DOCUMENT RESUME

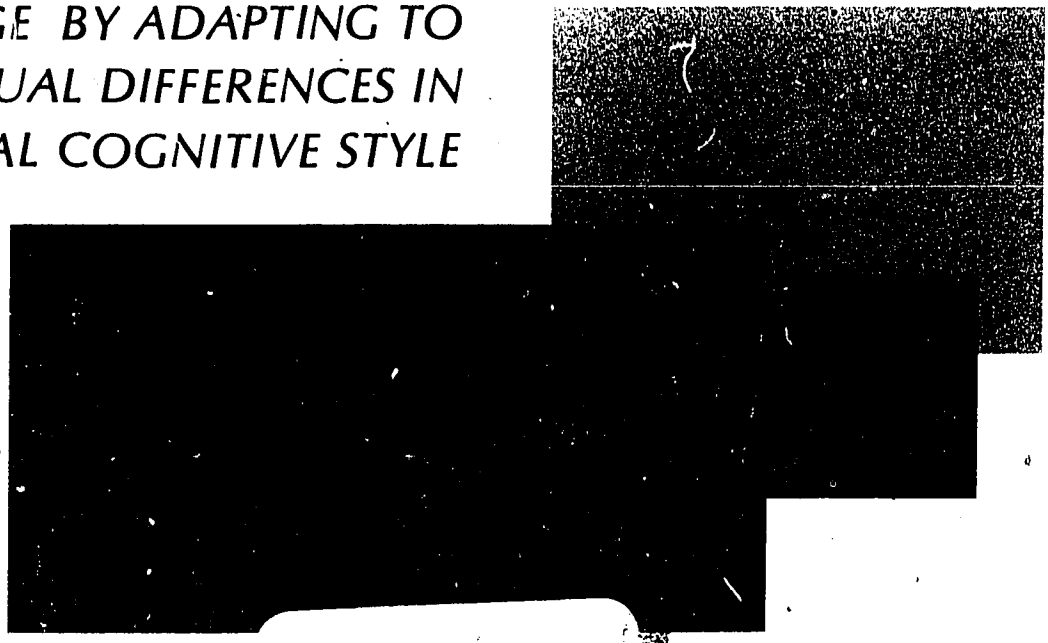
ED 158 699 HE 010 451

TITLE	Promoting Student Learning in College by Adapting to Individual Differences in Educational Cognitive Style. Final Evaluation Report.
INSTITUTION	American Coll. Testing Program, Iowa City, Iowa.
SPONS AGENCY	Fund for the Improvement of Postsecondary Education (DHEW), Washington, D.C.
PUB DATE	Dec 77
NOTE	68p.
AVAILABLE FROM	The American College Testing Program, Iowa City, Iowa
EDRS PRICE	MF-$0.83 HC-$3.50 Plus Postage.
DESCRIPTORS	Cognitive Processes; *Cognitive Style; *College Instruction; Evaluation Methods; Higher Education; *Individual Differences; *Individualized Instruction; Intermode Differences; Learning Characteristics; Learning Modalities; Measurement Instruments; Models; Program Evaluation; *Student Improvement; Tables (Data)
IDENTIFIERS	Macomb County Community College MI; Michigan State University; Oakland Community College MI

ABSTRACT

Two postsecondary institutions in Michigan, Macomb County Community College and Michigan State University, participated in a two-year program that attempted to implement and evaluate a set of procedures developed for measuring and mapping each student's educational cognitive style and using the resulting maps to individualize educational programs to accommodate students' styles. Based on a program developed by Joseph E. Hill of Oakland Community College in Michigan, the project specified four objectives: (1) to develop and test procedures for the measurement of the 32 dimensions of Hill's model of educational cognitive style; (2) to train faculty and staff of the participating institutions to understand the model; (3) to assist these trained faculty members in developing and carrying out plans for implementing cognitive style mapping procedures in making educational decisions in their individual courses; and (4) to plan and carry out systematic evaluations of the effect of the mapping procedures and data on educational outcomes in each setting. The project results did not establish the existence of significant relationships between the use of cognitive style measures and data on educational outcomes. Study results are presented in numerous tables and an appendix contains the reports of the evaluation advisory panel. (JMD)

PROMOTING STUDENT LEARNING IN COLLEGE BY ADAPTING TO INDIVIDUAL DIFFERENCES IN EDUCATIONAL COGNITIVE STYLE



Final Evaluation Report
December 1977

The American College Testing Program

The research reported herein was supported by a grant from the Fund for the Improvement of Postsecondary Education, Department of Health, Education, and Welfare.

TABLE OF CONTENTS

INDEX OF TABLES AND FIGURES

ACKNOWLEDGMENTS

The American College Testing Program project staff wish to acknowledge the special contribution made to this project by the late Dr. Joseph E. Hill, President of Oakland County Community College and originator of the concept of educational cognitive style. As an educator, Dr. Hill was sincerely dedicated to the improvement of educational opportunities of his students. As a scholar, he was determined to advance the frontiers of educational psychology. Both of the qualities were reflected in his enthusiastic participation in and invaluable contribution to this project.

In addition, we wish to express our sincere thanks for the personal commitment of those who participated in a year of training and a second year of experimental implementation of instructional procedures so that this study could be completed. The participants from Macomb County Community College were:

Sylvia Bartolucci, Science Department
Glen Lahti, Humanities Department
Joyce Monte, Student Services
John Orris, Physical Education Department

Those participating from Michigan State University were:

Richard DeSpelder, College of Education
Ralph Kron, University Counseling Center
Peggy Reithmiller, College of Education
Cecil Williams, University Counseling Center.
Irvin Lehmann, Office of Learning and Evaluation Services

We also thank the students enrolled in the courses in which the research was conducted. Their patience and willingness to contribute to the effort were greatly appreciated.

Significant contributions to the project were also made by members of the Oakland Community College faculty and staff. Special thanks are due to James Orr, Derek Nunny, and Betty Setz.

Finally, our sincere appreciation is extended to the members of the project's National Advisory Panel: Robert C. Birney, John E. Roueche, Richard E. Snow, and William F. Taylor.

PROJECT STAFF

Project Codirectors

Dr. Richard J. Stiggins
Director
ACT Test Development Unit

Dr. Richard L. Ferguson
Vice President
ACT Research and Development Division

Special Consultant

Dr. Joseph E. Hill
President
Oakland County Community College

On-site Project Coordinator

Ms. Linda Henderson
Research Associate
ACT Test Development Unit

Coordinator of Instrument Development

Ms. Cynthia B. Schmeiser
Assistant Director
ACT Test Development Unit

Coordinator of Data Analysis

Dr. Barbara Plake
Research Associate
ACT Test Development Unit

Evaluation Advisory Panel

Dr. Robert Birney
Vice President for Academic Affairs
Hampshire College

Dr. John E. Roueche
Professor and Director
Community College Leadership Program
The University of Texas at Austin

Dr. Richard E. Snow
Professor of Education
Stanford University

Dr. William F. Taylor
Dean of Students
Polk Junior College

CHAPTER 1

INTRODUCTION

Overview of the Problem

In the past decade, there has been a marked change in the characteristics of the postsecondary student population. An unprecedented proportion of the total population of high school graduates has sought some form of postsecondary education. Individuals traditionally denied access to higher education, especially those from low socioeconomic backgrounds and members of minority groups, have enrolled in ever-increasing numbers. This increased diversity of the postsecondary student population has been accelerated by the growing number of adults who are returning to school for the additional training or retraining required in a dynamically changing society. As a result of all of these past and present changes, there are substantial variations in the background experiences, personality characteristics, and entering academic and occupational competencies of students enrolling in postsecondary institutions.

In contrast to this great change in student-body characteristics, there have been few significant changes in instructional procedures at most postsecondary institutions. Education is often viewed as a process in which the instructor is the dispenser of knowledge and the student the receptor. Only modest attempts have been made to provide remedial or enrichment experiences for students who are ill equipped to enter the mainstream of the institutions' programs. Little emphasis has been placed on identifying educationally relevant individual differences among students and even less has been placed on adapting the learning environment to accommodate those differences.

Attrition among postsecondary students—a problem that is especially apparent in community colleges—may be a result of the institutions' failure to respond to the increasingly diverse needs of a changing student population. Since a complex technological society demands advanced training for an increasing number of citizens, students' different needs should be analyzed and new teaching techniques designed to provide a reasonable probability of successful accomplishment of educational objectives.

Although some attempts have been made to alleviate the problems arising from the diversity in the capabilities of entering students, these attempts have typically been stopgap in nature. Special recruitment programs and special tutorial and support services, although helpful, have only made superficial attacks on symptoms rather than attempts to address causal factors. Moreover, attempts to provide tutorial assistance in sheltered learning environments for students with academic deficiencies have sometimes been accompanied by a lowering of expectations of performance.

A potential solution to this problem of accommodating individual differences in postsecondary instruction has been developed by Dr. Joseph E. Hill, President, Oakland Community College, Bloomfield Hills, Michigan, and his associates. Hill has suggested an approach to the measurement of student characteristics which is a reflection of the manner in which individual learners derive meaning from their environment. Using measures of achievement, attitude, and interests, Hill maps each student's educational cognitive style. He and others working with him assert that they can match styles of each student with diverse modes of instruction, thus enhancing the educational process. Indeed, over the past several years, they have implemented such procedures at several institutions, including Oakland Community College.

Review of Project Objectives

The overall purpose of this project was to implement Hill's educational cognitive style mapping procedures in institutions other than Oakland Community College so that the effectiveness of such procedures could be systematically and objectively evaluated in terms of educational outcomes. The specific objectives of the project were:

1. to devise, develop, field test, and refine procedures for the measurement of the various dimensions of Hill's model of educational cognitive style;
2. to train faculty and staff in postsecondary educational settings to understand the conceptual framework of educational cognitive style;
3. to assist these trained faculty members in developing and carrying out plans for implementing cognitive style mapping procedures in making educational decisions in their individual settings; and

4. to plan and carry out systematic and objective evaluations of the effect of the cognitive style mapping procedures and data on educational outcomes in each implementation setting.

Project Limitations

There are many diverse conceptualizations of cognitive style that have been developed over the years. This study concentrated totally on *educational* cognitive style as conceptualized by Hill. This conceptualization includes a total of 32 style dimensions in three categories: (1) Symbols and Their Meanings, (2) Cultural Determinants, and (3) Modalities of Inference. Each of these style dimensions or elements is listed in the brief overview of educational cognitive style elements provided in Table 1.1.

Definitions of cognitive style, such as those espoused by Witkin; Kagan, Siegel; and Moss; and others, were not addressed in this project. Therefore, the term cognitive style in this document refers only to the Hill model. In addition, all generalizations and conclusions made apply *only to the Hill model as implemented in this study* and not to other conceptualizations of cognitive style.

TABLE 1.1

Dimensions of the Cognitive Style Map

I. Symbols and Their Meanings

Two types of symbols, theoretical and qualitative, are created and used by individuals to acquire knowledge and derive meaning from their environments and personal experiences. Theoretical symbols present to the awareness of the individual something different from that which the symbols are. Words and numbers are examples of theoretical symbols. Qualitative symbols present and then represent to the individual that which the symbol is. Feelings, commitments, and values are examples of the meanings conveyed by qualitative symbols. Theoretical symbols include:

T(VL)—Theoretical Visual Linguistics—ability to find meaning in written words

T(AL)—Theoretical Auditory Linguistics—ability to acquire meaning through hearing spoken words

T(VQ)—Theoretical Visual Quantitative—ability to acquire meaning in terms of numerical symbols, relationships, and measurements that are written

T(AQ)—Theoretical Auditory Quantitative—ability to acquire meaning in terms of numerical symbols, relationships, and measurements that are spoken

The four qualitative symbols associated with sensory stimuli are:

Q(A)—Qualitative Auditory—ability to perceive meaning through the sense of hearing

Q(O)—Qualitative Olfactory—ability to perceive meaning through the sense of smell

Q(T)--Qualitative Tactile—ability to perceive meaning through the sense of touch, temperature, and pain

Q(V)—Qualitative Visual—ability to perceive meaning through sight

The qualitative symbols that are programmatic in nature are:

Q(PF)—Qualitative Proprioceptive (Fine)—ability to synthesize a number of symbolic mediations into a performance demanding monitoring of a complex task involving small, or fine, musculature (e.g., playing a musical instrument, typewriting)

Q(PG)—Qualitative Proprioceptive (Gross)—ability to synthesize a number of symbolic mediations into a performance demanding monitoring of a complex task involving large, or gross, musculature (e.g., throwing a baseball, skiing)

Q(PKF)—Qualitative Proprioceptive Kinematics (Fine)—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

Q(PKG)--Qualitative Proprioceptive Kinematics (Gross)—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

Q(PTF)—Qualitative Proprioceptive Temporal (Fine)—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

Q(PTG)—Qualitative Proprioceptive Temporal (Gross)—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 are defined as:

Q(CEM)—Qualitative Code Empathetic—sensitivity to the feelings of others

Q(CES)—Qualitative Code Esthetic—ability to enjoy the beauty of an object or an idea

Q(CET)—Qualitative Code Ethic—commitment to a set of values, a group of principles, obligations and/or duties

Q(CH)—Qualitative Code Histrionic—ability to exhibit a deliberate behavior, or play a role to produce some particular effect on other persons

Q(CK)—Qualitative Code Kinesics—ability to understand, and to communicate by, non-linguistic functions such as facial expressions and motions of the body (e.g., smiles and gestures)

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

Q(CP)—Qualitative Code Proxemics—ability to judge the physical and social distance that the other person would permit, between oneself and that other person

Q(CS)—Qualitative Code Syrnoetics—personal knowledge of oneself

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

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

II. Cultural Determinants

There are three cultural determinants of the meaning of symbols:

I—Individuality—uses one's own interpretation as an influence on meanings of symbols

A—Associates—symbolic meanings are influenced by one's peer group

F—Family—influence of members of the family, or a few close personal friends, on the meanings of symbols

III. Modalities of Inference

The third set of cognitive style data includes elements that indicate the individual's modality of inference, i.e., the form of inference used:

M—Magnitude—a form of categorical reasoning that utilizes norms or categorical classifications as the basis for accepting or rejecting an advanced hypothesis

D—Difference—a tendency to reason in terms of one-to-one contrasts or comparisons of selected characteristics of measurements

R—Relationship—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

L—Appraisal—the modality of inference employed by an individual who uses all three of the modalities noted above (M, D, and R), giving equal weight to each in the reasoning process

Review of the Project Activities

Project activities spanned two years. During the first year, measurement procedures were developed, faculty were trained, implementation plans were developed, and evaluation procedures for the implementation were designed. During the second year, the implementation plans were carried out and evaluation data were gathered, analyzed, and interpreted.

In developing procedures for measuring educational cognitive style for this project, the initial step was to assemble a battery of measures parallel to those used at Oakland Community College. To do this, Hill and selected members of the Oakland Community College staff reviewed existing assessment instruments at ACT and selected portions of those instruments that could provide the most efficient measures of the various educational cognitive style elements. ACT instruments were used whenever possible because they are both nationally normed and nationally used. In instances where existing ACT instruments did not provide measures of style elements, alternative instruments were identified and/or developed. The measurement instruments were selected by Hill and several of his colleagues at Oakland Community College because of their expertise in the technical knowledge required to match some of the complex cognitive style dimensions with measurement instruments. After the individual measures for the various cognitive style elements were assembled into a battery, they were administered on a pilot test basis, analyzed for psychometric properties, and revised to maximize the efficiency, reliability, validity, and objectivity of the assessment.

Year one activities also included the training of participating faculty. The training process began with orientation meetings with faculty at the two participating postsecondary institutions: Macomb County Community College (MCCC) in Mt. Clemens, Michigan, and Michigan State University (MSU) in East Lansing, Michigan. These institutions participated in the project because both offer a full range of postsecondary programs to students who have a wide variety of backgrounds, goals, and aspirations. Evaluation of cognitive style in these contexts would maximize the generalizability of results. In addition, these two institutions were located in relatively close proximity to Oakland Community College (OCC), thus allowing easy access of the project staff and participants to the best available technical knowledge about cognitive style. The training process began with basic instruction on the conceptual framework of educational cognitive style and proceeded through six months of regular monthly, weekly, and individual meetings during which project staff members, Hill, and OCC faculty instructed the participants on the cognitive style mapping procedures. The training culminated with eight participants developing plans for the implementation of the mapping procedures in their own instructional settings. Seven plans were developed, as two participants developed a joint plan.

The implementation plans included provisions for evaluating the effect on educational outcomes of the use of educational cognitive style data and procedures. For each implementation setting, a study was planned to assess the relationship between the mapping of educational cognitive styles and student learning and attitudes. Procedures were also developed for the systematic assessment of the effect of implementation on the procedures and attitudes of participating faculty members.

At the onset of year two (i.e., during the 1976 fall term at MSU and MCCC), participating faculty members put their plans into action. Project staff made periodic observations throughout the term to verify that implementation was carried out according to plan. Six of the seven plans were carried out. For each of these, evaluation data were gathered. These data and other data on teacher reactions and opinions were then analyzed and interpreted.

Evaluation Advisory Panel

Periodically during the planning and completion of project activities, project staff met and consulted with an Evaluation Advisory Panel. This panel of four educators provided formative input throughout the project and, in addition, provided expert judgment on the meaning of the implementation and evaluation data. Panel members were: Dr. Robert Birney, Vice President for Academic Affairs, Hampshire College, Amherst, Massachusetts; Dr. John E. Roueche, Professor and Director, Community College Leadership Program, University of Texas, Austin, Texas; Dr. Richard F. Snow, Professor of Education, Stanford University, Stanford, California; and Dr. William F. Taylor, Dean of Students, Polk Junior College, Winter Haven, Florida. The panel met in formal session with project staff four times during the two-year project. In addition, panel members were consulted on an individual basis at various times throughout the project. Formal Advisory Panel reports were prepared and submitted to FIPSE at the end of each project year. Those reports are included in Appendix A of this report. Finally, panel members made recommendations and provided input for this final report of the project.

Purpose of the Report

The primary purpose of this document is to provide a detailed record of the outcomes of the activities discussed above. A second purpose is to indicate the project staff's preliminary conclusions about the outcomes of the project—especially the potential use of cognitive style mapping procedures for improving postsecondary educational practices—and to summarize the staff's recommendations for continued exploration of educational cognitive style.

Overview of the Report

Each of the next three chapters of the report addresses a specific facet of the project from the perspectives of the project objectives, implementations, results, and recommendations.

Chapter 2 deals with the training phase of the project. It describes the faculty participants, the objectives of training, the instructional strategies used in training the faculty participants, and the training outcomes.

Chapter 3 concerns the development and evaluation of the procedures/instruments used to measure educational cognitive style elements. The development sequence is reviewed, the instruments are described, and the results of a series of psychometric analyses of the instruments are presented. Technical issues associated with the measurement of educational cognitive style are explored.

Chapter 4 addresses the effect of cognitive style mapping on educational outcomes in each of the implementation settings. Each implementation setting is described, as is the evaluation design and the results of that evaluation. General project-wide evaluation data are then presented and discussed.

The fifth and concluding chapter provides a summary and an interpretation of project results. All conclusions are listed, and unresolved issues are reviewed. Finally, recommendations for future research and development are summarized.

CHAPTER 2

PARTICIPANT TRAINING

A key element in the study was the effective use of cognitive mapping procedures by faculty at the two participating institutions. Thus, a training program was planned and conducted to provide faculty with a thorough knowledge of the conceptual framework of cognitive style, the individual style elements, and their uses in educational settings. The purpose of this chapter is to describe the key aspects of this training activity.

