To The Graduate Council:

I am submitting herewith a dissertation written by Roger H. Stiles entitled "Learning Style Preferences for Design and Their Relationship To Standardized Test Results." I have examined the final copy of this dissertation for form and content and recommend that it be accepted in partial fulfillment of the requirements for the degree of Doctor of Education, with a major in Curriculum and Instruction.

Robert S. Thurman, Major Professor

We have read this dissertation
and recommend its acceptance:

A. Paul Weisbart

Lynn C. Fox

Lester N. Kingsley

William A. Pappen

Accepted for the Council:

Vice Provost
and Dean of The Graduate School

LEARNING STYLE PREFERENCES FOR DESIGN AND THEIR RELATIONSHIP TO STANDARDIZED TEST RESULTS

A Dissertation

Presented for the

Doctor of Education

Degree

The University of Tennessee, Knoxville

Roger H. Stiles

June 1985

DEDICATION

It is impossible to express one's appreciation to everyone who encouraged and aided in the completion of the course begun. This volume is dedicated to those who have made great sacrifices in order that the author could attain this goal. To my wife, Betty, and our children; Cindy, Todd, and Kim is this work lovingly dedicated. Betty would have had a great deal more difficulty than she experienced had it not been for the support she received from my parents, Mr. and Mrs. George M. Stiles, Sr., who are to share in the dedication of this dissertation.

ACKNOWLEDGMENTS

In the course of this research a great deal of assistance and patience was given by Dr. Robert S. Thurman, the writer's major professor throughout his doctoral studies. His understanding and direction when external demands prevented meeting certain deadlines is more than can be expressed in this space.

Acknowledgment of and appreciation for the assistance and advice of the other members of the committee in bringing this study to completion must be expressed. Dr. Lester N. Knight and Dr. Lynn C. Cagle were able teachers and contributors to this work throughout the author's studies. Dr. William Poppen made valuable observations and suggestions that improved the study greatly. In the absence of Dr. Thurman, Dr. A. Paul Wishart gave unselfishly of himself to coordinate this committee and profitably critique the writing of this paper.

The advice and encouragement of Dr. Buddy Nichols, my academic dean and good friend, should be recognized as vital to the completion of this project. To Dr. David Bragg, who took much more work on himself than was required in order that the time could be given to completing this research, appreciation is expressed.

No work of this kind can be brought to fruition without the hard work and silent patience of a typist who served also as a record keeper for references. Miss Kay Taylor was more than could ever have been expected of the typist of a paper.

This writer must acknowledge that as Jesus said, ". . . without me ye can do nothing." Acknowledgment is made of my debt to Him "who loved me, and gave Himself for me."

ABSTRACT

The purpose of this study was to determine whether the design of the testing environment influenced standardized test scores of fifth grade students when their diagnosed preferences for the learning style element of design were matched or mismatched with the design of the environment.

This investigation tested the following null hypotheses:

1. There will be no significant difference between the mean scores when students, whose diagnosed preference for a formal design, are tested in a setting that is matched and mismatched with their preference on tests of
   a. mathematics concepts and applications, and
   b. reading comprehension
2. There will be no significant difference between the mean scores when students who have a diagnosed preference for an informal design are tested in an environment that is matched and mismatched with their preference on tests of
   a. mathematics concepts and applications, and
   b. reading comprehension
3. There will be no significant difference between the mean scores of students with no diagnosed preference for formal or informal design when

tested in a formal and an informal environment on tests of

a. mathematics concepts and applications, and

b. reading comprehension

The findings of this study resulted in the acceptance of all three null hypotheses.

The Learning Style Inventory (LSI) developed by Dunn, Dunn, and Price was administered to 163 fifth grade students attending six private schools. According to their scores on the LSI the students were assigned to three categories. Those students scoring above 60 were assigned to the category of preference for a formal environment, while students with a score below 40 were assigned to the informal preference category, and students scoring between 40 and 60 were categorized as having no preference for the environmental element of design. Subjects in each category were equally and randomly assigned to two groups. Each group was composed of 39 students: 13 with a diagnosed preference for formal design; 13 with a diagnosed preference for informal design; and 13 with a diagnosis of no preference for design. Group One was tested in a formal environment, and Group Two was tested in an informal environment. Each

group was administered the California Achievement Test (1977), Mathematics Concepts and Applications, and the Reading Comprehension Subtests.

Four observers were utilized in each testing session to record any behavior of students that might signal an attempt to formalize the informal setting, or make the formal more informal.

The experimental design involved two independent variables: (1) the testing environment; and (2) the diagnosed preference or no preference for the learning style element of design. The two dependent variables were the mathematics concepts and application scores, and the reading comprehension scores.

A *t* test of correlated samples was applied to the mean scores for each preference group tested in an environment matched and mismatched with their diagnosed preference on tests of mathematics concepts and applications, and on tests of reading comprehension. In all analyses, *t* scores significant at the .01 level were deemed large enough to reject the null hypothesis.

This study concluded that preference or a lack of preference for the formal or informal design of the learning environment does not affect standardized test scores in mathematics concepts and applications or in reading comprehension of fifth grade students when they are tested in a formal or informal environment.

This study concluded that although some students made positional adjustments to the environment mismatched with their learning style preference, these adjustments were not great enough to indicate that the students' adjustments modified the testing environment from a mismatch to a match.

TABLE OF CONTENTS

LIST OF TABLES

CHAPTER 1

INTRODUCTION

A. STATEMENT OF THE PROBLEM

The emergence of the proficiency testing movement has created a situation in which schools must administer these tests in a setting most conducive to student success. Students' performance on tests depends not only on their knowledge and skills, but also on conditions under which tests are taken. "Conditions of test administration affect test performance and hence test reliability by having differing effects on different test takers."[1]

Recent research in the area of student learning style indicates that the various environmental elements of sound, light, temperature, and design affect student learning and test performance.[2] This research indicates that different individuals learn or perform better in various environmental

---

[1]Bruce W. Tuckman, Measuring Educational Outcomes: Fundamentals of Testing (New York: Harcourt Brace Jovanovich, Inc., 1975), p. 265.

[2]Rita Dunn, Kenneth Dunn, and Gary E. Price, "Identifying Individual Learning Styles," in Student Learning Styles: Diagnosing and Prescribing Programs, (Reston: National Association of Secondary School Principals, 1979), pp. 41-44.

settings. The findings suggest that new investigations into the effects of environmental elements upon students' test performance are needed at the elementary school level.

B. STATEMENT OF THE PURPOSE

It was the purpose of this study to determine whether the design of the testing environment influenced standardized test scores in mathematics concepts and applications and in reading comprehension of fifth grade students when their diagnosed preferences for the learning style element of design were matched or mismatched with the design of the environment.

Specifically this investigation was conducted to seek answers to the following questions:

1. What will be the effects, if any, on mean test scores when students who have a preference for a formal arrangement of the physical components of the classroom are tested in a setting that is matched and mismatched with their preference?
2. What will be the effects, if any, on mean test scores when students who prefer an informal arrangement of the physical components of the classroom are tested in a setting that is matched and mismatched with their preference?

3. What effects, if any, will the testing environment have on the mean test scores of those students who indicate no diagnosed preference for either formal or informal design?

C. HYPOTHESES

In answer to the questions posed above, this investigation tested the following null hypotheses:

1. There will be no significant difference between the mean scores when students, whose diagnosed preference for a formal design, are tested in a setting that is matched and mismatched with their preference on tests of
   a. mathematics concepts and applications, and
   b. reading comprehension
2. There will be no significant difference between the mean scores when students who have a diagnosed preference for an informal design are tested in an environment that is matched and mismatched with their preference on tests of
   a. mathematics concepts and applications, and
   b. reading comprehension

3. There will be no significant difference between the mean scores of students with no diagnosed preference for formal or informal design when tested in a formal and an informal environment on tests of
   a. mathematics concepts and applications, and
   b. reading comprehension

D. LIMITATIONS OF THE STUDY

This study was concerned with the relationship between students' preference for the learning style element of design and their performance on tests of mathematics concepts and applications and of reading comprehension in matched and mismatched testing environments.

The limitations of this study were as follows:

1. The environmental element of design was the only element to be investigated of the 18 elements of learning style identified by the Learning Style Inventory developed by Dunn, and Dunn.[3]
2. The subjects for this study were limited to fifth grade students in private elementary schools in the Chattanooga, Tennessee, area.

---

[3]Rita Dunn, "A Learning Style Primer," Principal, 14 (May 1981), 31-34.

3. The design of the testing environment was limited to the testing environment employed in this investigation and the operational definitions utilized in the study to identify formal design and informal design.
4. This research was limited by the use of the California Achievement Test, Level 16, Form C, Mathematics Concepts and Applications and Reading Comprehension. This is a standardized achievement test of mathematics concepts and applications and of reading comprehension performance.

E. ASSUMPTIONS

The assumptions of the study were:

1. That the students' learning style remained stable for the period of the experiment.
2. That the consistent use of the same investigator to conduct this research controlled the testing conditions.
3. That the use of a test administrator who was blind to the purpose and hypotheses of this study controlled possible experimentor bias.

4. That data collected were interval type data and appropriate for the use of parametric statistics.
5. That the subjects were randomly selected from a normally distributed population.

F. DEFINITION OF TERMS

The following definitions were employed in the study:

Learning Style: Cognitive, affective, and physiological traits that serve as relatively stable indicators of how learners perceive, interact with, and respond to the learning environment.[4]

Design: One of the four environmental elements of learning style as set forth by Dunn and Dunn. It identifies the formality or informality of the environment in which an individual prefers to study.[5]

Formal Design: The category of learning environment containing hard straight chairs and tables or desks, as found in a classroom, library, or kitchen.[6]

---

[4]James W. Keefe, "Assessing Student Learning Styles: An Overview," in Student Learning Styles and Brain Behavior, (Reston: National Association of Secondary School Principals, 1982), p. 44.

[5]Rita Dunn, "You've Got Style: Now's The Time to Find Out What It Is," Early Years, 13, No. 5, 26.

[6]Dunn, "A Learning Style Primer," op. cit., p. 32.

Informal Design: The category of learning environment containing upholstered chairs, sofas, pillows, floors, and/or carpet.[7]

G. IMPORTANCE OF THE STUDY

There is evidence that students benefit when their learning styles are accommodated and they do less well when their styles are ignored.[8] These data imply that some students may be disadvantaged when tested in a traditional environment as their learning style preferences do not match what has been traditionally recognized as the proper environment for testing.

Although much research has been conducted on the effects of the environmental elements of sound, light, and temperature on learning and test performance, there has been a paucity of research on the effects of design. Only one investigation has dealt specifically with this topic. Shea found that secondary students did better

---

[7]Dunn, "You've Got Style: Now's The Time To Find Out What It Is," op. cit., p. 28.

[8]Rita Dunn and Kenneth Dunn, "Educational Accountability in Our Schools," Momentum, October 10, 1977, p. 12.

on tests when the learning style element of design was matched to their diagnosed preference.[9]

It is important that the effects of an element of learning style, design, be investigated with elementary students. If research findings indicate that the traditional setting for testing places an added burden upon students who are mismatched with their learning style preference, for the element of design, adjustments need to be made in design for the testing environment of students diagnosed as such.

H. METHODS AND PROCEDURES

The present research compared student mathematics concepts and applications, and reading comprehension scores when: (a) the testing environment was matched with diagnosed learning style; (b) when the testing environment was mismatched with diagnosed learning style; and (c) when the learning style element of design was diagnosed as being of no preference to the learner.

---

[9]Thomas C. Shea, "An Investigation of the Relationships Among Selected Instructional Environments, Preferences for the Learning Style Element of Design, and Reading Achievement Testing of Ninth Grade Students to Improve Administrative Determinations Concerning Effective Educational Facilities," (Unpublished Doctoral Dissertation, St. John's University, 1983) pp. 106-114.

The Learning Style Inventory (LSI) developed by Dunn, Dunn, and Price was administered to 163 fifth grade students attending six private schools in the vicinity of Chattanooga, Tennessee. The authors and publishers of the LSI state that scores at or above 60 indicate a preference for formal design, at or below 40 are indicative of a preference for informal design, while all scores between 40 and 60 indicate no preference for design.

The students fell into three categories according to their scores on the LSI. Twenty-six students scored above 60 on the LSI and were assigned to the formal preference category. Twenty-nine students scored below 40 on the LSI and were assigned to the informal preference category. The remaining 118 students scored between 40 and 60 on the LSI and were assigned to the no preference category.

