July 26, 1974

To the Graduate Council:

I am submitting herewith a thesis written by Adolphus Hayward Pelley entitled "A Comparison of Enactive, Iconic, Symbolic Representational Modes and a Combination of all Three in the Teaching of Map Reading Skills and Interpretation." I recommend that it be accepted for nine quarter hours of credit in partial fulfillment of the requirements for the degree of Master of Science, with a major in Educational Psychology.

Willard A. Smith
Major Professor

We have read this thesis and
recommend its acceptance:

Joseph M. Cozzy
R. O. Kenyon
Deena Sue Fuller

Accepted for the Council:

Hilton A. Smith
Vice Chancellor for
Graduate Studies and Research

A Comparison of Enactive, Iconic, Symbolic Representational Modes and a Combination of all Three in the Teaching of Map Reading Skills and Interpretation

---

A Thesis

Presented to

the Graduate Council of

The University of Tennessee

In Partial Fulfillment

of the Requirements for the Degree

Master of Science

---

by

Adolphus Hayward Pelley

August 1974

ACKNOWLEDGEMENTS

For his perceptive, timely and demanding guidance during the preparation of this thesis, the author wishes to express sincere appreciation to Dr. Willard Smith. It was his study which the author attempted to expand.

Appreciation is also expressed to Mr. Richard Cannon whose class the author used. Thanks go to Dr. Joe Cozy for his challenging philosophical questions which kept the cognitive processes of the author operating.

An especial expression of gratitude to Mrs. Jan Stroud whose typing enabled the author to finish on time.

1165510

ABSTRACT

The purpose of this study was to compare a combination of Bruner's representational modes (Enactive, Iconic and Symbolic) with the individual representational modes. It was hypothesized that the results would indicate the combining of modes would be differentially effective for teaching specific skill areas.

Four heterogeneous groups from the seventh grade classes at Westside Elementary School in Springfield, Tennessee, were used in the study. Each group was randomly assigned to one of four experimental groups: Combined, Enactive, Iconic and Symbolic. Each group received five (5) instructional periods lasting fifty (50) minutes each.

Results of the study indicated that there were no significant differences between the mean scores of the groups. Therefore, combining the modes did not differentially affect the teaching of specific skill areas.

TABLE OF CONTENTS

CHAPTER		PAGE
I.	INTRODUCTION	1
II.	REVIEW OF RELATED LITERATURE	5
III.	PURPOSES AND HYPOTHESES	15
IV.	RESEARCH DESIGN	17
	Design	17
	Procedure	18
	Results	20
V.	DISCUSSION	25
REFERENCES		27
BIBLIOGRAPHY		30
APPENDIXES		35
A.	DESCRIPTIONS AND LESSON PLANS FOR FOUR TEACHING MODES COMPARED IN THE STUDY	36
B.	TEST INSTRUMENT	52
C.	BASIC DATA	56
VITA		64

LIST OF TABLES

TABLE		PAGE
I.	Sample Characteristics of Subjects	18
II.	Summary of Criterion Test Subscale and Total Mean Scores	20
III.	Summary of Analysis of Total Scores	21
IV.	Summary of Analysis of Subscale Scores	22
V.	Summary of Subscale Comparisons	23
VI.	Basic Data - Symbolic Group	56
VII.	Basic Data - Iconic Group	58
VIII.	Basic Data - Enactive Group	60
IX.	Basic Data - Combined Group	62

CHAPTER I

INTRODUCTION

The need for improved map reading skills in elementary school children has been of concern to educators and geographers for the past several decades (Fine, 1951; Howe, 1933; Bartz, 1965). However, the teaching of map reading skills has still been relegated to that of examining city, county and state road maps. Maps of regional areas of countries and continents are found displayed (more often rolled up or turned around and used as a projection screen) around the classroom but seldom used by the children. This indicates a lack of concern on the part of curriculum supervisors relevant to teaching map reading and interpretation skills.

Although the classroom teacher and supervisors indicate little willingness to incorporate map reading skills, efforts to develop material and curriculum changes have led to several new approaches. Some of these are: Smith's (1972) study which examined various methods of teaching map reading skills; Miller's (1969) USOE supported research in redesigning maps for children; Blaut and Stea's (1971) study in the use of aerial photographs or maps; Sabaroff's (1957) proposed curriculum sequence framework for development of map skills in primary grades; and Harris's Handbook of Map and Globe Usage (1959) provided a detailed program for use with Rand McNally map and globe materials in grades kindergarten through high school.