Description of Trainees

At the outset of the project, invitations were sent to a limited number of faculty at both MSU and MCCC inviting them to participate in the project. Those interested were encouraged to attend an introductory meeting; about 20 persons did so. During the course of the project, changing responsibilities and conflicting work commitments resulted in the withdrawal of some of these volunteer participants from the project. Of the original group of 20, 8 completed training, 4 each at MCCC and MSU.

The participants from MSU included the Director of the University Counseling Center, the Director of Research for that unit, a faculty member in undergraduate teacher education, and a professor in graduate curriculum and instruction. MCCC participants included a faculty member from the department of natural sciences, a physical education instructor, a humanities instructor, and the director of a program for students with special academic and social needs.

Training Objectives

The overall purpose of the training program was to ensure that the participants understood and could apply the cognitive style elements and the process of cognitive style mapping in the educational context. To accomplish this purpose, seven training objectives were identified. Upon completion of the training, each participant was to:

1. understand the conceptual framework for educational cognitive style mapping;
2. understand the definitions of the cognitive style elements and identify corresponding behavioral patterns in students;
3. understand and interpret the data yielded by administration of the Educational Cognitive Style Test and Inventory;
4. empirically map a subject by using observation and discussion and by adapting the cognitive style data generated by the inventory to accommodate the behaviors the student exhibited in particular situations;
5. diagnose probable mode of understanding (elements of cognitive style crucial for successful completion of a given instructional task);
6. understand his or her own cognitive style;
7. develop strategies for using cognitive style mapping procedures in his or her own educational setting.

Attainment of the first objective was essential to the accomplishment of all of the other objectives. Once the participants were knowledgeable about the conceptual framework for educational cognitive style mapping, they then learned definitions for the individual style elements and how to translate student behaviors into these style elements. This satisfied the second objective. The third objective required participants to acquire the ability to accurately interpret the data resulting from the Educational Cognitive Style Test and Inventory. These data were reported in the form of a computer-generated cognitive style map. The process of literally translating test data into a written map is called *mathematical* mapping.

Cognitive style mapping involves much more than an interpretation of the mathematical map. It also includes the use of information about the student obtained by the teacher through observation and conversation. The combined use of test and observational data in determining cognitive style is referred to as *empirical* mapping. The fourth objective of the training program was to teach participants to map style empirically. Empirical mapping was stressed in the training program as one of the most crucial skills the participants needed to acquire. Although mathematical mapping results in a useful profile of a student, empirical mapping allows the educator or counselor to alter the cognitive style map to reflect a student's preferences or attitudes in a particular context. Consideration of the context within which a map is interpreted (e.g., the particular educational task and setting) is crucial to valid use of the map.

The fifth objective involved training the participants to diagnose the critical elements of cognitive style necessary for a student to successfully complete a *given* instructional task. Once these critical elements of cognitive style are diagnosed, educational materials/methods that match the student's cognitive style can be assigned. Alternatively, the instructor may assign materials/methods which are intended to expand or augment the student's style. The instructor or counselor must continuously monitor the student's progress and coordinate instructional materials/methods with the style the student exhibits in changing educational contexts. Empirical mapping can play a crucial role in this process.

The sixth objective was for the participants to identify and understand their own cognitive styles and the implications of their styles for teaching, counseling, and administrative functions. Each participant took the Educational Cognitive Style Test and Inventory and was then involved in a step-by-step interpretation of the elements contained in the map. This self-knowledge facilitated the participants' understanding of the potential differences between themselves and their students, and of the need for reconciling the differences in planning instruction.

Participants attained the seventh and final objective by developing implementation plans for applying cognitive style mapping procedures in their own educational settings. They formulated plans by integrating formative input from project staff with the knowledge and skills gained through the training process.

Training Strategies

Participant training was coordinated and conducted by a full-time project staff member who had extensive training in and experience with mapping and using educational cognitive style. This experience included planning and participating in workshops on cognitive style throughout the country. Hill also played a major role in the training process by presenting lectures and seminars and by working on a one-to-one basis with trainees.

A variety of instructional methods—including lectures, small group discussions, seminars, simulations, films, and individual meetings—were used to help the participants achieve the seven training objectives. In addition, the participants were given reading materials and take-home assignments. Training sessions were held at each institution to accommodate local scheduling needs. The particular methods used to achieve each of the seven objectives are indicated by Xs in Table 2.1.

TABLE 2.1

Methods Used for Achieving Training Objectives

Training Objective	Lectures	Small Group Discussions/ Seminars	Simulations	Films	Individual Meetings
1. Framework of cognitive styles	X	X		X	X
2. Definitions of elements	X	X	X		X
3. Mathematical mapping	X	X	X		X
4. Empirical mapping	X	X	X		X
5. Diagnosis of instructional tasks	X	X	X		X
6. Understanding of own cognitive style		X	X		X
7. Development of implementation plans	X	X			X

Two of the five instructional methods, small-group discussions/seminars and individual meetings, were used in achieving each of the seven objectives. Lectures were used frequently to accomplish six of the seven objectives. Simulation techniques were used to accomplish five of the objectives. Participants were paired so that each person could empirically map his/her partner. The end result was a partial profile of each participant derived through observation and discussion with that person. Finally, a film was used once during the orientation session. Staff from Oakland Community College who were skilled in the use of educational cognitive style mapping also assisted in the training process.

One of the most difficult training objectives to accomplish was the mastery of the language specific to educational cognitive style. To ease this difficulty, participants were deliberately placed in training situations where they had to use the language. This technique, combined with the use of flash cards and other devices, eventually proved successful.

Evaluation of Training Procedures

Four major evaluation activities were conducted to help determine whether the training procedures were successful. First, at the end of the initial six-month training sequence, the participants received a questionnaire asking them whether they felt comfortable and competent in using information contained in a cognitive style map. Those participants who responded negatively received individualized training during the summer prior to implementation.

A more formal evaluation activity was conducted at the end of the first year. Each participant was given five cognitive style maps to review and was asked to provide written interpretations of the maps. Project staff rated these interpretations on a scale from 1 (low) to 10 (high); the rating yielded a score reflecting the participant's ability to interpret maps. Each participant demonstrated a high level of performance.

The third activity was an evaluation of the degree of competency and understanding demonstrated by participants in the design of their implementation plans. Conceptualizing and designing an implementation plan required a fundamental understanding of the cognitive style process and language. Participants developed seven plans, each of which exhibited the required understanding.

The final evaluation activity occurred at the end of the project. Participants were asked to judge whether they had been adequately trained for effectively implementing the mapping procedures. All participants responded affirmatively.

Conclusions about the Training Procedures

Project staff, consultants, and participants agreed at the beginning of the project that a meaningful and objective evaluation of the effect of cognitive style mapping on students' learning would be possible only if knowledgeable and well-trained instructors implemented the mapping procedures. Consequently, participants completed an extended period of training carefully geared to the accomplishment of specific training objectives. The end result was a group of participants well founded in cognitive style mapping. These educators successfully completed objective assessments of their competence; experts in educational cognitive style attested to their level of competence; and the trainees themselves reported that they were confident of their knowledge of the cognitive style procedures. Thus, the training phase of the project was judged highly successful.

CHAPTER 3

DEVELOPMENT OF COGNITIVE STYLE MEASURES

A principal goal of the project was to develop and refine measures of the various dimensions of educational cognitive style. These measures were to be used in mapping students' cognitive style and in evaluating the impact of the use of cognitive style maps on educational outcomes. This chapter describes the specific objectives, procedures, and results of that effort.

Objectives of the Instrument Development Phase

The primary objective of the instrument development phase of the project was to select existing instruments or to develop new instruments for assessing the 32 cognitive style elements (see Table 1.1, pp. 2-3). A second objective was to administer the instruments to a group of students in order to carry out a comprehensive technical analysis of the efficiency, objectivity, reliability, and validity of the measures.

The paper and pencil instruments themselves constitute but one step in the mapping of cognitive style—that is, the mathematical mapping process. A second step in cognitive style mapping, empirical mapping, is the process of generating a cognitive style map on the basis of subjective assessments of student characteristics resulting from conversations with and direct observations of the student. Due primarily to the complexity of the empirical mapping process, it was not studied in detail in this project. Rather, all the description and technical analyses reported in this chapter address mathematical mapping. Research should be conducted on the empirical mapping process itself, since it is a key element of the mapping process.

Instrument Development Procedures

The two project objectives related to instrument development were achieved by carrying out the following steps:

Step 1. Copies of the measurement instruments available at ACT were provided to the educational cognitive style specialists on the OCC staff, who identified those style elements that could be effectively measured by the instruments. The OCC staff also identified for adaptation OCC-originated instruments that measured style elements that could not be assessed by the ACT instruments. OCC had previously developed/assembled a battery of instruments for measuring the cognitive style elements. The battery had been extensively used in numerous contexts.

Step 1 was carried out early in the first year of the project. OCC staff were uniquely knowledgeable of what constituted appropriate measures for the very complex and highly specialized set of variables that comprise the cognitive style map. Existing ACT instruments included measures consistent with the Hill conceptualization of cognitive style—aptitude measures, preference measures, and attitude measures—and therefore served as the core of the cognitive style measurement instruments.

Step 2. The selected or adapted instruments were assembled into a battery and administered to a group of students (n=135) on a pilot basis at MSU and MCCC for the purpose of analyzing the reliability and efficiency of the measures.

This step, also carried out during the first year of the project, identified any obvious inadequacies in the assessment procedures, so that refinements and adjustments could be made prior to project implementation during year two. In addition, this pilot testing aided in training the participants by giving them experience in administering and interpreting the assessment battery.

Step 3. The revised battery was administered at MSU and MCCC (n=258), and the data were subjected to a comprehensive technical analysis from various perspectives, including efficiency, objectivity, reliability, and intercorrelations among measures.

Step 3, carried out during the second year of the project, documented the psychometric characteristics of the measures related to the elements of the educational cognitive style map. The data were also used to evaluate the congruence between the measures and the various cognitive style elements.

Step 4. Several major components of the cognitive style battery assembled specifically for the project and the original OCC-developed battery were administered simultaneously to a group (n=93) of students at MCCC.

This step also took place during year two. It provided a basis for a systematic evaluation of the concurrent validity of the measures selected or adapted by the OCC staff for the project. The question addressed was whether the project battery assembled by educational cognitive style experts yielded measures of the individual style elements comparable to the OCC measures.

Outcomes of Instrument Development

Instrument Assembly

The first four columns of Table 3.1 and all of Table 3.2 indicate the linkage between the project measures and the individual cognitive style elements. The first line of Table 3.1, for example, indicates that the Language Usage Test of ACT's Career Planning Program was judged appropriate to measure the Theoretical Visual Linguistic (TVL) style dimension.

Results of the Preliminary Technical Analysis

The reliabilities of instruments in the preliminary version of the Project Cognitive Style Test and Inventory are listed in Table 3.1. All instruments (except the Inventory of Preferences used to measure Cultural Determinants—addressed below) yielded appropriately high internal consistency reliability estimates.

The data also show that the initial battery required 156 minutes to administer. In an effort to reduce the amount of testing time, three changes were made in the research battery: (1) the two math tests in the original battery were equated to eliminate redundancy; (2) a different, shorter reading test was adopted; and (3) the mechanical reasoning test was shortened by one-half. The resulting battery required only 109 minutes to administer.

Results of the Final Technical Analysis

The data resulting from administration of the battery in year two of the project were used in a second technical analysis of the instruments. This second analysis included the determination both of internal consistency reliability estimates for the measures and of a matrix showing coefficient correlations between the various measures. The reliability estimates are reported on the right side of Table 3.1. They are all slightly lower than previous estimates, but are within acceptable limits with the exception of the measure of Cultural Determinants.

One obvious reason for the low reliability estimates of the Cultural Determinant scales is the length of the scales. A 10-item instrument with a reliability around .55, if extended to 20 to 40 items, would yield a reliability estimate of .70 to .85, a range comparable to that of other instruments in the battery. Therefore, the instrument was retained and used during the project in spite of the relatively low reliability estimates.

The matrix of intercorrelations is reported in Table 3.3. Several conclusions can be drawn from these data. First, with one notable exception, the various dimensions of style appear to be statistically independent. The exception is the relationship between Theoretical Visual Quantitative (TVQ) and Theoretical Auditory Quantitative (TAQ). The correlation between TVQ and TAQ is .69, which very nearly approximates the reliabilities of the two instruments. This correlation suggests that these supposedly independent style elements cannot be reliably differentiated on the basis of the particular measures provided in the battery. TVL is defined on page 2 as the "ability to find meaning in written words." A high score in this area indicates someone who reads with better than average comprehension. Yet, the correlation between the TVL measure selected by the OCC staff team and the standardized reading test is only .51. Further discussion of this point with specialists in educational cognitive style revealed that, conceptually, TVL includes verbal reasoning and grammar in addition to reading. These additional factors are covered by the language usage test included in the cognitive style battery.

Finally, of the many Inventory of Competency scales in Table 3.2 identified with the various Qualitative Symbol elements, scales said to measure the same style element are uncorrelated. Such an outcome is contrary to expectation, given the traditional definition of construct validity.

Results of the Coadministration of OCC and Project Batteries

To further investigate the validity of the project cognitive style measures, a subset of the OCC-generated and the project cognitive style measures was administered simultaneously to a group of 93 students. The relationships among nine Qualitative Symbol scores, three Cultural Determinant scores, and four Modalities of Inference scores resulting from this coadministration were determined, and are reported in Table 3.4. The median correlation between independent measures of the same element over the 16 elements is .06. The correlations range from −.17 to +.19, revealing a high level of statistical independence.

As a final step in this search for relationships between the OCC and project measures, more intensive analysis was conducted of the relationship between Inventory of Competency scales and OCC measures of selected style elements. The OCC staff members involved reviewed the scales associated with each style element and identified the one scale of those listed that was most similar to the OCC measure of the same style element. The results of that correlational analysis are reported in Table 3.5. Once again,

This step also took place during year two. It provided a basis for a systematic evaluation of the concurrent validity of the measures selected or adapted by the OCC staff for the project. The question addressed was whether the project battery assembled by educational cognitive style experts yielded measures of the individual style elements comparable to the OCC measures.

Outcomes of Instrument Development

Instrument Assembly

The first four columns of Table 3.1 and all of Table 3.2 indicate the linkage between the project measures and the individual cognitive style elements. The first line of Table 3.1, for example, indicates that the Language Usage Test of ACT's Career Planning Program was judged appropriate to measure the Theoretical Visual Linguistic (TVL) style dimension.

Results of the Preliminary Technical Analysis

The reliabilities of instruments in the preliminary version of the Project Cognitive Style Test and Inventory are listed in Table 3.1. All instruments (except the Inventory of Preferences used to measure Cultural Determinants—addressed below) yielded appropriately high internal consistency reliability estimates.

The data also show that the initial battery required 156 minutes to administer. In an effort to reduce the amount of testing time, three changes were made in the research battery: (1) the two math tests in the original battery were equated to eliminate redundancy; (2) a different, shorter reading test was adopted; and (3) the mechanical reasoning test was shortened by one-half. The resulting battery required only 109 minutes to administer.

Results of the Final Technical Analysis

The data resulting from administration of the battery in year two of the project were used in a second technical analysis of the instruments. This second analysis included the determination both of internal consistency reliability estimates for the measures and of a matrix showing coefficient correlations between the various measures. The reliability estimates are reported on the right side of Table 3.1. They are all slightly lower than previous estimates, but are within acceptable limits with the exception of the measure of Cultural Determinants.

One obvious reason for the low reliability estimates of the Cultural Determinant scales is the length of the scales. A 10-item instrument with a reliability around .55, if extended to 20 to 40 items, would yield a reliability estimate of .70 to .85, a range comparable to that of other instruments in the battery. Therefore, the instrument was retained and used during the project in spite of the relatively low reliability estimates.

The matrix of intercorrelations is reported in Table 3.3. Several conclusions can be drawn from these data. First, with one notable exception, the various dimensions of style appear to be statistically independent. The exception is the relationship between Theoretical Visual Quantitative (TVQ) and Theoretical Auditory Quantitative (TAQ). The correlation between TVQ and TAQ is .69, which very nearly approximates the reliabilities of the two instruments. This correlation suggests that these supposedly independent style elements cannot be reliably differentiated on the basis of the particular measures provided in the battery. TVL is defined on page 2 as the "ability to find meaning in written words." A high score in this area indicates someone who reads with better than average comprehension. Yet, the correlation between the TVL measure selected by the OCC staff team and the standardized reading test is only .51. Further discussion of this point with specialists in educational cognitive style revealed that, conceptually, TVL includes verbal reasoning and grammar in addition to reading. These additional factors are covered by the language usage test included in the cognitive style battery.

Finally, of the many Inventory of Competency scales in Table 3.2 identified with the various Qualitative Symbol elements, scales said to measure the same style element are uncorrelated. Such an outcome is contrary to expectation, given the traditional definition of construct validity.

Results of the Coadministration of OCC and Project Batteries

To further investigate the validity of the project cognitive style measures, a subset of the OCC-generated and the project cognitive style measures was administered simultaneously to a group of 93 students. The relationships among nine Qualitative Symbol scores, three Cultural Determinant scores, and four Modalities of Inference scores resulting from this coadministration were determined, and are reported in Table 3.4. The median correlation between independent measures of the same element over the 16 elements is .06. The correlations range from −.17 to +.19, revealing a high level of statistical independence.

As a final step in this search for relationships between the OCC and project measures, more intensive analysis was conducted of the relationship between Inventory of Competency scales and OCC measures of selected style elements. The OCC staff members involved reviewed the scales associated with each style element and identified the one scale of those listed that was most similar to the OCC measure of the same style element. The results of that correlational analysis are reported in Table 3.5. Once again,

This step also took place during year two. It provided a basis for a systematic evaluation of the concurrent validity of the measures selected or adapted by the OCC staff for the project. The question addressed was whether the project battery assembled by educational cognitive style experts yielded measures of the individual style elements comparable to the OCC measures.

Outcomes of Instrument Development

Instrument Assembly

The first four columns of Table 3.1 and all of Table 3.2 indicate the linkage between the project measures and the individual cognitive style elements. The first line of Table 3.1, for example, indicates that the Language Usage Test of ACT's Career Planning Program was judged appropriate to measure the Theoretical Visual Linguistic (TVL) style dimension.

Results of the Preliminary Technical Analysis

The reliabilities of instruments in the preliminary version of the Project Cognitive Style Test and Inventory are listed in Table 3.1. All instruments (except the Inventory of Preferences used to measure Cultural Determinants—addressed below) yielded appropriately high internal consistency reliability estimates.

The data also show that the initial battery required 156 minutes to administer. In an effort to reduce the amount of testing time, three changes were made in the research battery: (1) the two math tests in the original battery were equated to eliminate redundancy; (2) a different, shorter reading test was adopted; and (3) the mechanical reasoning test was shortened by one-half. The resulting battery required only 109 minutes to administer.

Results of the Final Technical Analysis

The data resulting from administration of the battery in year two of the project were used in a second technical analysis of the instruments. This second analysis included the determination both of internal consistency reliability estimates for the measures and of a matrix showing coefficient correlations between the various measures. The reliability estimates are reported on the right side of Table 3.1. They are all slightly lower than previous estimates, but are within acceptable limits with the exception of the measure of Cultural Determinants.

