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THE EFFECT OF A COGNITIVE STYLE MAPPING PROGRAM ON ACHIEVEMENT OF COMMUNITY COLLEGE STUDENTS WITH INTERNAL LOCUS OF CONTROL AND EXTERNAL LOCUS OF CONTROL

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THE UNIVERSITY OF OKLAHOMA

GRADUATE COLLEGE

# THE EFFECT OF A COGNITIVE STYLE MAPPING PROGRAM ON ACHIEVEMENT OF COMMUNITY COLLEGE STUDENTS WITH INTERNAL LOCUS OF CONTROL AND EXTERNAL LOCUS OF CONTROL

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THE EFFECT OF A COGNITIVE STYLE MAPPING PROGRAM

ON ACHIEVEMENT OF COMMUNITY COLLEGE STUDENTS

WITH INTERNAL LOCUS OF CONTROL AND

EXTERNAL LOCUS OF CONTROL

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THE EFFECT OF A COGNITIVE STYLE MAPPING PROGRAM
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WITH INTERNAL LOCUS OF CONTROL AND
EXTERNAL LOCUS OF CONTROL

# CHAPTER I

# INTRODUCTION

## Background and Rationale

Educators have developed many and varied techniques to improve the process of education. The emphasis recently has changed from education for all to education for each individual. As Cross has said

> American higher education has worked hard for the past quarter of a century to achieve educational opportunity for all. It looks very much as though we shall spend the remaining years of this century working to achieve education for each. (Cross 1976, p. 3)

Bruner and Bloom have indicated that high percentages of people should be able to learn. Bruner says ". . . any subject can be taught effectively in some intellectually honest form to any child at any stage of development." (Bruner 1961, p. 33) Bloom in his theory of mastery learning has suggested that 90 percent of those who are interested in learning should be able to do so. According to Bloom,

> . . . if students are normally distributed with respect to aptitude, but the kind and quality of instruction and learning time allowed are made appropriate to the characteristics and needs of each learner, the majority of students will achieve mastery of the subject. And, the correlation between aptitude measured at the beginning of instruction and achievement measured at the end of instruction should approach zero. (Bloom 1976, p. 4)

Various methods of individualized instruction have been developed to meet the differing needs of students. Programmed instruction, individually paced materials, audio-visual aids, computer assisted instruction, and peer tutors are examples. Snow (1976) and McKeachie (1963) point out that none of the innovations has been a panacea.

> One reason for the host of experimental comparisons resulting in non-significant differences may be simply that methods optimal for some students are detrimental to the achievement of others. (McKeachie 1963, p. 1157)

A more recent development, then is to personalize education by making available to each student those modes of learning that will be of the most benefit to that student. Progress has been made as McKeachie and Kulik (1975) note in a 1975 review of educational research. Individual differences and their interactions with the learning process have been researched extensively, but still there are few simple generalizations "because education really is complicated" (McKeachie and Kulik 1975, p. 199). Martin (1976) recommends that post secondary education needs to improve its ability to match students to the kinds of instruction that will be most beneficial to them if the institutions are to serve the needs of the older student population.

Cognitive style and locus of control are two constructs of individual differences that have been considered in terms of their interactions with learning. "Cognitive style" refers to an individual's "contrasting modes of functioning (which represent) an individual's characteristic and pervasive manner of processing the information received from within and from the world around him" (Witkin and Cox 1975, p. 2). Messick (1970, 1976a,b,c), Kogan (1971), Glaser (1973), Nelson (1975), Witkin, Moore, Goodenough, and Cox (1977), Cronbach and Snow (1977), and Ausburn and Ausburn (1978) have discussed cognitive styles and their implications for education, and have reviewed the related research. Glaser (1973) speaks of cognitive styles as the "new aptitudes" and recommends an adaptive educational environment that realizes many goals and ways of succeeding as opposed to a selective educational environment where only those who fit the mode will be successful.

Messick (1970, 1976b) explores the various possibilities and consequences of matching and mismatching individual learners, teachers and instructional modes. Messick (1970, 1976c) also differentiates between cognitive styles, which are relatively stable and influence behavior over a wide range of situations, and cognitive strategies which are more dependent on specific situations.

A number of cognitive styles have been identified with varying degrees of research. Messick (1976c) lists nineteen different styles. Witkin's model of field independence--field dependence is most familiar and well researched (Witkin, Moore, Goodenough and Cox 1977). Nelson (1975), Messick (1976c) and Ausburn and Ausburn (1978) enumerate several differences between cognitive styles and abilities. Abilities are quantitative with maximum levels, while cognitive styles relate to typical behavior and are bi-polar. Since abilities have maximum desired levels, there is value associated with ability levels. Cognitive style is value free as, in general, one pole of a cognitive style is not considered more beneficial than the other pole. Cognitive styles have broader application than abilities which are often specific to a very limited area. Cognitive styles are qualitative while abilities are quantitative.

Several models of cognitive styles involve the concept of cognitive style mapping and deal with more than one cognitive style. Examples of such models are the models of Messick and McKenny (Martens 1975), Canfield (Canfield 1974), Kolb (Claxton and Ralston 1978), Dunn (Dunn, Dunn and Price 1977), and Hill (Hill 1976, 1981). Hill's model is called The Educational Sciences and is Hill's attempt to give education a precise structure and language.

> . . . educational cognitive style is an applied body of information designed to deal with practical considerations associated with contexts involving both informal and formal education endeavors. It is not the purpose of educational cognitive style to describe and explain psychological behaviors of the individual throughout his or her life-space. It is a means, however, for improving the logical consistency and precision of analyses, validations, and syntheses of informal and formal educational endeavors and contexts. Recalling that education is defined in the educational sciences to be the process of searching for or seeking meaning, wherein that process is a system composed of the generic elements of: persons, processes, and properties, educational cognitive style is an applied or practical construct that can be used to accomplish practical goals related to the functions of analysis, validation, and synthesis in the realms of formal and informal education, respectively. (Hill 1981, pp. 65-6)

The model is made up of seven sciences. The first science, Symbolic Orientations, describes an individual's learning preferences dealing with theoretical symbols, words and numbers, and qualitative symbols. Qualitative symbols involve senses, feelings, cultural codes, and values and insights used to give meaning to one's environment and personal experiences. The second science, Cultural Determinants, refers to ways individuals gain meaning from social relationships or cultural influences. The main social influences are family, associates and authority figures. The third science, Modalities of Inference, is concerned with the methods of reasoning used by individuals to reach conclusions. The fourth science concerns memory and its biochemical and electrophysiological aspects. Cognitive styles of individuals is the fifth science. The cognitive styles are made up of the first three sciences. The sixth science concerns teaching styles, administrative styles and counseling styles. The last science is called systemic analysis decision making and deals with evaluation in deriving optimal decisions for the system (Hill 1976, 1981; Reece 1978).

Cognitive style mapping procedures involving the first three sciences--symbols, cultural determinants and modalities of inferences--to determine individual learning preferences have been the widest application of the model. The mapping process in the original Hill model includes diagnostic tests, behavioral observations, interviews and an inventory (Nunney 1978; Hill and Nunney 1971). The results of an individual's cognitive style map are then used to prescribe personalized learning situations. The mapping and prescription procedures are based on several assumptions: (1) each individual benefits from training in his or her own unique way; (2) it is possible to determine which elements of a person's educational cognitive style have enabled him to succeed in the past; (3) ninety percent of all individuals can and do achieve at a ninety percent level of success in certain informal and/or formal educational settings of their choice; (4) it is possible to match an individual's educational cognitive style to a mode of understanding or form of presentation in order to produce a ninety percent achievement level (Nunney 1978, p. 51).

Research on some of these assumptions has produced conflicting results. Griffin (1975), Hoogasian (1970), Ogden and Bruster (1977), Rundio (1973), and Schwendinger (1976) were able to differentiate on the basis of cognitive style among individuals at different levels of success in various disciplines. However, the American College Testing Program (1977) studies were generally unable to differentiate between groups based on cognitive style profiles.

Ehrhardt (1980) at Mountain View College has modified the Hill model to produce an individual's cognitive style map using only an inventory. The shortened mapping procedure makes its use in community colleges much more feasible. Corvey and Ehrhardt (1979) indicate that eighteen community colleges are using the modified Hill model and others are using different mapping models. More and more two-year colleges are adding the program in various degrees. Institution-wide support is found at Mountain View (Ehrhardt 1980) and Mount Hood Community College (Keyser 1980a,b). Spartanburg Technical College began to use cognitive style mapping in their developmental studies and secretarial science programs (Reece 1978a) and have expanded the mapping process to include the allied health division (Atkins 1978, 1979). Interested instructors at South

Oklahoma City Junior College use a mapping inventory that is a slight modification of the Mountain View Inventory. The areas making the most use of the mapping process presently are developmental studies, occupational therapy and management.

The use of cognitive style mapping for the "new" community college student, particularly in the developmental studies area, has been widely recommended (Ehrhardt and Corvey 1980; Neil 1975; Nunney 1978; Robinson 1969; Keen 1975). These are the individuals who have been most unsuccessful with traditional approaches to learning. Not only does a cognitive style mapping program require an institution and its instructors to provide the alternatives necessary for learners with different cognitive styles to succeed, but it places responsibility on the students who have been mapped to use the information gained about their own learning styles in choosing and adapting to learning situations (Keyser 1980b; Ehrhardt 1980).

Locus of control, according to Lefcourt,

> refers to the degree to which individuals perceive the events in their lives as being a consequence of their own actions, and thereby controllable (internal control), or as being unrelated to their own behaviors and, therefore beyond personal control (external control). (Lefcourt 1972, p. 2)

Reviews of locus of control research are found in Rotter (1966), Rotter, Chance and Phares (1972), Fanelli (1977), Lefcourt (1972, 1976) and Joe (1971). Relating locus of control to learning Joe says

> Several studies suggest that the locus of control variable plays a major role in the learning process and the striving for achievement by influencing an individual's strategy preferences in confronting problem-solving and risk-taking situations. (Joe 1971, p. 635)

According to Rotter, Chance and Phares the effectiveness of reinforcements on learning is related to an individual's locus of control.

> . . . if a person perceives a reinforcement as contingent upon his own behavior, then the occurrence of either a positive or negative reinforcement will strengthen or weaken potential for that behavior to recur in the same or similar situation. If he sees the reinforcement as being outside his own control or not contingent, that is depending upon chance, fate, powerful others, or unpredictable, then the preceding behavior is less likely to be strengthened or weakened. (Rotter, Chance and Phares 1972, p. 265)

Other characteristics of people with an external locus of control are that these externally controlled people are

> . . . more accepting than internals of . . . extensive personal descriptions derived from minimal test data . . . , are more likely to yield to others' arguments . . . (and are) more positively affected by anticipated social evaluation. (Lefcourt, Hogg and Sordoni 1975, p. 22)

A characteristic of internals is that "Internals seem more eager to gain information that would help increase their probabilities for success experiences." (Lefcourt 1972, p. 14) Lefcourt also states that "The overwhelming majority of studies . . . do report positive association between internality and achievement behavior . . ." (Lefcourt 1972, p. 18)

Locus of control and cognitive styles have been related in several studies. Wolk and DuCette (1974) and Kassin and Reber (1979) found indications of differences in the cognitive processes used by externals and internals. Lefcourt and Telegdi (1971) reported no previous relationship between locus of control and field dependence--independence. However, their research produced surprising results when comparing the cognitive activity of the four combinations: field independent--internal, field dependent--external, field independent--external, and field dependent--internal. As expected, field independent--internals showed the most cognitive activity, but unexpectedly the field dependent--external group was second. Lefcourt and Telegdi felt this was because of the congruence of field dependence and externality. The two incongruent groups showed lower levels of cognitive activity (Lefcourt and Telegdi 1971). Tobacyk, Broughton and Vaught (1975) carried the congruence--incongruence aspects of cognitive style and locus of control further. Using the same four groupings, they found the congruent groups demonstrated better personality adjustment than the incongruent groups. In a study of Piagetian formal reasoning, both locus of control and field dependence--independence were correlated with various aspects of formal reasoning and made significant contributions to the regression equations (Linn and Pulos 1979). Thus the research does show that there is some relationship between cognitive style and locus of control.

Students in developmental programs are often characterized as being externally controlled (Mink 1971; Roueche and Snow 1977; Baker 1972). Studies relating achievement and self-concept to locus of control have produced mixed results. Roueche and Snow (1977) and Spann (1976) reported significant relationships while Cain (1980) found none.

Reueche and Snow (1977) suggest that locus of control scales and cognitive style mapping inventories would be useful tools for personalizing learning situations and identifying students who will benefit the most.

A great deal of research has involved the constructs of cognitive style and locus of control in instructional settings. Hill's cognitive style mapping model and modifications of it have been the subject of much research. Institution-wide course completion rates have been compared by Ehrhardt (1980) and Keyser (1980b). The effects of teacher and student cognitive styles were compared by Boozer and Anderson (1977), Lange (1972) and others. Lepke (1975), Terrell (1976), and Hand (1972) studied the interactions of cognitive style and instructional mode. Fourier (1980) examined the effectiveness of a cognitive style mapping program on community college students and found a significant increase in final grades of students who participated in the program. Blanzey (1970), Grasser (1973), Ribley (1977) and Shuert (1970) used Hill's cognitive style mapping to successfully distinguish between successful and unsuccessful college math students. Berke (1976) concluded that a mapping program was a factor in the success of a mathematics program for disadvantaged college students. None of the research concerning Hill's model or its modifications has included the locus of control construct as it affects the effectiveness of a mapping program.