The students in each category were randomly assigned to either of two groups. Each group consisted of (1) subjects who were diagnosed as preferring a formal learning design; (2) subjects who were diagnosed as preferring an informal learning design; and (3) subjects who were diagnosed as indicating no design preference.

Group one was composed of 39 students: 13 with a diagnosed preference for formal design; 13 with a diagnosed preference for informal design; and 13 with a diagnosis of no preference for design. Group one was tested in a formal

testing environment. The formal testing environment was a large room with student desks. The room was 18' x 45' and was meant for 90 student desks.

Group two was made up of 39 students: 13 with a diagnosed preference for formal design; 13 with a diagnosed preference for informal design; and 13 with a diagnosis of no preference for design. Group two was tested in an informal setting the following day in the same room and at the same time of day as group one. The room was completely rearranged by removing the desks, and the informal environment prepared by bringing in four long upholstered sofas, three short upholstered sofas, nine upholstered chairs, three vinyl covered arm side chairs, four lounge chairs, and ten large cushions. A diagram of the informal learning environment is found in Appendix A, page 97. A paradigm of the research design is in Figure 1.

Both groups were administered the California Achievement Test (1977), Level 16, Form C, Mathematics Concepts and Applications, and The Reading Comprehension Subtests in the testing environment to which they were assigned at the beginning of the experimental period.

The test was administered on each occasion by a certificated, experienced elementary school teacher, who was blind to the hypotheses of this study. Four observers were utilized in each testing session to record any

Testing Environment	Learning Style Preference
Group One Formal Design	(F_1) Formal - 13 Students
	(I_1) Informal - 13 Students
	(NP_1) No Preference - 13 Students
Group Two Informal Design	(F_2) Formal - 13 Students
	(I_2) Informal - 13 Students
	(NP_2) No Preference - 13 Students

Figure 1. A Paradigm of the Research Design

behavior of students that might signal an attempt to formalize the informal setting, or make the formal more informal. Copies of these observation record sheets are found in Appendix B, pages 99-100.

A *t* test for correlated samples was utilized to analyze the differences between the mean scores of F_1 and F_2, I_1 and I_2, and NP_1 and NP_2. In all analyses, *t* scores significant at the .01 level were deemed large enough to reject the null hypothesis.

I. ORGANIZATION OF THE STUDY

Chapter I contains the statement of the problem, statement of the purpose, hypotheses, limitations of the

study, assumptions, definitions of terms, importance of the study, and methods and procedures and sources of data. Chapter II consists of the review of the related literature. Chapter III presents the subjects for the study and the instruments utilized for data gathering. Chapter IV is an analysis of the data in relation to the hypotheses. Chapter V includes a summary, conclusions, recommendations, and implications for further study.

CHAPTER II

REVIEW OF RELATED LITERATURE

The review of the related literature is divided into four separate sections. The first section presents background on the subject of learning styles, the development of the concept, distinctions between cognitive style and learning style, and a description of various approaches to learning style. Section two presents research on the various environmental elements of learning style, while the third section is a presentation of research on the environmental element of design. Section four presents a brief summary of the chapter.

A. BACKGROUND ON LEARNING STYLE

1. Development of the Concept

Two terms appearing repeatedly are learning style and cognitive style. These two terms are related, but are not synonymous. Cognitive style, which denotes the mental processes used by an individual to learn, is the narrower term of the two. Learning style, which is inclusive of cognitive style, identifies the stimuli most conducive to the effective use of cognitive style.

The concept of learning style, according to Shea and Keefe, appears to have developed out of the work on

individual differences and learning constructs by such men as Gordon Allport, J. P. Guilford, L. L. Thurston, and P. E. Vernon during the early years of this century.[1]

It was not until the 1930's that the concept of cognitive styles appeared. Keefe contended, but did not document, that Gordon W. Allport coined the term "cognitive style" in 1937 to refer to a quality of living and adapting influenced by distinctive personality types.[2] A study of Allport's writings in 1937, however, revealed that while the concept of cognitive style was set forth clearly, it was not so labeled. He wrote about "styles of behavior,"[3] "styles of adaptation,"[4] "modes of social adaptation,"[5] and "types of intelligence."[6]

---

[1]Thomas C. Shea, "An Investigation of the Relationships Among Selected Instructional Environments, Preferences for the Learning Style Element of Design, and Reading Achievement Testing of Ninth Grade Students to Improve Administration Determinations Concerning Effective Educational Facilities," (Unpublished Doctoral Dissertation, St. John's University, 1983) pp. 23-29.

[2]James W. Keefe, "Learning Style: An Overview," in Student Learning Styles: Diagnosing and Prescribing Programs, (Reston: National Association of Secondary School Principals, 1979), pp. 4-5.

[3]Gordon W. Allport, Personality: A Psychological Interpretation (New York: Henry Holt and Company, 1937), p. 46.

[4]Ibid., p. 320.

[5]Ibid., p. 411.

[6]Ibid., p. 407.

Confirmation of Allport's intention to describe what could have been labeled cognitive styles in 1937 is found in his book published in 1965, Pattern and Growth in Personality. In the opening sentences of the Preface, the author stated that, "in one sense this volume is a revision of my book, Personality: A Psychological Interpretation (1937), ..."[7] In the 1965 book, Allport used the term "cognitive style" and devoted a section of the book to the concept.[8]

As the concept of cognitive style evolved, elements of what was to become learning style appeared. As early as 1938, Carlson and Carr conducted research to compare memory for material presented visually or vocally. They found that superiority in visual or vocal learning resulted in better learning through use of the superior mode.[9] By the term, superior mode, Carlson and Carr related to the modality, visual or vocal, by which individuals demonstrated a superiority in memorizing and recognizing words.[10]

---

[7]Gordon W. Allport, Pattern and Growth in Personality (New York: Holt, Rinehart and Winston, 1965), p. ix.

[8]Ibid., pp. 258-274.

[9]H. B. Carlson and H. A. Carr, "Visual and Vocal Recognition Memory," Journal of Experimental Psychology, 23 (1938), 523-530.

[10]Ibid., p. 524.

In 1962, James made a breakthrough in the expansion from cognitive style toward learning style. Earlier works had studied factors of intelligence from the position of an abstract construct. James studied the differences in learning as measured by achievement on a standardized test between those who expressed a personal preference either for reading or for lecture presentation of the material to be learned.[11] He found that there was a significant difference in test scores between those presented material in their preferenced mode and those presented material in the mode they did not prefer. He found no significant difference between the achievement scores of those preferring a particular mode of presentation and those indicating no preference.[12]

While James was conducting his experiments at the University of Minnesota, research of the same nature was being conducted elsewhere. Herman Witkin at Brooklyn College worked with the ability of the person to identify a figure against a background field. He identified this ability as the cognitive trait of field dependence or independence. He expanded this idea of field dependence

---

[11]Newton E. James, Personal Preference for Method As A Factor in Learning," Journal of Educational Psychology, 53 (1962), 43-47.

[12]Ibid.

or independence to include analytic or global cognitive function.[13] R. W. Gardner and his colleagues at the Menninger Foundation concentrated on cognitive style as a complex arrangement of cognitive control factors. The control factors identified by Gardner were differentiation vs. undifferentiation, leveling vs. sharpening, flexible vs. constructed control, and tolerance for unrealistic experiences.[14] Jerome Kagan and his associates at the Fels Institute focused on analytic styles of thinking and problem solving. Kagan's work identified a reflective vs. impulsive dimension to cognitive style. The reflective person tends to analyze and differentiate a concept, while an impulsive person is inclined to make quick responses.[15]

It was during this same period that the term learning style was used. Frank Riessman, working out of the Urban Studies Center at Rutgers University identified "the style of learning" as "the idiosyncratic style elements in the learning process."[16] Some of the elements of learning

---

[13]Keefe, op. cit., p. 5.

[14]Ibid.

[15]Ibid.

[16]Frank Riessman, "The Strategy of Style," Teachers' College Record, 65 (1964), 484-489.

style cited by Riessman were visual or auditory learning, temperature, a single mode of learning or a flexible use of several modes, preference for pressure or plenty of time for learning, need for mobility, and need for few or many breaks during learning.[17]

Since its emergence from the early concepts of cognitive style, learning style has been refined and clarified by experimentation.

2. Distinctions Between Cognitive Style and Learning Style

As investigations are conducted in the subject of learning style, more specific information and more clearly delineated distinctions are being drawn between the different aspects of the subject.

Cognitive style is the narrow term indicating the mental processes used by an individual to learn, while learning style is the inclusive term identifying the stimuli most conducive to the effective use of one's cognitive style. Learning style points out the individual's preferred situation for learning through his personal cognitive style or habits for processing the data to be learned.

---

[17] Ibid.

3. Various Elements of Learning Style

Learning styles are described in various ways. Some researchers emphasized cognitive elements, others focused upon affective elements, while others stressed the physiological elements. Keefe, to demonstrate the relatedness of these various elements rather than their exclusiveness, classified the various approaches into three groups: (a) cognitive styles; (b) affective styles; and (c) physiological styles.[18]

a. Cognitive Style Emphasis of Learning Style.

According to Messick, cognitive style is the "information processing habits representing the learner's typical mode of perceiving, thinking, problem solving, and remembering."[19] This definition accommodates Keefe's two dimensions for cognitive style: the style for receiving information and the style for forming concepts and retaining information.[20]

(1) Cognitive Style for Retaining Information.

Reinert described four perceptual modes for reception of information: (a) visualization--a mental picture of some object or activity; (b) written word--a mental picture

---

[18]Keefe, "Learning Style: An Overview," op. cit., pp. 6-17.

[19]Ibid., p. 8.

[20]Ibid., pp. 9-10.

of the word spelled out for reading; (c) listening--no mental picture but the sound of the word carries meaning; and (d) activity (kinesthetic)--physical or emotional feeling about the word.[21]

Witkin identified two ways of depicting the individual's perception of the learning environment. He labeled them field dependent vs. field independent.[22] Learners who differentiated the information to be learned from the background field in which it was presented were identified as field independent learners. To the field dependent learner the material to be learned was integrated with the field of which it was a part. Witkin typed the field independent person as an analytical learner while the field dependent person was cast as a global type of learner.

Another method of receiving information was set in a continuum from scanning to focusing. The scanning strategy attempts to relate the pieces of the learning situation into a large picture, while the focusing strategy deals with the details of the learning situation.[23]

---

[21]Harry Reinert, "One Picture is Worth a Thousand Words? Not Necessarily!" Modern Language Journal, April 1976, pp. 160-168.

[22]Keefe, "Assessing Student Learning Styles: An Overview," op. cit., pp. 45-46.

[23]Keefe, "Learning Style: An Overview," op. cit., p. 9.

The scanning to focusing continuum might be described as a continuum from discrete learning to a global orientation. The scanning strategy could be compared to the field independent learner depicted by Witkin.

Gardner and Holtzman at the Menninger Foundation identified three bipolar control factors in perceiving information. Perceptual differentiation and undifferentiation as set forth by Gardner matches well with the analytic (differentiation) to global (undifferentiation) of Witkin.[24] Gardner described the learner who is susceptible to distraction while receiving information as possessing a constricted style of information reception while the individual who can concentrate on the task as a flexible style of information receiver.[25] Gardner's third control factor in receptive cognitive style was the individual's tolerance for incongruous or unrealistic learning situations.[26] Low tolerance would signify that new learning needs to be couched in a familiar environment, while a high tolerance would indicate an ability to deal with information presented in a unique fashion.

---

[24]Ibid., p. 5.

[25]Ibid., p. 9.

[26]Ibid.

Broverman classified cognitive receptive style as strong automatization vs. weak automatization. Strong automatizers were defined as having the ability to perform single repetitive tasks longer than expected from the individual's general level of performance on a battery of heterogeneous tasks. Weak automatizers were defined as the other extreme of not being able to perform single repetitive tasks as long as expected.[27]

Cognitive style reception was protrayed by McKenney and Keen on a four point perpendicular bi-polar continuum. Figure 2 is a representation of this continuum. One bi-polar continuum represents the information gathering style of the individual while the other is indicative of the individual's information processing style. The two poles on the continuum for gathering information are perceptive vs. receptive. Perceptive information gathering assimilates new information into previously learned concepts. Receptive information gathering receives information literally with very little interpretation or application. The two poles on the information processing continuum are systematic vs. intuitive. Systematic style leans toward developing clear sequential plans for

---

[27]Donald M. Broverman et al., "The Automatization Cognitive Style and Physical Development," Child Development, 35 (1964), 1344.

information processing while intuitive style would tend to develop ideas freely from the data and to skip from part to whole without a predetermined plan.[28] Figure 2 presents the way McKenney and Keen conceptualized and represented their ideas.