One obvious reason for the low reliability estimates of the Cultural Determinant scales is the length of the scales. A 10-item instrument with a reliability around .55, if extended to 20 to 40 items, would yield a reliability estimate of .70 to .85, a range comparable to that of other instruments in the battery. Therefore, the instrument was retained and used during the project in spite of the relatively low reliability estimates.

The matrix of intercorrelations is reported in Table 3.3. Several conclusions can be drawn from these data. First, with one notable exception, the various dimensions of style appear to be statistically independent. The exception is the relationship between Theoretical Visual Quantitative (TVQ) and Theoretical Auditory Quantitative (TAQ). The correlation between TVQ and TAQ is .69, which very nearly approximates the reliabilities of the two instruments. This correlation suggests that these supposedly independent style elements cannot be reliably differentiated on the basis of the particular measures provided in the battery. TVL is defined on page 2 as the "ability to find meaning in written words." A high score in this area indicates someone who reads with better than average comprehension. Yet, the correlation between the TVL measure selected by the OCC staff team and the standardized reading test is only .51. Further discussion of this point with specialists in educational cognitive style revealed that, conceptually, TVL includes verbal reasoning and grammar in addition to reading. These additional factors are covered by the language usage test included in the cognitive style battery.

Finally, of the many Inventory of Competency scales in Table 3.2 identified with the various Qualitative Symbol elements, scales said to measure the same style element are uncorrelated. Such an outcome is contrary to expectation, given the traditional definition of construct validity.

Results of the Coadministration of OCC and Project Batteries

To further investigate the validity of the project cognitive style measures, a subset of the OCC-generated and the project cognitive style measures was administered simultaneously to a group of 93 students. The relationships among nine Qualitative Symbol scores, three Cultural Determinant scores, and four Modalities of Inference scores resulting from this coadministration were determined, and are reported in Table 3.4. The median correlation between independent measures of the same element over the 16 elements is .06. The correlations range from −.17 to +.19, revealing a high level of statistical independence.

As a final step in this search for relationships between the OCC and project measures, more intensive analysis was conducted of the relationship between Inventory of Competency scales and OCC measures of selected style elements. The OCC staff members involved reviewed the scales associated with each style element and identified the one scale of those listed that was most similar to the OCC measure of the same style element. The results of that correlational analysis are reported in Table 3.5. Once again,

TABLE 3.2

Relationships between Style Elements and Inventory of Competencies

Style Element	Corresponding Competency Scale[a]
Qualitative Symbols	
Auditory	Trade, BD
Olfactory	Trade
Tactile	Trade, Tech, Arts, BD
Visual	Trade, Tech, SC, Arts, SS, BD
Proprioceptive	
Fine	Trade, Tech, SC, Arts, BC, BD
Kinematic Gross	BC
Temporal Gross	Trade, Arts, BC, BD
Proprioceptive	
Gross	Arts, BC
Kinematic	BC
Temporal	BC
Empathetic	SS, BC
Esthetic	Trade, Tech, SC, Arts, SS, BC, BD
Ethic	Trade, Tech, SC, Arts, SS, BC, BD
Histrionic	Trade, Arts, SS, BC, BD
Kinesics	Arts, SS, BC
Kinesthetic	Trade, Tech, SC, Arts, SS, BC, BD
Proxemics	SS, BC
Synnoetics	Trade, Tech, SC, Arts, SS, BC, BD
Transactional	SS, BC
Temporal	Arts, SS, BC, BD
Modalities of Inference	
Magnitude	Trade, Tech, BD
Difference	Arts
Relationship	SS, BC
Appraisal	SC, Mechanical Reasoning Test

[a]BC = Business Contact; BD = Business Detail; SC = Science; SS = Social Service; Tech = Technical.

TABLE 3.3

Intercorrelations among Tests and Subscales Contained in the Project Cognitive Style Test and Inventory Booklet

	TVL	TAQ	TVQ	MR	TAL	Rdg.	Trades	Tech.	Sci.	Arts	SS	BC	BD	I	A	F
TVL	.81	.41	.37	.08	.35	.51	-.23	-.02	.11	.13	.13	.06	.20	.00	.02	.15
TAQ		.80	.69	.39	.46	.55	.01	.22	.10	-.15	.01	.06	.11	-.03	.20	.19
TVQ			.77	.44	.50	.49	.18	.26	.10	-.18	.02	.08	.08	-.11	.18	.19
MR				.79	.37	.25	.53	.50	.21	-.17	-.08	.10	-.10	-.09	.12	.28
TAL					.66	.55	.09	.11	.09	.04	.23	.16	.15	-.09	.11	.11
Rdg.						.81	-.15	-.05	.06	.02	.12	-.04	.16	-.07	.19	.12
Trades							.86	.74	.27	-.17	-.05	.27	-.07	-.07	-.01	.09
Tech.								.83	.46	.00	.06	.28	.03	-.04	-.01	.06
Science									.83	.38	.25	.20	.06	-.08	.01	.05
Arts										.77	.58	.25	.26	.04	-.01	-.08
Social Serv.											.87	.36	.35	-.06	.00	-.03
Bus. Contact												.63	.56	-.04	.06	.05
Bus. Detail													.81	.01	.10	.09
I														.54	.03	.07
A															.51	.46
F																.52

Note: KR_{20} or coef alpha reliabilities are on diagonal.

TABLE 3.4

Results of Coadministration of OCC and Project Cognitive Style Batteries

Style Element	Correlation	OCC		Project	
		$\bar{X}$ Decile	S.D.	$\bar{X}$ Decile	S.D.
Qualitative Symbols					
Empathetic	−.06	6.25	1.90	6.77	2.40
Esthetic	.02	6.09	2.01	8.33	1.26
Ethic	−.05	6.04	2.05	8.32	1.26
Histrionic	.17	5.36	1.82	7.98	1.62
Kinesics	.07	5.17	1.79	7.25	1.89
Kinesthetics	.19	5.30	1.83	8.32	1.26
Proxemics	.13	5.01	1.84	6.77	2.40
Synnoetics	.13	6.44	1.43	8.33	1.26
Transactional	−.05	5.53	1.65	6.77	2.40
Cultural Determinants					
Individual	.06	5.77	1.26	5.23	1.52
Associate	−.17	3.45	0.95	4.51	1.37
Family	.06	3.87	1.16	4.23	1.40
Modalities of Inference					
Magnitude	.05	4.00	1.34	7.83	1.49
Difference	.08	2.98	1.89	5.48	2.13
Relationship	.06	3.41	1.08	6.78	2.40
Appraisal	.03	4.93	1.27	5.84	2.76

TABLE 3.5

Correlations between Deciles on Inventory of Competency Subscales and Decile Value for Selected Qualitative Symbols as Measured by the OCC Cognitive Style Battery

Project Measure	OCC Measure								
	CES	CS	CET	CT	CH	CK	CKH	CEM	CP
TR	−0.12	0.12	−0.14	0.00	−0.22	−0.00	0.01	−0.12	−0.13
TE	−0.13	0.07	−0.05	0.11	0.00	−0.12	0.12	−0.03	−0.02
SC	0.05	0.14	−0.09[a]	0.14	−0.17	0.07	0.07	−0.03	0.02
AR	0.10[a]	0.01	−0.15	0.06	−0.01[a]	0.11[a]	0.26[a]	−0.01	0.01
SS	0.08	0.10[a]	−0.00	0.17[a]	0.02	−0.04	0.11	−0.01	0.09
BC	−0.02	0.08	−0.04	−0.05	0.05	0.01	0.07	−0.11[a]	0.06[a]
BD	−0.10	0.11	0.05	−0.00	0.13	−0.06	0.04	−0.04	0.17

[a]Indicates the best possible match between the OCC measure and competency scale according to educational cognitive style specialists.

a universal lack of relationship between project measures and OCC measures was revealed. Even those measures which were a good match conceptually proved statistically unrelated. Clearly the OCC measures and the project measures selected by OCC staff were not tapping the same student characteristics.

Summary of Instrument Development

The project objectives regarding instrument development were: (1) to develop measures of the style dimensions and (2) to field test those measures in order to conduct a comprehensive analysis of their psychometric characteristics. Both objectives were achieved. Participating OCC staff assembled a battery of instruments intended to measure the 32 dimensions of style, and that battery was administered and twice analyzed.

These analyses yielded the following conclusions:

1. The battery could be administered in a relatively short period of time (usually less than two hours) and could yield a great deal of data. Therefore, it was efficient.
2. With the exception of the measure of Cultural Determinants, the measures were found to be sufficiently reliable for purposes of the study. The deficiency in the Cultural Determinants measure was considered correctable.
3. High intercorrelations for some of the measures suggested some redundancy in the instruments.
4. Intercorrelations among independent measures of some of the cognitive style dimensions revealed an absence of construct validity among the measures.

The problem of validity as it relates to the ability to interpret the research results is addressed in the introduction to Chapter 4.

CHAPTER 4

THE RELATIONSHIP BETWEEN THE USE OF EDUCATIONAL COGNITIVE STYLE MAPPING AND EDUCATIONAL OUTCOMES

Implementation Goals and Strategies

Another primary goal during the first year of the project was for participants to develop detailed plans for implementing the cognitive style mapping process in their own instructional settings. Each plan contained three parts. First, the overall goal of the implementation was described in terms of a mission statement. Second, the major objectives were described in terms of design criteria. Finally, the procedures to be used in achieving the objectives were described as performance goals. Collectively, these three parts formed a comprehensive description of the implementation procedures to be carried out by each participant during the second year of the project.

Participants formulated their implementation plans over a period of three months. A total of seven plans were developed: four by staff at Macomb County Community College and three by staff at Michigan State University. The primary instructional and evaluation objectives of each setting are outlined in Table 4.1. These objectives were achieved in six of the seven implementation settings. Implementation was not successfully carried out at the MSU Counseling Center, where local conditions made it impossible to complete the plan.

Implementation of plans in the remaining six contexts permitted exploration of the impact of educational cognitive style mapping on approximately 250 students of diverse backgrounds who were striving to achieve a wide range of educational goals. This chapter describes each implementation setting and the evaluation methodology used in each setting to explore impact; it also presents and interprets the results of the evaluation. In addition, following a review of the implementation settings, the results of structured teacher debriefing interviews and student attitude surveys are presented.

Alternative Perspectives on the Interpretation of the Implementation Results

For any study involving an assessment component, the validities of the instruments used are crucial to the interpretation of the results. If the instruments lack validity for the context in which they are used, the meaning of the outcomes of the study as measured by those instruments will be confounded. Therefore, a basic question concerning the instruments used in this study is: What constitutes an appropriate indicator of validity of the cognitive style measure?

The data reported in the previous chapter suggest that the particular instruments assembled for this study lack construct validity, which is a type of validity some researchers feel is essential in a study of this type. However, there are other researchers who view construct validity as secondary. Among those researchers who hold this alternative view, there is a large number who rely heavily on the content and face validity of measurement instruments.

This validity distinction is important in this study because the measures are used only to generate a mathematical map of individuals' cognitive style attributes. Hill's model does not stop with the mathematical map, but rather requires an empirical mapping of cognitive style attributes that combines relevant data from the mathematical map with all other types of data (e.g., the instructor's knowledge of an individual's prior experiences and information generated through direct contact between the instructor and the student). Such an approach relies on the data generated from the cognitive style measures to provide a point of departure, rather than an end point, for determination of an individual's cognitive style.

The cognitive style instruments used in this study were assembled by experts knowledgeable about the meaning of each of the cognitive style elements; these experts were confident that the various instruments provided adequate measures of the cognitive style elements from a content perspective. Therefore, there is strong reason to believe that the measures do have both face and content validity.

The preceding points should be considered by those who would conclude that the results of this study provide definitive evidence on the effect of cognitive style mapping in educational contexts similar to those at MSU and MCCC. No such conclusion can be made solely on the basis of this study by those who would require that the measures must possess construct validity because the evidence collected does not warrant such confidence in the instruments used. However, for those who are satisfied that the instruments possess sufficient content or face validity and that this type of validity is most crucial, the

TABLE 4.1

Summary of Implementations

Implementation Context	Instructional Objective	Evaluation Objective
MCCC Science	Tailor instructional materials to individual student styles	Assess impact of tailored instruction in academic and attitude outcomes compared to traditional instruction
MCCC Humanities	Offer a variety of instructional treatments to students to meet the demands of various students' styles	Assess the importance of match between student style and instructional method in predicting course outcomes
MCCC Special Needs	Provide preenrollment remediation to students with special academic needs using cognitive style oriented instruction	Evaluate the impact of special treatment in postenrollment educational performance compared to previous groups
MCCC Physical Education	Differentiate successful from unsuccessful golfers on the basis of style elements	Assess the reliability of the differentiation
MSU Educational Psychology	None	Evaluate the correlation between student-teacher style match and instructional outcomes
MSU Graduate Curriculum Course	Instruct students assigned to one of two instructional treatments designed to match their style	Assess degree of match between student style and treatment style and compare group performance
MSU Counseling Center	Conduct career/vocational counseling using information on style as a basis for the counseling process	Compare counseling outcomes achieved both with and without information about counselor's style

results offer more substantive evidence on the issues addressed by the study.

The results of this study reflect only the relationships between educational cognitive style as determined in this study (combining both mathematical and empirical mapping as proposed by Hill) and the outcomes resulting from the implementations carried out. Additional research is needed to address issues and questions on the potential in education for other conceptual models of cognitive style.

Implementation in a Science Course

Description

Two science classes (experimental and control) with equal mean course pretest scores were formed at MCCC. Each class was then randomly divided in half. Although all students in each class took the Educational Cognitive Style Test and Inventory, only half the members of each class received map interpretations of their style. The control class was taught using a traditional approach; the experimental class was given prescriptive instruction. Students in the experimental class whose maps were interpreted received prescriptions based on their mathematical cognitive style maps. Students in the remaining half of the class were randomly assigned individual prescriptions for learning.

Evaluation Methodology

Two analyses were performed on the resulting science-related data. First, the average class test performances for the students in the traditional and prescriptive instruction

classes were compared by means of an analysis of covariance procedure that took into account the students' entering ability level. This procedure was also used to investigate the impact of map interpretation and instruction on final average in science class and to study the interactive affect of method of instruction and receipt of map interpretation. Second, the dropout rate for the students in each of the two classes was compared to the average dropout rate, and the dropout rate for the prescriptive class was also compared to the average dropout rate for three traditional science classes taught the same semester by the same instructor.

There were two important limitations in the science evaluation. The instructor may have biased the control treatment by empirically (subjectively) mapping students who should have been randomly assigned a prescription for learning. For some of these students, then, the prescriptions may have been partially based on empirically mapped cognitive styles rather than randomly assigned. Further, those students who received prescriptions based on their cognitive styles were permitted to self-select any other materials they wished. This tainted the experimental condition.

Results

1. Final Average. Table 4.2 summarizes the final grade averages of the two instructional groups involved in the science implementation. The mean grade average for the students in the prescriptive (experimental) class was higher than that for the students in the traditional (control) class. The mean for the students in the prescriptive class who received map interpretation was slightly lower than the mean for students in the same class whose prescriptions were not based on their cognitive style maps. It is not possible to determine at this point whether the improvement in final grade average for the prescriptive class was a function of the experimental nature of the individualized instruction or of the impact of cognitive style map interpretation and instruction, although the former interpretation seems more likely. As further support for this interpretation, the analysis of covariance results shown in Table 4.3 identifies a significant instruction effect, but not a significant interaction effect.

In order to further investigate the implementation and nature of the instruction, a special set of interview ques-

TABLE 4.2

Final Average for Students in the Science, MCCC Class

		Instruction		
		Prescriptive	Traditional	Total
Interpretation	yes	75.4 (n=12)	71.1 (n=12)	73.2
	no	76.5 (n=15)	68.5 (n=10)	72.5
	Total	76.0	69.8	

TABLE 4.3

Summary Table

Analysis of Covariance

Source	df	SS	F	P
Pretest	1	2166.05	18.86	0.0001
Interpretation	1	0.37	0.00	0.9546
Instruction	1	1028.77	8.96	0.0045
Interaction	1	50.78	0.44	0.5096
Error	44	5054.67	---	---

tions was developed for the instructor to answer. The answers suggest that the students who received both map interpretations and prescriptions based on their cognitive styles were free to vary from and augment their prescriptions as they desired. The same was true for the students whose prescriptions were not based on their cognitive style maps. There is some reason to believe that the instructor may have assigned these students prescriptions on the basis of her assessment of their cognitive style, rather than randomly as was called for in the experimental design. Answers to some of the questions in the interview suggest that the students in the prescriptive class were aware of the nature of the experiment and had been advised that they were the group for which large gains in performance were expected.

2. Dropout Rate. Table 4.4 displays the number of students who withdrew from each class before the end of the semester. The analysis of this difference in dropout pattern between the two classes yielded a X^2 value of 5.11, which is significant at the .05 level.

A total of nine students dropped out of the two classes; seven of these were in the traditional class. The two students in the prescriptive class who did not complete the semester both received individualized instructional prescriptions based on their cognitive style maps.

During the fall semester, the instructor taught two science classes in addition to the two classes involved in this experiment. A traditional instructional approach was used in both classes. For the three classes taught using traditional techniques in the fall 1976 semester, the average dropout rate was 30 percent. When the 7.4 percent dropout rate for the prescriptive class is compared to the mean dropout rate for the traditional approach, the difference is statistically significant at the .05 level. It would appear, therefore, that there was a relationship between the method of instruction and the dropout rate of students in the science classes. Furthermore, that relationship, which favors prescriptive instruction, does not appear to be influenced by the way the prescription was determined.

TABLE 4.4

Comparisons of Number of Student Dropouts in Prescriptive and Traditional Classes and Who Did or Did Not Receive Map Interpretation

		Instruction		
		Prescriptive	Traditional	Total
Interpretation	yes	2	1	3
	no	0	6	6
	Total	2	7	9

Interpretation of Results

The impact of the instructional method is apparent in each of the sets of data analyzed. The prescriptive instructional method, whether or not the map was used, provided more positive results in the academic, retention, and attitude outcomes than nonprescription instruction. Students in the prescriptive class achieved an average grade significantly higher than that of the students in the traditional class. However, compared to the random assignment of a prescription for learning, the effect of map interpretation on the academic outcomes, as measured by final course test average, was not substantial. The retention rate was significantly higher for students in the prescriptive class than for students in the three traditional science classes taught by the same teacher the same semester. Within the traditional setting, there was a tendency for those students who received map interpretations to remain in the class throughout the semester.

Implementation in a Humanities Course

Description

The course instructor identified the pertinent cognitive style dimensions for each of three methods of presenting course material—lecture, group discussion, and media—and specified the optimal level of performance for each selected element. The map elements and optimal performance levels for each method were assembled to form the "probable mode of understanding" optimal style for each approach. In addition, a probable mode of understanding that included the common elements of the lecture, group discussion, and media approaches was developed for the entire course. The correlation between student style/mode match and course outcomes was evaluated.

Evaluation Methodology

Student cognitive style maps were generated and compared with the probable mode of understanding (optimal map) for each method and the course as a whole. The match between the actual student map and the optimal or ideal was then used to predict the student's final exam score.