In order for a cognitive style mapping program to be effective, alternative learning opportunities must be available for students to take advantage of their learning preferences or compensate for their weaknesses. Using a mapping program where alternatives are readily available gives the student the opportunity to take the responsibility for using the information gained about his or her learning preferences to improve his or her chances for success. It is naive to consider one technique to be helpful for all learners. It is more reasonable to study the effect of a mapping program on learners with differing characteristics. Both cognitive style mapping and locus of control have been indicated as important constructs for developmental studies students (Ehrhardt and Corvey 1980; Roueche and Snow 1977). Cognitive style mapping programs have been beneficial for community college students (Fourier 1980) and disadvantaged math students, in particular (Berke 1976). Therefore, it appears to be important to consider a cognitive style mapping program as it affects students with either an external or internal locus of control in a developmental studies mathematics course.

## Definition of Terms

Cognitive style mapping program. A student will have participated in a cognitive style mapping program if that student completes the Learning Preference Inventory (see Appendix A), attends an interpretation session and receives a cognitive style map.

Cognitive style map. A cognitive style map for an individual consists of the twenty-seven scores from the Learning Preference Inventory that determine whether each of the twenty-seven categories is a major, minor or negligible influence for that individual.

Cognitive style. Cognitive styles are "contrasting modes of functioning (which represent) an individual's characteristic and pervasive manner of processing the information received from within and from the world around him." (Witkin and Cox 1975, p. 2)

Locus of control. The locus of control of an individual is determined by

> the degree to which the individual perceives that . . . reward follows from, or is contingent upon, his own behavior or attributes (internal) versus the degree to which he feels . . . reward is controlled by forces outside of himself and may occur

independently of his own actions (external). (Rotter, Chance and Phares 1972, p. 261)

External. Students who score twelve or above on Rotter's I-E Scale (see Sppendix A) will be classified as external.

Internal. Students who score seven or below on Rotter's I-E Scale will be classified as internal.

## Statement of the Problem

What is the effect of a cognitive style mapping program on achievement of community college basic mathematics students with an internal locus of control or an external locus of control? More specifically,

A. Is there a difference in the effect of a cognitive style mapping program on the basic mathematics achievement of students who have an external locus of control and those who have an internal locus of control?

B. Within each of the categories of locus of control (internal, external) is there a difference in basic mathematics achievement between students who have completed a cognitive style mapping program and those who have received an equal amount of time of attention but have not participated in the cognitive style mapping program?

C. Is the difference on basic mathematics achievement between the cognitive style mapping and control groups for internals different from the difference between the cognitive style mapping and control groups for externals?

## Hypotheses

The above questions will be answered by testing the following null hypotheses:

1. There is no difference in basic mathematics achievement between students who have completed a cognitive style mapping program and similar students who have not.

2. There is no difference in the effect of a cognitive style mapping program on the basic mathematics achievement of students who have an external locus of control and those who have an internal locus of control.

3. Within the internal locus of control groups there is no difference in basic mathematics achievement between students who have completed a cognitive style mapping program and those who have received an equal amount of time of attention but have not participated in the cognitive style mapping program.

4. Within the external locus of control groups there is no difference in basic mathematics achievement between students who have completed a cognitive style mapping program and those who have received an equal amount of time of attention but have not participated in the cognitive style mapping program.

5. The difference on basic mathematics achievement between the cognitive style mapping and control groups for internals is not different from the difference between the cognitive style mapping and control groups for externals.

# CHAPTER II

# REVIEW OF RELATED LITERATURE

## Cognitive Styles

There appear to be two general areas of research relating cognitive styles to education. Research has been done to determine which cognitive styles lead to more success in various disciplines or careers (Witkin and Cox 1975). The second general area relates cognitive style to modes of instruction or learning. It is this area that is pertinent to the present study because cognitive style mapping involves diagnosing individual preferences for various modes of instruction. Since the literature involving cognitive styles is so extensive this review will be limited to literature concerning cognitive styles, instructional methods or learning modes and mathematics at the post secondary level. Literature involving the Hill model will be discussed later.

The field independent-dependent cognitive style has been the subject of much of the research. While it is generally agreed that mathematics ability and achievement are correlated with field independence (Splitter 1970, p. 171), research involving instructional methods in mathematics is not so conclusive.

A number of studies at San Diego State University have used preservice elementary teachers in mathematics classes as subjects (McLeod and Adams 1979b). Several of the studies involve the interaction of field dependence and independence with the level of guidance. Significant results were reported by McLeod, Carpenter, McCornack, and Skvarcius (1978) and Adams and McLeod (1979, p. 348) with field independents doing better with minimum guidance and field dependents doing better under maximum guidance. McLeod and Adams (1980) combined an expository presentation with deductive sequencing using maximum guidance as one treatment and discovery learning with inductive sequencing and minimum guidance as the other treatment and found no significant interactions with field independence and dependence. In two additional studies the level of guidance also did not interact with field independence and dependence (McLeod and Adams 1979a; Adams and McLeod 1979). Independent study with packets of programmed materials was used to study the interaction of inductive or deductive approaches with field independence-dependence (McLeod and Briggs 1980). An interaction was found on the immediate transfer test but not for the immediate or retention achievement tests or the retention transfer test. In addition to the significant interaction with level of guidance reported earlier, McLeod, Carpenter, McCornack and Skvaricus (1978) found no relationship between field independence-dependence and level of abstraction or dimensions of discovery learning.

Still dealing with field dependence-independence, Packer and Bain (1978) found that college math students benefited most from matching teacher and student cognitive styles when students and teachers were at extreme ends of the field dependent-independent ranges. For a unit on linear inequalities, Cullen (1980) provided instructional modes geared to the student's individual style of field dependence or independence and left or right cerebral hemisphere dominance in a learning center. The control sections were taught with a traditional lecture presentation. The mathematical achievement of the group making use of cognitive style and instructional mode matching was significantly greater than the achievement of the control group.

Boysen's (1980) research revealed a significant interaction between the type of feedback in computer assisted instruction and field dependence-independence on an algebraic equation unit. However, the interaction was in the opposite direction from that suggested by previous research. In Boysen's study field dependents performed better with feedback that provided less structure and the field independents performed better with feedback that provided more structure.

In community college developmental mathematics classes, field independent students performed better when taught by hueristic methods and field dependent students performed better when taught with algorithmic methods (Moore 1980). Nowrozi (1980) also found relationships between field dependence and independence and graphic and analytic instructional methods for upper level statistics students.

The following studies found no significant interaction between field dependence-independence and modes of instruction in college mathematics classes. Cohen (1972) compared whole-part sequencing with by-parts sequencing using programmed instruction for both sequences for a topic on limits. Anglin (1979) also used programmed instructional materials comparing an analytic approach with a graphic approach. Sheel (1981) compared the use of positive and negative instances with the use of all positive instances in a unit on introductory differentiation rules in a calculus course. Baldwin (1977) compared the mathematical achievement of field dependents participating in group study with that of field dependents in individualized study. Finally, Swanson (1979) used three different mediums: video, written and control.

A few studies are concerned with other cognitive style constructs, instructional methods and mathematics at the college level. Josephson (1978) found a significant interaction between the visual-haptic cognitive style and instruction begun with an advance organizer. Molina (1976) compared visual-verbal, auditory-verbal and symbolic cognitive styles with three instructional modes representing these styles and found mixed results. The independence and symbolic levels of cognitive style provided significant main effects and the visual level had a significant interaction with instructional method. The effects of teachers' instructional style preferences and students' learning style preferences on the mathematics and English achievement of developmental students in six different colleges were studied by Davis (1979). The regression equation for mathematics achievement showed that similarity between teacher and student on peer affiliation and differences on numerics contributed to higher achievement.

## Loss of Control

A number of studies have been concerned with the relationship between locus of control and different instructional strategies at the post secondary level. Allen, Giat and Cherney (1974), Daniels and Stevens (1976), Parent, Forward, Canter and Mohling (1975), Johnson (1977), and Roueche and Snow (1977) have reported significant relationships between locus of control and student-centered or teacher-centered instructional strategies with internally controlled students achieving better in student-centered situations. Externals did better in teacher-centered strategies which provided more structure. Sanders (1978) did not find a significant relationship with achievement, but the interaction with course satisfaction was highly significant. Kennedy-Liang (1980) found no interaction between locus of control and three different grading procedures, but she did find a small positive correlation between locus of control and trait anxiety. Johnson and Croft (1975) did not find locus of control related to achievement in a personalized system, but they found a significant change in locus of control towards internality at the completion of the course. There was a negative relationship between the degree of change and amount of proctor influence in the course. Cise (1978) also investigated the change in locus of control and achievement for a self-paced personalized system of instruction and instructor paced instruction. There are no significant differences for either change of locus of control or achievement overall. However, there was a significant change toward internality for students who received an incomplete grade in the self-paced instruction. Both Cain (1980) and Root and Gall (1979) found no interaction between locus of control and instructional methods.

Newson and Forworth (1980) investigated the relationship of locus of control and teaching strategies in a mathematics course for an Adult Basic Education and GED program with both change of locus of control and mathematics achievement as dependent variables. Using locus of control and demographic data in a multiple regression analysis to predict course completion status, locus of control and age were found to be significant predictors. Students in the contract learning mode of instruction had a significant change toward internality in their locus of control.

Locus of control has been hypothesized to be an important variable when dealing with instructional strategies for developmental or high-risk post secondary students. Spann (1976) obtained significant results when using locus of control as a predictor of college grade point and persistence of developmental students. Individual locus of control counseling used in connection with group counseling and study skills instruction was more effective than counseling and study skills instruction without the locus of control aspect for high-risk freshman (Whyte 1975). However, Skidmore (1979) found a counseling program had no significant effect on change of locus of control, achievement, attendance or attrition of students enrolled in developmental mathematics, reading and English classes. Watts (1976) also found reality therapy counseling, and individualized instruction produced no significant change in the locus of control of student in a developmental education program.

Using remedial mathematics classes at the University of Iowa, Urbatsch (1979) found significant interactions between change of locus of control, methods of instruction and math anxiety. The interaction of locus of control and method of instruction also reached significance when mathematics achievement was the criterion variable. Hickey's (1980) study involving college Finite Mathematics and Bachor's (1979) study using Business Mathematics and Statistics support Urbatsch's findings but only at the extremes of the locus of control variable. Also using Statistics, Burn's (1980) results do not support the above conclusions.

To test the hypotheses that two-year college students have a more external locus of control than four-year college students, Vukovich (1981) compared the locus of control of students in comparable math courses in a university and a two-year college. There was no significant difference in locus of control of the two groups of students. Even though the classes used in the study were labeled entry level mathematics courses, they are not typical of a developmental or remedial college math course.

In mathematics courses for perspective elementary teachers, the locus of control of the students showed a trend of interacting with the method of instruction (McLeod and Adams, 1979b). Interestingly internal students learned more in small group instruction, while externals did better in individually paced situations when they received help from the teacher. However, the differences were not significant.

## Cognitive Style and Locus of Control

A few studies at the post secondary level have involved both constructs of locus of control and cognitive style with either instructional modes or mathematics. Bertinot (1978) found no significant relationship between choice of learning format and locus of control, field dependence-independence and other personality variables. Using mathematics achievement, aptitude and attitudes of two-year college students as criterion variables, Hinton (1980) ran several multivariate statistical analyses with various cognitive styles and locus of control as predictor variables. Several of the cognitive styles produced significant relationships, but locus of control did not.

## Hill's Cognitive Style Mapping Model

### General Descriptions and Institutional Programs

The literature on Hill's model of cognitive style mapping is extensive. In addition to reports of research studies using the model, the literature consists of descriptions of the model and programs using the model with recommendations for further implementations. General descriptions of Hill's model are found in Hill (1976, 1981), Nunney (1977, 1978), Reece and Atkins (no date), Heun, Heun and Ratcliff (1975), Jimenez (1976), Mullally (1977), Neil (1975), Schall (1976), and Paige (1969). Bass (1978) also describes Hill's cognitive style mapping and interestingly suggests it as an aid to the demand for individualization and personalization of instruction in gerontological education. Several general discussions or bibliographies of cognitive style include Hill's cognitive style mapping descriptions. Examples are those by Abraham (1978), Claxton (1978), Ehrhardt (1977), Even (1978), Martens (1975), Steinke (1974) and Speer (1979).

Much of the implementation of cognitive style mapping using Hill's model or modifications there of is in two-year community colleges, technical schools or adult basic education programs which are all considered teaching institutions and therefore, do less research with their programs. Cognitive style mapping is used in adult basic education programs at Canadore College in Canada (Dudgeon 1973) and in Niagara Falls, New York (Skeen 1975; Niagara Falls Board of Education 1975, 1976). Valler (1978) describes the mapping program in communications courses at East Texas State University, and Hilgendorf (1974) describes the Fox Valley Technical Institute program. The latter program has extensive computer support which manages the system and makes the learning prescriptions based on learning styles. A complete evaluation system was built into the model, but the evaluation had not been tested at the time of Hilgendorf's report. Likewise, the program in Allied Health at Spartanburg Technical College has not been completely evaluated, but faculty and student attitudes are positive and expansion of the program is planned (Atkins 1978, 1979). Cognitive style mapping is also used in developmental studies and secretarial sciences programs at Spartanburg (Reece 1978a). A study involving these programs revealed no significant difference in either student acheivement or satisfaction, but outside evaluators gave the program a very good rating (Reece 1978b).

Personalizing Educational Programs, the name given the instructional system that uses cognitive style mapping at Oakland Community College where Hill was president, is described by Hill and Nunney (1971a, b), Nunney and Hill (1972), Manilla (1971), and Hampton (1972). Hampton indicates a drop in failure precentages between 1968 when Hill became president and institutionalized the system and 1972.

Both Central Piedmont Community College (Griffin 1974b) and Polk Community College (Lee 1975) have self-help courses which employ cognitive style mapping as one of the techniques. Both Griffin and Lee report positive evaluations of the courses.