David Kolb developed a Learning Style Inventory which included indicators of receptive style as well as style of retention and concept formation. Kolb's four receptive styles or modes of learning were (a) concrete experience (feeling); (b) reflective observation (watching); (c) abstract conceptualization (thinking); and active experimentation (doing).[29] Within Kolb's framework, the four styles or modes of reception were joined with four styles of processing data. These combinations were classified into four learning styles: (a) the converger; (b) the diverger; (c) the assimilator; and (d) the accommodator.[30]

---

[28]J. L. McKenney and P. G. W. Keen, "How Managers' Minds Work," Harvard Business Review, 52, No. 3 (1974), 79-90.

[29]Patricia Kirby, Cognitive Style, Learning Style, and Transfer Skill Acquisition, (Columbus, Ohio: The National Center for Research in Vocational Education at The Ohio State University, 1979) p. 74.

[30]Ibid., pp. 74-77.

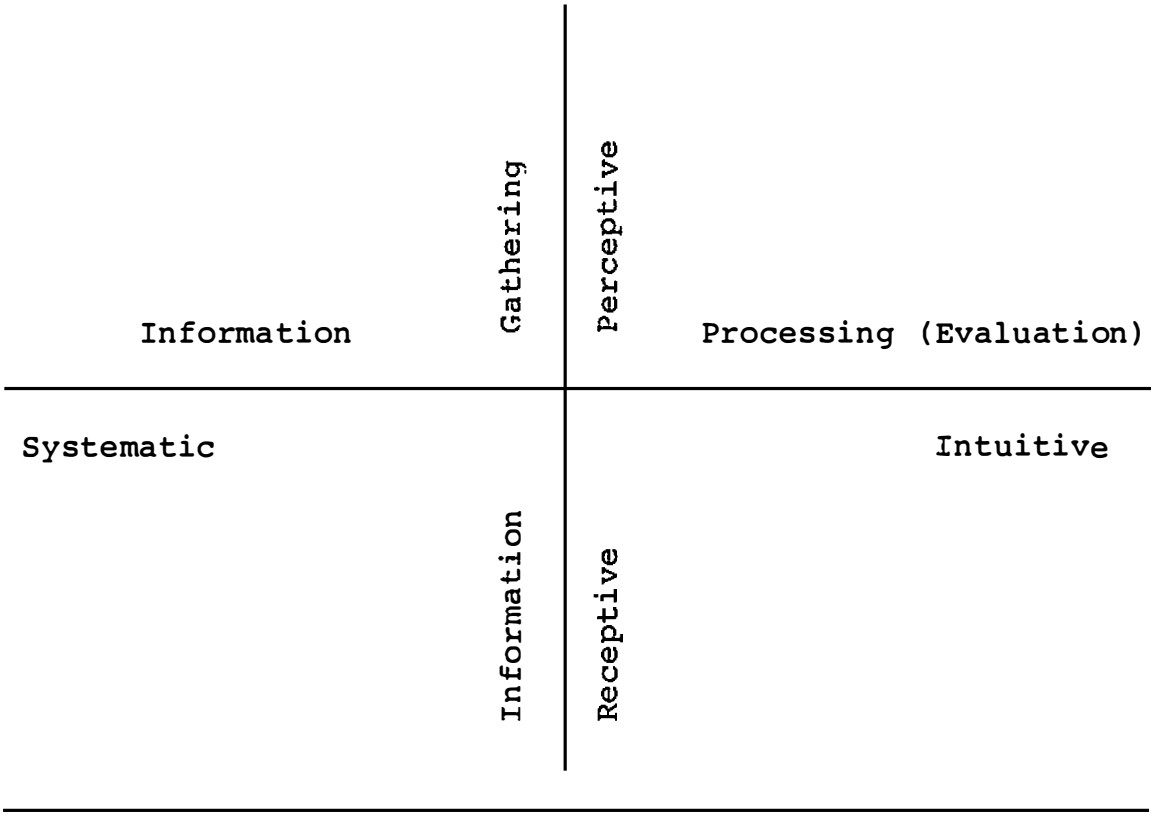


Figure 2. Receptive Cognitive Style Designed by McKenney and Keen.

(2) Cognitive Style for Concept Formation and Retention. Kagan developed two descriptors for cognitive style according to how people sorted and processed information. His first style description labeled cognitive style according to how people sorted information. This style was set on a continuum from analytic/descriptive to relational/contextual.[31] The relational style could also be identified as global. He developed a technique for identifying cognitive tempo in processing data. Information processing is set on a continuum from reflective to impulsive.[32]

The Gregorc Style Delineator developed by Anthony Gregorc provides a bi-dimensional model of cognitive style which combines two information processing dimensions. Gregorc described information processing on a concrete vs. abstract and random vs. sequential duality. The resultant matrix gave four cognitive styles or profiles. Gregorc's four styles of cognitive processing were labeled as (a) concrete sequential; (b) concrete random; (c) abstract sequential; and (d) abstract random.[33]

---

[31]Ibid., p. 56.

[32]Keefe, "Learning Style: An Overview," op. cit., p. 10.

[33]Anthony F. Gregorc, "Learning/Teaching Styles: Their Nature and Effect," in Student Learning Styles: Diagnosing and Prescribing Programs (Reston: National Association of Secondary School Principals, 1979), p. 20.

Hagberg and Leider developed an instrument with sets of words, and respondents are to choose the words which the respondents believe best describe themselves. From the responses to the instrument Hagberg and Leider classified individual learning abilities in the same way Kolb identified learning modes. Hagberg and Leider's learning abilities were receptive in nature as well as for concept formation and retention. These abilities are classified under concept formation and retention due to the emphasis the authors give to the effect of each learning ability on the behavior of the individual.[34]

Joseph Hill designed a unique way of conceptualizing cognitive style. Hill developed a large hierarchical system he called the seven educational sciences. Each science presumed to build on the ones below. Cognitive style was the fifth science on this hierarchical list. The first two sciences identified by Hill could be matched with cognitive receptive style, as they dealt with symbols and their meanings and cultural determinants. Sciences three and four, modalities of inference and educational memory, correlate highly with cognitive style of concept formation and retention.[35] Kirby suggests that Hill's

---

[34]Kirby, op. cit., pp. 80-81.

[35]Ibid., p. 59.

educational science of cognitive style could probably have been labeled learning style.[36] Hill's final two sciences were teaching: administrative, and counseling style as well as the individual's style for decision making.[37] Hill used the Cognitive Style Mapping Inventory to develop a cognitive style profile or map of an individual. This cognitive map would help match the learner with the proper learning environment or format.[38]

Charles Letteri developed an instrument for assessing cognitive style that combines several dimensions studied earlier by various researchers. Letteri's Cognitive Profile charts the student's style on seven bi-polar dimensions. The various dimensions provided by the Cognitive Profile are as follows:[39]

1. Analytical ⟷ Global

   This dimension is very similar to the field independence vs. field dependence style of receiving information identified by Witkin. Letteri's emphasis is on the use of this dimension for concept formation.

---

[36] Ibid.

[37] Ibid.

[38] Ibid., pp. 60-61.

[39] Keefe, "Assessing Student Learning Styles: An Overview," op. cit., pp. 47-48.

2. Focuser ⟷ Nonfocuser

This dimension attends to the degree of susceptibility of task attention to distraction. It parallels closely with the receptive style method of scanning vs. focusing.

3. Narrow ⟷ Broad

This aspect of concept formation deals with the breadth of categorization utilized by the individual in classifying and organizing information and tasks.

4. Complex ⟷ Simple

This dimension identifies the different ways persons construe the world, particularly social behavior, ranging from a multi-dimensional to a uni-dimensional perspective.

5. Reflective ⟷ Impulsive

This aspect of cognitive style concerns itself with the speed, accuracy, and consistency by which individuals process and utilize information.

6. Sharpener ⟷ Leveler

Sharpeners rely heavily on visual, rote memory, and recall facts and concepts as distinct and different. They do not easily see relationships or cause-and-effect inferences. Levelers tend to blue similar

memories and to merge new concepts readily with previously learned precepts. Levelers tend to over-generalize.

7. Tolerant ◄——————————► Intolerant

Letteri applies the dimension of style to concept formation. The tolerant individual is willing to accept concepts and experiences that appear to be at variance with what he considers conventional or accepted. The intolerant individual prefers more socially acceptable or predictable concepts or ideas.

b. Affective Style Accent of Learning Style. The affective domain of learning style is identified by Keefe as comprising personality traits involved in attention, emotion, and valuing. These personality traits are included in the processes of motivation. Keefe defined affective learning styles as "those same motivational processes viewed as the learner's typical mode of arousing, directing, and sustaining behavior."[40]

Dunn, Dunn, and Price have done extensive work on the affective domain of learning style. They identified four

---

[40]Ibid., p. 48.

emotional elements of learning style: motivation; persistence; responsibility; and structure.[41]

(1) Motivation: An Affective Element of Learning Style. Dunn, Dunn, and Price identify the student on a continuum from highly motivated to unmotivated by use of their Learning Style Inventory (LSI). The motivated student is eager to learn, while the unmotivated student is described as unenthusiastic about learning.

(2) Persistence: An Affective Element of Learning Style. Dunn, Dunn, and Price identify persistence as an emotional element of affective learning style. A high persistence score on the LSI indicates an individual with a strong orientation toward task completion. A low score indicates an individual who will leave a task at the slightest encounter with difficulty or distraction.

(3) Responsibility: An Affective Element of Learning Style. The LSI identifies a student on a continuum between highly responsible and not responsible. The highly responsible student is a person who follows and completes directions--a compliant person. This indicates

---

[41]Rita Dunn, Kenneth Dunn, and Gary E. Price, "Identifying Individual Learning Styles," in Student Learning Styles: Diagnosing and Prescribing Programs, (Reston: National Association of Secondary School Principals, 1979), p. 42.

that the less responsible student is one who does not follow and complete instructions.

(4) Structure: An Affective Element of Learning Style. Structure refers to the degree of specific rules and guidelines needed by a student in order to achieve or complete an assignment.

(5) Sociology: An Affective Element of Learning Style. Keefe included the sociological elements of learning style under the affective domain.[42] The sociological elements of learning style are the individual's preference for learning with a group of his peers, alone, as a pair, under the direction of an authority figure, or using varied sociological groupings.[43]

c. Physiological Domain of Learning Style. Keefe identified the third realm of learning styles to be physiological. He defined physiological styles of learning to be "biologically based modes of response that are founded on sex-related differences, personal nutrition and health, and reaction to the physical environment."[44]

---

[42]Keefe, "Assessing Student Learning Styles: An Overview," op. cit., pp. 48-49.

[43]Ibid.

[44]Ibid., p. 49.

The LSI is the primary instrument used for measuring the physiological factors in learning style.

(1) The Physical Elements of the Physiological Domain. There are four physical elements to learning style. They are labeled as perceptual, intake, time and mobility.[45]

(a) Perceptual Elements of Learning Style. The LSI identifies the perceptual strength or preference of an individual. The perceptual senses identified are auditory, visual, tactual, and kinesthetic. Any one singular perceptual preference or any combination of the four can be identified.

Auditory perceptual preference indicates that the individual prefers learning by listening, while the visual preference for perceptual style identifies a person who learns by viewing. A person with a tactual perceptual preference learns best by touching and the kinesthetic preferenced individual prefers to learn by doing or being physically involved in the learning activity.[46]

---

[45]Ibid., p. 42.

[46]Rita Dunn, "Now That You Understand Your Learning Style. . . What Are You Willing To Do To Teach Your Students Through Their Individual Style?" Early Years, 13, No. 7, 30-31.

(b) Intake as a Physical Element of Learning Style. Intake as an element of learning style is an indication of the personal preference for period breaks in study for food or drink.

(c) Time as a Physical Element of Learning Style. The time of day at which an individual learns most effectively is included as a physical element of learning style. The LSI identifies a student's preference for learning in the morning, late morning or noon, late afternoon, or evening.