Results

Student-to-Instructional-Method Match. The four instructional methods used to communicate the course material—lecture, group, media, and course—and their optimal decile level are shown in Table 4.5. This table lists the cognitive style elements and the scores on those elements that the student should have achieved to maximize the chances of (1) profiting from the instruction presented and (2) succeeding in the class. Four sets of match scores—one set for each of the probable modes of understanding—were calculated for each student enrolled in a humanities class in fall 1976. Match scores were calculated for the elements in the method's probable mode of understanding map. Since there are 15 elements in the probable mode of understanding map for the lecture method, 15 match scores were calculated for every student in each humanities class. The formula used for the generation of match scores was the one recommended and used by Hill:

$$XM_{ij} = XR_{i/10} \frac{1 - |XR_i - XS_{ij}|}{10}$$

where: XM_{ij} = match score for element $_i$ for student $_j$

XR_i = instructional approach (referent) optimal decile level for map element $_i$

XS_{ij} = student $_j$ decile value on map element $_i$

For each instructional method, two stepwise regression procedures were used to predict the same criterion score on the final exam. The first stepwise regression included decile scores on the mode of understanding and the match variables as predictors. In a second analysis, the match variables were used alone as predictor variables. A significance level of .10 was stipulated for each analysis. Tables 4.6 and 4.7 show summaries of the results of the analyses. Included are the regression equations obtained and the percent of variance accounted for by use of the appropriate map deciles concatenated with match scores, and match scores on the appropriate map elements as predictor variables, respectively.

For each of the stepwise regression equations, the percent of variance accounted for by the predictor variables is less than 30. To pursue further the relationship between the predictor variables and the criterion, correlations were calculated and are presented in Tables 4.8 through 4.11 for the lecture, group, media, and course approaches, respectively. These tables indicate that, except for TAL and TVL, the correlations do not appear to be different from zero at the .05 significance level.

TABLE 4.5

Probable Modes of Understanding of Humanities Instructional Methods

(1) Lecture/Discussion

Style element	Percentile
FR T(AL)	80-89
12 T(VL)	70-79
Q(A)	70-79
Q(CKH)	80-89
Q(CES)	70-79
Q'(CT)	60-69
Q'(CET)	60-69
Q'(CEM)	60-69
Q'(CTM)	50-59
Q(CK)	70-79
I	70-79
A'	60-69
M	80-89
D'	60-69
R'	50-59

(2) Group Activities

Style element	Percentile
12 T(AL)	70-79
10 T(VL)	70-79
Q(V)	80-89
Q(CT)	70-79
Q(CES)	70-79
Q(CEM)	70-79
Q(CS)	70-79
Q'(CET)	60-69
Q'(CH)	50-59
Q'(CK)	50-59
Q(CP)	50-59
I	70-79
A	70-79
F'	40-49
M	80-89
D'	60-69

(3) Media (Audio-Visual)

Style element	Percentile
FR T(AL)	70-79
Q(V)	80-89
Q(A)	70-79
Q(CKH)	80-89
Q(CES)	70-79
Q(CET)	70-79
Q(CTM)	70-79
I	80-89
A'	60-69
M	70-79
R	70-79

(4) Course Overall

Style element	Percentile
12 T (AL)	70-79
I	70-79
A	60-69
M	70-79
Q(CES)	70-79
Q(CET)	60-69

TABLE 4.6

Stepwise Regression Equations Obtained by Using Appropriate Map Deciles and Respective Match Scores as Predictors

Instructional Method	R^2	Prediction Equation
Lecture	.28	32.01 + 1.00 (TAL) + 1.48 (TVL) – 14.19 (match TVL) – 8.49 (A)
Group	.29	37.04 + 1.07 (TAL) + 1.59 (TVL) – 16.86 (match TVL) – 26.26 (match F)
Media	.07	32.88 + 1.27 (TAL) – 13.34 (match A)
Course	.16	30.15 + 1.27 (TAL) – 17.46 (match I)

TABLE 4.7

Stepwise Regression Equations Obtained by Using Match Scores on Appropriate Map Elements as Predictors

Instructional Method	R^2	Prediction Equation
Lecture	.21	12.66 + 17.93 (TAL) + 11.49 (TVL) + 10.14 (R)
Group	.18	10.74 + 22.80 (TAL) + 11.50 (TVL) + 9.23 (Q(CP))
Media	.13	18.51 + 20.41 (TAL) + 5.61 (TVL)
Course	.03	34.45 – 25.21 (I) + 6.41 (M)

Interpretation of the Results

Attempts were made to use map deciles concatenated with appropriate match scores or match scores alone to generate a stepwise regression equation for predicting the score on the final examination for any of the instructional methods; these attempts failed. The small percent of variance accounted for by the regression equations is due, at least in part, to the nearly zero correlations between the majority of predictor variables and the criterion final examination score. With the match criteria selected for this research, there was essentially no statistical relationship between the majority of the elements in the maps of the methods of instruction and the final examination score. The language area is the one instance where there does seem to be some relationship between test data and course outcomes. TVL and TAL, which could be interpreted as measures of verbal scholastic aptitude, were found to have a nonzero correlation with humanities course grades.

Implementation in a Special Needs Setting

Description

MCCC offers preenrollment orientation classes for students whose probability of success at college is low. One objective of the orientation program is to build up the students' basic skills in order to improve their chances of success once they enroll. This implementation called for the use of cognitive style information in choosing instructional materials intended to help students develop in their basic skill areas.

TABLE 4.8

Correlations between Predictor Variables and Final Exam Score: Lecture Approach

Map Element	Raw Score Correlation with Criterion	Match Score Correlation with Criterion
TAL	.405[a]	.394[a]
TVL	.388[a]	.249[a]
I	.110	.177
A	−.065	−.146
M	−.046	−.014
D	−.103	.012
R	.008	.071
Q(A)	.008	−.087
Q(CEM)	.008	.070
Q(LES)	−.038	−.049
Q(CET)	−.038	−.063
Q(CK)	−.045	.021
Q(LKH)	−.038	−.042
Q(CT)	.008	.070
Q(CTM)	−.034	−.030

[a]Significantly different from zero at α = .05 level.

TABLE 4.9

Correlations between Predictor Variables and Final Exam Score: Group Approach

Map Element	Raw Score Correlation with Criterion	Match Score Correlation with Criterion
TAL	.405[a]	.352[a]
TVL	.388[a]	.249[a]
I	.110	.177
A	−.065	−.065
F	−.041	.007
M	−.046	−.014
D	−.103	.012
Q(V)	−.026	−.050
Q(CEM)	.008	.053
Q(CES)	−.038	−.049
Q(CET)	−.038	−.063
Q(CA)	−.095	.012
Q(CK)	−.045	.005
Q(CP)	.008	.071
Q(CT)	−.039	−.049
Q(CTM)	.008	.053

[a]Significantly different from zero at α = .05 level.

TABLE 4.10

Correlations between Predictor Variables and Final Exam Score: Media Approach

Map Element	Raw Score Correlation with Criterion	Match Score Correlation with Criterion
TAL	.405[a]	.352[a]
I	.110	.177
A	−.065	−.147
M	−.046	−.010
R	.008	.053
Q(A)	.008	−.087
Q(V)	−.026	−.050
Q(CES)	−.038	−.050
Q(CET)	−.038	−.050
Q(CKH)	−.038	−.042
Q(CTM)	−.038	−.079

[a]Significantly different from zero at α = .05 level.

TABLE 4.11

Correlations between Predictor Variables and Final Exam Score: Course Approach

Map Element	Raw Score Correlation with Criterion	Match Score Correlation with Criterion
TAL	.405[a]	.005
I	.110	−.158
A	−.065	−.035
M	−.046	.095
Q(CES)	−.038	.044
Q(CET)	−.038	.044

[a]Significantly different from zero at α = .05 level.

Evaluation Methodology

Two data sets were examined in order to ascertain the impact of incorporating cognitive style information in the orientation program of special needs students at MCCC. First, the academic progress of the 31 students in the 1976 orientation class—students for whom cognitive style data were collected—was compared with the progress of the 66 students in the 1975 orientation class—students for whom cognitive style data were not collected. Second, since 10 of the 31 members of the orientation class were retested on the Educational Cognitive Style Test and Inventory after the orientation program was completed, growth on the basic skill map elements was evaluated.

There were two limitations in this evaluation. First, the year when instruction was received was totally confounded with the treatment condition, since control and experimental treatments occurred in different years. Second, only one-third of the experimental group participated in the retest to assess growth in basic skills. Therefore, the results may not be representative of the entire group.

Results

1. Academic Progress. A comparison was made of the indices of academic progress for the 1975 (control) and 1976 (experimental) orientation groups. The indices included percent completing orientation, percent of those completing orientation who enrolled for credit, average number of credits attempted, average proportion of credits completed, and mean grade point average. The results of those comparisons are presented in Table 4.12.

The results suggest that, although the sizes of the two groups differed greatly, the proportion of students in each group completing the orientation program was constant. The principal difference between the groups was in the proportion of those completing orientation who actually enrolled for college credit. A higher proportion of 1976 students (experimental) enrolled. However, although they enrolled for a slightly larger number of credits on the average, they tended to complete a slightly smaller proportion of those credits and achieved slightly lower grades.

A probable outcome of the incorporation of cognitive style information in the orientation program of the special needs students, therefore, may have been an increase in the numbers of special needs students who enrolled in academic courses at MCCC. Since these students, on the average, had a lower grade point average than the 1975 students, the use of cognitive style information during orientation may have given more confidence to the less able students and motivated them to proceed into course work. An interesting follow-up study would involve determining whether these students who were less successful than their 1975 counterparts actually have pursued their academic programs into subsequent terms. Such data are not presently available.

2. Growth in Cognitive Style Elements from September to December 1976. Of the 32 students in the orientation class, 10 retested in December 1976. The small sample size for the retesting was a function of scheduling problems and student availability. As was noted above, this small voluntary sample may not be representative of the entire group.

Table 4.13 shows the mean decile ranking for the two groups for each of the 32 map elements. Although, on the whole, the mean for the group tested in December was higher than the mean for the group tested in September, the question of growth is confounded by the select nature of the December cohort. To examine the issue of growth more fully, the five basic skill map elements of most importance to this setting (TAL, TAQ, TVL, TVQ, and Reading Level) were compared for each of the 10 students retested to assess the change in scores between September and December. The results of this analysis are presented in Table 4.14. Grade level norms are reported for the Theoretical Symbols and Reading Level. An increase from September to December testing was defined as a change in grade level score of one year or more (about two standard errors of measurement). A decline was defined as a decrease in performance reflected by a one year or more drop in grade level score. All other changes in scores were reported as no change. Of the 50 possible score increases, 10 actually occurred. Theoretical symbols TVL and TVQ,

TABLE 4.12

Comparison of Special Needs Students' Academic Progress for 1975 and 1976 Classes

	1975	1976
Number scheduled to begin orientation	66	31
Number completing orientation	56 (85%)	25 (81%)
Number of those completing orientation who enrolled for credits	39 (70%)	23 (92%)
Mean number of credits attempted	11.2	11.5
Mean proportion of credits completed	63.0	60.9
Mean GPA	2.09	1.94

and Reading Level were the map elements indicating growth for some students. Ten percent of the scores showed decline in performance from September to December; TAL and TVL were the map elements on which some decline was noted. Seventy percent of the scores from the two testing experiences differed by less than one grade level. Since no data were available on the normal growth experienced by the special needs students after the orientation program, no determination could be made of the extent to which the cognitive style implementation impacted growth.

TABLE 4.13

Comparison of Map Results for Original Group of Students and a Subset of Those Students Who Were Available for Retesting in December 1976

Map Element	Mean Decile	
	September (n = 32)	December (n = 10)
TAL	4.5	4.5
TAQ	2.8	3.6
TVL	4.6	3.1
TVQ	3.9	5.0
Q(A)	7.1	7.7
Q(O)	6.5	7.1
Q(T)	7.5	8.5
Q(V)	7.6	8.5
Q(CEM)	6.1	6.2
Q(CES)	7.8	8.6
Q(CET)	7.8	8.6
Q(CH)	7.7	8.3
Q(CK)	6.7	7.5
Q(CKH)	7.8	8.6
Q(CP)	6.1	6.2
Q(CS)	7.8	8.6
Q(CT)	6.1	6.2
Q(PF)	7.8	8.6
Q(PKF)	5.2	5.2
Q(PTF)	7.7	8.3
Q(PG)	6.5	7.5
Q(PKG)	5.2	5.2
Q(PTG)	5.2	5.2
Q(CTM)	7.0	7.6
I	5.1	5.6
A	4.5	4.8
F	4.5	3.8
L	4.1	5.1
M	7.3	8.3
D	5.0	5.8
R	6.1	6.2

Interpretation of Results

More students from the 1976 orientation class completed courses than did students from the 1975 class, but the 1976 group's grade point average was lower than that for the 1975 cohort. The fact that more of the less able students were motivated to complete courses may be viewed as evidence of an impact of the use of cognitive style information in the orientation. The results of an investigation into the amount of growth from September to December in the 1976 class were confounded by the lack of data on the typical amount of growth experienced by the special needs students. For the Theoretical Symbols and Reading Level, 70 percent of the students retested in December did not appear to change in their relative abilities, 10 percent showed score declines, and 20 percent showed score increases. Since only a small, voluntary sample was available for the retest and attitude data collection, generalizations beyond these subjects are not justified.

Implementation in a Physical Education Setting

Description

Using videotape recordings, golf students were evaluated on a set of criteria for their golf swings. On the basis of these data, two groups were formed: successful and unsuccessful. Cognitive style maps for the students in these groups were used to generate maps characterizing successful and unsuccessful students.

TABLE 4.14

Growth in Theoretical Map Elements and Reading Level between September and December 1976 Testing

Map Element	Growth		
	Decline	No Change	Increase
TAL	2	8	0
TAQ	0	10	0
TVL	3	2	5
TVQ	0	7	3
Reading Level	0	8	2
Total	5	35	10

Evaluation Methodology

The physical education implementation afforded an opportunity to investigate techniques for developing maps that could be used to collectively describe or portray the cognitive style characteristics of a group. Three methods for determining group maps were compared. Also, a stepwise regression procedure was used to generate a prediction equation on half of the students and to cross-validate on the other half. The overall intent was to try to identify procedures that would reliably differentiate cognitive style among groups of students.

Results

On the basis of the frequency distribution of criterion scores from two sections of golf students, two groups at extreme ends of the golf swing ability scale were selected to form the successful and unsuccessful groups. Table 4.15 displays the distribution of criterion scores and the scores of the students in the two groups.

Three methods of forming group maps were investigated. The first was the method used most frequently in the work of Hill, his associates, and his students. According to this method of analyzing group cognitive style, if 70 percent of the members of the group indicated a decile ranking on a particular map element of 70 or higher, the element entered the group map at a "major" level. If 70 percent of the group showed a decile ranking on a particular map element of 30 or higher, the element became a member of the group map at the "minor" level. Each of the 32 elements of the map was considered one at a time, and its membership in the collective map for the group was determined. Table 4.16 shows the maps which describe successful and unsuccessful groups of student determined by this method.

The second method for determining group maps was the averages method. According to this method, the group average decile ranking for each of the 32 map components was used to determine the major or minor status of the elements in the group's collective map. Table 4.17 displays the maps formed for the successful and unsuccessful groups using the averages method.

The third method for determining group maps employed an analysis of variance procedure. The decile rankings for the elements of each of the four map areas—Theoretical Symbols, Qualitative Codes, Cultural Determinants, and Modalities of Inference—were subjected to an ANOVA procedure to determine which elements reliably differentiated groups. Only the Qualitative Codes area provided an F-ratio that was significant at the .0001 level. A Bonferonni follow-up was used to identify the elements that contributed to the group differences for the 21 qualitative code symbols.

Since the 21 qualitative codes are generated from the seven competency scales, an ANOVA procedure comparing the competency scale deciles for the two groups was considered. This procedure provided an F-ratio that was not significant, indicating that the difference for the two groups lay in the translation of the competency scale results into the qualitative codes and not in their performance on the competency scales. A summary of the analysis of variance results is shown in Table 4.18. Table 4.19 contains the results from the Bonferonni follow-up procedures that were used to identify the qualitative codes contributing to the significant F-ratio.

TABLE 4.15

Identification of Criterion Scores of Subjects in Successful and Unsuccessful Groups

Section	Score	
5100	88	
5100	88	
5100	110	**Unsuccessful**
5100	114	
5100	115	
5100	130	
5101	130	
5100	134	
5100	134	
5101	135	
5100	137	
5100	138	
5100	140	
5100	143	
5101	150	
5101	153	
5100	154	
5100	157	
5100	160	
5100	165	
5101	165	
5100	165	
5100	180	
5101	190	
5100	195	
5101	195	
5100	195	**Successful**
5101	196	
5101	210	

A comparison of the collective maps determined by the three methods described above is shown in Table 4.20. Only the 70-percent-of-the-group method was successful in identifying any map elements that would be unique to the maps of the successful or unsuccessful groups.

A stepwise regression was used to determine the predictability of the criterion score by the cognitive style elements. This regression procedure used raw scores on the 16 tests and subscales of the Educational Cognitive Style Test and Inventory as predictors of the criterion score. Seventeen of the 31 students were systematically chosen to represent the range of criterion scores. The regression equation shown below accounted for 90 percent of the variance.

$\hat{y}$ = −6.28 + 5.74 (Listening Comprehension) + 2.94 (Science) = −2.13 (Arts) + 4.98 (Business Contact) − 5.91 (Associates)

Raw scores for the remaining 14 students were then used in the regression equation to predict criterion scores. The Spearman's Rho correlation index for the predicted and actual ranking on the criterion score was 0.3.

Since the averages and ANOVA methods were unsuccessful in determining unique map elements, and the cross-validation of the regression equation yielded unsatisfactory predictability, an investigation was initiated to examine the characteristics of the profiles on the cognitive style elements of the students in the successful and unsuccessful groups. Sample profiles are shown in Figures 4.1 and 4.2 for the map areas Theoretical Symbols and Cultural Determinants. By examining these profiles, it is possible to visualize much within-group variance on the map elements. This large within-group variance contributes to the inability to reliably differentiate among groups with respect to style.

Interpretation of Results

The commonly used and accepted statistical decision rules were unable to reliably differentiate between the successful and unsuccessful groups on the basis of these educational cognitive style data. The 70-percent-of-the-group rule was the only one that was able to identify unique elements and differentiate the groups. The extent to which these groups are in fact psychologically or educationally different from one another—as educational cognitive style specialists suspect they are—is a matter deserving further investigation.