Mountain View College (Ehrhardt 1980) and Mount Hood Community College (Keyser 1980, 1981) have institution-wide cognitive style mapping programs. Both report an increase in the percentage of completion rates since the implementation of the mapping programs. Mountain View publishes the "Mirror" each year which lists for every course and instructor the instructional modes used giving students more opportunity to choose classes based on their learning styles (Ehrhardt 1980).

Townsel (1975) also describes Hill's cognitive style mapping model and its use in the Del Paso Heights School District. The East Lansing School District in Michigan has incorporated cognitive style mapping into the teacher inservice education program. The number of teachers making use of the program has increased as well as the teachers' confidence in providing individualized instruction based on student cognitive styles (Bowman 1976). Warner (1981) developed two competency based self-paced learning modules to provide instructors with the knowledge and skills necessary for implementing cognitive style mapping. The two modules were field tested and found to be effective in the training of instructors.

## Development of New Models

Hill's model has been used in two studies to create new models. Fernandez (1974) created a Unified Model of abstract thinking in mathematics and then compared it with Hill's model for consistency. Eaton (1975) combined Hill's model with Erickson's model for psychohistorical inquiry to map the fourth science, memory set, of Hill's model. McIntire (1976) compared Eaton's new model to cognitive style mapping and found Eaton's significantly better in predictive accuracy for achievement and mode of understanding. Salowich (1971) also investigated the relationship between cognitive style mapping (the first, second, third, and fifth educational sciences) and the fourth science, memory, and its biochemical indicators. Students with similar cognitive styles who performed differently had different biochemical makeups.

## Administrator Styles

The sixth science deals with administrative styles. Zussman (1968, 1971) described the elements of administrative styles and compared the styles of administrators in a community college and a large public school system. DeLoach (1969) analyzed cognitive, administrative and teaching styles of administrators as these styles may affect the evaluation of instructors. Cognitive styles and teaching styles were significant variables in the evaluation of instructors. Korin (1974) found significant differences in several areas of administrative style between successful school principals and Educational Administration graduate students.

Still dealing with administrators in education, but using cognitive style rather than administrative style, Bonen (1977) found the degree of cognitive style match between the principal and faculty and the rating of the principals' leadership effectiveness to be significantly related. Niles (1974) found differences in cognitive styles when comparing the cognitive styles of the most successful directors of community education to a randomly selected group of community education directors. Cognitive styles have significant relationships with conflicts in role expectations for administrators (Eisenman 1973), effective collective bargainers (Stuart 1976), role expectations for student leaders (Otts 1977) and those working with a Program Planning Budgeting System (Ervin 1974), and the degree of effectiveness of student leaders (Sigren 1973).

According to Covella (1976) matches between individuals' cognitive styles can explain important variation in alienation and satisfaction between individuals and their work, supervisors or co-workers. Cognitive styles of those successful or unsuccessful in a specific firm were identified by Summers (1971). But differences or similarities of the cognitive styles of employees and their supervisors did not account for favorable or unfavorable ratings of either group for each other or the firm.

## Hill's Model and Other Individuality Constructs

Cognitive style has been compared to other constructs of individuality. Both Bateman (1974) and Crowe (1974) found significant relationships between educational cognitive styles and the Career Maturity Inventory. Cognitive style is also indicative of academic achievement motivation which can be increased by an orientation course including cognitive style mapping (Blosser 1971). The self-concept-as-a-learner of eighth graders showed a significant gain when their instruction was designed with the aid of a media specialist and cognitive style mapping (Hodges 1977). Retzke (1976) found an improvement in the motivational levels of junior high school students who were taught by instructional methods based on their cognitive styles. Doney (1980) concluded that there is only a loose relationship between the Myers-Briggs Type Indicator of personality constructs and the Cognitive Style Mapping Inventory. The effects of advertising on people with varying cognitive styles produced no significant differences in responses to the advertising. However, preferences for the media used for the advertising did vary according to cognitive styles (Fruse 1974).

Cognitive Styles Related to Disciplines of Study

Academic. A number of studies have used cognitive style mapping to differentiate cognitive styles of successful and unsuccessful students in various disciplines. Significant differences were found for sixth grade spelling (Schwendinger 1976) and computer programming (Beleutz 1975), eighth grade reading comprehension (Horvath 1980), and high school science (Rundio 1973; Bruster 1976; Ogden and Bruster 1977). At the college level significant differences have been found for freshman English (Hoogasian 1970; Krupa 1974), beginning shorthand (Stencel 1974), self-paced typing (Luckadoo 1980), nursing (Volk 1975), art (Davenport 1978), and piano (Woughter 1974). Lycan (1980) used cognitive style mapping along with attitudinal measures to successfully predict the success of pre-nursing students in an anatomy-physiology class. However, the different instructional modes used did not produce different results. In a more general study Cotter (1970) found that the total cognitive style map was a reliable indicator of curricular choice, but the set of cultural determinants alone was not.

Developmental Studies. In a study of cognitive styles of developmental studies students at the college level, Griffin (1974a) found the cognitive styles of thirty-three students varied greatly. A later study by Griffin (1975) showed that developmental communication students differ from regular communication students on the first four theoretical symbolic elements. The regular students have more majors in this area and thus can receive theoretical information in more ways. However, high-risk students who are lacking in theoretical symbolic orientations but have majors in qualitative symbols can attain success in college and develop increases in their theoretical symbolic orientations (Robinson 1969). At the fifth and sixth grade levels, Basco (1974) concluded that cognitive style mapping had application in the teaching of students with impaired reading skills. Smithers (1974) compared the cognitive styles of students in three instructional levels and native and non-native students in Canadian secondary schools. There were several significant differences particularly between the urban-native students and other groups.

Non-academic. Cognitive style mapping has also been used to determine cognitive styles of persons successful in technical areas, various vocations, or non-academic areas. Robbins (1980) and Brennan (1977) found a significant relationship between levels of achievement and cognitive style mapping elements for electronics technology students. A collective cognitive style of both industrial technology teachers and students has been identified, but the student profile was found to differ only slightly from that of transfer students (Fragale 1969). Gural (1972) also used cognitive style mapping to develop a vocational counseling process for matching people and occupations, and he developed a program for training vocational counselors to use cognitive style mapping. Cognitive styles of instructors in Area Vocational Technical Institutes differentiated between instructors rated as effective and uneffective by both supervisors and students. However, the supervisors and students ratings did not coincide, so Van Ast (1976) concluded that cognitive style mapping could not be used as a device to select instructors. Boyer (1976) identified cognitive styles of successful persons in ten different occupations. Awtrey, Skipwith and Goldblatt (1979) have instituted a longitudinal research study to determine cognitive styles of students at various levels of success in nursing education. Sprecth (1978) found only a minor difference in cognitive style for "good" and "poor" drivers who had completed a drivers' education course. There was no significant difference in cognitive styles between successful and unsuccessful students in a college physical education golf class (American College Testing Program 1977) or between ideal and non-ideal students in law enforcement, cosmetology or business administration (Rice 1973).

## Counseling

The results of Greyson's (1971) evaluation of a counseling program comparing students' preferences for getting information about themselves via standardized tests or cognitive style mapping was inconclusive. Greyson did report that all students felt cognitive style mapping supplied useful new information and the mapping procedure was no more complicated than the standardized testing. The evaluation of orientation classes at Macomb County Community College produced mixed results also.

A larger percentage of the students in the orientation class using cognitive style mapping subsequently enrolled in academic courses, but their grade points in those courses were slightly lower than those of the control group (American College Testing Program 1977).

The results were more positive at the Woodbridge Campus of Northern Virginia Community College where cognitive style mapping was used in a general orientation class for all new degree seeking students. Cognitive style mapping was selected as a program to help these students develop a more positive academic self concept. In a study conducted in 1976 students who received both group and individual interpretations of their cognitive style map significantly improved their academic self concept scores. The study also showed a correlation of both academic self concept and degree of match of cognitive style and mode of instruction with grade acheivement (Mustachio 1977; Niles and Mustachio 1978).

Brodbeck (1974) did not use cognitive style mapping as a counseling tool, but he used it and the Preferred Counseling Style Questionnaire to determine the effects on counseling sessions of the degree of match between counselor and counselee on both cognitive and counseling styles. In a community college general orientation class there were higher degrees of satisfaction with the counseling sessions when there were major matches of cognitive style and to a lesser degree matches of counseling style.

The composite cognitive styles of students receiving forms of financial aid at a community college are different from each other. The differences in cognitive styles indicated that cognitive style mapping would be useful for counseling students receiving financial aid, and developmental or remedial instruction should be available for students receiving Economic Opportunity Grants (Zapinski 1973).

## Modes of Instruction

The major premise of cognitive style mapping is that individuals have unique preferences for various instructional modes and interact with instructional modes with varying degrees of effectiveness depending on their individual cognitive style. This interaction has been investigated in numerous studies with generally, but not entirely, positive results. Two studies of social science courses at Oakland Community College using cognitive style mapping and the BRUST program to provide the alternatives in instructional modes that individual student cognitive styles needed reported favorable results (Wangler 1974; Frever 1975). Frever's study showed a significant increase in course grades. Harper (1973) discussed particular elements in a cognitive style that were "necessary for students to enjoy and profit from individualized study" (Harper 1973, p. 6). Martin (1980) compared inductive and deductive instructional methods with sixth graders on a verbal concept attainment task. The results showed a significant interaction with cognitive style on initial learning but not on retention. Students whose cognitive style matched the instructional mode were found to be more successful by Terrell (1976) and Rafeld and Fraas (1980).

Other researchers have looked at the situation from another viewpoint by reporting significant differences in the cognitive styles of achievers and non-achievers in given instructional modes (DeNike 1973; Holm 1978; R. A. P. Smith 1974; Strother 1973; Lepke 1975, 1977; Hauser 1975; Rundio 1973; Warner 1970; Granger 1978). Frase (1977) reported mixed results as there were no significant differences of cognitive styles of students who were successful in either the lecture or discussion instructional method used, but there were significant differences in the cognitive styles of the unsuccessful students in each of the methods.

Terrell (1976) investigated the effect of matching cognitive styles and instructional styles on A-trait anxiety levels. Students with high A-trait anxiety experienced more reduction in anxiety in a matched situation than students who were unmatched by cognitive style. In another study college students given the opportunity to choose from three instructional modes chose modes that matched their cognitive styles even though they were not given the information about their styles (Gray 1976). In the Cultural Determinant set, not all elements were equally effective indicators of success. The students experienced all three instructional modes. Of the top achievers in each mode only two students were common to all groups and twenty-four were in only one group (Gray 1976).

Results were less positive in the two American College Testing Program (1977) studies involving instructional modes and cognitive styles. The study using a science course resulted in significant achievement gains for the experimental individualized program, but the effect of cognitive style mapping on the experimental group was unclear. It was impossible to tell if the gains in achievement were due to the experimental nature of the treatment classes or the cognitive style mapping program. The graduate education course study produced mixed results, for students matched to the peer/discussion mode showed gains in achievement but those matched to the individual/independent group did not. A third study using a humanities course found no significant relationship between cognitive styles and instructional modes. In other studies Hand (1972), Goodnow (1980), and Stringfellow (1975) also found no significant relationship between matching cognitive styles with instructional modes and achievement.

## Matching Teacher and Student Styles

Another area of cognitive style mapping has been concerned with the effects of matching the cognitive styles of teachers and students. Again the results range from significant effects to mixed results to no effects with the predominance of the results in the first category. In a study involving a high school English teacher and her students, Schoreder (1970) discovered a significant relationship between student-teacher cognitive style matches and both student ratings of teacher effectiveness and students' grades. McAdam (1971) found similar results in a college level communications course setting. Boozer and Anderson (1977) indicated increases in achievement in college classes in physical education, health, accounting and business law when students' cognitive styles were matched to teacher cognitive styles. Flagale (1969) also indicated the importance of matching student and faculty cognitive styles. Ort's (1971) research involved two teachers of French I and included other student and teacher characteristics in addition to cognitive style. The set of independent variables had a significant relationship to the teachers' evaluation of students. An interesting trend in this study was that "unlike" characteristics were more associated with student success than "like" characteristics were (Ort 1971).

By differentiating between cognitive style, teaching style and preferred teaching style, Lipson (1974) had mixed results that varied by achievement level in a junior high school class. Lange (1972) also reported mixed results when she used the failure-withdrawal rate and final grades as measures of achievement for a study involving thirty-three instructors and two hundred fifty-five students in a college nursing department. A significant relationship was found between matches and attitudes. Only two studies led to no significant relationship between student-teacher cognitive style matching and achievement or attitudes. One of these studies done by Whitney (1978) used adult learners who were enrolled in night and Saturday classes at the University of Iowa and were considered the more non-traditional student. The other study with no significant results involved teacher education classes at Michigan State University (American College Testing Program (1977).

Donahue (1975) found that using cognitive style matching to pair students, random pairing or student selected pairs for study groups did not significantly change either the achievement or attitudes of the students.

## Teacher Cognitive Styles

Cognitive style mapping has been used to determine styles of teachers as well as students. The effect of mapping information on teacher behavior has also been the subject of research. Bowman (1975) found that teachers varied their classroom behavior more after receiving information about their students' cognitive style and the teaching behaviors were more focused to specific needs. In another study teachers placed in teaching situations that did not match their teaching style did not perform as well as those whose styles were matched to the teaching situation (Wyett 1967).. Crookes (1977) compared cognitive styles and teaching styles of teachers in applied fields with those in academic areas. Four of the cognitive style elements and one of the teaching style elements were significantly different, but the majority of the elements in both cognitive and teaching styles showed a great deal of similarity. Perry (1975) compared the cognitive styles of elementary teachers and the para-professional working with each teacher. He found that the teams of teacher and para-professional were well matched on cognitive style, actual teaching style and preferred teaching style. Perry hypothesized that the good relationships between the members of the teams possibly existed because of the matches in style.