(d) Mobility as a Physical Element of Learning Style. Mobility indicates the individual's need to vary his stance, posture, or location to facilitate learning.

(2) The Environmental Elements of the Physiological Domain. The environmental elements of learning style are four: sound, light, temperature, and design.[47]

Sound as an environmental element of learning style relates to the individual's preference for learning in a quiet environment or one with noise.

Pizzo investigated the relationship between selected acoustic environments and students' diagnosed preference for sound as they affect the reading achievement and

---

[47]Dunn, Dunn, and Price, op. cit., p. 42.

attitudes of male and female sixth grade students. She used 64 sixth-grade students who were diagnosed as having a preference for quiet or sound. Half of the subjects were tested in an acoustic environment congruent with their diagnosed preference for sound, and half were tested in an acoustic environment that was incongruent with their diagnosed preference for sound.

The subjects were administered the comprehension subtest of the Gates-MacGinitie Reading Tests and a semantic differential scale developed by the researcher to measure the attitudes of sixth grade students.

Pizzo discovered that sixth grade students tested in an acoustic environment congruent with their learning style preference as diagnosed by the LSI performed significantly higher on reading comprehension and attitude scores than their peers tested in an acoustic environment incongruent with their preferred style.[48]

The element of light is measured as to the person's preference for subdued or bright light. Krimsky administered the LSI to fourth grade students to determine each student's preference for the learning style element of

---

[48]Jeanne Sottile Pizzo, "An Investigation of the Relationship Between Selected Acoustic Environments and Sound, An Element of Learning Style, As They Affect Sixth Grade Students' Reading Achievement and Attitudes," (Unpublished Doctoral Dissertation, St. John's University, 1981) pp. 171-194.

light. Half of the students were tested in an environment matching their preference for light and the other half were tested in an environment mismatched with their preference. He found that students performed significantly better on tests of reading speed and accuracy when the lighting in their testing environment was matched with their learning style preference for bright or dim lights.[49]

Temperature is an indicator of the subject's preference for a cool or warm learning environment. Several studies have been conducted to determine the effect of classroom temperature upon school performance. None of the studies have considered student performance when operating in an environment matched and mismatched with the student's preference for the element of temperature.

Design as an element of learning style identifies the individual's preference for an informal or formal learning environment.

B. DESIGN AS AN ENVIRONMENTAL ELEMENT OF LEARNING STYLE

Design as an element of learning style is defined as the individual's preference for a formal environment

---

[49]Jeffrey Stephen Krimsky, "A Cognitive Study of the Effects of Matching and Mismatching Fourth-Grade Students With Their Learning Style Preferences for the Environmental Element of Light and Their Subsequent Reading Speed and Accuracy Scores," (Unpublished Doctoral Dissertation, St. John's University, 1981) p. ii.

containing straight chairs and tables or desks, as found in a classroom, library, or kitchen; or for an informal environment of upholstered chairs, sofas, pillows, and carpet.[50]

Design may appear to be very similar to structure, which has been described as an emotional element of learning style, but there is a basic difference. Structure has to do with the amount of teacher direction and instruction the student desires for work he is to perform. Design deals with the physical environment in which the person prefers to work.

According to Dunn, Dunn, and Price, a high design score on the LSI indicates the individual's preference to work in a more formal arrangement that has straight back chairs and tables or desks as found in the library, classroom or kitchen. A low design score suggests the individual's preference for study in a more informal arrangement that might have upholstered chairs, sofas, pillows on the floor, or the individual lying in the floor.[51]

The only research studies conducted on design as an environmental element of learning style have been by Dunn,

---

[50]Rita Dunn, "You've Got Style: Now's The Time to Find Out What It Is," Early Years, 13, No. 5, 28.

[51]Ibid.

Dunn, and Price in establishing the reliability of the LSI and by Thomas C. Shea.

In their research to establish the reliability of the LSI, Dunn, Dunn, and Price found the following particulars:

(1) Males in grades 5, 6, and 11 liked a more informal design than females.

(2) Individuals with high achievement scores in reading and math generally desired a more formal design, while those with low achievement scores in reading and math liked an informal design when studying.[52]

Shea administered the LSI to four hundred and twenty ninth grade students attending a junior high school within a racially mixed middle class suburban school district in Suffolk County, New York. Based upon their scores on the LSI, two preferenced subgroups were established: (1) strong preference for a formal design (score on the LSI between 70 and 80); and (2) strong preference for an informal design (score on the LSI between 20 and 30). Shea used the term, "strong preference. . .," because he used a more restrictive scoring range for both formal and informal design. According to the authors of the LSI, any

---

[52]Gary E. Price, Rita Dunn, and Kenneth Dunn, Learning Style Inventory Technical Manual (Lawrence: Price Systems, Inc., 1976), pp. 15-20.

score above 60 can be considered as an indication of preference for formal design, and any score below 40 can indicate a preference for informal design. Shea doubled the range of scores indicating no preference for the element of design. By so doing he narrowed the range of scores indicating both formal and informal learning style to the point he could label it as a strong preference. From the pool of the two subgroups Shea randomly selected 16 students strongly preferring formal design and 16 students strongly preferring informal design. Half of the 32 subjects were tested in an instructional environment matched with their diagnosed strong learning style preference, and half were tested in an instructional environment mismatched with their diagnosed strong learning style preference. The subjects were randomly assigned to the instructional environments. Both groups of 16 were administered the Metropolitan Achievement Test, Advanced 1, Form JS, Reading Comprehension Subtest. The design of both the formal and informal instructional environments followed the recommendations of Dunn, Dunn, and Price. Shea found no significant difference at the .01 level in the mean reading comprehension scores of students with a diagnosed strong preference for formal design in a matched and a mismatched environmental setting. Shea noted, however, that students with a strong preference for formal design

adapted the informal environment to their needs for posture and comfort without detriment to their achievement. Shea implied that the adaptation of the formal preferenced students in the informal environment invalidated the informal environment and thus made suspect this portion of the data. Shea found a significant difference at the .01 level between the mean reading comprehension scores of informal preferenced students when tested in a matched and a mismatched environmental setting. Shea concludes that the results of his study support the hypothesis that:

> . . . subjects tested in instructional environments congruent with their learning style preferences for design would achieve significantly higher reading achievement scores than their peers tested in a setting that was incongruent with their strong preferences for design.[53]

C. SUMMARY

The literature reviewed for this investigation indicates that the concept of cognitive style grew out of theory and research on individual differences and learning. As the idea of learning style was refined and clarified, it was evident that the earlier term of cognitive style was one of three substyles comprising what came to be known as learning style. These three groups of substyles were

---

[53]Shea, op. cit., pp. 116-134.

labeled as (1) cognitive styles; (2) affective styles; and (3) physiological styles.

Cognitive style identifies how an individual receives information, how the information received in concept formation is used, and how it is retained for later use by the individual.

The affective domain of learning style deals with the effect of personality traits involved in attention, emotion, and valuing. The affective elements of learning style are identified as motivation, persistence, responsibility, structure, and sociological.

The third realm of learning styles is the physiological domain. This substyle includes the physical elements of learning style and the environmental elements.

The learning style element of design is one of four considered to be a part of the environmental elements of learning style. The other three environmental elements of learning style are recorded as sound, light, and temperature. The research indicated that the environmental elements of sound, light, and temperature have measurable effects on the individual's learning and performance. Shea conducted research into the area of environmental design and its impact on learning and testing. Shea found that when seventh grade students were tested in an environment matching their preference for the learning

style element of design they performed better on standardized tests of reading comprehension.

This literature review carries the concept of learning style origination through its development into a broad term encompassing many aspects or substyles. It presents research regarding the effects of the various environmental elements on student learning and performance relative to the student's diagnosed learning style. It describes the previous research in the area of design in laying the foundation for understanding and utilizing the results of this study.

CHAPTER III

METHODOLOGY

This chapter explains the procedures utilized to determine whether the design of the testing environment influenced standardized test scores of fifth grade students when their diagnosed preferences for the learning style element of design were matched or mismatched with the design of the environment. This chapter describes the subjects for the study, the instruments utilized, the procedures used for grouping the subjects and gathering the data, as well as the research design and statistical analysis.

A. SUBJECTS FOR THE STUDY

The population for this study was fifth grade students attending six private schools in the area of Chattanooga, Tennessee. The six schools enrolled 163 fifth grade students at the time of this investigation.

The families and communities from which the students in the six schools came were primarily middle class. Each school had an open academic admissions policy. The average reading and mathematics achievement in the schools as measured by the Stanford Achievement Test ranged from slightly above grade level to one and a half grades above

the national mean, with scores in reading for one school averaging three years above grade level.

B. INSTRUMENTS USED IN THE STUDY

1. Learning Style Inventory (LSI)

The Learning Style Inventory (LSI) consists of 104 True/False statements that survey the individual's preference for each of 24 different elements of learning style. Subjects are instructed to read each statement and to indicate whether the statement is usually true or false for them when they are learning something new. They are to give their immediate or first response to each item. The inventory is untimed in its administration.

The LSI reports scores on 22 sub-scales based on two to eight test items for each sub-scale. These sub-scales are listed in Table 1.

The reliability data reported in the research report on the LSI were based on a sample of 1,836 subjects tested in Kansas, Michigan, New Jersey, New York, Pennsylvania, and Texas. Of the 1,836 students, 942 were males and 894 females.[1] The Hoyt analysis of variance procedure was used to estimate the reliability for each sub-scale on

---

[1]Gary E. Price, Rita Dunn, and Kenneth Dunn, Learning Style Inventory: Research Report (Lawrence: Price Systems, 1977), p. 4.

TABLE 1

THE 22 SUB-SCALES REPORTED ON THE LSI

Number	Low Score	Sub-scale	High Score
1	Quiet	Noise Level	Sound Present
2	Low	Light	Bright
3	Cool	Temperature	Warm
4	Informal	Design	Formal
5		Motivation	
6		Persistence	
7		Responsible	
8		Structure	
9		Learning Alone/Peer Oriented	
10		Authority Figure Present	
11		Learn in Several Ways	
12		Auditory	
13		Visual	
14		Tactile	
15		Kinesthetic	
16		Requires Intake	
17		Evening - Morning	
18		Late Morning	
19		Afternoon	
20		Needs Mobility	
21		Parent Figure Motivated	
22		Teacher Motivated	

the LSI. The Hoyt procedure is equivalent to the Kuder-Richardson Formula 20.[2]

Price reports the reliability analysis for the various elements on the LSI for grades 1 through 12 as follows:

> . . . 33% were greater than .70, 25% were between .50 and .69, 23% were between .30 and .49 and 10% were less than .29 with only seven items per sub-scale, at the most. Thus, the reliabilities were generally very good considering the small number of items in each sub-scale.[3]

The reported reliability for the environmental elements ranged from .33 to .82, with an average of .67.[4] The design element test consists of four of the 104 items. They are given in order; #6, #7, #19, #40:

6. I study best at a table or desk.
7. When I study I like to sit on a soft chair or couch.
19. I like to sit on a hard chair when I study.
40. I like to sit on carpeting or rugs when I study.[5]

The reliability coefficient for the learning style element of design was .33.[6]

---

[2]Ibid., p. 9.

[3]Ibid.

[4]Ibid., p. 26.

[5]Rita Dunn, Kenneth Dunn, and Gary E. Price. Learning Style Inventory (Lawrence: Price Systems, 1978), p. 1.

[6]Price, op. cit., p. 95.

Shea refers to the work of Price in studying the stability of selected elements of the LSI across time. Price found that certain elements of learning style tended to be stable over time, while others appeared to follow the child's developmental pattern. The element of design appeared to vary from preference for formal toward preference for informal as age and independence increased.[7] Shea reports that in a test-retest reliability design, eight percent of the elements in the LSI were significant at the .05 level of confidence, and 56 percent were significant at the .01 level. The test-retest design worked with an eight-month interval between testings. Evidence was that the greatest degree of fluctuation in reliability scores was during the middle school grades of six, seven, and eight.[8]

In regards to the reliability and validity of the LSI, Ohio State University's National Center for Research in Vocational Education reported after a two-year review of

---

[7]Thomas C. Shea, "An Investigation of the Relationships Among Selected Instructional Environments, Preferences for the Learning Style Element of Design, and Reading Achievement Testing of Ninth Grade Students to Improve Administration Determinations Concerning Effective Educational Facilities," (Unpublished Doctoral Dissertation, St. John's University, 1983) p. 94, citing Gary E. Price, "Research using the learning style inventory." Paper presented at the second annual conference on teaching students through individual learning styles, New York, July, 1980.