TABLE 4.16

Unsuccessful and Successful Collective Maps Determined by the 70-Percent-of-the-Group Method

Unsuccessful Map						
TAL′	Q(T)	Q(PF)	I′	L′		TE
TAQ′	Q(V)	Q(PTF)	A′	M		SC′
TVL′	Q(CES)	Q(PG)	F′	D′		ARTS′
TVQ′	Q(CET)	Q(CTM)				BD′
	Q(CH)					MECH R′
Successful Map						
TAL′	Q(A)	Q(CKH)	Q(PKF)′	I′	M	TR′
TAQ′	Q(O)′	Q(CP)	Q(PKF)′	A′	L′	TE′
TVL′	Q(T)	Q(CS)	Q(PTG)′	F′	D′	ARTS′
TVQ′	Q(V)	Q(CT)			R	BC′
	Q(CEM)	Q(PF)				BD′
	Q(CES)	Q(PTF)				MECH R′
	Q(CET)	Q(PG)				
	Q(CH)	Q(CTM)				
	Q(CK)					

TABLE 4.17

Unsuccessful and Successful Collective Maps Determined by the Averages Method

Successful					
TAL′	Q(A)	Q(CT)	I′	L′	TR′
TAQ′	Q(O)′	Q(PF)	A′	M	TE
TVL′	Q(T)	Q(PTF)	F′	D′	SC′
TVQ′	Q(V)	Q(PG)		R′	ARTS′
	Q(CEM)	Q(CTM)			SS′
	Q(CES)	Q(PFK)′			BC′
	Q(CET)	Q(PKG)′			BD′
	Q(CH)	Q(PTG)′			MECH R′
	Q(CK)				
	Q(CKH)				
	Q(CP)				
	Q(CS)				
Unsuccessful					
TAL′	Q(T)	Q(A)′	I′	L′	TR′
TAQ′	Q(V)	Q(O)′	A′	M′	TE′
TVL′	Q(CES)	Q(CEM)′	F′	D′	SC′
TVQ′	Q(CET)	Q(CP)′		R′	AR[illegible]′
	Q(CH)	Q(CT)′			S[illegible]
	Q(CK)	Q(PKF)′			[illegible]
	Q(CKH)	Q(PKG)′			[illegible]′
	Q(PF)	Q(PTG)			MECH R′
	Q(PTF)				
	Q(PG)				
	Q(CTM)				

TABLE 4.18

Analysis of Variance Results Successful and Unsuccessful Groups

Map Component	F Value	PR F
Theoretical Symbols	0.25	.6137
Qualitative Codes	17.38	.0001
Affiliation	0.02	.8827
Modalities of Inference	0.62	.4355
Competency Scales	0.40	.5313

TABLE 4.19

Bonferonni Follow-up
Qualitative Codes

		Q(A)	Q(O)	Q(S)	Q(T)	Q(V)	Q(CEM)	Q(CES)	Q(CET)	Q(CH)	Q(CK)	Q(CKH)	Q(CP)	Q(CS)	Q(CT)	Q(PF)	Q(PKF)	Q(PTF)	Q(PG)	Q(PKG)	Q(PTG)	Q(CTM)
Unsuccessful	$\bar{X}$	4.8	4.4	0	7.4	7.4	5.2	7.8	7.8	7.2	7.2	7.8	5.2	7.8	5.2	7.8	5.0	7.2	7.2	5.0	5.0	7.2
	sd	2.6	2.9	--	1.1	1.1	3.9	0.8	0.8	1.5	1.5	0.8	3.9	0.8	3.9	0.8	4.2	1.5	1.5	4.2	4.2	1.5
Successful	$\bar{X}$	7.4	5.2	0	8.2	8.4	7.8	8.6	8.6	8.4	7.8	8.6	7.8	8.6	7.8	8.4	6.2	8.4	7.6	6.2	6.2	8.4
	sd	1.5	1.1	--	0.4	0.5	1.3	0.5	0.5	0.9	1.3	0.5	1.3	0.5	1.3	0.5	3.1	0.5	1.1	3.1	3.1	0.8
$\bar{X}_s - \bar{X}_u$		2.6	0.8	0	0.8	1.0	2.6	0.8	0.8	1.2	0.6	0.8	2.6	0.8	2.6	0.6	1.2	1.2	0.4	1.2	1.2	1.2
t value[a]		1.73	0.27	--	0.68	1.71	1.26	1.69	1.69	1.37	.60	1.69	1.26	1.69	1.26	1.27	.46	1.52	.43	.46	.46	.48

[a]Using a Bonferonni technique to control the experiment-wise type I error rate at the .05 level, $.05_{EW}t8 = 4.50$.

TABLE 4.20

Comparison of Results
from 70%-of-the-Group, Averages, and ANOVA Techniques

Collective Map Formation

Technique	Number of Elements in Collective Map		Number of Unique Elements in Collective Map	
	Successful	Unsuccessful	Successful	Unsuccessful
1. 70% of the group	31	19	12[a]	0
2. Averages	31	31	0	0
3. ANOVA	32	32	0	0

Note: Maximum number of map elements = 32.

[a]Six of the map elements present at the "major" level in the Successful collective map were identified as members of the Unsuccessful collective map at the "minor" level.

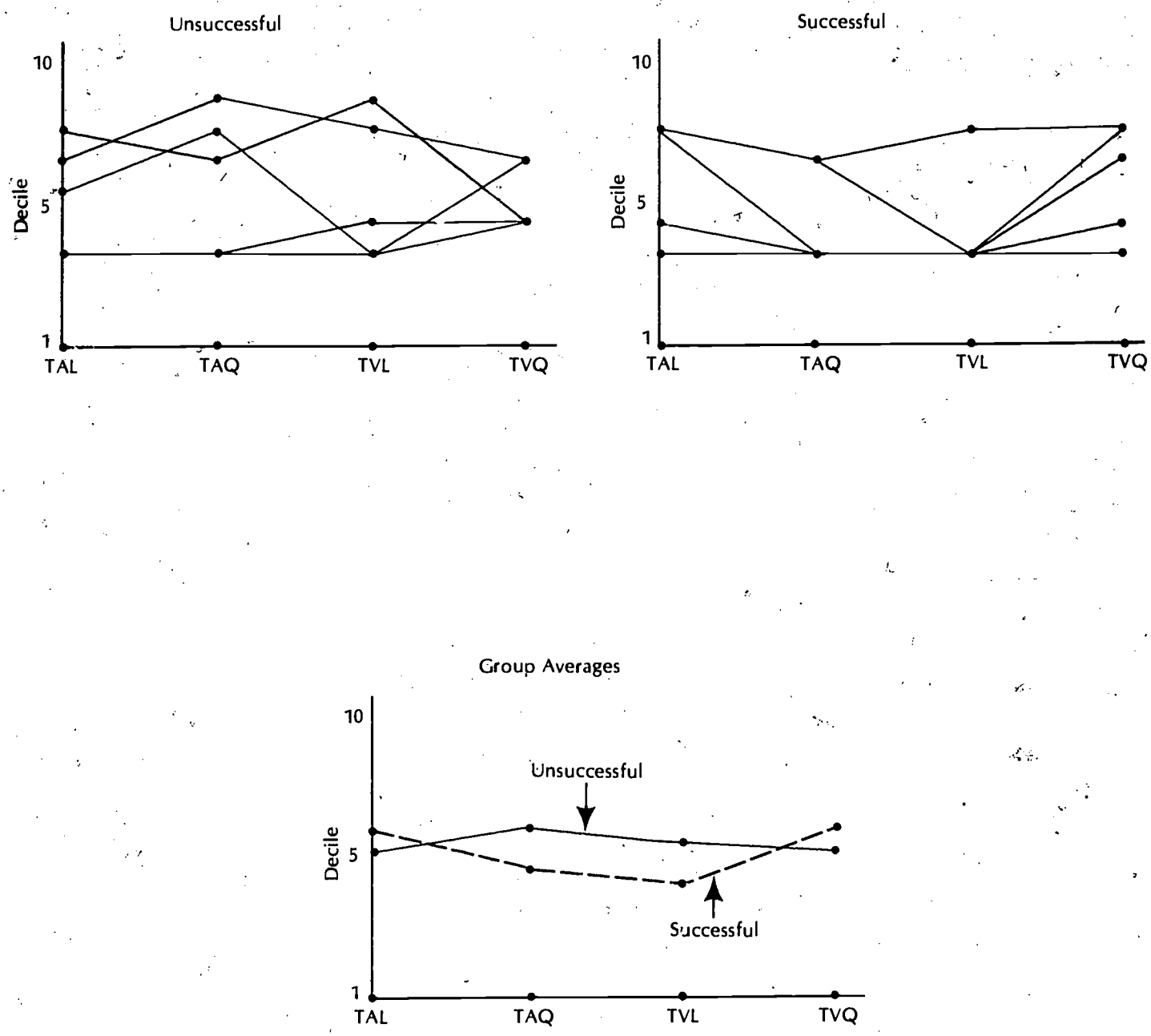
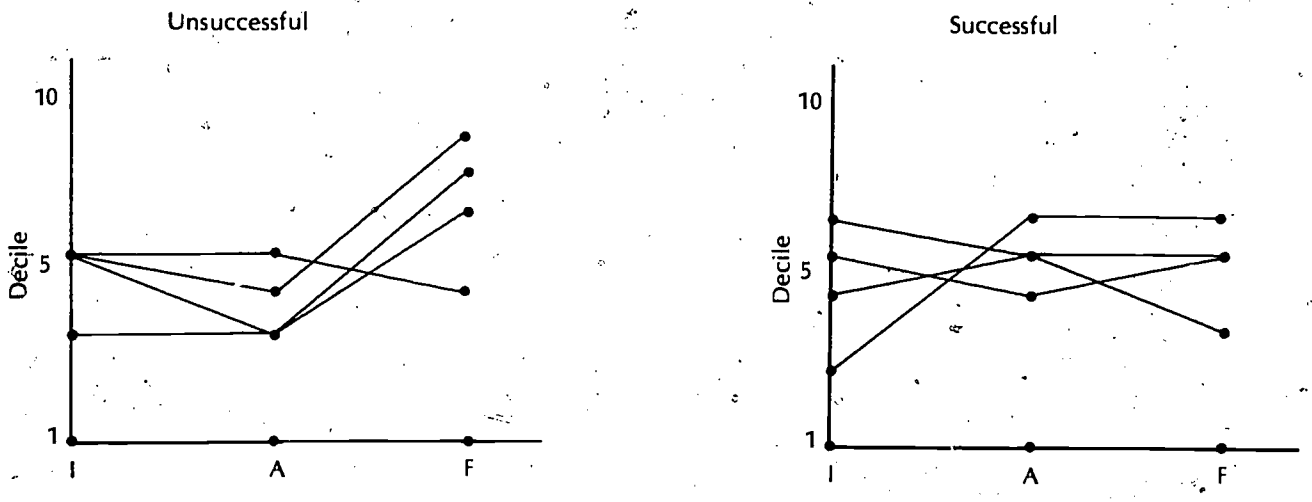


Figure 4.1. Map Profiles, Physical Education—MCCC.



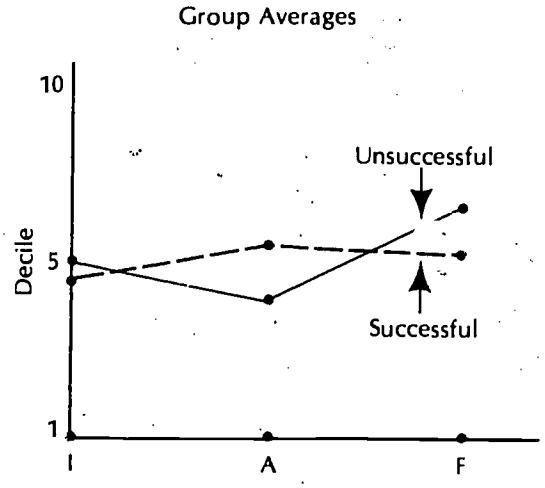


Figure 4.2. Map Profiles, Physical Education—MCCC.

Research in an Educational Psychology Setting

Description

Six interpersonal skills laboratory classes participated in this implementation. For each of the classes, match scores between each student and the lab instructor were calculated on the tests and subscales of the Educational Cognitive Style Test and Inventory. Information derived from the cognitive style battery did not influence instruction in the classes; neither teachers nor students had their maps interpreted until the end of the semester.

Evaluation Methodology

The participants from the MSU School of Teacher Education provided six classes for investigating the relationship between the degree of student/teacher match on cognitive style elements and course outcomes. A behavioral outcome measure and a series of attitudinal measures were considered.

Results

For each of the six classes, raw scores on the 16 tests and subtests of the Educational Cognitive Style Test and Inventory were used to calculate 16 match scores between teacher and student according to the Hill procedure:

$$XM_{ij} = XR_{i/t_i}\left\{\frac{1 - |\, XR_i - XS_{ij}\,|}{t_i}\right\}$$

where:

XM_{ij} = match score on test$_i$ for student$_j$

XR_i = referent (teacher) score on test$_i$

XS_{ij} = student$_j$ score on test$_i$

t_i = maximum score on test$_i$

The students' match scores were then concatenated with their raw scores on the 16 tests and subscales of the Educational Cognitive Style Test and Inventory. The scores were then used as predictor variables for four separate end-of-course criteria:

1. Final score on the course behavioral observation checklist
2. Attitude Instrument Subscale 1: Teacher Evaluation
3. Attitude Instrument Subscale 2: Learning Outcomes
4. Attitude Instrument Subscale 3: Group Participation

The teacher determined a student's final score on the course behavioral observation checklist by rating the student at three levels of mastery on a series of interpersonal skills. The three subscale scores were determined from the end-of-course administration of an attitude instrument designed specifically for the MSU educational psychology course. The students were instructed to rate each of 23 statements on a continuum from one through five ranging from strongly agree to strongly disagree. The items identified as measures of each of the three subscales are listed in Table 4.21; scale reliabilities are also given.

Table 4.22 summarizes the results of the stepwise regression procedures used to predict each of the four criteria using the 32 predictor variables (16 raw scores and 16 match scores). The criterion for the inclusion of variables was set at $\alpha = .10$ for each regression equation. The regression equation for the group participation subscale score criterion accounted for 37 percent of the variance. The two criteria most directly related to teacher and student interaction—the behavioral observation checklist determined by the teacher and the students' evaluation of the TA—yielded regression equations that accounted for 11 and 29 percent of the variance, respectively.

Since the major purpose of this implementation was to determine the relationship between student/instructor cognitive style match and course outcome measures, the four course outcome measures were used as criterion variables in stepwise regression procedures using only the 16 match scores as predictor variables. The results of these regression analyses are shown in Table 4.23. The criterion for variable inclusion was, again set at $\alpha = .10$.

The correlations between the criterion measures and the 32 predictor variables were examined in order to investigate further the lack of success in obtaining regression equations that account for a satisfactory amount of variance. Tables 4.24, 4.25, 4.26, and 4.27 present correlations of the predictor variables with the behavioral observation, evaluation of TA, learning outcomes, and group participation criteria. The magnitudes of the correlations suggest that there is very little relationship between the predictor variables and the criterion. This is especially true for the correlations between match score and criterion.

Interpretation of Results

No relationship was found between the match—as defined in the study—of student and teacher style and any of the four criteria used in the study.

TABLE 4.21

Subscales from Educational Psychology Attitude Instrument

Subscale 1: Evaluation of TA (reliability = .81)

Items

7. I feel that my TA cares about me as a person.
9. My TA does not confront me in the IPL group.
13. My TA is usually on time for the IPL session.
17. I feel very threatened by my TA.
19. My TA usually gives me responsible feedback.
20. In general, I am very satisfied with my IPL group leader.
21. My TA adequately integrates the Ed 200 content (textbook material) with IPL.

Subscale 2: Learning Outcomes (reliability = .67)

Items

2. I am satisfied with my own progress in mastering the IPL skills.
11. My TA presents the Ed 200 "subject matter" in a way I understand.
18. I feel that my TA's confrontation of me is facilitating my growth.
23. I am satisfied with my own level of mastery of the IPL skills.

Subscale 3: Group Participation (reliability = .89)

Items

3. My group leader usually helps me feel comfortable in the group.
4. My TA is helping me feel like sharing myself honestly with this group.
5. I feel that I belong in this group.
8. My TA is helping me feel that I belong in this group.
10. I feel comfortable participating in my group.
15. I know the names of most of the people in my IPL.
16. I usually feel like talking in my group.
22. Most (or all) group members help me to feel good about what is happening in the group.

Implementation in a Graduate Education Course

Description

Two approaches to instruction—Individual/Independent and Peer/Discussion—were designed and implemented for two units in a graduate education course. Referent maps identifying the key map components for the approach were formed for each group. This was accomplished by project staff and the instructor, who evaluated the material and methods to be used in the two approaches and determined the key map elements and

TABLE 4.22

Results of Stepwise Regression Procedures to Predict Behavioral Observation and Attitude Measures Using the 16 Raw Scores Concatenated with 16 Match Scores as Predictor Variables

Criterion	R^2	Predictor Equation
Behavioral Observation	.11	49.11 – 38 (Social Service) + 34.16 (Match Social Science)
Evaluating TA	.28	19.22 + 0.29 (TVL) – 0.20 (TAL) – 0.49 (Science) + 15.64 (Match Science) – 9.75 (Match Arts)
Learning Outcomes	.07	10.84 – .167 (Business Contact)
Group Participation	.37	30.40 + 0.40 (TVQ) – 0.31 (Mechanical Reasoning) – 0.56 (TAL) – 2.56 (Social Service) + 0.13 (Reading Rate) + 14.42 (Match Mechanical Reasoning) – 10.88 (Match Business Detail)

TABLE 4.23

Results of Stepwise Regression Procedures to Predict Behavioral Observation and Attitude Measures Using 16 Match Scores as Predictor Variables

Criterion	R^2	Regression Equation
Behavioral Observation	.08	32.80 + 24.12 (Social Service) + 23.79 (Trades)
Evaluation of TA	.06	24.266 – 6.488 (Listening Comprehension) – 5.744 (Arts)
Learning Outcomes	.13	14.404 + 3.654 (Mechanical Reasoning) – 8.688 (Trades) – 7.423 (Business Detail)
Group Participation	.17	21.310 + 18.285 (Language Usage) + 9.015 (Mechanical Reasoning) – 22.479 (Listening Comprehension) – 12.900 (Business Detail)

their minimum decile value for optimum learning. A set of map elements was determined for each approach; students in the class were divided into two groups by comparing each student's cognitive style map with the referent map of each approach.

Evaluation Methodology

Class members were sorted into two groups so as to maximize students' chances of learning the course material. Assessment of the reliability of this sorting process was part of the evaluation. In addition, two outcome measures—scores on a written theme and scores on a multiple-choice test—were used to compare the performance of the two groups.

Results

1. Learning Outcomes. The primary objective of the implementation plan was to sort the graduate education

TABLE 4.24

Correlations between Predictor Variables and the Behavioral Observation Criterion

	Raw Score Correlation with Criterion	Match Score Correlation with Criterion
Language Usage	.146	.051
Numerical Computation	.185	.128
Mathematics Usage	.119	.038
Mechanical Reasoning	.150	.065
Listening Comprehension	.121	.043
Trades	.035	.240
Technical	.022	.198
Science	.053	.088
Arts	−.045	.050
Social Service	−.073	.287
Business Contact	.009	.206
Business Detail	.113	.150
Individual	.074	−.069
Associates	−.038	.140
Family	−.009	−.153
Reading Rate/ Comprehension	.095	.023

TABLE 4.25

Correlations between Predictor Variables and the Evaluation of TA Criterion

	Raw Score Correlation with Criterion	Match Score Correlation with Criterion
Language Usage	.193	.073
Numerical Computation	.055	.083
Mathematics Usage	.135	−.061
Mechanical Reasoning	−.089	.017
Listening Comprehension	−.174	−.144
Trades	−.114	−.076
Technical	−.086	−.012
Science	−.209	−.007
Arts	−.105	−.187
Social Service	−.045	−.053
Business Contact	−.220	.011
Business Detail	−.104	−.121
Individual	−.051	.007
Associates	.044	.114
Family	−.054	−.045
Reading Rate/ Comprehension	.093	.031

TABLE 4.26

Correlations between Predictor Variables and the Learning Outcomes Criterion

	Raw Score Correlation with Criterion	Match Score Correlation with Criterion
Language Usage	.046	-.021
Numerical Computation	.000	.006
Mathematics Usage	.050	-.093
Mechanical Reasoning	-.055	.117
Listening Comprehension	-.121	-.102
Trades	-.213	-.194
Technical	-.126	-.133
Science	-.092	-.063
Arts	-.056	-.144
Social Service	-.149	-.132
Business Contact	-.274	-.163
Business Detail	-.159	-.244
Individual	-.148	-.045
Associates	.067	.123
Family	.044	-.045
Reading Rate/ Comprehension	.133	.025

TABLE 4.27

Correlations between Predictor Variables and the Group Participation Criterion

	Raw Score Correlation with Criterion	Match Score Correlation with Criterion
Language Usage	.205	.108
Numerical Computation	.178	.122
Mathematics Usage	.239	-.041
Mechanical Reasoning	-.035	.147
Listening Comprehension	-.237	-.209
Trades	-.194	-.162
Technical	-.148	-.149
Science	-.181	-.061
Arts	-.072	-.137
Social Service	-.264	-.193
Business Contact	-.238	-.174
Business Detail	-.176	-.193
Individual	-.189	-.098
Associates	.146	.029
Family	.004	-.003
Reading Rate/ Comprehension	.134	.017

class students into two groups on the basis of the comparison of students' cognitive style maps with two referent maps. The referent maps, labeled the Individual/Independent approach and Peer/Discussion approach maps, are shown in Table 4.28. The eight students whose cognitive style maps matched the Individual/Independent referent map received that individualized instruction. The remaining nine students, whose cognitive style maps matched the Peer/Discussion referent map, were presented material through group discussion.

