CT)	I	R
Q(V)	Q(T)	Q(S)		L
Q(P) --	Q(O)	Q(A) +		(K)

ANECDOTAL OBSERVATION WORKSHEET

026	ENGINEERING DESIGN	CARL C. MONROE
STUDENT	COURSE	INSTRUCTOR

DATE	COMMENTS	SYMBOLS
9/14/78	Student is argumentative about everything.	Q'(CT) Q(CH) Q'(CEM) Q(CET)
10/4/78	Student does well when confronted with mathematical problems to solve.	(K)
10/23/78	Student was extremely slow in defining a problem to work on when he was given the option of making his own selection.	L
11/6/78	Student has excellent visualization techniques.	Q(V)
11/13/78	Student has volunteered to be a class guide.	Q(CEM) Q(CP) Q(CT) Q(CTM) Q(CH)
11/27/78	Student sometimes stays away from the other students during break.	I

T(VL)	T(AL)
T(VQ)	T(AQ)

Q(CEM) -+	Q(CES)	Q(CET) +	A	M
Q(CH) ++	Q(CK)	Q(CKH)	F	D
Q(CP) +	Q(CS)	Q(CT) -+	I +	R
Q(V) +	Q(T)	Q(S)		L +
Q(P)	Q(O)	Q(A)		(K) +
Q(CTM) +				

ANECDOTAL OBSERVATION WORKSHEET

027	ENGINEERING DESIGN	CARL C. MONROE
STUDENT	COURSE	INSTRUCTOR

DATE	COMMENTS	SYMBOLS
9/4/78	Student has very poor visual abilities. Wonder what he is doing in a drawing class--though it may help improve his visualization.	Q'(V)
10/9/78	Student resists being pinned down to an exact answer as he seems to be looking for other probabilities.	L
11/3/78	Student prefers to work alone rather than with his peers.	I
11/1/78	Student stated that he dislikes reading very much.	T'(VL)
11/29/78	Student likes to help other students with their personal problems.	Q(CEM) Q(CT) Q(CS) Q(CH)

T(VL)	T(AL)
T(VQ)	T(AQ)

Q(CEM) +	Q(CES)	Q(CET)	A	M
Q(CH) +	Q(CK)	Q(CKH)	F	D
Q(CP)	Q(CS) +	Q(CT) +	I +	R
Q(V) -	Q(T)	Q(S)		L +
Q(P)	Q(O)	Q(A)		(K)

ANECDOTAL OBSERVATION WORKSHEET

028	ENGINEERING DESIGN	CARL C. MONROE
STUDENT	COURSE	INSTRUCTOR

DATE	COMMENTS	SYMBOLS
9/13/78	Student enjoys listening to the sound page with the earphones on.	T(AL) Q(A)
9/27/78	Student has very orderly equipment drawer.	R
10/3/78	Student spends too much time with his peers in random discussion.	A Q(CT)
10/18/78	During the showing of a silent film the student was observed sleeping.	T(AL)
11/2/78	Student enjoyed working on a project with another student. He was helpful toward the student and assumed the role of teacher.	A Q(CP) Q(CH)

T(VL)	T(AL) ++
T(VQ)	T(AQ)

Q(CEM)	Q(CES)	Q(CET)	A ++	M
Q(CH) +	Q(CK)	Q(CKH)	F	D
Q(CP +	Q(CS)	Q(CT) +	I	R +
Q(V)	Q(T)	Q(S)		L
Q(P)	Q(O)	Q(A)		(K)

ANECDOTAL OBSERVATION WORKSHEET

029	ENGINEERING DESIGN	CARL C. MONROE
STUDENT	COURSE	INSTRUCTOR

DATE	COMMENTS	SYMBOLS
9/13/78	Student discusses his family a great deal. He has indicated that he is Jewish and they are well known for close family ties.	F
9/27/78	Student had a great deal of trouble in selecting his project for the semester grade.	L
10/3/78	Student always goes on his break with other students rather than alone.	A
10/18/78	Student enjoyed working on a project with another student. He was surprised that they were allowed to work together for credit rather than alone.	A Q(CP) Q(CH)
11/2/78	Student indicated that he disliked to play in competitive sports, but does like to participate in sports.	Q(CKH)