[8]Ibid., p. 95.

instruments designed to identify learning styles, that, "Price, Dunn, and Dunn have established impressive reliability and face and construct validity."[9]

2. California Achievement Test (1977), Level 16, Form C, Mathematics Concepts and Applications, and the Reading Comprehension Subtests

The content validity of the California Achievement Tests (CAT) is documented in a detailed description of the various skills and concepts measured by the test found in Technical Bulletin 1.[10] The different objectives covered by the tests are represented by figures in the manual and the process for arriving at the content to be included is discussed.

The publishers state that "the validity of CAT C and D was established during the process of test development and does not depend upon correlation with any other test."[11] The manual includes tables of the correlation coefficients for the various subtests of the CAT and the intelligence quotients of students measured by the

---

[9]Patricia Kirby, Cognitive Style, Learning Style, and Transfer Skill Acquisition, (Columbus, Ohio: The National Center for Research in Vocational Education at the Ohio State University, 1979) p. 72.

[10]Technical Bulletin 1. California Achievement Tests, Forms C and D, (Monterey: CTB/McGraw-Hill, 1979) pp. 7-12.

[11]Ibid., p. 18.

Short Form Test of Academic Aptitude (SFTAA). The SFTAA is a revision of the California Test of Mental Maturity. The validity correlation between the CAT, Level 16 and the SFTAA, Level 3 was .76 for mathematics concepts and applications and was .79 for reading comprehension.[12]

The reliability of the CAT was established during the norming and standardization process. The reliability coefficients for alternate forms of the CAT, Level 16 at an interval of two to three weeks were Reading Comprehension, .75 and Mathematics Concepts and Applications, .77. The correlation coefficients for repeated administration of the same test after six months was .84 for Reading Comprehension and .84 for Mathematics Concepts and Applications.[13]

C. PROCEDURES IN THE STUDY

It was the purpose of this study to determine whether standardized test scores in mathematics concepts and applications and in reading comprehension of fifth grade students were influenced when the learners were tested in an environment that matched and mismatched their diagnosed preferences for the learning style element of design.

---

[12]Ibid., p. 20.

[13]Ibid., pp. 116 and 129.

To determine students' preference for the learning style element of design in the learning environment, the Learning Style Inventory (LSI) by Dunn, Dunn, and Price was administered to 163 fifth grade students in six private schools in the vicinity of Chattanooga, Tennessee. The students fell into three categories according to their scores on the LSI. The students scoring below 40 on design on the LSI were placed in the category identified as preferring an informal design of the learning environment. Subjects scoring above 60 on design on the LSI fell into the category diagnosed as preferring a formal design of the learning environment, and those scoring between 40 and 60 on design on the LSI were categorized as indicating no preference for the element of design in the learning environment. The students then were randomly assigned from each of the three categories to two groups. Each group consisted of subjects who were diagnosed as (1) preferring formal learning design; (2) preferring informal learning design; and (3) indicating no preference for the environmental element of design.

Group one was tested in a formal environment. This group consisted of 39 subjects: 13 with a diagnosed preference for formal design; 13 with a diagnosed preference for informal design; and 13 with a diagnosis of no preference for design.

Group two was tested in an informal environment. This group was composed of 39 subjects: 13 with a diagnosed preference for formal design; 13 with a diagnosed preference for informal design; and 13 with a diagnosis of no preference for design.

Both groups were tested in a room with dimensions of 18' x 45' that was designed for 90 students. The formal testing environment for group one consisted of 90 side arm student desks. On the following day group two was tested at the same time of day with the room completely rearranged for the informal testing. All desks were removed and an informal setting prepared by using four long upholstered sofas, three short upholstered sofas, nine upholstered chairs, four lounge chairs, three vinyl covered arm side chairs, and ten large cushions. These pieces were arranged in an informal setting with easy visual access to the person administering the tests. A diagram of the informal test setting can be found in Appendix A, page 97.

The students in group one were not assigned seats but were instructed to sit in every other desk in each odd numbered row. The subjects in group two were instructed to choose the seat and location of their choice.

The subjects were administered the California Achievement Test (1977), Level 16, Form C, The Mathematics Concepts and Applications, and The Reading Comprehension Subtests in the testing environment to which they were assigned at the beginning of the experimental period. These tests were scored, and the scores for mathematics concepts and applications were recorded, as were the scores for reading comprehension. Comparisons were made for both mathematics concepts and applications, and reading comprehension scores when: (1) the testing environment was matched with diagnosed learning style; (2) when the testing environment was mismatched with diagnosed learning style; and (3) when the learning style element of design was diagnosed as being of no preference to the subject.

The test for each group was administered by the same certificated, experienced elementary school teacher, who was blind to the hypotheses of the study. The same four observers were utilized in each testing session to record any behavior by students that might indicate an attempt to make the formal environment more informal, or an effort to formalize the informal setting. A copy of these observation record forms can be found in Appendix B, pages 99-100.

The four observers were trained to observe in the test setting on the day of each test administration. The training consisted of a presentation of the purpose for the observations and the kinds of behavior for which they were to watch. Observers were instructed to be certain the student maintained a posture for approximately one minute before recording it on the observation form. Each observer was assigned to record the behavior of the students in a specified area of the classroom.

D. RESEARCH DESIGN

The research design of this study involved two independent variables: (1) testing environment, and (2) diagnosed preference or no preference for design.

The two dependent variables were the mathematics concepts and applications, and the reading comprehension as measured by the mean scores on the mathematics concepts and applications, and the measures on the reading comprehension subtests of the California Achievement Test (1977), Level 16, Form C.

E. STATISTICAL ANALYSES

A correlated *t* test was applied to the data for the experimental group means utilized for this investigation. Those analyses yielded a *t* score for each of the groups

included in the study. In all analyses, *t* scores significant at the .01 level were deemed large enough to reject the null hypotheses.

The statistical analyses were used to compare mean achievement test scores in mathematics concepts and applications and in reading comprehension for the subjects of this study:

1. When those with a diagnosed preference for the formal design of the learning environment were tested in an environment matched and mismatched with their preference.
2. When those with a diagnosed preference for the informal design of the learning environment were tested in an environment matched and mismatched with their preference.
3. When those with no diagnosed preference for the learning style element of design were tested in a formal environment and when they were tested in an informal setting.

CHAPTER IV

ANALYSIS OF DATA

This chapter presents the results of the evaluation procedures utilized to test the hypotheses of this investigation. These hypotheses were tested by computing the mean scores on the dependent variables and analyzing them through a correlated *t* test procedure.

A. DISCUSSION

This study investigated the relationship among selected testing environments and students' diagnosed preference or lack of preference for the learning style element of design. Mean achievement test scores of fifth grade students were compared when students with a diagnosed preference for formal design and those with a diagnosed preference for informal design were tested in an environment matched and mismatched with their diagnosed preferences. Students with a diagnosis of no preference for the learning style element of design were compared when tested in a formal and an informal environment.

1. Null Hypothesis One

There will be no significant difference between the mean scores when students, whose diagnosed preference for a formal design, are tested in a setting that is matched and mismatched with their preference on tests of

a. mathematics concepts and applications, and
b. reading comprehension.

2. Null Hypothesis Two

There will be no significant difference between the mean scores when students who have a diagnosed preference for an informal design are tested in an environment that is matched and mismatched with their preference on tests of

a. mathematics concepts and applications, and
b. reading comprehension.

3. Null Hypothesis Three

There will be no significant difference between the mean scores of students with no diagnosed preference for formal or informal design when tested in a formal and an informal environment on tests of

a. mathematics concepts and applications, and
b. reading comprehension.

4. Report of Data

The data gathered by the procedures utilized in this study, and compared by the statistical analyses employed by this study, are presented in relation to the three groups studied by this investigation: students having a preference for formal design, students having a preference for informal design, and students indicating no preference for the learning style element of design.

The mean scores for all three groups of subjects when tested in both a formal and an informal environment on mathematics concepts and applications are presented in Table 2. Table 3 contains the mean scores for all three groups of subjects when tested on reading comprehension in both a formal and an informal environment. Table 4 presents the calculated data for the *t* test on the mean scores for each of the three design preference groups on the test of mathematics concepts and applications. Table 5 presents the computed data for the *t* test on the mean scores for each of the three design preference groups on the test of reading comprehension.

a. Students Having a Preference for Formal Design.

Students having a formal preference were tested in a matching (formal) environment and a mismatching (informal) environment.

TABLE 2

MEAN TEST SCORES ON A TEST OF MATHEMATICS CONCEPTS AND APPLICATIONS OF STUDENTS WITH DIAGNOSED LEARNING STYLE PREFERENCE OR NO DIAGNOSED PREFERENCE FOR FORMAL OR INFORMAL DESIGN WHEN TESTED IN A MATCHED OR MISMATCHED TESTING ENVIRONMENT

Preference	Formal Environment	Informal Environment
	F_1	F_2
Formal Preference	$\bar{X}$ = 26.38 Range = 9-38 (29) mdn = 29 n = 13	$\bar{X}$ = 26.62 Range = 14-35 (21) mdn = 26 n = 13
	I_1	I_2
Informal Preference	$\bar{X}$ = 31.77 Range = 12-41 (29) mdn = 35 n = 13	$\bar{X}$ = 30 Range = 15-44 (29) mdn = 32 n = 13
	NP_1	NP_2
No Preference	$\bar{X}$ = 26.15 Range = 12-43 (31) mdn = 26 n = 13	$\bar{X}$ = 27.69 Range = 17-39 (22) mdn = 29 n = 13

TABLE 3

MEAN TEST SCORES ON A TEST OF READING COMPREHENSION OF STUDENTS WITH DIAGNOSED LEARNING STYLE PREFERENCE OR NO DIAGNOSED PREFERENCE FOR FORMAL OR INFORMAL DESIGN WHEN TESTED IN A MATCHED OR MISMATCHED TESTING ENVIRONMENT

Preference	Formal Environment	Informal Environment
	F_1	F_2
Formal Preference	$\bar{X}$ = 26.77 Range = 7-37 (30) mdn = 28 n = 13	$\bar{X}$ = 27.62 Range = 18-37 (19) mdn = 26 n = 13
	I_1	I_2
Informal Preference	$\bar{X}$ = 29.85 Range = 16-38 (22) mdn = 32 n = 13	$\bar{X}$ = 30 Range = 14-38 (24) mdn = 33 n = 13
	NP_1	NP_2
No Preference	$\bar{X}$ = 22.84 Range = 9-37 (28) mdn = 25 n = 13	$\bar{X}$ = 27 Range = 10-35 (25) mdn = 28 n = 13

TABLE 4

RESULTS OF *t* TEST FOR THREE DESIGN PREFERENCE GROUPS WHEN TESTED IN A MATCHED AND MISMATCHED ENVIRONMENT ON A TEST OF MATHEMATICS CONCEPTS AND APPLICATIONS

Design Preference Groups	M Formal Environment	SD	M Informal Environment	SD	*t*	*p*
Formal Preference	26.38	9.31	26.62	7.58	.07	NS
Informal Preference	31.77	8.54	30	8.03	.54	NS
No Preference	26.15	11.04	27.69	7.16	.42	NS

p at the .01 level requires a *t*-score greater than 2.66 for 2 tailed-test at 70 df.

TABLE 5

RESULTS OF *t* TEST FOR THREE DESIGN PREFERENCE GROUPS WHEN TESTED IN A MATCHED AND MISMATCHED ENVIRONMENT ON A TEST OF READING COMPREHENSION

Design Preference Groups	M Formal Environment	SD	M Informal Environment	SD	*t*	*p*
Formal Preference	26.77	8.43	27.62	6.6	.29	NS
Informal Preference	29.85	6.96	30	7.46	.05	NS
No Preference	22.84	10.16	27	7.11	1.21	NS

p at .01 level requires a *t*-score greater than 2.66 for 2 tailed-test at 70 df.

The mean score on the test of mathematics concepts and applications for the subjects with a diagnosed preference for formal design was 26.38 when tested in a formal setting and 26.62 when tested in an informal setting. The computed t score (t=.07) for the subjects preferring a formal design tested in an environment matched and mismatched with their diagnosed preference on the test of mathematics concepts and applications was not significant at the .01 level. The subjects with a diagnosed preference for formal design had mean scores on the test of reading comprehension of 26.77 in a formal testing environment and 27.62 in an informal testing environment. The computed t score (t=.29) for the subjects preferring a formal design tested in an environment matched and mismatched with their diagnosed preference on the test of reading comprehension was not significant at the .01 level.