Two outcome measures—a term paper and a test—were used in the course. Results for these outcome measures are presented in Table 4.29. Students in the Peer/Discussion group performed significantly better on the test than did students in the Individual/Independent group.

2. Reliability of Sorting. Profiles of the students in the two groups were plotted so that an evaluation could be made of the degree of success achieved in using cognitive maps with referent maps to sort students into the two groups. Figure 4.3 shows sample profiles for the Theoretical Symbols map areas. Three separate graphs are displayed: Individual/Independent, Peer/Discussion, and Group Averages. Relevant referent points are indicated on the group averages graph. Examination of these plots makes it possible to determine visually if the two groups differ in their map structures and also to check the degree of match between the referent group map and the average map profiles of the two groups. This was done for all of the elements, although only a sample of these plots is presented.

An analysis of variance procedure was used to identify map elements that were different for the two groups. A summary of the results is presented in Table 4.30. None of the F-ratios reported was significant at the .05 level.

TABLE 4.28

Referent Maps for Individual/Independent and Peer/Discussion Groups

Element	Percentile Required	Element	Percentile Required	Element	Percentile Required
Individual/Independent					
12-FR					
T(VL)	70-79	I	70-79	R	70-79
Q(CS)	70-79	A'	50-59	L	70-79
Q(CET)	80-89			M'	60-69
Q(CTM)	70-79			D'	50-59
Q(CH)	60-69				
Q(CEM)	40-49				
Peer/Discussion					
FR					
T(AL)	80-89	I	70-79	L	70-79
T(VL)	50-59	A	70-79	M	70-79
Q(CET)	70-79	F	40-49	R	60-69
Q(CEM)	60-69			D	50-59
Q(CH)	70-79				
Q(CS)	50-59				
Q(CTM)	70-79				
Q(CT)	70-79				

TABLE 4.29

Outcome Measures for Individual/Independent and Peer/Discussion Groups

		Individual/ Independent	Peer/ Discussion	t value [a]
	n	8	9	
paper	$\bar{x}$	3.56	3.44	0.02
	sd	0.30	0.39	
test	$\bar{x}$	3.31	3.81	
	sd	0.46	0.26	2.50

a $_{.05}t_{15} = 1.75$

$_{.05}t_{14} = 1.76$

TABLE 4.30

Analysis of Variance Results for Map Components of Individual/Independent and Peer/Discussion Groups

Map Component	F Value	PR F
Theoretical Symbols	0.91	.3429
Qualitative Codes	0.10	.7491
Cultural Determinants	0.02	.8868
Modalities of Inference	0.37	.5468
Competency Scales	0.80	.3729

Interpretation of Results

The results suggest there was little success in separating the students into two distinct groups corresponding to the referent maps. This is evidenced by the differences between group profiles and referent profiles, and also by the large within-group variance in style. It is impossible to determine at this time whether another set of referent maps would allow for more success in group sorting. The task is quite complex, since there are many map elements to consider simultaneously in sorting the students into groups having similar profiles.

Inability to differentiate between groups on the basis of style was also seen in the physical education setting; inability to reliably match a desired or optimal style was seen in the humanities setting. These seem to be consistent outcomes.

Summary of Teacher Debriefing Interviews

Results of postimplementation debriefing interviews conducted with each participating teacher, are summarized below. The introductory statements and the questions are presented verbatim and are followed by general responses. The interviews were structured; each participant responded to the same questions.

Project Training. Now that you have participated in this initial implementation of educational cognitive style, we would like you to look retrospectively at the training phase of the project.

Q. Did the training process provide you with the skills and knowledge regarding cognitive style that you needed to implement the procedures properly? Please explain.

A. Without exception, the participants felt they were trained well enough to effectively implement the cognitive style mapping procedures.

Q. What were the most notable positive aspects of training?

A. Most positive aspects of training varied from participant to participant; they included the empirical mapping and simulation exercises, the development of implementation plans, and the commitment to training of OCC staff and project staff.

Q. What revisions or improvements in the training process would you suggest?

A. Participants agreed that training was ~~too~~ fragmented —a more intensive, extended training workshop would have been more helpful. In addition, more map interpretation training sessions were desired.

Implementation. Of course, one important aspect of the project is the wide variety of settings in which cognitive style is being implemented. It is very important therefore that we obtain rather complete descriptions of the actual implementation procedures in each setting.

Q. Would you please describe in some detail the manner in which you used cognitive style information in your instruction? How did this differ from the plan you outlined over the summer?

A. With the exception of the MSU counseling center, all were able to carry out implementations generally as planned, though there were changes within some settings.

Q. How did the instructional procedures resulting from this implementation differ from your normal procedures or procedures you used in previous terms.

Theoretical Symbols

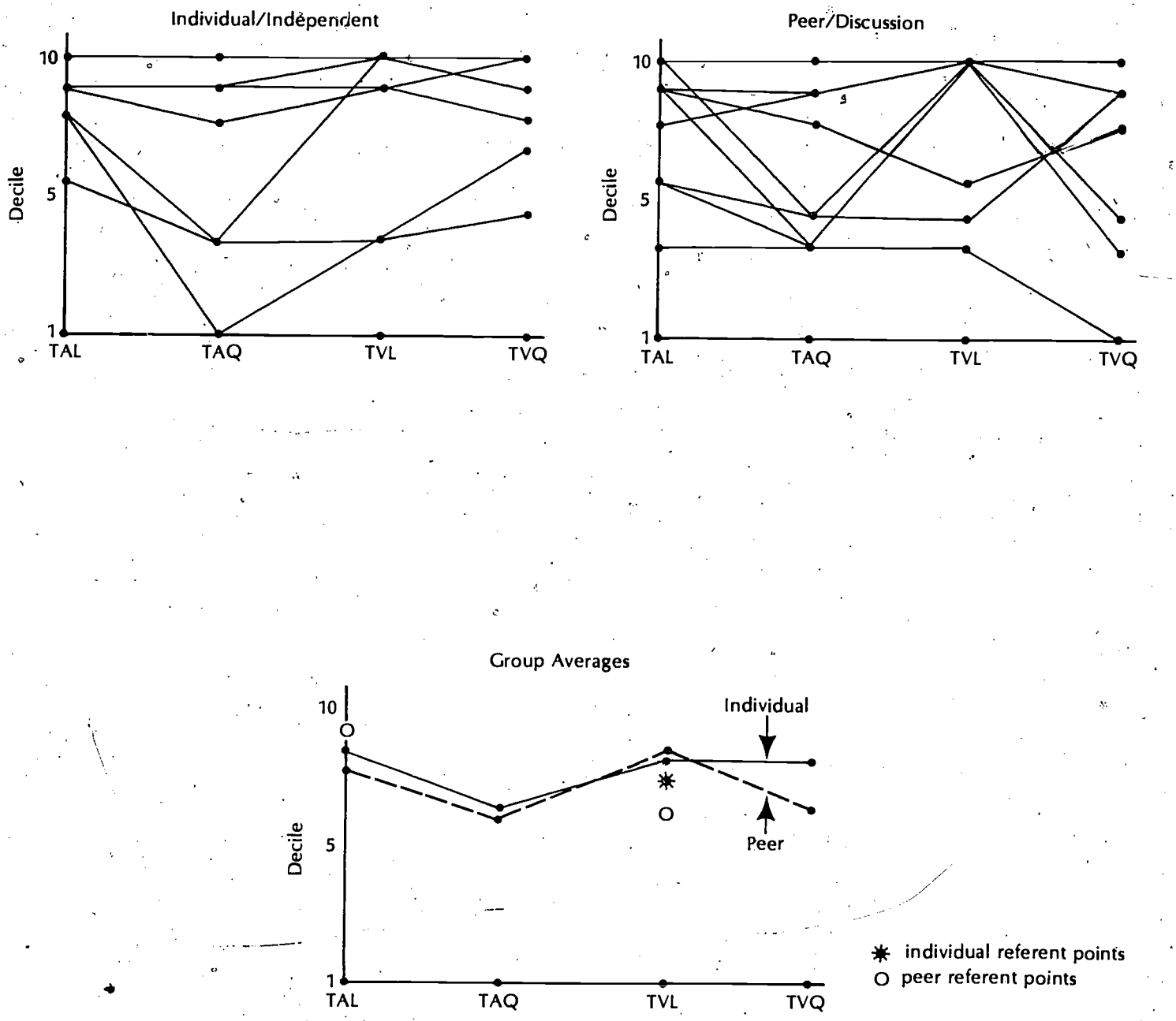


Figure 4.3. Map Profiles, Graduate Curriculum—MSU.

A. In most cases, the major impact of cognitive style mapping was greater precision in the kinds of instructional treatments assigned to students.

Q. If you were to plan another implementation in this same setting, what would you change? Why?

A. Participants generally agreed that they would spend more time with map interpretation.

Q. Have you continued to use the cognitive style mapping procedures this term? Why or why not?

A. Of the seven participants, two had continued into another semester and a third planned to continue. Circumstances prevented others from doing so.

Q. In retrospect, did you have the same confidence in your instructional procedures this term as you have had in previous terms? Why or why not?

A. The participants generally felt greater confidence because they believed they knew student needs better and understood how instructional treatment would be related to those needs.

Anecdotal Information. It is important in debriefing an experience such as this to make a record of special events, situations, or occurrences that seem noteworthy because they lead to some generalization or conclusion about the experience. We would like to note any such anecdotal instances in your implementation of educational cognitive style.

Q. Do any such events stand out in your mind?

A. Three participants mentioned that students seemed to sense an agreement between the maps and their own view of themselves.

Q. As you think about the relationship between your students and the instruction they received, were there any instances where you saw a particularly effective match between style and instruction or a very obvious mismatch? Why do you think this occurred and what resulted?

A. Strong Associates people seemed to work well together. In fact, obvious matches or mismatches reported in all cases involved the Cultural Determinants style dimension.

Q. Were there any special problems that arose? How were they handled?

A. The principal problem that arose was a shortage of time to devote to the project.

Reaction to Measurement Procedures. Another phase of the project that we would like your opinion about is the Cognitive Style Test and Inventory Booklet.

Q. At any time during the project, did you review the various instruments in the battery to see if they seemed to reflect cognitive style elements as you understand them? If so, what were your conclusions?

A. Four participating teachers labeled the auditory math test very anxiety producing; four cited the lack of apparent correspondence between the competency scales and qualitative map elements.

Q. Would you judge the battery to be an effective or ineffective measure of style? Why?

A. The participants thought that although the instrument seemed to lack some face validity, it was an effective measure of cognitive style.

Impact of Style on Students. We would also like your opinion about the impact of the implementation on your students, though we realize the impact data are yet to be analyzed and that you will be speculating.

Q. Briefly and in very general terms, what do you think was the impact of the project on students whose cognitive styles were mapped and whose instruction was influenced by that map?

A. Students tend to gain self-awareness—not just in areas of weakness, but in positive as well as value neutral areas.

Q. Were there any outcomes that you achieved that you had not been able to achieve previously—learning or attitude outcomes?

A. There was a general increase in individualization.

Q. Was there an impact on communication or any other aspect of the interpersonal atmosphere?

A. There was no generalized impact on interpersonal environment.

Q. How familiar did your students become with the actual construct of educational cognitive style and the vocabulary associated with its measurement? If they were instructed, did they understand the nature of the construct? How do you know?

A. There were no in-depth attempts to train students on style. Students generally understood the style concepts whenever they came into contact with them.

Level of Commitment. The next area we would like to explore is your attitude toward or commitment to educational cognitive style mapping as an instructional procedure.

Q. In retrospect, when you began training, what was your commitment?

A. Three participants were totally committed from the start of the project. The other participants were willing researchers who reported being committed to individualization.

Q. After training and before implementation, how would you characterize your commitment?

A. After training, all but one participant reported being committed to the concept.

Q. How would you characterize your current attitude or commitment?

A. All but one reported being highly committed at the time of the interview.

Q. Would you encourage your colleagues to learn about and use cognitive style mapping procedures in their instruction? Why?

A. All but one reported they would encourage colleagues to learn about and use cognitive style.

Impact on Teaching Practice. Finally, we would like to explore with you in some detail the impact of the project on some specific aspects of your instruction.

Q. Do you feel that you know your own cognitive style in most contexts?

A. All participants reported that they knew their own cognitive styles.

Q. Please state briefly how you think your knowledge of your own and your students' cognitive styles impacted each of the following: (If you do not understand any of these, I will explain them.)

1. your course preparation
2. your instructional methods
3. your ability to diagnose student strengths and weaknesses
4. your instructional efficiency
5. your feelings of success
6. your enjoyment of teaching
7. your acceptance of students
8. your understanding of students
9. your expectations of students

A. In all but one setting, participants reported that knowledge of their own and their students' styles impacted various aspects of instructional practice.

Summary of Student Attitude Survey

Students in several of the implementation studies were asked to complete the Student Attitude Survey so that project staff could assess the impact of cognitive style mapping on the attitudes of the student participants. Only students who received interpretations of their maps took the survey. Table 4.31 indicates the contexts in which survey data were obtained.

The student responses are those of individuals with relatively limited exposure to cognitive style mapping and its potential for improving educational programs and processes. Although the students who received map interpretations no doubt grasped much of the meaning of the cognitive style map as it related to them, the short-term nature of their exposure precluded a complete understanding of the full impact of the concept. The following data might be substantially different were the students involved on a continuing basis in an educational environment where cognitive style mapping was an integral part of the educational process.

The results of the survey are presented in Table 4.32. Responses are reported as percents and are broken down for each of the implementation settings in which the Student Attitude Survey was administered. The results for each item were analyzed to determine whether the response pattern for the group of students as a whole differed from a random pattern. All response patterns except that for item 4b proved to be other than random.

TABLE 4.31

Sources of Student Attitude Data

Institution	Number of Students	
Michigan State University	17	
Graduate Curriculum Course		17
Macomb County Community College	108	
Science		21
Humanities		79
Special Needs		8
TOTAL	125	125

Two sets of conditionals were analyzed for each of the personal reaction questions. The first conditional concerned individual map interpretation; the second concerned time during the semester when the map was interpreted. The response patterns were subjected to a χ^2 test to ascertain if either variable influenced students' responses to the personal reaction items.

Results

1. Verification of the Administration and Interpretation. Eighty-two percent of the 125 students indicated that they had gained knowledge of their educational cognitive style during the project. Fifty-six percent of the students indicated that their cognitive style maps had been individually interpreted. This latter figure is deflated by the students in the humanities classes; only 37 percent of these students reported individual interpretations. In each of the other classes, over 75 percent of the students indicated that their maps had been individually interpreted. Ninety-four percent of the students received information about their cognitive style within the first three weeks of the semester.

2. Validation of the Information Provided in the Cognitive Style Map. In every setting except one, less than half the students responded that they felt the map and its interpretation provided an accurate picture of themselves. Nearly as many students answered they were undecided. Fifty-four percent of those students reporting individual interpretation felt the map and its interpretation provided an accurate appraisal of themselves. Of the 55 students indicating they did not receive individual map interpretation, 34 percent viewed the map and its interpretation as valid. Acceptance of the interpretation of the cognitive style map as accurate does appear to be affected by the mode of map interpretation. Forty-three percent of the students reporting early feedback indicated that they felt the map and its interpretation presented an accurate picture of themselves. Of the eight students not reporting early feedback, 57 percent accepted the interpretation of the map as valid. In this case, early feedback did not appear to facilitate acceptance of the map interpretation.

Approximately half the students (51 percent) indicated that the map provided new information about themselves. Of those students reporting individual interpretations, 64 percent responded that the map information was new. Of the remaining students who did not report individual interpretations, 35 considered the information provided by the map to be new. Thus, it appears that the degree of new information gained by the map is a function, in part, of the mode of map interpretation. Comparison of the percent of students reporting early feedback with the percent not reporting early feedback shows that receiving map interpretation within the first three weeks does not appear to increase the number of students who perceive the map interpretations to be new information about themselves.

A large majority of the students (88 percent) felt that their cognitive styles were understood by their instructors. Individual interpretations and early feedback both appear to have a positive effect, which is demonstrated in the number of students reporting this opinion who had either individual (96 percent vs 79 percent) or early (89 percent vs 67 percent) interpretations.

3. Using Cognitive Style Information for Making Educational and Vocational Decisions. Less than half the students (42 percent) felt that the knowledge of their educational cognitive style would help them to make better decisions about their educational plans. This and the other results reported in this section must be interpreted cautiously, however, because the students were given little instruction on style and no instruction on or information about how it might assist them in making educational or vocational decisions. When the students reporting individual interpretations were considered, 46 percent replied that knowledge of their cognitive style would aid them in making better decisions about their educational plans. Thirty-six percent of the students not reporting individual interpretations felt that knowledge of their cognitive style would facilitate their educational planning. So it appears that, although individual interpretation does result in an increased number of students who view educational cognitive style as an aid in making educational decisions, less than half the students expressed this opinion regardless of the mode of map interpretation.

Of the students receiving early map interpretation, 44 percent felt that knowledge of their educational cognitive style would help them make better decisions about educational plans. Of the group not reporting early interpretation, none felt that such knowledge would be helpful. This seems to indicate that the timeliness of map interpretation has a marked effect on attitude toward this topic.

There is a similar pattern in the responses to the question concerning the use of knowledge of educational cognitive style for making better vocational decisions. One-third of the students responded that they felt knowledge of their cognitive style would be useful for this purpose. Very little difference is seen between the percent of students replying "yes" to this question whether students were or were not given individual map interpretations (35 percent and 32 percent, respectively). However, when the temporal factor is addressed, a difference in response tendency is noted. Of those students receiving feedback on their map within the first three weeks of the semester, 34 percent replied that they felt knowledge of their educational cognitive style would be useful in making better vocational decisions. Of those students not reporting early feedback, only 14 percent responded affirmatively to this question.

4. The Effect of Knowledge of Cognitive Style on Learning Outcomes. It is crucial to note here that there were no pre-

TABLE 4.32

Results of Student Attitude Survey

1. Did you gain knowledge of your educational cognitive style during this course?

	All	MSU	MCCC	Science	Humanities	Special Needs
% yes	82	94	80	86	76	100
% no	18	6	21	14	24	0

2. Did you have your cognitive style map individually interpreted by your instructor?

	All	MSU	MCCC	Science	Humanities	Special Needs
% yes	56	76	53	95	37	100
% no	44	24	47	5	63	0

3. Did you receive information about your cognitive style within the first 3 weeks of the semester?

	All	MSU	MCCC	Science	Humanities	Special Needs
% yes	94	100	93	95	92	100
% no	6	0	7	5	8	0

Personal Reactions

1. Do you believe that your educational cognitive style map and its interpretation presented an accurate picture of yourself?