T(VL)	T(AL)
T(VQ)	T(AQ)

Q(CEM)	Q(CES)	Q(CET)	A ++	M
Q(CH) +	Q(CK)	Q(CKH) +	F +	D
Q(CP) +	Q(CS)	Q(CT)	I	R
Q(V)	Q(T)	Q(S)		L +
Q(P)	Q(O)	Q(A)		(K)

ANECDOTAL OBSERVATION WORKSHEET

030	ENGINEERING DESIGN	CARL C. MONROE
STUDENT	COURSE	INSTRUCTOR

DATE	COMMENTS	SYMBOLS
9/31/78	This student does very well on all types of tests.	T(AL) T(AQ) T(VL) T(VQ)
9/21/78	I asked the student what he was studying in his mathematics class. Found out that he is in a course called analysis, which is the toughest math class they have in high school. He is doing well in it and seems to be enjoying mathematics considerably.	(K)
9/27/78	Student has difficulty in making decisions which involve important decisions to himself.	L
10/10/78	Student can work for long periods of time on his projects, and can mix in well with his peers.	I A
11/8/78	Student is always on time to class and is always on time after break. He turns his projects in on time or usually before they are due.	Q(CTM)

T(VL) +	T(AL) +
T(VQ) +	T(AQ) +

Q(CEM)	Q(CES)	Q(CET)	A +	M
Q(CH)	Q(CK)	Q(CKH)	F	D
Q(CP)	Q(CS)	Q(CT)	I +	R
Q(V)	Q(T)	Q(S)		L +
Q(P)	Q(O)	Q(A)		(K)
Q(CTM) +				

ANECDOTAL OBSERVATION WORKSHEET

031	ENGINEERING DESIGN	CARL C. MONROE
STUDENT	COURSE	INSTRUCTOR

DATE	COMMENTS	SYMBOLS
9/15/78	Student says that she prefers things that are opposite one another.	D
9/20/78	Student was sent to obtain a tool from the janitor's workroom. She wanted to take one of her friends along with her just to do this simple errand.	A
10/26/78	Student was assigned a project. When I later checked on her to find out her progress I found that she decided she did not like the assigned project and had decided to work on one of her own choosing.	Q'(CET)
11/21/78	Student showed signs of being very unstable. Would not talk to anyone in the class today. Later on she completely changed 180 degrees and was friendly.	Q(CH) Q'(CS) Q'(CT)

T(VL)	T(AL)
T(VQ)	T(AQ)

Q(CEM)	Q(CES)	Q(CET) -	A +	M
Q(CH) +	Q(CK)	Q(CKH)	F	D +
Q(CP)	Q(CS) -	Q(CT) -	I	R
Q(V)	Q(T)	Q(S)		L
Q(P)	Q(O)	Q(A)		(K)

ANECDOTAL OBSERVATION WORKSHEET

032	ENGINEERING DESIGN	CARL C. MONROE
STUDENT	COURSE	INSTRUCTOR

DATE	COMMENTS	SYMBOLS
9/19/78	Student has been turning extra lettering sheets in.	Q(CET)
9/21/78	Student has always been on time from break and to class in the morning.	Q(CTM)
10/4/78	Student has done well on all types of tests that he has been given.	T(VL) T(AL) T(VQ) T(AQ)
10/19/78	Student came to me today for advice on what type of drawing to do. I decided to let him make up his own mind after we reviewed the alternatives. He had considerable trouble grasping the concept that he was allowed to make up his own mind and decisions.	L Q(CS)
11/13/78	Student seems to enjoy his peers, but he does like to put them down by exerting his superiority.	Q'(CT)

T(VL) +	T(AL) +
T(VQ) +	Q(AQ) +

Q(CEM)	Q(CES)	Q(CET) +	A	M
Q(CH)	Q(CK)	Q(CKH)	F	D
Q(CP)	Q(CS) +	Q(CT) -	I	R
Q(V)	Q(T)	Q(S)		L +
Q(P)	Q(O)	Q(A)		(K)
Q(CTM) +				