Null hypothesis one of this study was accepted.

b. Students Having Preference for Informal Design. Students with a preference for informal design were tested in a matching (informal) environment and a mismatching (formal) environment.

The mean score on the test of mathematics concepts and applications for students with a diagnosed preference for informal design tested in a formal environment was

31.77 while it was 30 for the students with the same diagnosed preference tested in an informal environment. The computed *t* score (*t*=.54) for the subjects preferring an informal design tested in an environment matched and mismatched with their diagnosed preference on the test of mathematics concepts and applications was not significant at the .01 level. The mean score on the test of reading comprehension for students with a diagnosed preference for informal design tested in a formal setting was 29.85 and for students with the same preference tested in an informal environment the mean score was 30. The computed *t* score (*t*=.05) for the subjects preferring an informal design tested in an environment matched and mismatched with their diagnosed preference on the test of reading comprehension was not significant at the .01 level.

Null hypothesis two was accepted.

c. Students Having No Preference for the Element of Design. Students with no preference for the environmental element of design were tested in a formal and an informal environment.

The mean score on the test of mathematics concepts and applications for students with no diagnosed preference for the learning style element of design when tested in

a formal environment was 26.15 and when tested in an informal environment was 27.69. The computed t score (t=.42) for the subjects with no diagnosed preference for the element of design when tested in a formal and an informal environment on the test of mathematics concepts and applications was not significant at the .01 level. The mean score on the test of reading comprehension for students with no diagnosed preference for the element of design when tested in a formal setting was 22.84, and for the students having the same diagnosed lack of preference the mean score was 27. The computed t score (t=1.21) for the subjects with no diagnosed preference for the element of design when tested in a formal and an informal environment on the test of reading comprehension was not significant at the .01 level.

Null hypothesis three was accepted.

Students with a diagnosed preference for formal design scored slightly higher mean scores on both mathematics concepts and applications and reading comprehension when tested in an informal environment than when tested in a formal environment (Math: F_2=26.62>F_1=26.38) (Reading: F_2=27.62>F_1=26.77). Although the mean scores were higher, the median scores for this group were higher when tested in a formal environment. (Math: F_1=29>F_2=26) (Reading: F_1=28>F_2=26).

The range of scores for the group indicating a formal preference was greater when tested in a formal environment than in an informal environment. (Math: $F_1=29>F_2=21$ and Reading: $F_1=30>F_2=19$).

For students with a diagnosed preference for informal design, the mean and median scores on the tests of mathematics concepts and applications and reading comprehension do not follow the same pattern as the scores for the formal preferenced group. On the mathematics test informal preferenced students scored a higher mean and median in a formal than an informal environment (Mean: $I_1=31.77>I_2=30$ and Median: $I_1=35>I_2=32$). On the test of reading comprehension the informal preferenced group scored a higher mean and median in an informal testing environment (Mean: $I_2=30>I_i=29.85$ and Median: $I_2=33>I_1=32$). The students with a preference for informal design had a range of scores in a matched environment that was equal to or greater than the range in a mismatched environment (Reading: $I_2=24>I_1=22$ and Math: $I_2=29=I_1=29$.

While the mean and median scores have no consistent pattern, the range of these scores is greater for the students that were matched with their learning style preference than for the mismatched students (Math:

F_1=29>F_2=21 and I_2=29=I_1=29) (Reading: F_1=30>F_2=19 and I_2=24>I_1=22).

Such a pattern for the range of scores of students tested in a matched and mismatched environment raises several questions. Are students tested in an environment matched with their diagnosed preference for the learning style element of design more likely to perform at the extreme limits of their ability? If students in a matched environment are more likely to perform at the extreme limits of their ability, why is this so, and are there any characteristics of students performing at either extreme which would help identify or anticipate such performance?

Students with no diagnosed preference for the learning style element of design had higher mean and median scores when tested in the informal environment on both the mathematics concepts and applications and on the reading comprehension test. (Math Mean: NP_2=27.69> NP_1=26.15 and Reading Mean: NP_2=27>NP_1=22.84) (Math Median: NP_2=29>NP_1=26 and Reading Median: NP_2=28>NP_1=25). The range of both the mathematics and reading test for students with no preference for design was greater when tested in a formal environment (Math: Range NP_1=31>NP_2=22 and Reading: Range NP_1=28> NP_2=25).

The findings with students indicating no diagnosed preference for the learning style element of design raise several questions. Does a formal testing environment, which is familiar to the student with no diagnosed preference for design, create a situation where the student is more likely to perform at the extreme limits of his ability than in an informal environment? Does an informal testing environment include conditions that focus more attention on the task of test taking and thus generate higher average scores than a formal testing environment, and if so, why?

B. OBSERVATIONS

During his investigation of the relationship between the learning environment and diagnosed preference for the learning style element of design, Shea noted that when subjects who preferred formal design were exposed to the informal environment they chose seating positions which most closely resembled a formal posture. He explained as follows:

> Invariably, the subjects who preferred a formal design chose seating conditions which most closely resembled that type of posture, such as seating themselves extremely upright although on upholstered chairs or sofas. When such seats were unavailable, they chose a position on the floor directly against a wall so that their backs were straight and their body angles

> essentially approximated what would have occurred had they been sitting on a hard, wooden chair.[1]

Shea noted as well that in the informal environment, informally preferenced subjects became extremely informal. His description is as follows:

> . . . the informally preferenced subjects chose to sprawl or lie prone on the carpeted floor using pillows or their elbows for support; they slouched, slumped, curled, and/or put their feet onto adjacent furniture until they obtained a comfortable position.[2]

Shea gave the following explanation regarding the ability or inability of students with either diagnosed preference for design to adapt to the mismatched environment:

> Simply, the formally preferenced students made every attempt to "formalize" the informal environment in which they were placed by adopting postures suitable to rigid chairs and desks. That option of adaptation to the environment was just not available to the informally preferenced youngsters when placed in the formal experimental condition. Another consideration is that, although informally inclined youngsters had been required to learn in a formal environment during a major portion of their schooling, that

---

[1]Thomas C. Shea, "An Investigation of the Relationships Among Selected Instructional Environments, Preferences for the Learning Style Element of Design, and Reading Achievement Testing of Ninth Grade Students to Improve Administration Determinations Concerning Effective Educational Facilities," (Unpublished Doctoral Dissertation, St. John's University, 1983) p. 131.

[2]Ibid.

> constant exposure to the mismatched environment had not enhanced their ability to perform more effectively in that dissonant, rather than a more complementary, setting.[3]

Due to the notations and explanations of Shea, this investigation employed four observers to record the students' behavior during each testing situation. The observers were to record the adjustments of individual students to determine any attempts to formalize the informal testing environment or to make the formal testing environment informal. The observations of Shea were the basis for constructing the observational record forms. A copy of the Observation Record Form for the Informal Testing Environment and for the Formal Testing Environment can be found in Appendix B, pages 99-100. Observations were recorded each time the student made a physical adjustment in position that could be interpreted as an environmental adjustment. A summary of the observations recorded during the informal testing environment can be found in Table 6. Table 7 is a summary of the observations recorded during the formal testing environment.

Although the subjects tested in the formal environment made more recorded adaptations than the subjects

---

[3]Ibid., pp. 131-132.

TABLE 6

SUMMARY OF THE OBSERVATIONS RECORDED OF STUDENT POSITIONING DURING INFORMAL TESTING ENVIRONMENT

Category	Students With A Diagnosed Preference for Formal Design	Students With A Diagnosed Preference for Informal Design	Students With A Diagnosis of No Preference for the Element of Design
Student positions himself against a solid structure in a rigid seat like position	10	8	12
Student sits on floor and uses chair or couch as a table	7	0	3
Student sits rigidly in sofa or chair and uses arm of sofa or chair as a desk	14	11	14
Totals	31	19	29

TABLE 7

SUMMARY OF THE OBSERVATIONS RECORDED OF STUDENT POSITIONING RECORDED DURING THE FORMAL TESTING ENVIRONMENT

Category	Students With A Diagnosed Preference for Formal Design	Students With A Diagnosed Preference for Informal Design	Students With A Diagnosis of No Preference for the Element of Design
Rests chin in hand	8	18	13
Rests head on desk (on or off arm)	9	2	8
Props feet on desk in front	17	31	32
Stretches legs out on desk seat in front	4	5	4
Folds leg under self	10	1	6
Slumps or slides down in desk	7	5	13
Constantly changes seating positions	9	9	6
Totals	64	71	82

tested in the informal environment, this counting difference can be accounted for by the greater number of categories for recording behavior changes on the observation record form for the formal environment than on the observation record form for the informal environment.

From the record of these observations it is quite evident that the subjects tested in the environment mismatched with their diagnosed preference made more adaptations or movements than the subjects tested in the same environment matched with their diagnosed preference.

The totals in Table 6 show that, in an informal testing environment, the students with a formal preference made 31 adaptations compared with 19 by those with a preference for informal design, and 29 by those with no preference for the environmental element of design.

Table 7 indicates that in a formal testing environment the students mismatched with their preference for informal design made 71 adjustments, while those matched with the preference for formal design made 64 movements, and those diagnosed as having no preference for the element of design adapted 82 times. These findings give support to Shea's observations regarding the attempts of students to adapt the environment to their design preference.

The findings of this study show that students with no diagnosed preference for the environmental element of design made a great number of movements or adjustments. This raises a question regarding those subjects indicating no diagnosed preference for design. Do those who register no preference for design actually have no preference, or are they uncertain as to their preference? Such uncertainty could lead to variable responses on the inventory resulting in a no preference score. Such uncertainty could result in constant adjustments to either environmental design.

CHAPTER V

SUMMARY, CONCLUSIONS, RECOMMENDATIONS, AND IMPLICATIONS

A. SUMMARY

The purpose of this study was to investigate the influence of diagnosed preferences for the learning style element of design on standardized test scores. This research compared students' scores on a test of mathematics concepts and applications and on a test of reading comprehension for fifth grade students: (1) when the testing environment was matched with the diagnosed learning style preference; (2) when the testing environment was mismatched with the diagnosed learning style preference; and (3) when the diagnosed learning style indicating no preference was tested in a formal or an informal environment.

1. Hypotheses

This investigation tested the following null hypotheses:

a. There will be no significant difference between the mean scores when students, whose diagnosed preference for a formal design, are tested in a setting that is matched and mismatched with

their preference on tests of

(1) mathematics concepts and applications, and

(2) reading comprehension

b. There will be no significant difference between the mean scores when students who have a diagnosed preference for an informal design are tested in an environment that is matched and mismatched with their preference on tests of

(1) mathematics concepts and applications, and

(2) reading comprehension

c. There will be no significant difference between the mean scores of students with no diagnosed preference for formal or informal design when tested in a formal and an informal environment on tests of

(1) mathematics concepts and applications, and

(2) reading comprehension

2. Subjects

The subjects for this study were drawn from fifth grade students attending six private schools in the vicinity of Chattanooga, Tennessee.

The Learning Style Inventory (LSI) developed by Dunn, Dunn, and Price was administered to 163 fifth grade students in the six schools. The students fell into

three categories according to the scores on the LSI. Each student scoring above 60 on the LSI was diagnosed as indicating a preference for formal design. Twenty-six (26) students fell into this formal preference category. Each student scoring below 40 on the LSI was diagnosed as preferring an informal design. Twenty-nine students were classified as preferring informal design. The remaining 118 students scored between 40 and 60 on the LSI and were categorized as having no preference.

The students in each of the three categories were randomly assigned to either of two groups. Each group consisted of (1) subjects who were diagnosed as preferring formal design in the learning environment; (2) subjects who were diagnosed as preferring informal design; and (3) subjects who were diagnosed as indicating no preference for the environmental element of design.

Group one was composed of 39 students: 13 with a diagnosed preference for formal design; 13 with a diagnosed preference for informal design; and 13 with a diagnosis of no preference for design. Group one was tested in a formal testing environment.

Group two consisted of 39 students: 13 with a diagnosed preference for formal design; 13 with a diagnosed preference for informal design; and 13 with a diagnosis of no preference for design. Group two was tested in an informal setting.