## Cognitive Style Mapping Inventory

The cognitive style mapping inventory has been the subject of several studies itself in an attempt to assertain its validity and its structure. A factor analysis of the modified inventory used at Mountain View College produced five factors from the twenty-seven elements in the cognitive style map. No attempt was made to identify the characteristics of any of the five factors (Clark and Sheriff 1976; Sheriff 1977). Sailor (1976) also ran a factor analysis on the mapping inventory and included measures of field dependence and locus of control and other demographic data. Three factors specific to the cognitive style map along with five other factors emerged. Of the twenty-eight mapping elements in this inventory only four were related to field dependence or locus of control.

Timm (1980) analyzed seventeen of the twenty-seven elements in the cognitive style mapping inventory used at Fox Valley Technical Institute for sex bias. Forty-eight of the one hundred forty-seven statements were judged to be sex biased. The statements were rewritten to eliminate the bias and the new statements were found not to affect the outcome of the inventory significantly.

Attempts to establish the validity of the mapping procedure have met with varying degrees of success. Baker (1977) compared the cognitive styles of high school foreign language students as determined by cognitive style mapping with their teachers' informal diagnosis after a year of study. Correlations of .69 and .73 on only two elements met the established criterion. The correlations ranged from .19 to .73 with a mean of .48. Baker felt the lack of correlation between the two measures was sufficient enough to question the validity of either measure.

Cognitive style map elements were used as predictors for six measures of academic competency by London (1975) in his attempt to establish concurrent validity of cognitive style mapping for lower-class students. The qualitative elements were the best predictors. While the relationships were low, the F ratios were significant.

Bass (1972, 1977) also tested the validity of selected qualitative elements for nursing students by comparing the mapping results to evaluations by experts of video tapes of task performances. There were no significant differences in mapping results and evaluations.

Keyser (1980b) discusses five types of validity and the self validation procedure contained in the mapping process as students are encouraged to change those mapping elements with which they are in disagreement. Keyser states that face validity and content validity are not involved with statistical significance but are based on the judgment of the staff administering the inventory and outside experts. Keyser also presents percentages showing that a vast majority of students participating in the mapping found it useful and informative (Keyser 1980b, pp. 20-1). Boyer (1976) also finds the inventory valid, for in three hundred interviews with people who had completed the inventory and had the results interpreted, no one denied or refuted the information in the map. Comparing the results of the complete Hill model to observed behaviors of college freshman chemistry students, Holm (1978) concluded that the cognitive style map accurately determined the students' cognitive styles and preferred behaviors.

Reliability and validity for the cognitive style inventory as used at Northeast Missouri State University were established using edumetric measures as opposed to psychometric measures. Edumetric measures involve changes within individuals rather than differences between individuals (Heun, Heun and Schnucker 1975; Heun, Heun, Martin and Schnucker 1976).

## Mathematics

Some research has been done in the area of mathematics using Hill's model or modifications to determine cognitive style. Mapping the cognitive styles of a sample of sixth graders and their teachers. Wasser (1969) found that the teachers' system of grading in mathematics as well as some other subjects may depend on the similarity of the teacher and student cognitive styles. The relationship did not exist for reading or spelling. Speer (1976, 1977) developed a clinical model for diagnosing mathematics learning disabilities and prescribing successful corrective teaching. Hill's cognitive style mapping is built into the model.

Blanzy (1970), Grasser (1973), Ribley (1977), Hollis (1974) and Shuert (1970) all concluded from their studies that it was possible to differentiate between students who are successful and unsuccessful in mathematics courses. Hollis's sample was elementary school children while the remaining studies concerned college students. Grasser used elementary algebra students; Ribley used general statistics students, and Shuert's sample included students from several mathematics classes. Blanzy (1970) also found a relationship between student-teacher cognitive style match and achievement in two of the three classes used and in ratings of teacher effectiveness by the students. Blanzy's study also included programmed instructional methods and found students with preferences for reading and independence performed better with programmed instruction than those who did not have these preferences. Hollis also found a relationship between cognitive styles and instructional strategies and teachers' and parents' perceptions of the students' cognitive styles (Hollis 1974).

Berke (1976) used cognitive style mapping as an aid for teachers of developmental college students in a program involving reading, writing and mathematics. The teachers used the results of the students' cognitive style maps to choose appropriate instruction for the students. The overall results showed no significant difference between groups using cognitive style mapping information and those that did not. However, the mathematics program using cognitive style mapping was judged to be the most successful. Berke also hypothesized that students who were versed in cognitive style mapping theory would be able to select their own cognitive style map from a group of several maps. However, the students' selections of their cognitive style map were not significantly different from chance selections.

Gormley (1978) outlines instructional procedures that can be used for the various mathematics courses offered in community colleges and includes the advantages and disadvantages of the instructional procedures. The characteristics of students in each of the types of courses are also discussed with cognitive style mapping via the Mountain View Modification of the Hill model suggested for use to determine individual student cognitive styles.

## Cognitive Style Mapping Programs

Young (1974) and Fourier (1980) both investigated the effects of a cognitive style mapping program with disclosure of the students' maps of learning preferences to the students themselves. The results of the two studies are conflicting. Young used community college freshman English students and found no significant differences between experimental and control groups on either achievement or self esteem. Fourier's study produced significant differences in achievement comparing the cognitive style mapping program used in the experimental groups to the Allport-Vernon-Lindzey Study of Values instrument in the control groups. Community college students in Introduction to Psychology, Life Sciences and Humanities courses made up Fourier's sample.

The research involving cognitive styles, locus of control, learning modes, developmental studies or mathematics at the post secondary level is not conclusive. The same is true of research using Hill's model of cognitive style mapping to identify individual preferences for learning modes and the use of that information to improve achievement particularly in mathematics education or developmental studies. None of the research involving Hill's model has considered the effect of such a mapping program on students differing in locus of control. Therefore, it seems worthwhile to combine the constructs of a cognitive style mapping program and locus of control to determine if the combination can explain the varying effects of a mapping program on post secondary developmental mathematics students.

## CHAPTER III

## DESIGN OF THE STUDY

### Sample

The sample used in this study was selected from regularly enrolled basic mathematics students at South Oklahoma City Junior College in the fall of 1981. Several modes of instruction are available in the mathematics program at South Oklahoma City Junior College. Examples of the modes available are slide-tape presentations, peer tutoring, small group sessions, concrete manipulative materials and individual pacing. Therefore, basic mathematics students have a variety of modes available from which to choose. Those students who participate in a cognitive style mapping program have ample opportunity to make use of the information gained about their learning style preferences by choosing appropriate learning modes.

In the fall of 1981 there were eleven sections of basic mathematics offered. Five of the sections were selected for the treatment group receiving the cognitive style mapping program and six of the sections were selected for the control group. Two of the control classes were very small. The total initial enrollment in treatment classes was 90 students and in control classes was 104. International students were not used in the study to eliminate language problems as a confounding variable. The night classes meeting one night a week at 5:30 p.m. have some students attending who enroll in an eight-week course and attend both the Monday and Wednesday classes or the Tuesday and Thursday classes. While these students were not included in the study, their presence at two of the night classes necessitated the Monday and Wednesday 5:30 p.m. classes and the Tuesday and Thursday 5:30 p.m. classes being both control or both experimental. One instructor taught four sections of basic mathematics and a second instructor taught two sections. All other sections were taught by instructors teaching only one section of basic mathematics. Each of the instructors teaching more than one section was assigned an equal number of control and treatment sections. An attempt was also made to have an equal number of night and day sections in each of the treatment and control groups. The one section on Saturday morning was treated as a night section because its meeting schedule and students are more like the night sections than the day sections. All the basic mathematics classes meet in the math lab, and students are free to enter the lab when they arrive. Therefore, classes that met in consecutive time periods also needed to be in the same treatment or control situation. Satisfying all of these constraints was possible. Table I gives the meeting times of the classes in the treatment group and control group.

The cognitive style mapping program is used regularly at South Oklahoma City Junior College in a variety of classes. The students in the control sections who participated in the mapping program in a class other than their basic mathematics class were eliminated from the study because they had received the treatment. The identity of these students was determined by checking all the cognitive style maps produced for the college for the fall 1981 semester.

TABLE I

CLASS MEETING TIMES

A. Treatment

| | |
|---|---|
| 5:30 p.m. - 8:00 p.m. | Tuesday |
| 5:30 p.m. - 8:00 p.m. | Thursday |
| 8:05 p.m. - 9:20 p.m. | Tuesday, Thursday |
| 8:30 a.m. - 9:55 a.m. | Monday, Wednesday |
| 10:00 a.m. - 10:55 a.m. | Monday, Wednesday, Friday |

B. Control

| | |
|---|---|
| 5:30 p.m. - 8:00 p.m. | Monday |
| 5:30 p.m. - 8:00 p.m. | Wednesday |
| 8:30 a.m. - 11:00 a.m. | Saturday |
| 9:30 a.m. - 10:55 a.m. | Tuesday, Thursday |
| 11:00 a.m. - 12:25 p.m. | Tuesday, Thursday |
| 1:30 p.m. - 2:55 p.m. | Tuesday, Thursday |

All students in the basic mathematics classes were given Rotter's I-E Scale to determine their locus of control. Based on those results, an external group and an internal group were formed within each of the treatment and control groups. Twelve students were selected to form each of the four groups for the sample. A cell size of twelve gives a power of at least .90 to detect as significant at the .05 level a difference of one standard deviation. In order to have students in the sample that scored on the extremes of the locus of control instrument, all students scoring thirteen and above were part of the external groups and those scoring five and below were part of the internal groups. To have exactly twelve students in each group enough students were randomly selected from those scoring twelve for the external groups and six or seven for the internal groups to bring the total to twelve in each of the four groups.

## Procedure

During the first week of classes students in both treatment and control classes completed Rotter's I-E Scale and a test of their basic mathematical skills (see Appendix A). The skills test is used regularly as a diagnostic tool to place students at the appropriate content level in the beginning of the course.

The cognitive style mapping program began with the first class meeting of the semester. The Learning Preference Inventory used to produce a student's learning preference map was briefly explained and handed out. The students were asked to complete the inventory outside of class and return the completed inventory at the second class meeting. Those students who did not have a completed inventory at the beginning of the second class meeting completed the inventory during that class meeting or returned a completed inventory by the end of the second week of classes.

The inventories were computer scored and the results returned to the students during the third week of classes. At the same time an interpretation session was held. The interpretations lasted about an hour and were all led by the researcher. A script and a series of slides were used for the interpretations with a question and answer period following. There were few questions asked. Handouts of written suggestions for students who scored a major on each element and also for those who scored a minor or negligible on each element were given to each student. The suggestions concerned ways to use profitably the learning preferences for qualities with a score in the major area and methods of compensation for qualities with a score in a minor or negligible area. Students who were not present for the interpretation sessions viewed a video tape of another similar interpretation during the third or fourth week of classes.

The control groups participated in a sentence completion activity (see Appendix A) the first week of classes. The sentences the students completed concerned their feeling about mathematics. The instructor collected the completed sentences and read selected responses to the class to show that the students were not alone in their feelings about mathematics. During the third week in classes that met more than once a week and during the fourth week in classes meeting once a week, the instructors again had the control classes get together as a group. More of the earlier sentence completions were discussed along with the students' present feelings after having been involved in a math class for a few weeks. Thus the control classes had group activities in which the treatment classes did not participate. The activities took approximately the same amount of time as the activities involved in the cognitive style mapping program.

As the basic mathematics students passed a module in the course, they completed a learning methods check list (see Appendix A). On the check list the students indicated which of the instructional modes and materials they had used on the module.

Posttests of basic mathematical skills (see Appendix A) were administered during the tenth and eleventh weeks of the semester. The test was administered to students during the first class period they attended during that two-week period. That time frame gave students in the treatment groups at least seven weeks to apply the information gained about their individual learning styles to their basic mathematics course.

## Instruments

The basic mathematical skills test used as the pretest is a forty problem test requiring computations with whole numbers, fractions, decimals and percents. The test is the diagnostic instrument used in all basic mathematics classes at South Oklahoma City Junior College. Another version of the test was used for the posttest. The pretest and posttest were examined by the mathematics professors at South Oklahoma City Junior College who were involved with the basic mathematics program. The two tests were judged to be comparable and valid measures of the mathematical skills included in the basic mathematics course.

The Learning Preference Inventory consists of 216 statements to which a student decides whether the statement applies to him rarely, sometimes or usually. The responses are weighted with "rarely" receiving a weight of one, "sometimes" a weight of three and "usually" a weight of five. The total of eight statement scores makes up the total score for each quality. The inventory was originally developed by Hill as part of the Educational Sciences and shortened and adapted by Ehrhardt at Mountain View College. The inventory used in this study is a further minor revision of the Mountain View instrument, a revision done by the faculty of South Oklahoma City Junior College.

The Learning Preference Inventory maps twenty-seven qualities. These qualities give information in three general areas. The first area is called Symbolic Orientations and describes an individual's learning preferences dealing with theoretical symbols, words and numbers, and qualitative symbols. Qualitative symbols involve senses, feelings, cultural codes, values and insights which are used to give meaning to one's environment and personal experiences. The second area, Cultural Determinants, refers to ways individuals gain meaning from their social relationships or cultural influences. The main social influences are family, associates and authority figures. The last area, Modalities of Inference, is concerned with the methods of reasoning used by individuals to reach conclusions (Hill 1976; Reece 1978).

If a score on a particular quality ranges from 27-40, this quality is interpreted to be a major influence in an individual's learning preferences. This range of scores corresponds to the fiftieth to the ninety-ninth percentiles of a population of persons possessing this quality. A score of 16-26 categorizes a quality as a minor influence corresponding to the twenty-fifth to forty-ninth percentiles. A score of less than 16 indicates the quality is of negligible influence (Hill 1981, p. 426; Cognitive Style Mapping Student Guide, no date).