ANECDOTAL OBSERVATION WORKSHEET

033	ENGINEERING DESIGN	CARL C. MONROE
STUDENT	COURSE	INSTRUCTOR

DATE	COMMENTS	SYMBOLS
9/13/78	Student compalined about having to do written assignment involving reading.	T'(VL)
9/27/78	Student takes considerable amount of time to make up his mind about any decision he has to make. Could be appraisal mode.	L
10/3/78	Decided to have the student read to me because of further complaining about assignments involving reading. Found that his reading is extremely poor.	T'(VL)
10/18/78	Student sometimes goes to break with his friends and other times he does not want to be bothered with them.	I A'
11/2/78	Student dislikes sports of any kind.	Q'(CKH)

T(VL) --	T(AL)
T(VQ)	T(AQ)

Q(CEM)	Q(CES)	Q(CET)	A -	M
Q(CH)	Q(CK)	Q(CKH) -	F	D
Q(CP)	Q(CS)	Q(CT)	I +	R
Q(V)	Q(T)	Q(S)		L +
Q(P)	Q(O)	Q(A)		(K)

ANECDOTAL OBSERVATION WORKSHEET

034	ENGINEERING DESIGN	CARL C. MONROE
STUDENT	COURSE	INSTRUCTOR

DATE	COMMENTS	SYMBOLS
9/6/78	Student voiced his displeasure over having to do regular lettering sheets and work sheets the same as the rest of the class.	Q'(CET)
10/24/78	Student stated that he likes to use the soundpage. He particularly likes to use the soundpage with earphones.	T(AL)
10/30/78	Student prefers to work in the library by himself when he uses the soundpage.	Q(A) Q(CP) I Q(CS)
11/13/78	Student keeps his equipment drawer in very neat order.	R
11/21/78	Student has shown considerable interest in mechanical artifacts. Is constantly dismembering them, but does have trouble in putting them back together.	R
11/22/78	Student does not like to watch silent movie strips.	T(AL) T(AQ) Q(A) Q(CS)

T(VL)	T(AL) ++			
T(VQ)	T(AQ) +			
Q(CEM)	Q(CES)	Q(CET) -	A	M
Q(CH)	Q(CK)	Q(CKH)	F	D
Q(CP) +	Q(CS) ++	Q(CT)	I +	R ++
Q(V)	Q(T)	Q(S)		L
Q(P)	Q(O)	Q(A) ++		(K)

ANECDOTAL OBSERVATION WORKSHEET

035	ENGINEERING DESIGN	CARL C. MONROE
STUDENT	COURSE	INSTRUCTOR

DATE	COMMENTS	SYMBOLS
10/3/78	Student went out to the parking lot during break (they are not allowed in the parking lot). When I asked the student why he went to the parking lot even though he knows it is off limits, he said that his friends had told him to go with them.	A
10/5/78	Student was assigned a project to do with some other students. Later when I checked on him he was doing something else while the others were doing his job for him.	Q'(CET) Q'(CEM) Q(CH) Q(CS)
10/25/78	Student is usually late to class and late after break.	Q'(CTM)
11/1/78	Student was very upset because I sent to his parents a progress report about his poor performance.	F

T(VL)	T(AL)
T(VQ)	T(AQ)

Q(CEM) -	Q(CES)	Q(CET) -	A +	M
Q(CH) +	Q(CK)	Q(CKH)	F +	D
Q(CP)	Q(CS) +	Q(CT)	I	R
Q(V)	Q(T)	Q(S)		L
Q(P)	Q(O)	Q(A)		(K)
Q(CTM) -				

ANECDOTAL OBSERVATION WORKSHEET

036	ENGINEERING DESIGN	CARL C. MONROE
STUDENT	COURSE	INSTRUCTOR

DATE	COMMENTS	SYMBOLS
9/8/78	Student seems to enjoy "putting on" the male students in the class.	Q(CH) A Q(CK) Q(CP) Q(CS) Q(CT)
9/15/78	The student is very adept at using body language.	Q(CT) Q(CP) Q(CH)
10/3/78	Student maintains a very neat equipment drawer.	R
10/17/78	Student pays close attention to lecturer.	T(AL)