The students were administered the California Achievement Test (1977), Level 16, Form C, The Mathematics Concepts and Applications, and the Reading Comprehension Subtests in the testing environment to which they were assigned. The test was administered by the same person who was blind to the hypotheses of the study.

Observers were employed in each testing environment to record student behavior that indicated an attempt to formalize the informal setting, or an effort to make the formal environment more informal.

3. Design of the Testing Environment

The test setting for both groups was a large room with dimensions of 18' x 45' which was designed for 90 students. The formal testing environment for group one consisted of 90 student desks in this room. The informal setting for testing group two was set up on the day following the testing of group one, at the same time of day. The room was completely rearranged for the informal testing. All the desks were removed and replaced with four long upholstered sofas, three short upholstered sofas, nine upholstered chairs, four lounge chairs, three vinyl covered arm side chairs, and ten large cushions. These pieces were arranged in an informal setting with easy view of the test administrator.

4. Experimental Design

The design involved two independent variables: (a) the testing environment, and (b) the diagnosed preference or no preference for the learning style element of design. The two dependent variables were the mathematics concepts and application scores, and the reading comprehension scores on the California Achievement Test, (1977), Level 16, Form C.

5. Statistical Analysis

A *t* test was applied to the mean scores for each preference group tested in an environment matched and mismatched with their diagnosed preference. The *t* test was computed for mean scores on tests of mathematics concepts and applications, and on tests of reading comprehension. In all analyses, *t* scores significant at the .01 level were deemed large enough to reject the null hypothesis.

6. Observations

Due to suggestions made by Shea in his investigation of the relationship between strong preference for the learning style element of design and performance in matched and mismatched environments, this study employed four observers to record the students' behavior during each

testing condition. The observers were to record the physical adaptations of individual subjects to make the formal environment informal or to formalize the informal setting.

7. Results

As a result of the calculated *t* scores for each of the design preferenced groups, no significant differences were found at the .01 level when students with a preference for either formal or informal design were tested in an environment matched and mismatched to their diagnosed preference.

Thus, the three null hypotheses tested by this research were accepted at the .01 level of confidence.

a. There will be no significant difference between the mean scores when students, whose diagnosed preference for a formal design, are tested in a setting that is matched and mismatched with their preference on tests of
   (1) mathematics concepts and applications, and
   (2) reading comprehension
   Null hypothesis one was accepted.

b. There will be no significant difference between the mean scores when students who have a diagnosed preference for an informal design

are tested in an environment that is matched and mismatched with their preference on tests of

(1) mathematics concepts and applications, and

(2) reading comprehension

Null hypothesis two was accepted.

c. There will be no significant difference between the mean scores of students with no diagnosed preference for formal or informal design when tested in a formal and an informal environment on tests of

(1) mathematics concepts and applications, and

(2) reading comprehension

Null hypothesis three was accepted.

B. CONCLUSIONS

No significant difference was demonstrated between the mean test scores of fifth grade students when tested in an environment that was matched and mismatched with their diagnosed preference for the learning style element of design. This leads to the conclusion that preference or a lack of preference for the formal or informal design of the learning environment does not affect standardized test scores in mathematics concepts and applications or in reading comprehension of these fifth grade students when they are tested in a formal or informal environment.

The scores on the California Achievement Test by the subjects whose diagnosed preference for the learning style element of design was informal are noteworthy. The mean scores of these students were higher in both reading comprehension and mathematics concepts and applications than the mean scores of students with a diagnosed preference for formal design or with no diagnosed preference for design.

These findings appear to be at variance with previous research into the relationship between scores on achievement tests of reading and math and the diagnosed preference for the learning style element of design. Price, Dunn, and Sanders studied 85 elementary school students who were grouped into high and low reading groups according to their scores on the New York State Pupil Evaluation Program in Reading. The students were then administered the Learning Style Inventory (LSI) by Dunn, Dunn, and Price. The findings of Price, Dunn, and Sanders indicated that individuals with high reading achievement prefer a formal environment, while those with low reading achievement prefer an informal environment.[1]

---

[1]Gary E. Price, Rita Dunn, and William Sanders, "Reading Achievement and Learning Style Characteristics," The Clearing House, 54 (1981), 226-228.

Dunn and Price found the same results in their study of 109 gifted students compared to 160 students not identified as gifted.[2]

In each of the studies referred to above, the students were identified as to math and reading achievement prior to being administered the LSI to determine preference for the element of design. In the current investigation the students were diagnosed as to their preference for the element of design prior to being tested for achievement in math and reading.

The differences in these results raise some important questions. Is the traditional method for grouping students by achievement test scores of intelligence test results the best technique for grouping students? After grouping students by the traditional method, are we then making generalizations from this group to all gifted or advanced placement students? If the group is incorrectly identified, then any generalization from the group to the population of gifted or advanced students is faulty.

The observations of student behavior during both testing situations lead to the conclusions that although some students made positional adjustments to the environment mismatched with their learning style preference, these

---

[2]Rita S. Dunn and Gary E. Price, "The Learning Style Characteristics of Gifted Students," Gifted Child Quarterly, 24 (1980), 33-36.

adjustments were not great enough to indicate that the students' adjustments modified the testing environment from a mismatch to a match.

C. DISCUSSION

Research conducted previously has supported the concept of learning style and its relationship to individual performance. Carbo discovered a positive relationship between the perceptual elements of learning style and the academic achievement of students.[3] Pizzo studied the effects of sound on the performance of students according to their acoustical preference. Her results indicated that students performed significantly better when in an environment matched with their acoustical preference.[4] Krimsky obtained the same

---

[3]Marie Antoneti Carbo, "An Analysis of the Relationships Between the Modality Preferences of Kindergarten and Selected Reading Treatments As They Affect the Learning of A Basic Sight-Word Vocabulary," (Unpublished Doctoral Dissertation, St. John's University, 1980) pp. 86-97.

[4]Jeanne Sottile Pizzo, "An Investigation of the Relationship Between Selected Acoustic Environments and Sound, An Element of Learning Style, As They Affect Sixth Grade Students' Reading Achievement and Attitudes," (Unpublished Doctoral Dissertation, St. John's University, 1981) pp. 171-218.

results with learning style and light as Pizzo did with sound.[5]

There are several ways that learning style can be classified or categorized. It has been classified as a receptive, concept formative, or retentive mode of cognitive style; and as affective or physiological domains of learning style. With the development of various instruments for identifying learning style characteristics or preferences have come many ways of characterizing learning style. David Kolb's Learning Style Inventory classifies learning style into four categories: (1) the converger; (2) the diverger; (3) the assimilator; and (4) the accommodator.[6] The Gregorc Style Delineator divides learning style into four categories.[7] Joseph Hill's Cognitive Style Mapping Inventory is another scheme

---

[5]Jeffrey Stephen Krimsky, "A Cognitive Study of the Effects of Matching and Mismatching Fourth-Grade Students With Their Learning Style Preferences for the Environmental Element of Light and Their Subsequent Reading Speed and Accuracy Scores," (Unpublished Doctoral Dissertation, St. John's University, 1981) p. ii.

[6]Patricia Kirby, Cognitive Style, Learning Style, and Transfer Skill Acquisition, (Columbus, Ohio: The National Center for Research in Vocational Education at The Ohio State University, 1979), p. 74.

[7]Anthony Gregorc, "Learning/Teaching Style: Their Nature and Effect," in Student Learning Styles: Diagnosing and Prescribing Programs (Reston: National Association of Secondary School Principals, 1979), p. 20.

developing a profile of the individual's learning style.[8] Letteri's Cognitive Profile[9] and Hunt's Paragraph Completion[10] are two different instruments for identifying and classifying learning style.

The instrument used to identify learning style for the purpose of this research was the Learning Style Inventory by Dunn, Dunn, and Price. The validity and reliability of these instruments in identifying the learning style preferences of individuals and groups has been the concern of the authors of the instruments. These issues are important if predictions of academic performance based on matching learning style with instructional techniques are used. The Research Report published for the Learning Style Inventory by Price, Dunn, and Dunn presents evidence of its validity and reliability.[11]

---

[8]Ibid., pp. 59-65.

[9]Gordon W. Allport, Personality: A Psychological Interpretation (New York: Henry Holt and Company, 1937), p. 9.

[10]D. E. Hunt et al., Assessing Conceptual Level by the Paragraph Completion Method (Ontario: Ontario Institute for Studies in Education, 1977), pp. 1-6.

[11]Gary E. Price, Rita Dunn, and Kenneth Dunn, Learning Style Inventory: Research Report (Lawrence: Price Systems, 1977), p. 4.

As Tuckman recognizes, the conditions under which tests are administered affect the test performance of students in differing ways.[12] Schools have traditionally administered standardized tests in a formal environment, in the morning, and in the middle of the week.[13]

The findings of this study indicate that the design of the testing environment does not have a significant impact on standardized test results, thus the test environment could be formal, informal, or any combination of the two.

D. RECOMMENDATIONS

The results of this study lead to the recommendations that students in the intermediate grades be allowed to accommodate themselves individually to the testing environment in the manner most productive for them. Since the students' preference or a lack of preference did not affect their mean test scores significantly in either a formal or an informal environment, students should be allowed some latitude or choices in adapting themselves

---

[12]Bruce W. Tuckman, Measuring Educational Outcomes: Fundamentals of Testing (New York: Harcourt Brace Jovanovich, Inc., 1975), p. 265.

[13]Victor H. Noll, Dale P. Scannell, and Robert C. Craig, Introduction to Educational Measurement, 4th ed. (Boston: Houghton Mifflin Company, 1979), pp. 415-416.

to the testing environment. Although group preferences regarding environmental design may not affect group mean scores on standardized tests, a mismatch between design preference and environmental design could greatly affect the scores of an individual. To reduce such a problem, the possibility of accommodating the testing environment to one's preference could accommodate the needs of the individual.

E. IMPLICATIONS FOR FURTHER STUDY

This investigation has provided information regarding the effect of the testing environment on standardized test scores of fifth grade students. In addition to supplying data on which decisions can be based, it raises questions that imply a need for further study.

1. Discrimination of the LSI

The environmental element of design as measured by the Learning Style Inventory (LSI) has a low reliability coefficient of .33, and a limited number of items (four) by which the element of design is measured. A study needs to be conducted to determine whether the LSI is discriminatory enough for this element. Such a study could aid in a decision regarding the feasibility of developing more items for the measurement of design to be included in the LSI.

2. Environmental Designs in Conjunction With Other Elements

Consideration should be given to the study of the effects of environmental design in conjunction with other factors or elements of learning style. Price, Dunn, and Dunn found that design was negatively correlated with light, and that informal design preference was negatively correlated with the elements of self-motivation, adult-motivation, teacher-motivation, and persistence.[14] Informal design was discovered to be negatively correlated with peer oriented preference, food intake, and need for mobility.[15] No positive correlations have been reported between the environmental element of design and other elements of learning style. Investigation into the effects of environmental design when linked with other elements of learning style appears to be needed. Price, Dunn, and Dunn found that individuals with a preference for formal design functioned well in a low light environment.[16] They reported that individuals achieving in reading were generally persistent, responsible, self-motivated, preferred a formal environment, and did not

---

[14]Price, Dunn, and Dunn, op. cit., p. 9.

[15]Ibid., p. 11.

[16]Ibid., p. 19.

like bright light.[17] This study indicated that preference for formal design, persistence, and functions best in late morning discriminated the most between subjects having high and low achievement scores in math.[18] These related elements of learning style would make a fertile area to begin such an investigation.

3. Similar Study With Grades Four Through Six

As a result of this study there needs to be a similar study conducted with elementary students in grades four through six.

4. Achievement Level of Students in Relation to Environmental Design

The range of scores found when students were tested in an environment matched or mismatched with the students' preference for the element of design indicates the need for a study of the effects of design when the students' level of achievement is controlled. Price, Dunn, and Dunn found that students with high reading and math achievement preferred formal design, while students with low reading and math achievement preferred

---

[17] Ibid.

[18] Ibid., p. 20.

informal design.[19] More studies should be conducted in the areas of reading and mathematics as well as other areas measured by achievement tests. Such studies should also be conducted for total achievement test scores.