Are our schools providing adequate map reading skills? Research by Fine (1951), Bartz (1965), Drumheller (1956), and Miller (1965) all

indicated that the majority of our students are leaving school unable to effectively interpret maps. (The answer to the question relevant to adequate development of map skills by our schools is in most instances "No".) Another question relevant to map reading and interpretation skills is: can they be taught successfully to typical groups of elementary school children? This may be answered with a qualified yes. Research by Smith (1972), for example, indicated that fourth grade children could learn map interpretation skills. Savage and Bacon (1969) indicated that first grade children when provided special maps could learn map symbols. Robozzi (1961) found fifth and sixth graders capable of learning the uses of latitude and longitude. McAuley (1962) found that through the use of special maps, second grade students could work with time-distance relations, map symbols, and respond to questions of immediate environment as well as removed environment.

A review of intervention studies prior to Smith (1972) revealed an apparent lack of two rather basic components: (1) a clearly defined theoretical base in learning or instructional theory and (2) an experimentally-confined design for teaching map interpretation skills to children at various ages. Smith's (1972) study was used extensively in the present study. Whereas Smith established training protocols, this study also endeavors to establish additional training protocols based on contemporary instructional theory. Cognizance of child development literature was undertaken with Piagetian philosophy being examined in search of further extension of the learning theory and instructional techniques. An extensive record was kept for other researchers, curriculum specialists and teachers who might wish to

build on this work. Also, an effort was made to develop interest in map reading with the classroom teacher and supervisor.

Bruner, in Toward a Theory of Instruction (1966), provided a learning/instructional rationale of potential utility to investigators concerned with development of map interpretation skills. Bruner described learning as occuring in one or a combination of three basic representational modes. The enactive mode was described as a process whereby the learner is involved actively with a learning task in his immediate environment. Real objects, not models or pictures were involved, and the learner engaged in motoric interactions with these objects. The iconic mode of representation was described as a process of learning which incorporated the use of models and visual aids. The symbolic mode of representation was identified as the upper level of abstraction, where the use of language and other abstract symbolism constituted the major source of information--and the raw materials for higher intellectual operations. (An expanded description of Bruner's modes of representation, with an emphasis on map skills, will be found in Appendix A.) As might be anticipated, considering the small number of investigators actively involved in the field and the recency of the Bruner statement, with the exception of Smith (1972), comparative studies testing the utility of each of the modes in teaching map interpretation skills were not found.

Wood (1939) and Sylvester (1962), however, recommended a teaching process that amounted to an enactive mode of teaching map skills. They maintained the best method of teaching such skills would entail use of the natural environment as a classroom. In the program described in

their papers, students would do field work in an area represented by maps provided by the instructor. Thus, the study of map symbols, terminology, and relationships would proceed on-site. However, neither author was able to test his program in a comparative, experimental study.

Putnam (1943) described a method of map skill instruction built around pictures, models, and other iconic devices. Indeed, use of such "icons" in development of map skills, has become a part of most recommended elementary school social studies programs. Research establishing such approaches as superior to mainly enactive or mainly symbolic programs, has been undertaken only by Smith (1972).

Dury (1952) proposed a symbolic method for map instruction based on verbal explanations and line drawings. Grietzer (1944) reported a similar method in his approach to teaching map reading skills. As further support for programs organized in the symbolic mode, Savage and Bacon (1969) established that first grade pupils were able to use abstract symbolism on the map they constructed. The authors suggested that the need for lessons based primarily on enactive and iconic modes may be overstated.

Smith's (1972) study was the first attempt at determining the comparative effectiveness of Bruner's representational modes. He developed a training, instructional model for all three modes and compared each as well as a control group. His findings indicated that fourth graders could learn to interpret maps and that the iconic and enactive modes proved more effective.

CHAPTER II

REVIEW OF RELATED LITERATURE

Three objectives of the search of available research were to: (a) provide a theoretical basis for instructional strategies to be compared; (b) find major stages or factors encompassed in "map learning"; (c) identify those "map skills" which are generally required for successful cartographic interpretation. This search was completed prior to the investigation reported. The following is a summary of the search.