T(VL)	T(AL) +			
T(VQ)	T(AQ)			
Q(CEM)	Q(CES)	Q(CET)	A +	M
Q(CR) ++	Q(CK) +	Q(CKH)	F	D
Q(CP) ++	Q(CS) +	Q(CT) +	I	R +
Q(V)	Q(T)	Q(S)		L
Q(P)	Q(O)	Q(A)		(K)

ANECDOTAL OBSERVATION WORKSHEET

037	ENGINEERING DESIGN	CARL C. MONROE
STUDENT	COURSE	INSTRUCTOR

DATE	COMMENTS	SYMBOLS
9/15/78	Student was assigned task of developing her own project to work on. After a considerable amount of agonizing over the problem, she decided on what the project should be. Progress from this point on was very sure and rapid.	L
10/3/78	Student has shown considerable interest in doing drawings that require considerable difficulty and problem-solving ability.	(K)
10/9/78	The student volunteered to act as class guide.	Q(CEM)
11/3/78	Student does exceptionally well on all types of tests and test situations.	T(AL) T(AQ) T(VL) T(VQ)

T(VL) +	T(AL) +
T(VQ)	T(AQ)

Q(CEM) +	Q(CES)	Q(CET)	A	M
Q(CH)	Q(CK)	Q(CKH)	F	D
Q(CP)	Q(CS)	Q(CT)	I	R
Q(V)	Q(T)	Q(S)		L +
Q(P)	Q(O)	Q(A)		(K) +

ANECDOTAL OBSERVATION WORKSHEET

038	ENGINEERING DESIGN	CARL C. MONROE
STUDENT	COURSE	INSTRUCTOR

DATE	COMMENTS	SYMBOLS
10/3/78	Student resists being pinned down to an exact answer as she seems to be looking for other possibilities.	L
10/25/78	Student prefers to work alone rather than with her peers.	I
11/3/78	Student does not care too much for reading.	T'(VL)
11/15/78	Student is very quiet in class.	I Q(CP) Q(CS)
11/17/78	Student likes to help other students.	Q(CEM) Q(CT) Q(CS) Q(CH)
11/20/78	Student likes to help visitors that come to the class.	Q(CH)

T(VL) -	T(AL)
T(VQ)	T(AQ)

Q(CEM) +	Q(CES)	Q(CET)	A	M
Q(CH) ++	Q(CK)	Q(CKH)	F	D
Q(CP) +	Q(CS) ++	Q(CT) +	I ++	R
Q(V)	Q(T)	Q(S)		L +
Q(P)	Q(O)	Q(A)		(K)

ANECDOTAL OBSERVATION WORKSHEET

039	ENGINEERING DESIGN	CARL C. MONROE
STUDENT	COURSE	INSTRUCTOR

DATE	COMMENTS	SYMBOLS
9/13/78	Student has a very difficult time stay-on his work project--he is not hyper-kinetic but just the opposite and lethargic.	Q'(CTM)
10/3/78	Student was assigned a project. When I checked on him later, he was working on something else. He could not understand why he could not work on what he wished to. He said that what I assigned was not important and unnecessary.	Q'(CET) Q'(CT) A(CS)
11/1/78	Student is constantly late after break and quite late to class. Student also has an excessive amount of absenteeism.	Q'(CTM)
11/3/78	Student is spending too much time talk-ing to other students.	A Q'(CTM)
11/6/78	Student dislikes reading assignments.	T'(VL) T'(VQ) Q'(V)
11/15/78	Student never finishes assignments on time.	Q'(CTM)
11/20/78	Student tries hard to please authority figures. Does not follow through as soon as they are not present.	F

T(VL) -	T(AL)
T(VQ) -	T(AQ)

Q(CEM)	Q(CES)	Q(CET) -	A +	M
Q(CH)	Q(CK)	Q(CKH)	F +	D
Q(CP)	Q(CS) +	Q(CT) -	I	R
Q(V) -	Q(T)	Q(S)		L
Q(P)	Q(O)	Q(A)		(K)
Q(CTM)----				