	All	MSU	MCCC	Science	Humanities	Special Needs
% yes	45	44	45	48	38	100
% undecided	41	37	41	33	47	0
% no	15	19	14	19	14	0

Conditionals	1 individual interpret.			2 1st 3 weeks		
	Yes	No		Yes	No	
% yes	54	34	$*\chi^2 = 6.7$	43	57	$\chi^2 = 3.4$
% undecided	32	53		42	29	
% no	13	13		15	14	

2. Did the map provide you with information about yourself that you did not have before?

	All	MSU	MCCC	Science	Humanities	Special Needs
% yes	51	47	52	52	48	88
% undecided	20	13	21	24	22	0
% no	30	40	27	24	30	12

$*\chi^2$ value is significant at $\alpha = .05$ level

Conditionals	1 individual interpret.			2 1st 3 weeks		
	Yes	No		Yes	No	
% yes	64	35	*χ^2 = 11.1	54	71	χ^2 = 2.4
% undecided	12	29		21	0	
% no	24	36		25	29	

3. Do you feel your instructor understood your educational cognitive style?

	All	MSU	MCCC	Science	Humanities	Special Needs
% yes	88	88	88	95	84	100
% no	12	12	12	5	16	0

Conditionals	1 individual interpret.			2 1st 3 weeks		
	Yes	No		Yes	No	
% yes	96	79	*χ^2 = 7.8	89	67	*χ^2 = 7.3
% no	4	21		11	33	

4. Do you believe that knowledge of your educational cognitive style will help you to make better decisions about your:

a) educational plans?

	All	MSU	MCCC	Science	Humanities	Special Needs
% yes	42	29	44	40	40	88
% undecided	28	29	28	35	27	12
% no	30	41	29	25	33	0

Conditionals	1 individual interpret.			2 1st 3 weeks		
	Yes	No		Yes	No	
% yes	46	36	χ^2 = 3.8	44	0	*χ^2 = 8.5
% undecided	30	24		26	67	
% no	24	40		29	33	

b) vocational plans?

	All	MSU	MCCC	Science	Humanities	Special Needs
% yes	33	18	36	30	32	65
% undecided	30	24	32	35	32	35
% no	36	59	33	35	37	0

*χ^2 value is significant at α = .05 level

(continued)

TABLE 4.32 *(continued)*

Conditionals	1 individual interpret.			2 1st 3 weeks		
	Yes	No		Yes	No	
% yes	35	32		34	14	
% undecided	33	26	$\chi^2 = 1.3$	31	43	$\chi^2 = 0.3$
% no	32	42		35	43	

5. Is it your opinion that knowledge of your educational cognitive style in this course probably helped you to:

a) learn course material faster than you usually do?

	All	MSU	MCCC	Science	Humanities	Special Needs
% yes	16	12	17	0	18	57
% undecided	34	35	34	40	33	28
% no	50	53	49	60	49	14

Conditionals	1 individual interpret.			2 1st 3 weeks		
	Yes	No		Yes	No	
% yes	16	17		17	14	
% undecided	31	39	$\chi^2 = 0.64$	35	29	$\chi^2 = 0.6$
% no	52	44		48	57	

b) learn course material more thoroughly than you usually do?

	All	MSU	MCCC	Science	Humanities	Special Needs
% yes	25	24	26	22	23	71
% undecided	30	35	29	38	27	14
% no	45	41	46	40	50	14

Conditionals	1 individual interpret.			2 1st 3 weeks		
	Yes	No		Yes	No	
% yes	28	23		27	0	
% undecided	25	34	$\chi^2 = 1.6$	29	50	$\chi^2 = 4.2$
% no	46	43		43	50	

c) enjoy the course more than you usually do?

	All	MSU	MCCC	Science	Humanities	Special Needs
% yes	36	41	35	37	32	71
% undecided	27	24	27	21	31	14
% no	37	35	38	42	37	14

Conditionals

	1 individual interpret.			2 1st 3 weeks		
	Yes	No		Yes	No	
% yes	41	28		39	0	
% undecided	18	40	$*\chi^2 = 7.6$	27	33	$\chi^2 = 2.7$
% no	41	32		34	67	

6. Did knowledge of your cognitive style and the styles of others increase your awareness of the divc sity of human beings?

	All	MSU	MCCC	Science	Humanities	Special Needs
% yes	55	77	51	33	54	75
% undecided	20	0	23	43	18	13
% no	25	23	26	24	28	12

Conditionals

	1 individual interpret.			2 1st 3 weeks		
	Yes	No		Yes	No	
% yes	72	54		65	50	
% undecided	22	19	$*\chi^2 = 8.7$	29	33	$\chi^2 = 0.7$
% no	6	27		6	17	

7. Would you recommend that your friends take courses in which educational cognitive styles are mapped?

	All	MSU	MCCC	Science	Humanities	Special Needs
% yes	63	88	59	57	57	100
% undecided	29	12	32	29	34	0
% no	8	0	9	14	9	0

Conditionals

	1 individual interpret.			2 1st 3 weeks		
	Yes	No		Yes	No	
% yes	72	51		65	57	
% undecided	22	38	$\chi^2 = 5.1$	29	29	$\chi^2 = 0$
% no	6	11		6	14	

$*\chi^2$ value is significant at $\alpha = .05$ level

(continued)

TABLE 4.32 *(continued)*

8. Do you believe that other instructors would benefit from using educational cognitive style maps in their courses?

	All	MSU	MCCC	Science	Humanities	Special Needs
% yes	69	69	69	67	66	100
% undecided	23	25	23	29	24	0
% no	8	7	8	5	10	0

Conditionals

1 individual interpret.

	Yes	No
% yes	70	65
% undecided	24	23
% no	6	12

$X^2 = 1.7$

2 1st 3 weeks

	Yes	No
% yes	69	71
% undecided	25	0
% no	5	29

$X^2 = 3.3$

conceived expectations regarding the effect of style on student perception of learning outcomes. The questions asked were simply exploratory.

Half the students responded that knowledge of their cognitive style maps did not help them learn the course material faster than usual. The results do not seem to be affected by the mode of map interpretation. Of those students reporting individual interpretations, 16 percent said "yes" to the question concerning learning course material faster. Of those students not reporting individual interpretations, 17 percent responded "yes" to this question. The timing of map interpretations did not appear to impact these results either. Of the 117 students reporting early feedback, 17 percent responded "yes," whereas 14 percent of those not reporting early feedback replied "yes." Therefore, regardless of the mode of interpretation or time of feedback, less than 20 percent of the students felt that knowledge of educational cognitive style helped them to learn the course material faster.

It should be noted, however, that over half (57 percent) the special needs students felt that knowledge of educational cognitive style facilitated the speed of acquisition of course material. The students in the science, humanities, and graduate curriculum classes did not, on the average, view knowledge of educational cognitive style as an aid in learning the course material faster.

When the issue of the impact of knowledge of style on learning course material is addressed, results are similar for the overall group and for those students who did or did not report receiving individual interpretations. In each case, the percent of students who responded "yes" was about 25 percent. Of those students who reported receiving early map interpretation, 27 percent replied "yes." Of the students without early feedback, none thought that the thoroughness of their learning of the course material was influenced by knowledge of their cognitive style. Of the students in the special needs setting, 88 percent indicated that knowledge of their cognitive style did influence their learning, at least to some degree. This was not the case in any of the science, humanities, or graduate curriculum settings.

Thirty-six percent of the students, still less than half, responded that knowledge of their cognitive style probably did enable them to enjoy the course more than they usually do. Of those students reporting individual interpretations, 41 percent indicated they enjoyed the course more because of their knowledge of their educational cognitive style. Of those students not reporting individual interpretations, only 28 percent responded "yes" to this question. Thus, whether or not the students received individualized map interpretations did influence how they perceived the effect of the knowledge of their cognitive style on the enjoyment of the course. A similar result is found for the issue of the time of map interpretation feedback. Of the students receiving early map interpretation, 39 percent responded "yes," whereas zero percent of the students who received no early feedback replied "yes." Once again, a large majority (79 percent) of the students in the special needs setting reported that knowledge of their cognitive style aided in their enjoyment of the class. This reaction was not found in the other classroom settings.

5. Increasing the Awareness of the Diversity of Human Beings. Fifty-five percent of the students indicated that knowledge of their own style increased their awareness of the diversity of human beings. This increase in awareness appears to be a function of the mode of interpretation, since 72 percent of those students receiving individual

interpretation signified an increase in awareness while 54 percent of those students not reporting individualized interpretations indicated an increase. A potentially important though not statistically significant difference in the percent of those responding "yes" is also seen between those students who did and did not report early feedback (75 and 50 percent, respectively). The students in the graduate curriculum course and the special needs setting appeared to be more sensitive to the diversity of human beings, as indicated by 77 percent and 75 percent, respectively, responding "yes" to the item.

6. Recommendations for Future Use of Cognitive Style Maps. The students definitely recommended that other students take courses in which cognitive styles are mapped (63 percent said "yes") and believed that cognitive style maps would be beneficial to other instructors (69 percent responded favorably). Of those students reporting individualized map interpretations, 72 percent recommended that their friends take courses in which educational cognitive styles are mapped. Of those students not reporting individual interpretations, 51 percent recommended such classes to their friends. Although the percentage of students responding affirmatively varies somewhat depending on the mode of interpretation, both interpretation groups tend to favor recommending courses employing cognitive style maps to their friends. Little practical difference in the responses to this question is seen between the students reporting and not reporting early feedback; both groups reported a majority of "yes" respondents (65 and 57 percent, respectively). The mode of interpretation and time of map feedback do not appear to be factors for seeing cognitive style maps as beneficial to instructors of other courses.

Summary of Survey Results

The above results can be summarized as follows:

1. Most students verified that they had gained knowledge of their cognitive style; most received individualized interpretations within the first three weeks of the semester.

2. Less than half the students felt certain that the map and its interpretation provided an accurate picture of themselves. A large proportion were not certain about their perceptions in this regard. However, they were not educated about style per se and may therefore have had difficulty judging the accuracy of the data. In a related area, the students were evenly divided with regard to the extent to which they thought the map provided new information about themselves.

3. Most students either felt that knowledge of their cognitive style did not influence their academic performance or enjoyment of the class, or they were undecided as to its influence.

4. The majority of students reported that knowledge of their own cognitive style increased their awareness of the diversity of human beings.

5. The majority of students demonstrated enthusiasm for the cognitive style mapping experience as indicated by their readiness to recommend the experience to other students.

6. The impact of the mode of interpretation is evidenced primarily in the questions pertaining to the perceived validity of the cognitive style map. Individual interpretation of a student's map by the instructor seemed to influence the perceived accuracy of the map and the extent to which students believed their cognitive style was understood by their instructor.

Results of the student questionnaire imply that the students, on the whole, did find the cognitive style map experience to be positive. However, the reason for the positive attitude cannot be easily isolated and identified.

Conclusions Based on Impact Research

The following conclusions are based on the results of educational efforts in the six implementation settings and the results of evaluation activities across settings.

1. Little or no relationship was found between the measures of style used in this project and educational outcomes. (See the humanities and educational psychology settings.)

2. When the match between student style and mode of instruction or teacher style was used to predict course outcomes, prediction was found to be inaccurate. (See science, humanities, and educational psychology.)

3. The large amount of within-group variance in style measures relative to between-group variance made the reliable differentiation of group on the basis of style difficult. (See physical education and graduate education.)

4. Student reactions to the cognitive style mapping procedures ranged from undecided to positive. Students reported that these procedures had little real impact or value to them but suggested that cognitive style should be considered by other teachers.

5. Participating teachers enthusiastically supported the concept of cognitive style mapping.

These results must be carefully interpreted in light of the discussion of the validity of the measures at the beginning of the chapter, p. 19.

CHAPTER 5

SUMMARY AND RECOMMENDATIONS

The two-year project was an attempt to implement and evaluate a set of procedures designed to aid educators in individualizing instruction at the postsecondary level. The evaluation focused specifically on procedures developed by Dr. Joseph E. Hill of Oakland Community College in Michigan for measuring and mapping each student's educational cognitive style and using the resulting maps to individualize educational programs to accommodate students' styles.

The specific project objectives were:

1. to devise, develop, field test, and refine procedures for the measurement of the various dimensions of Hill's model of educational cognitive style;
2. to train faculty and staff in postsecondary educational settings to understand the conceptual framework of educational cognitive style;
3. to assist these trained faculty members in developing and carrying out plans for implementing cognitive style mapping procedures in making educational decisions in their individual settings; and
4. to plan and carry out systematic and objective evaluations of the effect of the cognitive style mapping procedures and data on educational outcomes in each implementation setting.

During year one of the project, the groundwork was laid for the implementation and evaluation by developing the measures of style, training faculty, developing specific implementation plans, and developing evaluation plans. During year two, the implementation plans were put into action, and the evaluation data were gathered. Although there were only six implementation and evaluation settings in two Michigan institutions, the project results will provide direction to future educational cognitive style researchers. Consequently, it can be concluded, as summarized below, that the project achieved its objectives.

Training

Training objectives established at the outset of the training phase of the project called for participating staff at MCCC and MSU to acquire specific knowledge and skills that would allow them to implement cognitive style maps appropriately in their own educational environments. A variety of training procedures were used over a period of six months; seven faculty members achieved sufficient proficiency in the mapping of knowledge and skills. Multifaceted evaluations of the cognitive and affective outcomes of training suggested that this phase of the project was carried out very effectively.

Developing Measures of Style

Objectives were also established at the outset of the project for the selection, field testing, and evaluation of procedures for measuring 32 dimensions of educational cognitive style. Participating cognitive style experts used available ACT measurement instruments and adapted OCC instruments to assemble a battery of cognitive style measures. These experts also established the face and content validity of the measures and the dimensions of style. The battery was pilot tested during year one. Excessive administration time during the pilot testing resulted in revisions that shortened the instruments for use during the year two implementations.

Technical analysis of the data resulting from the second administration suggested that the revisions yielded greater efficiency. The analysis also suggested that the various measures of style dimensions were sufficiently reliable. However, the validity of the measures as indicators of the various style dimensions could not be demonstrated empirically. Intercorrelations between independent measures of the same style dimensions using the project battery and the most current OCC cognitive style battery yielded chance correlations throughout, suggesting that corresponding measures were not tapping the same learner characteristics.

In the research on educational cognitive style completed to date, little or no data have been presented to demonstrate the psychometric adequacy of the measures employed. In those instances where validity is addressed, it is nearly always content or face validity based on expert judgment. Future research and development efforts focusing on educational cognitive style should give serious attention to the development or adaptation of measures that are demonstrated to be valid and reliable using all relevant scientific and psychometric standards as criteria. This work must be completed before implementation and evaluation of the impact of style can be generalized across settings or measures.

Assessing Impact

The final major objective of the project was to conduct a thorough and systematic evaluation of the impact of educational cognitive style on educational outcomes. This evaluation was conducted through the implementation of cognitive style mapping procedures in a variety of postsecondary educational settings. Participating educators planned for and implemented the experimental procedures in their regular classes. In addition, they planned for and supervised the collection of evaluation data in those classes. As a result, some useful information on the relationship between cognitive style mapping and a variety of educational outcomes was generated.

Summary of Results

Seven implementation studies were planned and six were carried out in two postsecondary settings: Macomb County Community College and Michigan State University. These addressed several important issues pertaining to the impact of using cognitive style mapping results in practical educational settings. Results from all of the sites that carried out their research plans are summarized below.

Four implementation studies were carried out at MCCC. In a science class, retention rate and final grades were enhanced by the individualized prescriptive treatment with or without cognitive style mapping. The true impact of cognitive style information is not clear due to several confounding factors in the design and its execution. In a humanities class, a series of stepwise regression procedures using student cognitive style data and match scores to predict final exam scores (using four probable modes of understanding—lecture, group discussion, media, and overall course) showed little relationship between these cognitive style variables and course outcomes. Special needs students who participated in the fall 1976 orientation program (experimental, cognitive style) tended to complete more course hours than did the previous year's orientation group. However, a lower grade point average also resulted for the group that had its maps interpreted, and few students showed hoped-for growth in the basic skills elements of the map. Attempts to generate consistent collective maps across a variety of methods failed in the physical education site. The large amount of within-group variance relative to between-group variance was cited as the principal explanation for this outcome.

Three implementations were planned at MSU and two were carried out. Participants at the Counseling Center were unable to implement their research plans. Educational psychology classes were the context for an investigation of the relationship between student and teacher match scores on academic and attitudinal outcomes. Little relationship was found. In the graduate education curriculum class, students were sorted into two instructional groups to match their cognitive styles. Partly because of the large amount of within-group variance on the key map elements used in group identification, it was found that the groups did not differ reliably on key map elements.

Overall, the six studies did not establish the existence of significant relationships between the use of cognitive style measures and data on educational outcomes. These project results were supplemented with firsthand reports of participating teachers and students; teachers were interviewed after implementation and students were administered an attitude survey. Both groups had generally positive attitudes about the experience.

Review of Limitations of the Research

Because of the nature of the evaluation contexts, some implementation problems occurred at nearly every site. These problems sometimes impacted the internal and external validity of the results.

In the science implementation, the instructor may have biased the control treatment by empirically (subjectively) mapping students. For some control group students, then, the prescriptions were based on empirically mapped cognitive styles rather than randomly assigned. Further, those students who received prescriptions based on their cognitive styles were permitted to self-select any other materials they wished. Finally, the results are further confounded because students were given information about the research intent and expectations.

The students in the humanities class were subjected to nearly two weeks of testing and interpretation of test results. Although the instructor feels that more efficient instruction was possible because of the test results, many of the students expressed concern over the loss of class time to testing.

Students in the special needs program were not required to take the cognitive style test a second time in December. Although special arrangements were made to encourage student participation, less than one-third were retested. The characteristics of the volunteer sample are unknown, and the generalizability of the results is definitely limited by the small retest sample size.

Originally, the physical education implementation was to continue into a second term. The plan was to select potential unsuccessful students, give half of them prescriptive instruction, then compare the performance of successful and unsuccesful students. However, this plan was not followed through, because the instructor accepted an administrative position in the college.

The educational psychology implementation proceeded as planned. It appears that the data resulting from this study were relatively free of confounding factors.

The graduate education curriculum implementation also proceeded as scheduled. However, the small sample size in

this setting and the lack of control data impacted the research design and the strength of the conclusions.

The limitations of the implementation at the MSU Counseling Center were the most serious of all. The directors of the Counseling Center who developed the implementation plans were unable to obtain the necessary cooperation from the counselors at the center to carry out the study.

Finally, an additional factor necessitates careful interpretation of the impact research results: the validity concerns identified in the previous chapter. If the instruments used in the study are not valid measures of the learner variables they are said to measure, then use of the map data could well result in erroneous decisions.

Collectively, these problems have the effect of reducing the generalizability of the findings and the breadth of the conclusions that can be drawn. However, they do not entirely negate the value of the research. Although they make it difficult to study cause and effect links between cognitive style mapping and educational outcomes, they do represent acceptable analyses of the relationship between cognitive mapping and educational outcome. This is an important distinction because, in addition to revealing the impact of methodological problems, it also highlights the true value of the project.