I. STRATEGIES FOR INSTRUCTION

The strategy for instruction was a furtherance of the work done by Smith (1972). Smith used Jerome Bruner's three representational modes. Bruner, in Toward a Theory of Instruction (1966), provided a learning/teaching rationale of possible utility in developing map interpretation skills. Bruner described learning as occuring in one or a combination of three representational modes - enactive, iconic, and symbolic. The enactive mode was described as a process whereby the learner is actively involved with a learning task in his environment. Real objects rather than models or pictures are involved and the learner engages in motoric interactions with the objects. The iconic mode of representation was described as a process of learning which incorporates the use of models and visual aids. The symbolic mode of representation was identified as the upper level of abstraction, where the use of language and other abstract symbolism constitutes the major source. This study of the three modes of learning will involve

the use of real world settings, models, and verbal instruction.

II. MAP LEARNING

A clear exposition of a theory of how children learn to read maps was not found in the literature. However, there are specified techniques or procedures frequently recommended by geographic educators. (Some of these techniques and procedures have not been empirically tested.)

Sylvester (1952) and Wood (1936) proposed the use of some on-site work in the testing of map skills. Wood (1936) recommended the field trip as a most desirable method of teaching map reading skills. A map of the area being studied would be provided during the field trip. This enabled the student to make one-to-one correspondent observations of the map with the landscape. These methods are very similar to the enactive mode described by Bruner.

Putnam (1943) espoused a method of learning whereby maps used in geographic problems would have large number of pictures, diagrams and block cross sections. His text Map Interpretation with Military Applications, used multiple diagrams correspondent with presentations of the map area. This method had much similarity to the iconic mode presented by Bruner.

Dury (1952) taught his version of basic map skills using the symbolic mode of language supplemented by some line drawings. Greitzer (1944) used similar approaches in his suggested methods of teaching map reading skills. Both approaches to map reading are very similar to the symbolic mode proposed by Bruner. Research on the comparative

effectiveness of Bruner's three modes was found in Smith (1972).

Sabaroff (1957) chose to recommend certain map skills at specific grade age level in school curriculum relationship to study. The Sabaroff recommendations did not project clear theoretical basis and remains to be tested.

This review of theoretical positions related to teaching map reading leaves one rather clear conclusion: an adequate theory of map learning and instruction remains to be published, although Smith (1972) seems to come closest.

III. MAP SKILLS

More research on the acquisition of specific map skills was found, but results still are inconclusive. Rushdoony (1968) in a summary of research on children's map reading skills, suggested six basic divisions into which map reading and interpretation research might be placed. The following six divisions of map research are based on Rushdoony's (1968) suggested divisions. Smith (1972) also used these divisions in his work.

Size and Shape

This division includes the elements of vertical and area scale, form of land-masses, cultural features, water features, and basic comparisons within these areas. The general findings of researchers are that there is a great deal of difficulty in working with this division. Bartz (1965) found that students in grades five through nine were unable to work effectively with area scales. Drumheller (1968) found that 20 percent of her subjects (sixth graders, college

freshmen and Master of Arts candidates in social studies) could not draw the basic shape and form of the continents of the world as presented on the Mercator projection. Hutter (1944) found beginning cadets in an Air Corps training program for navigators unable to identify correctly the continents of Africa and South America. Many cadets simply omitted an answer while others interchanged the names of the two continents. Towler and Nelson (1968) found that children in the primary grades were unable to properly manipulate symbols appropriate to the scale of a farm designed to examine subjects' spatial perception. However, Towler and Nelson (1968) found that children in the upper elementary grades were able to develop concepts of relative area scale, but still were not able to manipulate these concerns fluently.

McAuley (1962) found that by using special maps, second grade students were able to work with vertical scale and visualize the third dimension. Smith (1972) found fourth grade students capable of manipulating many of the elements of vertical scale. He found fourth grade students better able to learn the concepts of size and shape in the enactive mode of presentation. Brown (1972) found that the visualizing of relief form of contour lines, use of grade reference system may be introduced to children aged nine and eleven.

The discrepancies in the research cited above indicated a need for some central thrust and study to determine the abilities of students to handle the concepts and content of size and shape, and the special methods needed to develop these abilities. As is noted above, results of existing research are slightly ambiguous.