ANECDOTAL OBSERVATION WORKSHEET

040	ENGINEERING DESIGN	CARL C. MONROE
STUDENT	COURSE	INSTRUCTOR

DATE	COMMENTS	SYMBOLS
9/8/78	Student enjoys kidding around with the instructor. Likes a buddy relationship.	A F
9/15/78	Student has to have verbal instructions repeated many times. He will write it down and bring it back to me to make sure that it is correct.	T(VL) T(VQ) Q(V)
9/9/78	Student has told me today that he is on the wrestling team.	Q(CKH) Q(P)
10/2/78	Student had a problem with another student that ended in a fight. He came to me for understanding and support. May be a problem with Q(CS) and Q(CP).	F
10/26/78	Student was given the option of working from a complex layout or from the real thing; he chose the real part.	Q(T)
11/15/78	Student has had an excellent record of attendance and is always on time after the break period.	Q(CTM)
11/16/78	Student has had a difficult time in making up his mind when given various options to choose from.	L
11/20/78	Student likes to touch people that he is talking to.	Q(T) Q(CP) Q(CS)

T(VL) +	T(AL)
T(VQ) +	T(AQ)

Q(CEM)	Q(CES)	Q(CET)	A +	M
Q(CH)	Q(CK)	Q(CKH) +	F ++	D
Q(CP) +	Q(CS) +	Q(CT)	I	R
Q(V) +	Q(T)	Q(S)		L +
Q(P) +	Q(O)	Q(A)		(K)
Q(T) ++	Q(CTM) +			

APPENDIX B

COGNITIVE STYLE MAPPING

APPENDIX B

COGNITIVE STYLE MAPPING

Classifying the elements of a given set (e.g., Set A) into two categories included in a second set (e.g., Set B) is a process mathematicians call "mapping." The notation usually employed for this process is:

$$A \longrightarrow B \tag{3}$$

The notation in (3) indicates a correspondence between the elements of Set A and those of Set B. In this example, Set A is called the domain of the mapping, and B the range. Mathematical mappings employ only the theoretical symbols of abstract logic or mathematics. Empirical mappings involve persons making judgments on a "makes sense" or "does not make sense" basis to classify elements (e.g., persons, processes, and properties of a social system called "curriculum") into "logical" categories. This type of decision making employs not only theoretical symbolic mediations (e.g., "words" and "numbers") but demands qualitative symbolic aspects of reasoning (e.g., "picturing" the solution of a problem) as well. For example, in order to diagnose (map) the cognitive style "g" of an individual, the "educational scientist" (e.g., teacher) must consider the individual's level of educational development in terms of the elements included in the Sets S, E, and H, respectively. Empirically, the diagnostician ("scientist") must decide which elements in the Sets S, E, and H, respectively, are appropriate for inclusion in the sub-sets s, e, and h that form the individual's cognitive style. This approach demands the classification of the elements of S into two categories: s and s (not s); E into the two categories: e and e (not e); and H into h and h. The process involved here is called "empirical mapping." This type of mapping (diagnosis) *can only be effected by a person* (e.g., educational scientist) classifying the elements involved in a "makes sense," or "does not make sense" basis. If a *mathematical mapping* of these elements were desired, there would need to be a logical and theoretical vehicle (e.g., a formula, or equation) available by which the decision could be derived. In this case, a person is not actually involved in the decision-making process associated with the classification. Under these circumstances, the decision is rendered by performing indicated operations on the logical (mathematical) function used to determine the desired outcome. The point to be made is that the mapping of cognitive styles is mainly *empirical* in nature, and as such, is dependent upon the judgments of persons (diagnosticians) responsible for the process of classifying the elements of symbolic orientations, "cultural determinants," and modalities of inference into Cartesian products that represent the cognitive styles of the individuals under consideration.

The cognitive style of an individual cannot be empirically mapped without considering: (1) the level of educational development of the person, (2) the general symbolic conditions of educational tasks he will be called upon to accomplish, (3) certain antecedents (e.g., family) to his present state of development, and (4) the appropriateness of the elements under consideration for the conditions under which the educational tasks must be completed. The mapping of an individual's style is also affected by the diagnostician's cognitive style. In this context, diagnostic teams have generally been able to produce "styles" of higher predictive and concurrent validity than those "mapped" by the individual diagnostician.

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