Recommendations for Future Research

The five studies conducted during this project do not provide a basis for judging the extent to which educational cognitive style mapping can impact the outcomes of post-secondary educational experience. To date there has been little hard data to document that students with different styles learn better when provided with different instructional treatments. This project did not shed a great deal of additional light on this matter. Until such a causal link is established there is little reason to believe that the learning characteristics represented in the cognitive style map are any more appropriate or useful than the variables included in any other profile of student aptitudes, interests, and attitudes.

Establishing such links will require, as a first step, measures which reliably and validly measure cognitive style attributes. To that end, it is recommended that substantive effort and resources be devoted to the development of technically sound instruments for assessing cognitive style elements.

APPENDIX

EVALUATION ADVISORY PANEL REPORTS

Year One Report

This is the first report to be filed in writing by the Advisory Panel for the Cognitive Styles Project. The panel members, whose names appear below, have made two site visits to ACT headquarters in Iowa City: one in the fall of the year and one in the spring. The members have been supplied with the proposal as funded, a supplementary document regarding evaluation of the proposal, a copy of the renewal proposal, and publications from OCC related to cognitive styles. During the visits, the panel has had an opportunity to hear reports from Dr. Joseph Hill and Ms. Linda Henderson, who had the major responsibility for carrying out the activities described in the proposal. Reports have also been received from staff members assigned to the proposal by ACT; an additional report was received from Professor Glen Lahti, Department of Humanities, Macomb County Community College.

The format of the panel members' consultancy has been to receive from the project participants written and verbal reports of plans and progress made thus far. The panel members have also reviewed the test materials developed by ACT staff members, but it is important to emphasize there have been no direct site visits to the colleges where the program is being carried out.

An additional resource for the panel's deliberations has been the participation of Dr. William F. Taylor, Dean of Students at Polk Community College, where the Cognitive Styles Program has been actively utilized for nearly four years. Dr. Taylor has the most long-standing acquaintance with the content of the project, and the other members of the panel depend on him for background comment. None of the remaining panel members can claim intimate acquaintance with the literature or projects which have grown out of Dr. Hill's work.

It is the hope and intention of the panelists that this report will be found constructive in its comments and encouraging to the participants and to the Fund. The panel agrees that there is ample reason to hope that the cognitive styles approach represents an improvement in concept which may lead to possibilities of implementation of instructional strategies which heretofore have not followed from other similar kinds of testing efforts. The panel also understands that the Fund is devoted to development and implementation supports, rather than the support of theoretical research. Within these constraints, we hope to offer suggestions which will prove beneficial to all concerned with the project.

Formative Evaluation

Dr. Hill has suggested that evaluation of the extent to which the project is achieving the goals it set for itself in the first year be viewed as formative, by which he means devoted to an assessment of whether or not the proposed actions are, in fact, being undertaken. Following completion of these actions, the assessment of the project outcomes will constitute a final evaluation which must take into account the project as finally conducted. The panel accepts this distinction and wishes to offer the following formative comments.

A. The project plan calls for the selection of participant teachers who will learn the cognitive styles system and the arts of cognitive mapping. They will then modify their instructional plans to accommodate student styles identified by the information so gained and carry out their teaching plans so that assessment of student gains can be made. The original intention was that the completion of the teaching plan be achieved by the beginning of the summer term. However, the decision was made to rely on teacher volunteers rather than persons paid a small stipend to take part. In addition, it was discovered that there was an opportunity for participation by members of the School of Education at Michigan State University. These events have led to a slowing of completion of the schedule as planned. On the other hand, the addition of Michigan State University may provide a unique and beneficial data source for the evaluation work. Teacher training has begun, and the participants are currently involved in the creation of their implementation plans.

   It is clear to the panelists that it will be important for the Project Director to state the criteria for accepting or, if necessary, rejecting these plans as submitted. We suggest that it might be wise to evaluate the plans according to criteria identified by those who have a sound sense of the cognitive styles approach. It might be possible to grade or rate each teacher's plan so that, in the event some are quite superior to others, subsequent analysis can be performed with the estimate squarely in

mind. It is also important that whatever criteria are used to assign such ranks or grades be objectively stated so that they, too, can be subsequently reviewed during the summative stage.

A second issue we wish to emphasize is the necessity to urge the participating teachers to state as clearly as possible which aspects of student performance within their courses they hope to see improved or strengthened by their teaching plan. It may be wise to urge upon them a minimum number of within-course examinations, papers, and other assessments—e.g., not fewer than four separate measures—so that adequate comparisons across courses may be made.

A third recommendation is that occasional course visitation be made in an effort to provide independent assessment of the recognizable degree to which the implementation plan of each teacher is, in fact, being met. This might be best accomplished by a modified critical incident technique whereby the teacher is urged to invite an observer to come and see a course session which the teacher feels is an especially good example of the type of instructional effort being made.

B. The instrument development schedule established for ACT is clearly being met. The materials are now in hand, ready for use as scheduled. The preliminary statistical analyses of these new instruments—dealing in particular with reliability coefficients—will benefit from continued refinement with special attention given to generating reliabilities for the item cutoff strategies being adopted for use in the computer scoring procedures. This second level of reliability assessment should prove valuable when the time comes to review those items and batteries which may prove to have least predictive value. Otherwise, it is the panel's judgment that the instrument development schedule is being met according to plan.

C. In order to use the instrument, participating teachers must be trained in the art of cognitive mapping. The panel feels it important that records be kept of the performance evaluation made of the degree to which each teacher displays an acquaintanceship with the system and an ability to understand such mapping. In particular, we feel it important to elicit from the participating teachers their personal statement of how the normative mapping made of their class group has altered or provided the base for modifications that they make in their teaching plan. We are suggesting here that as the teachers proceed through the teaching term, they be encouraged to keep a journal or diary of how they are using their knowledge of the cognitive style scores.

Summary

The general assessment that the panel wishes to offer of the progress toward first year objectives is that, although the timing has necessarily lagged because of changes made in the plan so as to take advantage of new opportunities, the objectives are achievable. However, as a safeguard against having to proceed to implementation before all of the training time thought necessary has been spent, we urge adoption of these additional continuous evaluation procedures so that subsequent variation in performance may turn out to be predictable from these new assessments of achievement in the training phase. We find, too, that the procedures established in the first proposal are being honored by all parties, and that the capacity and willingness to provide improvements in the current evaluation plans are very much in evidence. The chief deficiency that we sense to date relates to the completion of the summative assessment design prior to the second year implementation phase. It is the panel's judgment that at least the outlines of the design should be in place and agreed to by the participants prior to the beginning of the actual implementation phase. Under the present schedule, there is a strong possibility that this will not be achieved, and we urge that ACT staff make the achievement of this design a high priority effort. Overall, we find the project on time and on course with some exciting possibilities in prospect.

Addendum

We are well aware that FIPSE does not support basic research. This project focuses on the application of a system which has been several years in formation; upon its completion, we may have evidence that the system deserves further development and dissemination. However, we think it important that the funders realize that in order for the system to achieve legitimacy in the eyes of psychologically trained persons, who will most certainly be asked in time to pass judgments on further proposals for its implementation and use, it will be necessary to provide potential users with a brief document, perhaps no more than five pages, which summarizes the theoretical framework out of which the cognitive styles thinking has come. This piece should also provide a significant bibliography chosen to provide the reader with an opportunity to explore the theses and publications which will provide a sense of the research evidence. At some point it will be necessary to conduct analytic studies of the instrument so as to satisfy the normal and responsible questions which will be posed regarding the cognitive styles instrument and its construct validity as seen in the context of other similar research. This is an effort which can be incorporated in part into the present project if other test data from the participating students can be made available to ACT. If there are difficulties securing such material, it will simply mean a postponement of the time when such comparisons will have to be made.

A second kind of observation may also be made regarding the issue of systems evaluation. The project essentially entails the beginnings of what will eventually have to be an ambitious effort to evaluate the usefulness of an entire system. The procedures being followed in the project are pro-

totypical, and may be looked on as preliminary exploratory experiences in system building. This project will shed considerable light on how the system creation must proceed. In time, the evaluation of the system for its own sake must be carried out. Thus, the presentation of the cognitive skills instrument, the training of persons in its use, the application of knowledge generated by the test battery to a practical context, and the design of appropriate assessment techniques are all matters which yield to careful and systematic analysis. Each of these elements is being partially evaluated in the present project, but, in time, a much more formal evaluation project of such a systems approach will have to be carried out.

This brings us to our final observation. We are impressed with the magnitude of difficulty the project members face in achieving the objectives they have set for themselves. The two-year effort for which funding is presently in place will, in our judgment, require repetition before sufficient experience is gained to provide relatively clear and unequivocal statements of the values which can be realized. We think it important to emphasize the open-ended character of the current project and the extent to which this project is part of a continuing effort to determine the usefulness of the cognitive styles approach. It is for this reason that we wish to reemphasize the need for ACT staff to capture unobtrusively as much supplementary information as possible about each and every phase of the project as it progresses. This type of information, examples of which are given above, can then provide in the summative evaluation stage first estimates of the effectiveness of various elements in the system which, strictly speaking, are not the focus and object of study.

We hope these suggestions and observations prove useful to members of the project and the Fund for the Improvement of Postsecondary Education.

End of Project Report

Implicit in the FIPSE Project on Educational Cognitive Style was a "field test" of the Hill model at Oakland Community College which would embrace the refinement of measurement instruments, the training of professional staff in educational cognitive style mapping, and the development and implementation of projects in various settings at Michigan State University and at Macomb County Community College.

Project Design Requirements

The requirements of the design used in the educational cognitive style project can be viewed from a systematic perspective. Essentially, the project consisted of 1) construction of assessment devices; 2) training in profile interpretation, 3) pedagogical applications; and 4) summative evaluation of the impact of the applications on teacher attitudes and on student attitudes and performance. These components unfold in a time sequence, which is itself marked off by deadlines and standards of competency. An adequate test of the basic effectiveness of the cognitive style instrument requires that each step in the system meet appropriate standards. In cases where such standards are not met, it is essential that provision be made for repeating the process until the minimal standards are achieved. Only when these standards are met can we be sure that the intervention as planned is actually taking place. If we view the project from this perspective, the strengths and weaknesses of the effort are obvious.

Initial Phases of Recruitment and Selection of Teachers, Training of Teachers, and Pedagogical Design

Teachers were recruited for the project by experts in the use of the cognitive style measures from Oakland Community College and The American College Testing Program. The incentives for participation were modest, consisting of the necessary release time and small stipends for weekend involvement. Thus the primary incentive for participation was the teachers' interest in the subject itself and their desire to explore its possible usefulness. Most of the teachers recruited were apparently well suited to the project, though it does seem clear that a wider applicant pool with more powerful incentives would have produced a group of teachers more knowledgeable about the field and better able to participate in the project.

Teacher training was carried out in two- to three-hour study sessions, with occasional opportunities to practice profile interpretation. Some participation was lost at this point; the experts selected the final seven participants by evaluating their ability to provide adequate interpretation of student profiles. Testimony of the participants, as well as the report of the project staff, indicates that the range of performance vis-à-vis the minimum standard was considerable. There is a general sense that, had time and deadlines permitted, more effort could have been profitably devoted to this phase of the project.

Given the selection of the teachers and the conclusion that they had at least a minimum mastery of the instrument, the next phase was the design of course applications of pedagogical technique to match the profiles of the students, and/or to carry out certain clearcut instructional modes with an eye to testing the effectiveness with which students with different profiles responded to them. Experts reviewed these designs to check on their theoretical plausibility and suitability. This was a fairly demanding phase of the program for the teachers, and the combination of monetary and intrinsic incentives was used. It is evident that for many teachers this was the most enjoyable portion of the project, and, once again, they would have liked more consultation and more time to gain confidence

that the pedagogical modes selected were well designed. It is our impression that the justification of these designs was informally carried out in conference between the teacher and an expert, and not subject to any systematic review against some common set of standards. Ideally, in a carefully-designed effort, this would be the moment when careful and intense review would take place, and those design proposals found to be weak would be returned for further work.

With this phase of the project concluded, it then remained to implement the instructional designs—including testing the students and informing them, where called for, of their profile findings. Task experts periodically monitored the implementation. Subsequently, teacher and student estimates were gathered of the extent to which the instructional effort was influenced by the use of the cognitive style assessment.

Implementations of this kind are always carried out within the constraints defined by the larger system within which the experiment is taking place. This particular design did not call for any accommodation by the larger system; rather, the instructional practice was wholly conventional from the perspective of the institutions. This means that no special types of instruction had to be attempted beyond those normally tolerated in the system, and no radical demands were placed on the system. It means, too, that the teachers and the students were operating within the usual and conventional expectations and incentives which motivate teacher and student outcomes. This is laudable because it minimizes the possible effects of "specialness" that often produce their own outcomes. Monitoring of the implementation could only be occasional. Ordinarily, it would be important to have frequent and widespread observation of the ways in which the teachers attempted to implement their knowledge of the students' cognitive styles.

The final stage of the design was the collection, collation, analysis, and interpretation of the outcome measures selected to test the effects of the instruction. In this case, the measures as collected were primarily attitudinal and introspective, with only a few objective performance measures available. Obviously, a wide variety of measures were possible. We might have chosen that particular teacher whose efforts seem to have set the highest standards of performance to the design and have treated that class by the case method: learn as much as possible about it and do our best to infer what may have occurred there. Or, we might have used a multi-factorial design in which certain treatments were systematically varied across others so that factors having social importance—such as norm groups, subject matter, teaching method, and perhaps economic efficiencies—could be assessed as contributory to cognitive style effects. In this project, neither the case method nor the multi-factorial design could be used. The seven classes for which data could be obtained may best be described as providing us with a mixed picture which shed some light on specific possibilities but which, when taken together, were not sufficiently systematic to provide a clearcut interpretation. The evaluative assessments as collected are reasonably usable, and do provide a rather clear-cut interpretable outcome. However, the causal analysis which we might seek is more difficult to complete since the project provides limited performance outcome data, and attitudinal expressions are not supportive of the inference of cognitive style effects.

The ACT Measurement System and its Analysis

1. The ACT staff, in cooperation with Dr. Hill, built a measurement system that seemed to reflect the cognitive style constructs previously embodied in the OCC instruments. It was reported that Dr. Hill seemed satisfied that the resulting ACT system was an adequate, perhaps even improved, measurement system.

2. As part of data collection in the various implementation sites, ACT gathered a variety of data bearing on the evaluation of the instrument. However, unforeseen and uncontrollable events in some sites forced the compromise of data collection plans. Hence, a full evaluation of the ACT instrument and its relation to the OCC instrument is not yet in hand.

3. Within the limits of the data collected, ACT has faithfully endeavored to examine from several viewpoints the educational and psychometric qualities of the measurement system. The process is one of detective work in a complex data set, rather than merely the application of routine psychometric and statistical methods. The ACT staff are to be commended for their thorough and thoughtful pursuit of the various empirical questions that can be asked of the data. At this writing, all relevant data analyses are not yet completed. Data are still coming in, and further ideas on data analysis are still emerging.

4. With respect to the evaluation of the ACT measurement system as an assessment of Hill's educational cognitive styles concept, one can apply six separate criteria: a) internal consistency reliability of the measures; b) stability of scores over time; c) interrelationships (or redundancy) among the different dimensions presumably measured within or between instruments; d) extent of correlation between like constructs based on different methods of measurement (e.g., between like constructs measured by the ACT and the OCC measures); e) predictive validity of style constructs in educational settings; and f) prescriptive or differential validity of style constructs in such settings, to demonstrate that the constructs are actually useful in prescribing different instructional treatments that benefit individuals, relative to, e.g., random assignment to treatments.

5. The complexity of the assessment procedure and concepts, however, makes each of these six criteria applicable at three different levels in the measurement system. At one level, one can ask about the adequacy of each of the independent base measures in the system. At another level of abstraction, one can ask the same questions about the map element scores derived through linkage rules from the base measures. This is complicated by the fact that some linkage rules are complex. Beyond this, one can inquire about adequacy and usefulness of the system at the level of the style profile descriptions and the educational prescriptions derived from these.

6. We can now review each of the six criteria, keeping in mind the three-level complexity, to document ACT's evaluation activities regarding the measurement system. We shall not try to describe in any detail the empirical results; this is the province of ACT's further analyses and final report, yet to be drafted.

   a) ACT obtained internal consistency estimates of reliability at the levels of individual base measures and some individual map elements. Most of these estimates show adequate reliability in this sense, though some scales show a level of reliability insufficient for individual prescription. It should be noted that individual prescription typically requires a much higher level of score accuracy than institutional or research uses of educational-psychological measurement.

   b) Stability over time is the more significant aspect of reliability or interest here because, for prescriptive purposes, style constructs must be regarded as relatively enduring characteristics of individuals. The system measures derived from previous ACT test research may be said to possess stability over time to the extent that these measures were not significantly changed in translating them for use in the style measurement battery. Unfortunately, the project site that was expected to produce some stability data failed to run as anticipated, so data on stability of other base measures, map elements, or profiles were not obtained. Ten individuals who were tested twice in one project show some variation in profile over time, but these individuals experienced instructional interventions between testings. Thus, the question of stability remains open, at least with respect to most map elements and profile characteristics.

   c) ACT has correlated base measures and some map elements with one another, within and between the ACT and OCC batteries. Partial results suggest substantial overlap between some purportedly different dimensions, but it is not clear if this overlap is of a degree high enough to justify reducing or combining measures. ACT rightly considers such a step somewhat premature.

   d) One site provided data allowing cross-correlation of like constructs from ACT and OCC batteries. These fail to support the claim that any pairs of measures from the two batteries actually do measure the same constructs. It is therefore doubtful that profile clusterings produced independently by the two batteries would place individuals in the same categories, but these analyses are as yet incomplete. ACT still needs to complete various statistical checks on these issues.

   e) Several sites yielded predictive validity data on the ACT battery. Analyses of these data are incomplete, but preliminary evidence suggests that educational outcomes are not substantially predicted by style constructs. Some relationships may be promising, however, and are being pursued.

   f) Prescriptive (differential) validity data were not obtained. One site altered the planned conduct of its study. While this may have had other virtues, it compromised the value of the data on this point. Another site yielded data that may provide some evidence of differential validity, pending further analyses.

7. Within the limitations of the data, then, ACT has attempted to answer questions relating to the above six criteria as applied to the different levels of assessment provided by the system of style constructs. The limitations on the analyses possible are a function of problems typically faced in field implementation and evaluation projects. It is unfortunate that the resources needed to support a stronger, more comprehensive test of the measurement system and its associated style constructs were not available. ACT has thought ahead in this connection and has plans for more systematic research on and development of this system. This is to be commended. What seems required now is a thorough examination of the concept of the system as it might be implemented in an instructional situation where comprehensive and controlled evaluation studies could be carried out. It is hoped that ACT will be able to pursue this line of work more intensively.

This review of the strengths and weaknesses of the project needs to be understood as illustrative of the effects of serious time and money constraints. The project was ambitious, and the participants are to be commended for the time, intelligence, and effort they devoted to it. However, the requirements of the project clearly were greater than could be met under its support terms. It remains unfortunately true that we continue to believe that such educational efforts are relatively inexpensive and unsophisticated in their demands. Actually, great patience, care, and time must be extended to implement and assess a program in education. As yet, it does not appear that this fact is sufficiently appreciated.

Respectfully submitted,

Robert Birney, Hampshire College
John E. Roueche, The University of Texas at Austin
William F. Taylor, Polk Community College
Richard Snow, Stanford University