The foundation of Hill's model of cognitive style mapping is an attempt to provide education with a precise language and structure. The emphasis is on educational cognitive styles as they are applied in both formal and informal situations (Hill 1981, p. 65). Hill defines educational cognitive style rather than attempting to adapt psychological definitions of cognitive style to education (Speer 1979, p. 25). Educational testing is primarily interested in measuring the growth within an individual as compared to psychological testing which is interested in measuring differences between individuals (Carver 1974, p. 512). Hill considers individual educational cognitive styles as dynamic in nature and changing in given situations (Hill 1981, p. 192). Therefore, Heun, Heun and Schnucker have established the reliability and validity of a cognitive style mapping instrument based on Hill's inventory in terms of edumetric measurements as opposed to psychometric measurements.

> . . . psychometric results show the measurement of individual differences in relation to a group but not necessarily the measure of what an individual has learned. . . . The edumetric test is designed to measure the gain or growth of an individual's knowledge, learning skills or abilities. (Heun, Heun and Schnucker 1975, pp. 1-2)

The difference in psychometric and edumetric reliability and validity is summarized by the same authors.

> . . . psychometric reliability involves the consistency of a test to show the relationship of an individual to a relevant group or population on one occasion. Edumetric reliability involves the consistency of a test to show the amount of gain or change within an individual on two different occasions. Psychometric validity involves the correlation between individual differences while edumetric validity involves the degree of sensitivity of a test to measure the change or gain of an individual. (Heun, Heun and Schnucker 1975, p. 4)

The reliability and validity of the cognitive style mapping instrument were established in a study that involved a sample of 71 freshman and sophomore students at Northeast Missouri State University in 1974. The cognitive style mapping inventory and other measures of skill development were administered to the students at the beginning and end of the fall semester as pretests and posttests. The differences in scores between the pretests and posttests were used as the measures of growth in the study to establish the edumetric reliability and validity of the cognitive style mapping inventory. Reliability was established using the Kuder-Richardson 20 formula and the split-half correlation approach. Twenty of the twenty-seven KR-20 coefficients were significant at the .05 level and 18 at the .01 level and ranged from .054 to .752. Internal validity was calculated by correlating the item gain scores with element total gain scores on criterion skill tests. External validity was calculated by correlation with concurrent skill test gains. Ninety-four percent of the items had internal validities significant at the .05 level and 81 percent were significant at the .01 level and ranged from .379 to .737. Two of the five external validity coefficients were significant at the .05 level (Heun, Heun and Schnucker 1975, pp. 6-9,11-13).

Since the range of ages and the educational levels of the sample were limited, the estimated reliability and validity coefficients were computed for the larger population using Hill's narrow range-wide range procedures. All estimated reliability and validity coefficients were significant at the .01 level and ranged from .584 to .938 (Heun, Heun and Schnucker 1975, pp. 7-9, 14).

Rotter's I-E Scale is a 29 item instrument. For each item a person is to select one of two choices that she or he more strongly believes to be the case as far as she or he is concerned. Six of the 29 items are filler items; therefore, the scores range from zero to 23 with the higher score representing an external locus of control.

Numerous reliability and discriminant validity studies of the I-E Scale have been done with college students. A study using Ohio State University students resulted in a split-half internal consistence correlation of .65. Kuder-Richardson reliabilities of .73 and .70 were reported. A study using a national stratified sample of high school students showed a Kuder-Richardson reliability of .69. Test-retest studies have also been done resulting in similar correlations. The I-E Scale when compared with the Marlow-Crowne Social Desirability Scale to determine discriminant validity resulted in correlations of -.35 to -.07 for samples of college students which indicate that the two instruments measure different constructs. Means of samples of college students ranged from 7.71 to 9.62 and standard deviations ranged from 3.59 to 4.07 (Rotter, Chance and Phares 1972, pp. 267-280).

## Data Analysis

An initial two-way analysis of variance was used on the pretest achievement scores. Locus of control was one main effect and the treatment and control groups involving the cognitive style mapping program were the other main effect. A significant difference of scores on the pretest on either of the main effects or the interaction at the .20 level necessitates the use of analysis of covariance on the posttest scores to control for the differences in pretest scores. This relatively liberal significance level was used to detect even small differences.

The first hypothesis stated at the end of Chapter I was tested by a two-way analysis of covariance on posttest achievement scores with the treatment-control main effect supplying the results at the .05 significance level. (This analysis was necessitated by the fact that there was a significant difference on the locus of control variable of the pretest.) The pretest scores were used as the covariate. Hypothesis five was also tested at the .05 level by the interaction effect of the same analysis of covariance. Hypotheses two, three and four were tested by simple main effects of the treatment level of the design. Hypothesis three was tested by the simple main effects of the internal level of locus of control and hypothesis four by the external level of locus of control. Table II is a chart of the design of the experiment.

The learning methods check lists were sorted by group. A tally was made of the number of students in each group using each of the instructional modes or materials available. The results of the tally are in Appendix B with the raw data.

TABLE II

DESIGN OF THE EXPERIMENT

| Locus of Control | Treatment | Control |
|---|---|---|
| | cognitive style mapping program | "feelings about math" activities |
| internal | A1 | A2 |
| external | B1 | B2 |

## CHAPTER IV

## FINDINGS OF THE STUDY

### Results Concerning the Pretest and the I-E Scale

The I-E Scale was scored by the researcher. Table III presents the means and standard deviations of each of the four groups in the sample on the I-E Scale. Raw scores are in Appendix B. The scores for the internal groups ranged from 1-7, and the scores of the external groups ranged from 12-18. The internal-treatment group had a mean of 4.33 and a standard deviation of 1.97. The internal-control group had a mean of 3.75 with a standard deviation of 0.87. The external-treatment group had a mean of 15.25 and a standard deviation 1.86, while the external-control group mean was 13.25 with a standard deviation of 1.36. The overall mean of all four groups was 9.15.

The pretests of basic mathematics skills were graded by personnel of the mathematics department of South Oklahoma City Junior College. There is a possible score of 40 on the pretest. The range of scores in the sample was from 1-31. Table IV presents the means and standard deviations for each of the groups on the pretest. Raw scores are in Appendix B. The mean for the internal-treatment group was 20.42 with a standard deviation of 5.57. The mean for the internal-control group was 17.83 and the standard deviation was 7.78. The mean of the external-control group was 15.0 with a standard deviation of 8.43. The overall mean for all groups together on the pretest was 16.85 with a standard deviation of 8.06.

TABLE III

LOCUS OF CONTROL STATISTICS

| | Treatment | Control |
|---|---|---|
| Internal | $\bar{X}$ = 4.33<br>$S_x$ = 1.97 | $\bar{X}$ = 3.75<br>$S_x$ = 0.87 |
| External | $\bar{X}$ = 15.25<br>$S_x$ = 1.86 | $\bar{X}$ = 13.25<br>$S_x$ = 1.36 |

TABLE IV

PRETEST STATISTICS

| | Treatment | Control |
|---|---|---|
| Internal | $\bar{X}$ = 20.42<br>$S_x$ = 5.57 | $\bar{X}$ = 17.83<br>$S_x$ = 9.39 |
| External | $\bar{X}$ = 14.17<br>$S_x$ = 7.78 | $\bar{X}$ = 15.0<br>$S_x$ = 8.43 |

To determine if the differences between the means of each of the four groups were significant at the .20 level, a two-way analysis of variance was used. The liberal significance level was used to detect even small differences. One main effect was the treatment and control groups. Locus of control was the other main effect. Table V contains the results of the analysis of variance.

TABLE V

ANALYSIS OF VARIANCE FOR THE PRETEST

| Source | df | Mean Square | F | Sign. of F |
|---|---|---|---|---|
| Group | 1 | 9.188 | 0.15 | 0.704 |
| Locus of Control | 1 | 247.521 | 3.95 | 0.053 |
| Group and Locus of Control | 1 | 35.021 | 0.56 | 0.459 |
| Error | 44 | 62.688 | | |
| Total | 47 | 64.893 | | |

The locus of control main effect F value of 3.95 is significant at the .20 level which shows that there is a difference in the pretest scores of the internal and external groups. The differences of the treatment and control groups and the interactions were not significant. However, since the locus of control main effect is significant, the analysis of covariance is used for the analysis of the posttest with the pretest scores as the covariate to control for the initial differences shown by the pretest scores.

Results Concerning the Posttest

The posttests were also scored by the personnel of the mathematics department at South Oklahoma City Junior College. As with the pretest, the posttest had a possible score of 40. The posttest scores in the sample ranged from 8-39. The means and standard deviations of the posttest scores for each group are presented in Table VI. The raw scores are in Appendix B. For the internal-treatment group the mean was 28.0 and the standard deviation was 7.27. The mean and standard deviation for the internal-control group were 30.25 and 6.22 respectively. The mean and standard deviation for the external-treatment group were 25.08 and 8.37 respectively. For the external-control group the mean was 28.58 and the standard deviation was 7.28. The overall mean and standard deviation were 27.98 and 7.33.

The above means which are the same as those in Table VI are the means for the posttest only and do not include the corrections for the pretest scores. It is the corrected means that result from the analysis of covariance with the pretest scores as the covariate that were used to test the hypotheses. The corrected means and the standard errors of the corrected means are presented in Table VII. The corrected mean for the internal-treatment group is 25.76 with a standard error of 1.61. The corrected mean for the internal-control group was 29.64 with a standard error of 1.58. For the external-treatment group the corrected mean was

26.77 and the standard error was 1.60. For the external-control group the corrected mean was 29.75 and the standard error was 1.58.

TABLE VI

POSTTEST STATISTICS
(uncorrected)

| | Treatment | Control |
|---|---|---|
| Internal | $\bar{X}$ = 28.0<br>$S_X$ = 7.27 | $\bar{X}$ = 30.25<br>$S_X$ = 6.22 |
| External | $\bar{X}$ = 25.08<br>$S_X$ = 8.37 | $\bar{X}$ = 28.58<br>$S_X$ = 7.28 |

TABLE VII

CORRECTED POSTTEST STATISTICS

| | Treatment | Control |
|---|---|---|
| Internal | $\bar{X}_c$ = 25.76<br>$SE_{\bar{X}}$ = 1.61 | $\bar{X}_c$ = 29.64<br>$SE_{\bar{X}}$ = 1.58 |
| External | $\bar{X}_c$ = 26.77<br>$SE_{\bar{X}}$ = 1.60 | $\bar{X}_c$ = 29.75<br>$SE_{\bar{X}}$ = 1.58 |

The two-way analysis of covariance and tests of the simple main effects were used to test the five hypotheses. The treatment and control groups were one main effect with locus of control as the second main effect. The pretest was used as the covariate. The .05 significance level was used. The results of the analysis of covariance appear in Table VIII. The first hypothesis, there is no difference in basic mathematics achievement between students who have completed a cognitive style mapping program and similar students who have not, can be rejected. The main effect involving treatment and control has an F value of 4.73 which is significant at the .05 level. Since both control group means are greater than the treatment group means, the control group's achievement was significantly better than the treatment group's achievement.

TABLE VIII

ANALYSIS OF COVARIANCE OF POSTTEST

| Source | df | Mean Square | F | Sign. of F |
|---|---|---|---|---|
| Group | 1 | 140.24 | 4.73 | 0.035 |
| Locus of Control | 1 | 3.44 | 0.12 | 0.735 |
| Group and Locus of Control | 1 | 2.37 | 0.08 | 0.779 |
| Pretest (covariate) | 1 | 1086.75 | 36.64 | (0.0001) |
| Error | 43 | 29.66 | | |
| Total | 47 | 53.81 | | |

The fifth hypothesis, the difference on basic mathematics achievement between the cognitive style mapping and control groups for internals is not different from the difference between the cognitive style mapping and control groups for externals, was tested by the interaction effect from the same analysis of covariance. The F value of the interaction was 0.08 which is not significant at the .05 level. Thus the fifth null hypotheses cannot be rejected.

The null hypotheses two, three, and four were tested using tests of simple main effects. Table IX summarizes the results of the simple main effects tests. The F tests are compared to a critical value of 4.07 for one and forty-three degrees of freedom (Mood and Graybill 1963, p. 429).

The second hypothesis, there is no difference in the effect of a cognitive style mapping program on the basic mathematics achievement of students who have an external locus of control and those who have an internal locus of control, was tested by the simple main effect using the treatment level means. The F value of this test was 0.20 which is less than the critical value of 4.07. Therefore, the second null hypothesis cannot be rejected.

The third hypothesis, within the internal locus of control groups there is no difference in basic mathematics achievement between students who have completed a cognitive style mapping program and those who have received an equal amount of time of attention but have not participated in the cognitive style mapping program program, was tested by the simple main effect using the internal level of locus of control. The value of F for this test was 3.03 which is less than the critical value of 4.07.

Therefore, the third null hypothesis cannot be rejected.

TABLE IX

SIMPLE MAIN EFFECTS TESTS

| Source | df | Mean Square | F | Critical F |
|---|---|---|---|---|
| Treatment Internal vs. External | 1 | 6.08 | 0.20 | 4.07 |
| Internal Treatment vs. Control | 1 | 89.93 | 3.03 | 4.07 |
| External Treatment vs. Control | 1 | 53.17 | 1.79 | 4.07 |
| Error | 43 | 29.66 | | |

The fourth hypothesis, within the external locus of control groups there is no difference in basic mathematics achievement between students who have completed a cognitive style mapping program and those who have received an equal amount of time of attention but have not participated in the cognitive style mapping program, was tested by the simple main effect using the external level of control. The F value of this test was 1.79 which is less than the critical value of 4.07. Hence, the fourth null hypothesis also cannot be rejected.

In summary, a significant difference in achievement exists between the treatment and control groups with the achievement of the control groups being greater than that of the treatment groups. The null hypotheses (two through five) involving the relationships between a cognitive style mapping program and locus of control were not rejected.