5. Procedures Used for Identifying and Grouping Advanced or Gifted Students

The unanticipated results of this investigation which indicated that students with a diagnosed preference for informal design scored higher on reading and mathematics tests than students with a diagnosed preference for formal design or no preference for design call for further study into the relationship between achievement test scores and diagnosed preference for the learning style element of design. Such studies should compare achievement test scores of students grouped by traditional methods as advanced or gifted and then tested for preference of design, as well as students grouped by preference for design and then tested by achievement tests. Such studies could clarify the apparent discrepancy between the findings of this study and those reported by earlier studies.

---

[19] Ibid., pp. 19-20.

6. Observation Instruments for Environmental Adjustments

With this first effort to purposefully observe both testing environments to attempt a determination of student physical adjustments in matched and mismatched environments, more attention needs to be given to this concern. The observation instruments utilized for this investigation need to be revised and improved through extensive use, analysis, and adaptation.

BIBLIOGRAPHY

BIBLIOGRAPHY

Allport, Gordon W. Pattern and Growth in Personality. New York: Holt, Rinehart and Winston, 1965.

_____. Personality: A Psychological Interpretation. New York: Henry Holt and Company, 1937.

Broverman, Donald M. et al. "The Automatization Cognitive Style and Physical Development," Child Development, 35 (1964), 1343-1359.

California Achievement Test Level 16, Form C. CTB/McGraw-Hill, 1977.

Carbo, Marie Antoneti. "An Analysis of the Relationships Between the Modality Preferences of Kindergarten and Selected Reading Treatments As They Affect the Learning of A Basic Sight-Word Vocabulary." Unpublished Doctoral Dissertation. St. John's University, 1980.

Carlson, H. B. and H. A. Carr. "Visual and Vocal Recognition Memory." Journal of Experimental Psychology, 23 (1938), 523-530.

Dunn, Rita. "A Learning Style Primer." Principal, 14 (May 1981), 31-34.

_____. "Now That You Understand Your Learning Style. . . What Are You Willing To Do To Teach Your Students Through Their Individual Style?" Early Years, 13, No. 7, 30-31.

_____. "You've Got Style: Now's The Time To Find Out What It Is." Early Years, 13, No. 5, 25-31.

Dunn, Rita and Gary E. Price. "The Learning Style Characteristics of Gifted Students." Gifted Child Quarterly, 24 (1980), 33-36.

Dunn, Rita and Kenneth Dunn. "Educational Accountability in Our Schools." Momentum, October 10, 1977, pp. 10-16.

Dunn, Rita, Kenneth Dunn, and Gary E. Price. "Identifying Individual Learning Styles." In Student Learning Styles: Diagnosing and Prescribing Programs. Reston: National Association of Secondary School Principals, 1979.

_____. Learning Style Inventory. Lawrence: Price Systems, Inc., 1978.

Gregorc, Anthony F. "Learning/Teaching Styles: Their Nature and Effect." In Student Learning Styles: Diagnosing and Prescribing Programs. Reston: National Association of Secondary School Principals, 1979.

Hunt, D. E., et al. Assessing Conceptual Level by the Paragraph Completion Method. Ontario: Ontario Institute for Studies in Education, 1977.

James, Newton E. "Personal Preference for Method As A Factor in Learning." Journal of Educational Psychology, 53 (1962), 43-47.

Keefe, James W. "Assessing Student Learning Styles: An Overview." In Student Learning Styles and Brain Behavior. Reston: National Association of Secondary School Principals, 1979.

_____. "Learning Style: An Overview." In Student Learning Styles: Diagnosing and Prescribing Programs. Reston: National Association of Secondary School Principals, 1979.

Kirby, Patricia. Cognitive Style, Learning Style, and Transfer Skill Acquisition. Columbus: The National Center for Research in Vocational Education at The Ohio State University, 1979.

Krimsky, Jeffrey Stephen. "A Cognitive Study of the Effects of Matching and Mismatching Fourth-Grade Students With Their Learning Style Preferences for the Environmental Element of Light and Their Subsequent Reading Speed and Accuracy Scores." Unpublished Doctoral Dissertation. St. John's University, 1981.

McKenney, J. L. and P. G. W. Keen. "How Managers' Minds Work." Harvard Business Review, 52, No. 3 (1974), 79-90.

Noll, Victor H., Dale P. Scannell and Robert C. Craig. Introduction to Educational Measurement. 4th ed. Boston: Houghton Mifflin Company, 1979.

Pizzo, Jeanne Sottile. "An Investigation of the Relationship Between Selected Acoustic Environments and Sound, An Element of Learning Style, As They Affect Sixth Grade Students' Reading Achievement and Attitudes." Unpublished Doctoral Dissertation. St. John's University, 1981.

Price, Gary E. "Research using the learning style inventory." Paper presented at the second annual conference on teaching students through individual learning styles. New York, July, 1980.

Price, Gary E., Rita Dunn, and Kenneth Dunn. Learning Style Inventory: Research Report. Lawrence: Price Systems, Inc., 1977.

_____. Learning Style Inventory Technical Manual. Lawrence: Price Systems, Inc., 1976.

Price, Gary E., Rita Dunn, and William Sanders. "Reading Achievement and Learning Style Characteristics." The Clearing House, 54 (1981), 226-228.

Reinert, Harry. "One Picture is Worth a Thousand Words? Not Necessarily!" Modern Language Journal, April 1976, pp. 160-168.

Riessman, Frank. "The Strategy of Style." Teacher's College Record, 65 (1964), 484-489.

Shea, Thomas C. "An Investigation of the Relationships Among Selected Instructional Environments, Preferences for the Learning Style Element of Design, and Reading Achievement Testing of Ninth Grade Students to Improve Administrative Determinations Concerning Effective Educational Facilities." Unpublished Doctoral Dissertation. St. John's University, 1983.

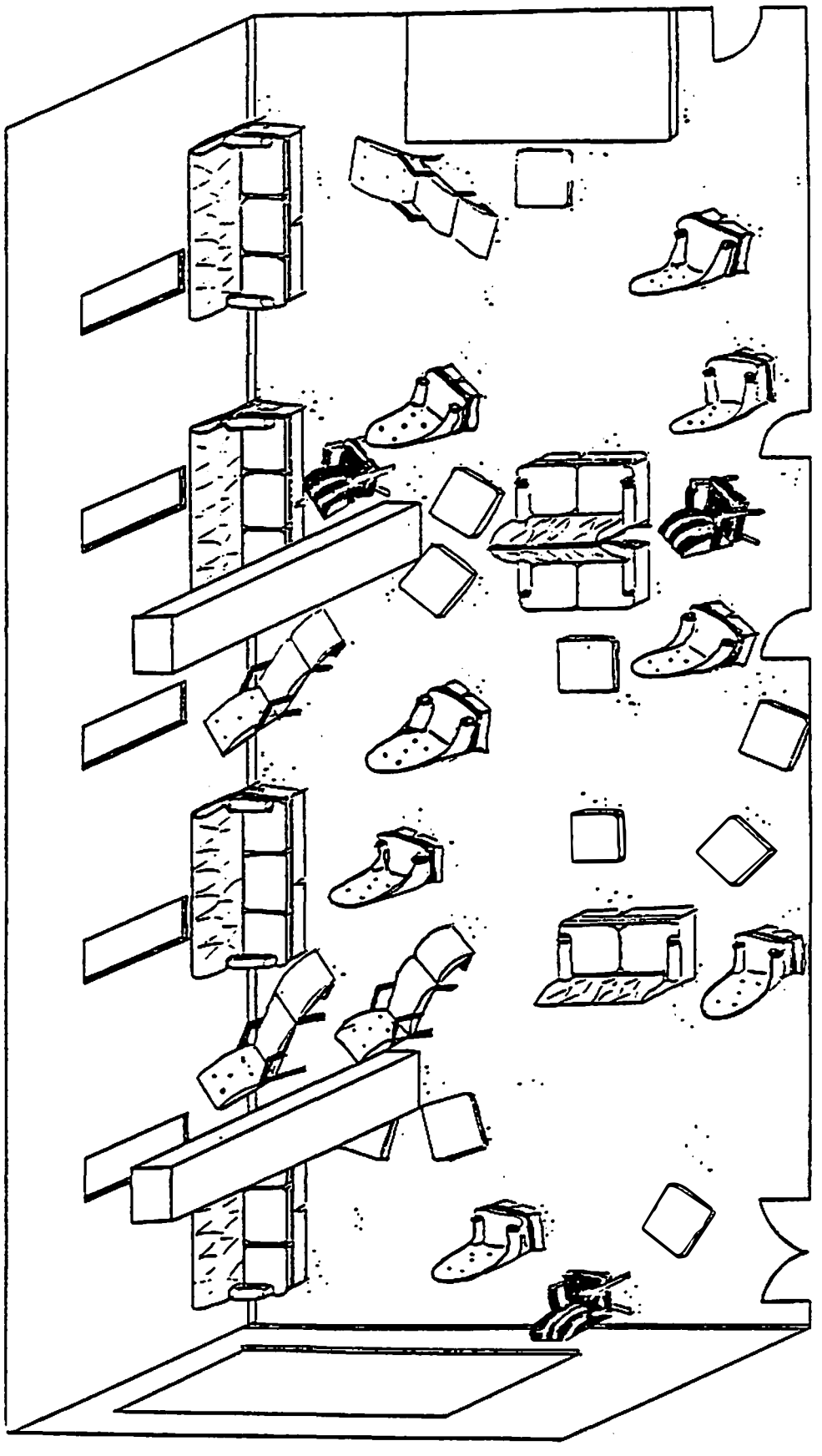
Technical Bulletin 1. California Achievement Tests, Forms C and D. Monterey: CTB/McGraw-Hill, 1979.

Tuckman, Bruce. Measuring Educational Outcomes: Fundamentals of Testing. New York: Harcourt Brace Jovanovich, Inc., 1975.

APPENDIXES

APPENDIX A

DIAGRAM OF THE INFORMAL TEST SETTING



APPENDIX B

OBSERVATION RECORD FORMS

OBSERVATION RECORD FORM

FORMAL TESTING ENVIRONMENT

Rests chin in hand									
Rests head on desk (on or off arm)									
Props feet on desk in front									
Stretches legs out on desk seat in front									
Folds leg under self									
Slumps or slides down in desk									
Constantly changes seating positions									

OBSERVATION RECORD FORM

INFORMAL TESTING ENVIRONMENT

Student positions himself against a solid structure in a rigid seat like position									
Student sits on floor and uses chair or couch as a table									
Student sits rigidly in sofa or chair and uses arm of sofa or chair as a desk									

VITA

Roger H. Stiles was born in Morgantown, Georgia on August 21, 1937. After attending several elementary schools in Georgia and South Carolina, he was graduated from Tucker High School in Tucker, Georgia in June 1955. In May of 1959 he received a Bachelor of Arts degree in Bible and Psychology from Tennessee Temple College in Chattanooga, Tennessee. After his marriage to Betty Dalton in June of 1959 he entered Temple Baptist Theological Seminary in Chattanooga, Tennessee. In May of 1963 he received his Bachelor of Divinity degree from the Seminary. While studying in Seminary, Mr. Stiles taught part-time for two years in Bible and Psychology at Tennessee Temple College.

In September of 1964 Mr. Stiles moved with his family to Knoxville to begin work in the Graduate School of the University of Tennessee. He received the Master of Science degree in Education in December of 1967.

After teaching social studies at Doyle High School in Knox County for one year, Mr. Stiles served the schools in eleven counties of South Carolina as a member of the staff of the Pee Dee Supplementary Education Center in Florence from 1968 to 1970. He accepted a position as supervisor of early childhood education for Williamsburg County in 1970, and served

this county until 1974 while living in Kingstree, South Carolina. While working in Williamsburg County, Mr. Stiles entered the University of South Carolina to begin work toward a Doctor of Philosophy degree in Education. He completed twenty-one hours toward the degree.

In September of 1974 Mr. Stiles returned to Chattanooga, Tennessee to teach in the education department of Tennessee Temple University. He has been teaching in the University since that time, and presently holds the position of Assistant Professor at Tennessee Temple University. In September of 1981 Mr. Stiles took over the duties as the principal of Tennessee Temple High School in addition to his university teaching responsibilities.

In 1976 Mr. Stiles began his work toward the Doctor of Education degree at the University of Tennessee in Knoxville, and in June of 1985 he was awarded this degree.

Mr. Stiles holds membership in Phi Delta Kappa, Association for Supervision and Curriculum Development, American Educational Research Association, Tennessee Association for the Education of Young Children, National Association for the Education of Young Children, and the Association for Childhood Education International.