# CHAPTER V

# CONCLUSION

## Summary of the Study

One of the current trends in education is to provide instruction that will lead to successful learning experiences for each learner. Individual differences have been acknowledged to have a significant effect on the effectiveness of instructional modes and materials. Research has shown that both cognitive styles and locus of control are constructs of individual differences that influence educational practices and results.

Hill's model of cognitive style mapping is an attempt to delineate a person's total educational cognitive style. The information gained by students from their cognitive style maps should enable them to choose instructional modes and materials which would be most meaningful to them. It should also aid the students in compensating for any particular weaknesses they may have. The whole idea of individual differences is that no one technique is beneficial for all. Therefore, a cognitive mapping program should not be equally helpful for all students.

Locus of control has been shown by research to be related to educational variables including achievement. Developmental studies students are often considered more external than more traditional students. These developmental students are also in need of more support services to be successful in community colleges.

There is no research relating interactions of cognitive style mapping programs and students of varying locus of control. This study attempts to study the effect of a cognitive style mapping program on the basic mathematics achievement of community college developmental studies students who have either an internal or external locus of control.

Basic mathematics classes at South Oklahoma City Junior College in the fall of 1981 were used to study this effect. The locus of control of all students was measured using Rotter's I-E Scale. The students were divided into treatment and control groups by classes. The treatment groups participated in a cognitive style mapping program based on the Mountain View College Modified Hill model. The control groups participated in a sentence completion activity and discussion dealing with their feelings about mathematics. The mathematics facilities at South Oklahoma City Junior College include several alternate instructional modes. Therefore, students gaining information about their learning preferences have an opportunity to use that information in choosing instructional modes and materials. Pretests and posttests of basic mathematics skills were used to determine achievement.

A two-way analysis of covariance and tests of the simple main effects were used to test the following hypotheses:

1. There is no difference in basic mathematics achievement between students who have completed a cognitive style mapping program

and similar students who have not.

2. There is no difference in the effect of a cognitive style mapping program on the basic mathematics achievement of students who have an external locus of control and those who have an internal locus of control.

3. Within the internal locus of control groups there is no difference in basic mathematics achievement between students who have completed a cognitive style mapping program and those who have received an equal amount of time of attention but have not participated in the cognitive style mapping program.

4. Within the external locus of control groups there is no difference in basic mathematics achievement between students who have completed a cognitive style mapping program and those who have received an equal amount of time of attention but have not participated in the cognitive style mapping program.

5. The difference on basic mathematics achievement between the cognitive style mapping and control groups for internals is not different from the difference between the cognitive style mapping and control groups for externals.

The only hypothesis rejected at the .05 level of significance was the first hypothesis. Since the control groups' achievement means were higher than the treatment groups', the significant difference was in favor of the control groups.

## Inferences

The only null hypothesis this study was able to reject was the first hypothesis. There was a significant difference at the .05 level of the achievement on basic mathematics skills between the treatment and control groups for this sample of basic mathematics students. However, it was the achievement of the control groups who participated in a sentence completion and class discussion activity that was significantly greater than the achievement of the treatment groups who participated in the cognitive style mapping program. The other four null hypotheses could not be rejected. Therefore, it appears that there was no difference between internals' and externals' basic mathematics achievement whether they were involved in a cognitive style mapping program or not.

The results of this study support those of Young (1974), Hand (1972), Goodnow (1980), Stringfellow (1975), and Reece (1978b). The Young and Reece studies involved cognitive style mapping programs in which the students were given information on their preferred learning styles. The achievement of students with this learning style information was compared to the achievement of students who did not receive the learning style information. The Reece study used secretarial science and developmental mathematics and English students in a two-year technical college. The instructors used the individual student cognitive style maps to prescribe instructional methods in consultation with the student. There were both group and individual interpretations of the maps (Reece 1978b). Young's sample was drawn from community college freshman English classes. The instructors, subject matter and teaching techniques were the same for both treatment and control groups (Young 1974). Both Young and Reece reported no significant differences in achievement between treatment and control groups.

The emphasis of the studies done by Goodnow (1980), Stringfellow (1975) and Hand (1972) was different from the present study and those done by Young and Reece, but the results are consistent. Goodnow, Stringfellow and Hand determined the degree of match between the preferred learning styles of the students and the instructional modes being used. Goodnow and Hand used a community college accounting course and a developmental science course respectively. Stringfellow's sample was chosen from a university College of Dentistry student population. All three studies used some form of individually paced instruction and compared the achievement levels of students with differing degrees of match between student learning style and instruction style and found no significant differences.

The cognitive style mapping program in an orientation course used by Mustachio (1977) had mixed results. The effect of various combinations of types of cognitive style mapping interpretations on student self concept and achievement provided mixed results. While there were no significant differences, students exposed to both group and individual interpretations did increase their global and academic self concepts. The study also considered the effect of the degree of match between learning styles and course schedules and found a direct relationship with achievement.

The results of the present study do not support the findings reported by Fourier (1980), Ehrhardt (1980), Keyser (1980a,b), Hampton (1972) and Frever (1975). Fourier's study involved community college students in psychology, life sciences and humanities courses. The subjects in both treatment and control groups were volunteers. The treatment group participated in a cognitive style mapping program with the interpretations done individually. The mapping inventory used was scored on a five point scale rather than a three point scale as was used in the present study. The control group completed the Allport-Vernon-Lindzey Study of Values instrument. The instructors for the courses were not aware of group membership--treatment or control--of the students involved in the study. Achievement measures were final grades in the courses. The differences in achievement between treatment and control groups were significant for all three courses with the treatment achievement means ranging from 6.77 to 8.19 percentage points higher (Fourier 1980).

Ehrhardt, Keyser, Hampton and Frever describe cognitive style mapping programs that are institution wide and involve the implementation of alternate instructional methods with the use of cognitive style mapping for prescriptive purposes. Most of the programs offer multiple methods of interpretation. Ehrhardt describes the program at Mountain View College where the program has been evaluated several times via an opinion questionnaire. The reactions of both faculty and students are very positive (Ehrhardt 1980). Keyser describes the program at Mount Hood Community College and Hampton and Frever describe the BURST program at Oakland Community College where Hill was president and implemented the program. Keyser, Hampton and Frever all report increases in the percentages of successful students since the implementations of the cognitive style mapping programs (Keyser 1980a, b; Hampton 1972; and Frever 1975).

The significant difference in achievement found between that of the control groups and treatment groups deserves discussion. The achievement of the control groups in this study was significantly greater than that of the treatment groups. The control groups participated in a sentence completion activity followed by a discussion during the first week of classes and a similar follow-up discussion during the third or fourth week. The sentence completions and discussions involved the students' feelings about mathematics and their interactions with various aspects of mathematics. While these activities were intended to be a placebo to control the Hawthorne effect, they may have indeed contributed to the feeling of well being of the students and become an alternate treatment rather than a placebo. These activities were well received by the students involved, and the instructors of the control sections were generally impressed with the responses of the students. Students' feelings about their abilities in mathematics and mathematics itself may influence their performance. The discussion of these feelings and the airing of the anxieties involved may have sufficiently contributed to the basic mathematics achievement of the students in the control group and account for the significant difference in their achievement when compared to the achievement of the students who completed the cognitive style mapping program.

## Recommendations

Numerous instructional modes and materials are available to all basic mathematics students at South Oklahoma City Junior College. Any of the materials or modes may be used at any time the student chooses during the course. This freedom of choice, the wide selection available, and the students' naturally occurring knowledge of their learning preferences may partially account for the lack of effect of the cognitive style mapping program on either external or internal basic mathematics students. Further study needs to be done in similar situations and in different subject areas as previous research has indicated that the results in various areas of developmental studies may not be consistent. Along the same line further research ought to compare the effects of a cognitive style mapping program on students in courses that are not considered developmental with those that are.

The implementation of a cognitive style mapping program can vary greatly from school to school and also from situation to situation within a school. The type of interpretation session can vary. Examples of some interpretation settings are one-on-one between the student and counselor or instructor; group discussions led by the course instructor, counselor, or other individual; or presentation of the interpretation by a video tape or some type of audio-visual medium with little student contact with the instructor or a counselor. It is also possible to use a combination of methods. The larger the program and the greater the number of faculty and staff trained in cognitive style mapping, then the greater the number of options available. The effects of a cognitive style mapping program may also depend on other aspects of the situation in which the students are introduced to cognitive style mapping. The effects may depend partly on whether the student voluntarily takes part in the program or is forced to take part as a member of a class or as an institutional requirement. The subject matter of a particular course involved may have some bearing on the effectiveness of a program offered as part of a course. Whether the course is an orientation or self-help course dealing with personal information, a people (other than self) oriented course or a science or mathematics course, for example, may influence the use of the cognitive style mapping information in the course. Another difference in approach that may influence the effectiveness is whether cognitive style mapping is presented to the student once and then not mentioned again or whether the topic is discussed on a continuing basis between student and instructor or counselor. The effects may also depend on whether the student, instructor or some degree of both instructor and student assume the responsibility of applying the learning preference information gained.

In the present study, group interpretation sessions were held. Although the researcher did the interpretations in person, slides and a written script were used. The researcher also was the instructor in two of the treatment classes. For the other three classes the researcher was not the instructor and was presented to the classes as another mathematics instructor versed in cognitive style mapping. There were no individual interpretations or discussions of a student's individual map. Students missing the group interpretation watched an interpretation on a video tape. It was the students' responsibility to use the learning preference information in the choice of learning materials. No particular mention of the students' Learning Preference Inventory results was made to the students by the researcher or other instructors after the interpretation sessions. The responsibility for using the learning preference information was left up to the students. Further research needs to investigate cognitive style mapping programs using various aspects of the above variables. In attempts to evaluate the effectiveness of cognitive style mapping programs, replications should include some measure of the changes in learning methods used by students who have participated in a cognitive style mapping program. However, it is difficult to compare research results because of the variety of approaches to cognitive style mapping possible.

Past research has involved modifications of the inventory itself and modifications of the scoring procedure. These differences along with the use of the full Hill model, the Mountain View Modified Hill Model and other variations in the model as well as the inventory make comparisons of results even more precarious. Caution must be used in making generalizations.

Logitudinal studies need to be done to determine if cognitive style mapping knowledge has a long term effect as students choose other courses and make other choices concerning their education or career.

One of the goals of developmental studies courses is to provide success for students who feel they are externally controlled. The lack of significance of the locus of control main effect in the analysis of covariance on the posttest shows that for this sample of basic mathematics students the achievement of the external students was comparable to the achievement of the internal students. Further study needs to be done using student locus of control as a variable with multiple instructional approaches and varying degrees of student choice.

Research has also indicated that internality is correlated with achievement. Another goal of developmental studies programs is to move the externally controlled students toward internality. Therefore, another area needing further research is the effect of a cognitive style mapping program on the locus of control of students, particularly the externally controlled developmental studies student.

In the search for positive interactions between individual differences and learning, the results of this study do not support the constructs of cognitive style mapping or locus of control. The sample of basic mathematics students used in the study did not significantly improve their achievement by making use of the information gained about their learning style preferences. The locus of control variable did not account for significant differences in the effectiveness of the particular application of cognitive style mapping used. Attempts to provide opportunities for success in learning, particularly for developmental studies students, need to probe these variables further.

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# APPENDIX A

## FORMS USED IN THE STUDY

# I-E SCALE

## INSTRUCTIONS

This is a questionnaire to find out the way in which certain important events in our society affect different people. Each item consists of a pair of alternatives lettered "a" or "b". Please select the one statement of each pair (and only one) which you more strongly believe to be the case as far as you're concerned. Be sure to select the one you actually believe to be more true rather than the one you think you should choose or the one you would like to be true. This is a measure of personal belief: obviously there are no right or wrong answers.

Your answers to the items on this inventory are to be recorded on a separate answer sheet. Print your name and other information requested on the answer sheet, then finish reading these directions.

Please answer these items carefully but do not spend too much time on any one item. Be sure to find an answer for every choice. Find the number of the item on the answer sheet and circle the "a" or "b" which you choose as the statement more true.

In some instances you may discover that you believe both statements or neither one. In such cases, be sure to select the one you more strongly believe to be the case as far as you're concerned. Also try to respond to each item independently when making your choice; do not be influenced by your previous choices.

1. a. Children get into trouble because their parents punish them too much.

   b. The trouble with most children nowadays is that their parents are too easy with them.

2. a. Many of the unhappy things in people's lives are partly due to bad luck.

   b. People's misfortunes result from the mistakes they make.

3. a. One of the major reasons why we have wars is because people don't take enough interest in politics.

   b. There will always be wars, no matter how hard people try to prevent them.

4. a. In the long run people get the respect they deserve in this world.

   b. Unfortunately, an individual's worth often passes unrecognized no matter how hard he tries.

5. a. The idea that teachers are unfair to students is nonsense.

   b. Most students don't realize the extent to which their grades are influenced by accidental happenings.

6. a. Without the right breaks one cannot be an effective leader.

   b. Capable people who fail to become leaders have not taken advantage of their opportunities.

7. a. No matter how hard you try some people just don't like you.

   b. People who can't get others to like them don't understand how to get along with others.

8. a. Heredity plays the major role in determining one's personality.

   b. It is one's experiences in life which determine what they're like.

9. a. I have often found that what is going to happen will happen.

   b. Trusting to fate has never turned out.

10. a. In the case of the well-prepared student there is rarely, if ever, such a thing as an unfair test.

    b. Many times exam questions tend to be so unrelated to course work that studying is really useless.

11. a. Becoming a success is a matter of hard work, luck has little or nothing to do with it.

    b. Getting a good job depends mainly on being in the right place at the right time.

12. a. The average citizen can have an influence in government decisions.

    b. This world is run by a few people in power, and there is not much the little guy can do about it.

13. a. When I make plans, I am almost certain that I can make them work.

    b. It is not always wise to plan too far ahead because many things turn out to be a matter of good or bad fortune anyhow.

14. a. There are certain people who are just no good.

    b. There is some good in everybody.

15. a. In my case getting what I want has little or nothing to do with luck.

    b. Many times we might just as well decide what to do by flipping a coin.

16. a. Who gets to be the boss often depends on who was lucky enough to be in the right place first.

    b. Getting people to do the right thing depends upon ability, luck has little or nothing to do with it.

17. a. As far as world affairs are concerned, most of us are the victims of forces we can neither understand, nor control.

    b. By taking an active part in political and social affairs, the people can control world events.

18. a. Most people don't realize the extent to which their lives are controlled by accidental happenings.

    b. There really is no such thing as "luck".

19. a. One should always be willing to admit mistakes.

    b. It is usually best to cover up one's mistakes.

20. a. It is hard to know whether or not a person really likes you.

    b. How many friends you have depends upon how nice a person you are.

21. a. In the long run the bad things that happen to us are balanced by the good ones.

    b. Most misfortunes are the result of lack of ability, ignorance, laziness, or all three.

22. a. With enough effort we can wipe out political corruption.

    b. It is difficult for people to have much control over the things politicians do in office.

23. a. Sometimes I can't understand how teachers arrive at the grades they give.

    b. There is a direct connection between how hard I study and the grades I get.

24. a. A good leader expects people to decide for themselves what they should do.

    b. A good leader makes it clear to everybody what their jobs are.

25. a. Many times I feel that I have little influence over the things that happen to me.

    b. It is impossible for me to believe that chance or luck plays an important role in my life.

26. a. People are lonely because they don't try to be friendly.

    b. There's not much use in trying too hard to please people, if they like you, they like you.

27. a. There is too much emphasis on athletics in high school.

    b. Team sports are an excellent way to build character.

28. a. What happens to me is my own doing.

    b. Sometimes I feel that I don't have enough control over the direction my life is taking.

29. a. Most of the time I can't understand why politicians behave the way they do.

    b. In the long run the people are responsible for bad government on a national as well as on a local level.

(Rotter, Chance and Phares 1972, pp. 272-275, 295)

## DIAGNOSTIC PRE-ASSESSMENT

| Write your answers on the answer sheet. Do not write on this paper. |
|---|

| MODULE 1 - Whole Numbers |
|---|

1. In 329,467 what digit lies in the "hundreds" place?

2. Do this addition: 68 + 507 + 49

Do the following subtractions:

3. $\begin{array}{r} 5{,}134 \\ \underline{-4{,}876} \end{array}$

4. $\begin{array}{r} 1{,}600 \\ \underline{-\quad 73} \end{array}$

Do the following multiplications:

5. $\begin{array}{r} 839 \\ \underline{\times\ 67} \end{array}$

6. $\begin{array}{r} 624 \\ \underline{\times\ 301} \end{array}$

Do the following divisions:

7. $6\overline{)624}$

8. $58\overline{)7{,}482}$

9. $240\overline{)15{,}600}$

10. Calculate $4^2$

MODULE 2 - Fractions

11. Complete: $\frac{5}{6} = \frac{?}{18}$

12. Reduce to lowest terms: $\frac{24}{32}$

13. Convert $\frac{17}{5}$ to a mixed number.

14. Convert $6\frac{3}{4}$ to an improper fraction.

Do the following problems. Write each answer in lowest terms.

15. $\frac{1}{3} + \frac{7}{12} =$

16. $\frac{5}{8} - \frac{3}{20} =$

17. $\frac{9}{10} \times \frac{2}{3} =$

18. $\frac{5}{6} \div 30 =$

19. $18\frac{3}{8} - 12\frac{5}{8} =$

20. $1\frac{1}{2} \times 2\frac{1}{4} =$

MODULE 3 - Decimal Numbers

21. In 47.325 what digit lies in the "tenths" place?

22. Write $\frac{53}{100}$ as a decimal number.

Do the following addition and subtraction:

23. 13.8 + 1.67 =

24. 3.2 - .64 =

Do the following multiplications:

25. $\begin{array}{r} 23.7 \\ \underline{\times \quad 4} \end{array}$

26. $\begin{array}{r} 41.2 \\ \underline{\times \ .21} \end{array}$

Do the following divisions:

27. $30 \overline{)2.4}$

28. $.05 \overline{).32}$

29. Find the quotient to the <u>nearest</u> <u>hundredth</u>: $2.3 \overline{)167}$

30. Convert the fraction $\frac{3}{5}$ to a decimal number.

MODULE 4 - Percent, Ratio, Proportion

31. Convert 66% to a fraction in lowest terms.

32. Convert $7\frac{1}{2}$% to a decimal number.

33. Convert .05 to a percent.

34. Convert $\frac{3}{5}$ to a percent.

35. Find 25% of 60.

36. 20% of what number is 50?

37. 35 is what percent of 70?

38. If a baseball team has a "won-loss" ratio of 5 to 3, how many wins do they have if they have lost 12 games?

39. A dieter lost 8 pounds in six weeks. At that rate, how long would it take to lose 20 pounds?

40. If a 30% down payment was required for a $600 purchase, find the amount of the down payment.

# POST ASSESSMENT

| Write your answers on the answer sheet. Do not write on this paper. |
|---|

1. In 486,259 what digit lies in the "thousands" place.

2. Do this addition: 86 + 705 + 94

Do the following subtractions:

3. $\begin{array}{r} 6,251 \\ \underline{-4,678} \end{array}$

4. $\begin{array}{r} 1,400 \\ \underline{-\quad 82} \end{array}$

Do the following multiplications:

5. $\begin{array}{r} 398 \\ \underline{x76} \end{array}$

6. $\begin{array}{r} 426 \\ \underline{x203} \end{array}$

Do the following divisions:

7. $7 \overline{)721}$

8. $56 \overline{)8736}$

9. $450 \overline{)23400}$

10. Calculate $2^4$.

11. Complete: $\frac{5}{7} = \frac{\quad}{28}$

12. Reduce to lowest terms: $\frac{27}{45}$

13. Convert $\frac{17}{6}$ to a mixed number.

14. Convert $5\frac{2}{3}$ to an improper fraction.

Do the following problems. Write each answer in lowest terms.

15. $\frac{1}{4} + \frac{5}{12} =$

16. $\frac{5}{6} - \frac{3}{8} =$

17. $\frac{3}{10} \times \frac{2}{9} =$

18. $\frac{5}{8} \div 20 =$

19. $12\frac{2}{7} - 9\frac{5}{7} =$

20. $2\frac{1}{3} \times 3\frac{1}{2} =$

21. In 742.536, what digit lies in the "hundredths" place?

22. Write $\frac{37}{100}$ as a decimal number.

Do the following addition and subtraction:

23. $31.6 + 7.43 =$

24. $2.3 - .46 =$

Do the following multiplications:

25. $\begin{array}{r} 23.6 \\ \underline{\times \quad 3} \end{array}$

26. $\begin{array}{r} 24.1 \\ \underline{\times \ .12} \end{array}$

Do the following divisions:

27. $40\overline{)3.6}$

28. $.03\overline{).216}$

29. Find the quotient to the <u>nearest</u> <u>hundredth</u>: $3.2\overline{)179}$

30. Convert the fraction $\frac{3}{8}$ to a decimal number.

31. Convert 84% to a <u>fraction</u> <u>in</u> <u>lowest</u> <u>terms</u>.

32. Convert $5\frac{1}{4}\%$ to a <u>decimal</u> <u>number</u>.

33. Convert .06 to a <u>percent</u>.

34. Convert $\frac{2}{5}$ to a <u>percent</u>.

35. Find 75% of 80.

36. 40% of what number is 60?

37. 15 is what percent of 60?

38. John's "win-loss" ratio on his TV basketball game is 5 to 4. How many losses does he have if he has wone 15 games?

39. Mark saved 18 dollars in four weeks from his paper route money. At that rate how long will it take to save 45 dollars?

40. If stoves are on sale for 20% off, how much do you save on a $500 stove?

LEARNING METHODS CHECK LIST

Please check on the blanks provided, the materials or methods you used for each of the modules in Basic Math.

| | MODULES | | | | | |
|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 |
| Audio Tapes | ____ | ____ | ____ | ____ | ____ | ____ |
| Concrete Materials | ____ | ____ | ____ | ____ | ____ | ____ |
| Extra Study Time in Math Lab | ____ | ____ | ____ | ____ | ____ | ____ |
| Handouts | ____ | ____ | ____ | ____ | ____ | ____ |
| Help From Instructor or Tutor | ____ | ____ | ____ | ____ | ____ | ____ |
| Pretest | ____ | ____ | ____ | ____ | ____ | ____ |
| Problem Sheets | ____ | ____ | ____ | ____ | ____ | ____ |
| Slide Tapes | ____ | ____ | ____ | ____ | ____ | ____ |
| Small Group Sessions | ____ | ____ | ____ | ____ | ____ | ____ |
| Studying With Others | ____ | ____ | ____ | ____ | ____ | ____ |
| Text Books | ____ | ____ | ____ | ____ | ____ | ____ |

# LEARNING PREFERENCE INVENTORY

This instrument is not a test--it does not measure what you know--there are no right or wrong answers. The results will give us a picture of the ways in which you derive meaning from your environment and give information to instructors to help provide learning alternatives for you.

DIRECTIONS:

Read each item carefully.

After reading a statement, decide if it pertains to you "rarely," "sometimes," or "usually." Fill in the circle under 1 if it pertains to you rarely. Fill in the circle under 2 if it pertains to you sometimes. Fill in the circle under 3 if the statement usually pertains to you.

Remember:

1 = rarely

2 = sometimes

3 = usually

Enjoy yourself. This should not be an awesome, threatening exam, but rather an adventure in self-understanding.

1. I understand the news better when I hear it rather than when I read it.

2. It is easy for me to remember numbers and prices I have heard during a conversation.

3. I prefer classes where we have to read textbooks rather than just listen to a lecture.

4. I am one of the first in my class to finish written math tests.

5. I can tell who is on the phone just by listening to the voice for a few seconds.

6. I can tell "what's cooking" by the smells of the food.

7. I can tell by tasting if vegetables have just the right amount of seasoning.

8. I can tell my hair needs washing by the way it feels when I touch it.

9. I notice people wearing mismatched colors.

10. I can walk up a staircase without slipping.

11. I know when a friend needs emotional support.

12. The appearance of my room or desk is important to me.

13. I keep working hard even when no one is watching.

14. I can act like I know what I am doing when it seems like a good thing to do.

15. I use facial expressions to show how I feel.

16. I know who I can ask a favor of without imposing.

17. I can predict how I will react in various situations.

18. I am a good salesperson.

19. I am on time for my appointments.

20. I like class projects with group work.

21. I make it a point not to let other things interfere with family plans.

22. I would rather do a class project alone than do it with a group.

23. If I find the article I had in mind I buy it without shopping further.

24. I feel that all people are different.

25. I learn what other people believe in by seeing how it is similar to what I believe in.

26. It takes me a long time to shop for clothes because I go to several places to compare.

27. I like games that require me to use logic.

28. I like mysteries, because I can solve them.

29. It takes me longer to reach decisions because I see so many possible ways to solve the problem.

30. I get to know someone new by finding all the ways we react alike.

31. I could better learn a topic if I see how it differs from other topics.

32. I think that rules and regulations should be followed.

33. I would rather do things my way even if it disappoints my family.

34. I talk with my family before doing anything that might affect them.

35. I like to have a friend go with me when I go shopping to help me make choices.

36. I am among the first to come to a meeting.

37. I am able to stop arguments between other people.

38. I know when I have taken on too much responsibility.

39. I know when people want to be left alone.

40. People say that when I talk my eyes talk, too.

41. I can pretend to be happy and comfortable even when I am not.

42. I would give up personal gain rather than do anything I think is wrong.

43. Some sounds give me pleasure.

44. I know when friends are angry even when they don't say so.

45. I do well in activities that require hand-eye coordination.

46. Pictures in textbooks help me to understand what the book is saying.

47. I can tell a nickel from a dime in my pocket with my fingers.

48. Water tastes different to me in different towns.

49. I can identify familiar flowers or plants by their smell.

50. I tune a radio by the sounds I hear and not by the numbers on the dial.

51. I solve math problems faster if they are written down.

52. I would rather read directions than hear them read to me.

53. I find it easy to solve arithmetic problems that are read to me.

54. I prefer verbal directions for finding a strange place.

55. I can make more sense out of what a person means when he speaks to me rather than if he writes me.

56. I can follow my math teacher's lectures better than most of my classmates.

57. I score well on tests which depend upon my knowing what I have read.

58. I need to write down a phone number in order to remember it.

59. If I am in another room, I can recognize a TV show by the voices.

60. I notice the smell of a new car.

61. I enjoy new foods because I like new tastes.

62. I can feel the difference between cotton and silk.

63. I choose clothes mostly because of the way they look on me.

64. I can walk with a drink without spilling a drop.

65. I try not to say something which might hurt someone's feelings.

66. I enjoy the look of a well-designed building.

67. I would give up money before I would give up what I believe in.

68. I can be polite even when I'm angry.

69. I use my hands to help me talk.

70. I know when it is O.K. for me to put my hand on another person's shoulder.

71. I can accept it when someone criticizes me and is right.

72. I'm a good leader.

73. I arrive at class on time.

74. I am influenced by my friends' political opinions.

75. My family is the biggest influence on my religious beliefs.

76. I prefer classes where I can do independent work.

77. Because there is a law which says we stop for red lights, I would always stop for a red light.

78. When explaining a game, I would tell how it differs from other games.

79. I like to figure out how parts of a whole fit together.

80. I want to know as much about a problem as I can before I make a decision.

81. I enjoy the reasoning patterns used in math courses.

82. I enjoy riddles or puzzles that must be solved where the correct answers can be figured out from information in the rules.

83. I like to look at a problem from as many ways as possible.

84. I can put together most jigsaw puzzles.

85. Situations are seen differently by different people.

86. I would rather work where the rules and standards are clearly stated.

87. I prefer to work alone most of the time when given a choice.

88. I think of my boss or instructor as if he or she is a father or mother figure; I don't want them to be "one of the gang."

89. I would want to talk with my friends before I took a new job.

90. I turn in assignments when they are due.

91. I can talk others into doing what I would like for them to do.

92. I know my strong points.

93. I can tell when it is O.K. to interrupt a conversation.

94. I can tell how a person feels by the way he sits or stands.

95. I can be the life of the party.

96. When I decide to do something, I usually carry through and do it.

97. I would go out of my way to see beautiful scenery.

98. I can understand and be patient with someone who is frightened.

99. I like to work with my hands.

100. I learn more from a picture than I do from a written description.

101. I would pick up and feel vegetables and fruits in a store before buying them.

102. The taste of food is more important to me than the way it looks.

103. I can identify familiar foods by their smell.

104. It bothers me when the radio is not tuned just exactly right.

105. I can better understand a math problem if I see it in writing.

106. I understand information better when I read it rather than when I hear it.

107. If I were buying a car, I would prefer having a salesman explain the gas mileage rather than reading about it.

108. I understand a story better if I hear it rather than read it.

109. I prefer lectures rather than reading assignments.

110. I find it easy to add in my head numbers that are spoken to me.

111. I would rather read a map than listen to someone give me directions.

112. If I were buying a car, I would ask the salesman to write out or show me the printed engine specifications.

113. I can listen to a song and recognize the "tune" the next time I hear it.

114. An unpleasant smell bugs me more than it does others.

115. I return to a restaurant because of the taste of food served there.

116. I would feel the material in an outfit before buying it.

117. I choose furniture for the way it looks.

118. I can fix things without looking at my hands.

119. I understand how a person feels when he is being punished.

120. I work better in a pleasant-looking place.

121. I live my life according to my own moral values.

122. I can imitate someone I know.

123. Even on the phone, I "talk with my hands."

124. I know how close I can stand to another person without making him uncomfortable.

125. I know my limits.

126. I am able to put others at ease in tense situations.

127. I know how long it will take to complete most tasks.

128. I learn something better when I can discuss it with friends.

129. I will always try to live by what my family says is right or wrong.

130. I solve my own problems without suggestions from others.

131. Life is simple when I go by the rules.

132. I learn by trial and error.

133. I like to take school subjects that have a lot in common.

134. I take longer to solve a problem than do others because I want to know more about it than do most people.

135. I believe I think in a very logical fashion.

136. I avoid guessing when solving problems.

137. I change my mind many times before making a final decision.

138. I tend to see all parts of the world as being related.

139. I learn how to be successful by looking at my mistakes.

140. I don't think people should break the law.

141. I consider my own goals ahead of the goals of others.

142. I check with my close family before making most decisions.

143. I enjoy an activity more if my friends do it with me.

144. I know exactly how many minutes it takes me to go places that I go a lot.

145. I am able to guide a conversation in the direction I want it to go.

146. I can do what I set out to do.

147. I know when I am not welcome in a group.

148. I shrug my shoulders when saying "I don't know."

149. I can pretend to feel a certain way when I really don't feel that way at all.

150. I do not let play interfere with completing an assignment.

151. I appreciate the work of a good craftsman.

152. I can be patient with someone who is "head over heels in love."

153. I can look at something with my eyes and do another task with my fingers all at the same time.

154. It bothers me when a movie picture is slightly fuzzy.

155. I would touch a realistic-looking plastic flower to see if it were real.

156. I like a special kind of sandwich because of the way it tastes.

157. I can tell when something's gone bad in the refrigerator by the smell.

158. I can listen to familiar sounds like a car engine or an air conditioner and tell if something is wrong with it.

159. I can understand most graphs and charts.

160. I prefer to read a newspaper myself rather than have someone read it to me.

161. I can remember a telephone number once I hear it.

162. After I write something, I like to hear it aloud so that I know how it sounds.

163. I prefer to follow spoken directions rather than written ones.

164. I remember "sale" prices I hear on the radio.

165. I like to read.

166. I do my best math work on written tests rather than on oral ones.

167. I can tell the quality of a stereo by listening to it.

168. I am among the first to smell gas odors in a car.

169. I notice that food is overcooked when others don't.

170. I prefer to write with a pen or pencil that "fits" my fingers.

171. I can understand a speaker better if I can see him talking.

172. I am better coordinated than most people.

173. I know when I've hurt someone's feelings.

174. I buy things because of the way they look.

175. I believe a promise should be kept.

176. I can act interested even though I am bored when listening to a teacher.

177. I know when a person's movements say something different than his words.

178. I know when I can "make myself at home" in someone's house.

179. I know how well I'll do in a course after the first class.

180. I can get a group to decide something when I am ready for them to finish.

181. It bothers me for a friend to be late for an appointment with me.

182. I like for my friends to help me make decisions.

183. I enjoy activities more when I am with my family.

184. I like to make up my own mind about what is right and wrong.

185. I must know what the rules are in order to know whether a person has done right or wrong.

186. I feel different on weekends.

187. I solve a problem by seeing if it is like other problems I have solved.

188. I think decisions are better ones if I think about them for a long time.

189. I find reasoning like the following helps me to understand my thinking:

All dogs have four legs.
Rover is a dog.
Therefore, Rover has four legs.

190. I like to solve a problem by starting with something I know is true.

191. I have to get enough information before I can decide things.

192. When I look at something (like a house), I like to compare it to others I have seen.

193. I could learn how to drive a new car by comparing how it was different from my old car.

194. I follow the rules of most games and do not "cheat."

195. I make my own political choices.

196. My political choices are influenced by my family's views.

197. I like to work in groups in class.

198. It bothers me when events do not start on time.

199. I can "take charge" of a situation.

200. I know my weak points.

201. I can tell how friendly I can be with a stranger.

202. When I greet someone, my actions tell the other person how I feel.

203. I can hide my emotions when I need to.

204. I would stop at a stop sign at three in the morning even if there were no one else around.

205. I think some ideas are beautiful.

206. I can put myself in someone else's place.

207. I can flip a coin and catch it.

208. I like visiting pretty places.

209. I can button my coat in the dark.

210. I can taste the difference between whole milk and skim milk with my eyes closed.

211. I feel that the smell of a store has a lot to do with its sales.

212. Outside noises take my attention from what I am doing.

213. In order to add seven or eight numbers, I have to write them down.

214. I read directions when I must put together or make something.

215. Oral math tests are easier for me than written ones.

216. I do better on tests which cover information I have heard rather than read.

| Summary of Learning Preference Inventory | | Your Map Analysis | | | | | |
|---|---|---|---|---|---|---|---|
| | | Your Score | | | | | |
| NO. | MEANING | Major | Minor | Negligible | Tend to Agree | Tend to Disagree | Undecided |
| 1. | Finding meaning through words you hear. | | | | | | |
| 2. | Finding meaning in spoken numbers or non-word symbols. | | | | | | |
| 3. | Finding meaning from words you see or read. | | | | | | |
| 4. | Finding meaning in seeing numerical or non-word symbols. | | | | | | |
| 5. | Finding meaning through the sense of hearing. | | | | | | |
| 6. | Finding meaning through the sense of smell. | | | | | | |
| 7. | Finding meaning through the sense of taste. | | | | | | |
| 8. | Finding meaning through touch. | | | | | | |
| 9. | Finding meaning through sight. | | | | | | |
| 10. | Physical coordination -- especially hand-eye coordination. | | | | | | |
| 11. | Sensitivity to other's feelings. | | | | | | |
| 12. | Enjoying the beauty of an object, scene or idea. | | | | | | |
| 13. | Commitment to a set of values, principles, obligations and/or duties. (Does not imply morality.) | | | | | | |
| 14. | "Playing a role" to influence others. | | | | | | |
| 15. | Understanding and communicating by body motions, gestures, smiles, facial expressions, hands. | | | | | | |
| 16. | Judging the physical and social distance that another person would permit. | | | | | | |
| 17. | Personal knowledge of one's self. | | | | | | |

(CONTINUED ON REVERSE SIDE)

| Summary of Learning Preference Inventory | | Your Map Analysis | | | | | |
|---|---|---|---|---|---|---|---|
| | | Your Score | | | | | |
| NO. | MEANING | Major | Minor | Negligible | Tend to Agree | Tend to Disagree | Undecided |
| 18. | Influencing another's behavior, effectively putting across an idea or selling a product. | | | | | | |
| 19. | Awareness of time and time expectations. | | | | | | |
| 20. | Degree of influence by associates -- persons other than family. | | | | | | |
| 21. | Degree of influence by family, church, authority figures. | | | | | | |
| 22. | Independence in decision making. | | | | | | |
| 23. | Reasoning by looking at rules and definitions. | | | | | | |
| 24. | Reasoning by looking for differences in concepts. | | | | | | |
| 25. | Reasoning by looking for similarities in concepts. | | | | | | |
| 26. | Reasoning by using all three of the above (23, 24, 25). | | | | | | |
| 27. | Logical deductive reasoning. | | | | | | |
| | | | | | | | |
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| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | Total Number Checked In Each Column: | | | Agree | Disagree | Undecided |

FEELINGS ABOUT MATH

NAME ______________________________ DATE ________________

1. The last time I used math was ____________________________
______________________________________________________

2. When I do math, I wish ______________________________
______________________________________________________

3. I remember first having trouble with math when I was __________
______________________________________________________

4. Doing math makes me feel ____________________________
______________________________________________________

5. Thinking about taking a math test makes me ______________
______________________________________________________

6. When I see a math problem I can't do, I ________________
______________________________________________________

7. If I were better at math, I would ____________________
______________________________________________________

OTHER COMMENTS: ______________________________________
______________________________________________________
______________________________________________________
______________________________________________________
______________________________________________________
______________________________________________________
______________________________________________________

# APPENDIX B

# RAW DATA

TABLE X

RAW SCORES FOR THE CONTROL GROUPS

| Student | I-E Scale | Locus of Control | Pretest | Posttest |
|---|---|---|---|---|
| 1 | 3 | Internal | 8 | 33 |
| 2 | 4 | Internal | 12 | 22 |
| 3 | 4 | Internal | 29 | 32 |
| 4 | 5 | Internal | 17 | 24 |
| 5 | 2 | Internal | 16 | 25 |
| 6 | 4 | Internal | 28 | 38 |
| 7 | 5 | Internal | 30 | 33 |
| 8 | 3 | Internal | 5 | 35 |
| 9 | 4 | Internal | 13 | 20 |
| 10 | 3 | Internal | 31 | 39 |
| 11 | 4 | Internal | 17 | 29 |
| 12 | 4 | Internal | 8 | 33 |
| 13 | 13 | External | 12 | 32 |
| 14 | 13 | External | 5 | 25 |
| 15 | 13 | External | 6 | 28 |
| 16 | 15 | External | 9 | 19 |
| 17 | 15 | External | 25 | 38 |
| 18 | 13 | External | 15 | 32 |
| 19 | 13 | External | 26 | 39 |
| 20 | 16 | External | 14 | 27 |
| 21 | 12 | External | 29 | 37 |
| 22 | 12 | External | 7 | 16 |
| 23 | 12 | External | 10 | 25 |
| 24 | 12 | External | 22 | 25 |

TABLE XI

RAW SCORES FOR THE TREATMENT GROUPS

| Student | I-E Scale | Locus of Control | Pretest | Posttest |
|---|---|---|---|---|
| 25 | 5 | Internal | 23 | 26 |
| 26 | 3 | Internal | 29 | 37 |
| 27 | 5 | Internal | 20 | 33 |
| 28 | 1 | Internal | 25 | 34 |
| 29 | 5 | Internal | 20 | 32 |
| 30 | 1 | Internal | 16 | 21 |
| 31 | 3 | Internal | 21 | 26 |
| 32 | 6 | Internal | 15 | 17 |
| 33 | 6 | Internal | 28 | 38 |
| 34 | 6 | Internal | 9 | 16 |
| 35 | 4 | Internal | 20 | 27 |
| 36 | 7 | Internal | 19 | 29 |
| 37 | 14 | External | 21 | 34 |
| 38 | 16 | External | 20 | 32 |
| 39 | 16 | External | 1 | 18 |
| 40 | 15 | External | 11 | 21 |
| 41 | 18 | External | 16 | 20 |
| 42 | 13 | External | 15 | 34 |
| 43 | 16 | External | 22 | 33 |
| 44 | 17 | External | 18 | 32 |
| 45 | 13 | External | 2 | 17 |
| 46 | 17 | External | 21 | 27 |
| 47 | 16 | External | 19 | 25 |
| 48 | 12 | External | 4 | 8 |

TABLE XII

LEARNING METHODS CHECK LIST

| Learning Method | Treatment Internal | Treatment External | Control Internal | Control External |
|---|---|---|---|---|
| Audio Tapes | 1 | 0 | 2 | 0 |
| Concrete Materials | 1 | 1 | 2 | 1 |
| Extra Study Time in Math Lab | 4 | 2 | 5 | 2 |
| Handouts | 1 | 3 | 2 | 0 |
| Help from Instructor or Tutor | 6 | 4 | 11 | 7 |
| Pretest | 8 | 11 | 12 | 7 |
| Problem Sheets | 5 | 7 | 6 | 4 |
| Slide Tapes | 0 | 0 | 1 | 2 |
| Small Group Sessions | 0 | 0 | 0 | 0 |
| Studying with Others | 1 | 3 | 2 | 3 |
| Text Books | 9 | 11 | 11 | 8 |
| Total Number of Students | 10 | 11 | 12 | 10 |

The numbers represent the number of students within each group that indicated on the check lists that they had used the particular learning method.