Orientation and Direction

Within the orientation and directional skills division are topics extending from the orientation of self with respect to direction, orientation of places with respect to self and orientation of self with respect to abstracted locations. Definitions used for research on directions extend from the egocentric concept of self as the center of the universe to the determination of accurate directional readings for two removed locales.

Bartz (1965) found that although the concepts of longitude and latitude as it related to orientation and direction could be correctly identified, students were unable to apply the concepts. Knowledge of direction was limited to recognition of the cardinal directions and map orientation was limited to "north at the top" without reference to the compass. Davis (1958) found that students in the upper elementary grades could learn the necessary elements of direction needed to develop understandings of time zones. Earlier, Edwards (1953) reported similar results in measuring ability of pupils in grades four through six to handle cardinal directions. He also found subjects competent to deal with orientation concepts relevant to latitude but not longitude. Howe (1931) found that elementary school children from kindergarten through grade six must be taught directions inasmuch as they were not as knowledgeable with directions as assumed. Brown (1972) reported an 8 year old could understand conventional signs and direction questions. Lanegram, Snowfield and Laurent (1970) found mental retardates (chronological ages 8-17) capable of manipulating questions about direction and distance in the immediate environment but were not able to adapt

conventional notations and abstractions used in mapping. Lord (1941) reported that students in grades five through eight gave seventy percent correct answers to questions about the eight cardinal directions. Like results were reported on questions of pointing to a neighboring city; however, when the question related to distant large cities, results were only twenty-three percent correct answers. Community orientation was poor as indicated by ten percent correct answers and fifty percent of the subjects not attempting to answer the questions about local community. The subjects were also taken for a ride in neighboring mountains to assess orientation while traveling. Results were that over forty percent were disoriented at the first stop and twenty-five percent of the boys remained oriented and eighteen percent of the girls indicate directions on the third stop. Smith (1972) found that teaching measurement of distance and knowledge of eight cardinal directions seemed to be a different task for fourth grade students.

McAuley (1966) concluded that children grow significantly in knowledge of direction and orientation during the second school year. Miller (1967) found that the academically average child becomes capable of adopting points of view other than his own for orientation of map photographs. This finding is consistent with Piaget's theory and research with European children on which this study was based.

Location

This basic division, which includes skills and concepts ranging from the relative location of objects in the immediate environment with respect to self on other objects to the absolute location of a place

by longitude and latitude, is perhaps the most researched geographic component of map interpretation.

Bradford (1932) found her subjects (grades five through nine) capable of identifying concepts and lines representing location but not capable of using the lines or concepts when answering questions relative to longitude and latitude. Bradford (1932) found (using over 1000 British students aged 13 through 16) little ability to demonstrate knowledge of relative location of cities, limited competency in using longitude and latitude for locating points on a map, and limited abilities to infer temperature from given latitudes of west coast exposure. Hutter (1944) in his work with Air Corp cadets in navigation found that they were unable to use longitude and latitude as well as identification of the major lines of orientation for locations like the Equator and Prime Meridian. Lord (1941) found students in grades five through eight able to indicate relative location of nearby cities, but not more distant large cities. Robozzi (1961) found that students in the fffth and sixth grades had the ability to learn to conceptualize and use longitude and latitude dependent upon instruction. If the instructions were properly given, those students could learn to conceptualize and use longitude and latitude. Shantz and Smock (1966), in an attempt to test Piaget's theories of spatial coordinates found that conservation of concept of distance was prerequisite for the development of concepts of Euclidean space. Smith (1972) found the use of slides to have students identify places helpful, especially if used in a one-to-one correspondence with on-site visits. Thus, existing research seems to indicate that most contemporary students fail to attain these skills of a lo-

cation although the research seems to indicate that the concepts and applications can be taught.

Distance

The concept of distance includes factors ranging from the relative distance of local and immediate objects to measurement of absolute distance to a high degree of accuracy through sophisticated instrumentation.

Bartz (1965) found that the concept of linear scale was poorly understood before seventh grade and poorly applied after the seventh grade. Bradford (1932) found secondary school subjects could not give distance to 10 world cities with respect to London. Edwards (1953) found students in grades four through six unable to handle concepts and applications of horizontal distances. McAuley (1962) found that second grade students capable of conceptualizing the relationship of large distance to time and travel if special maps were used. Rushdoony (1963) found that with proper instruction third graders could handle many skills including the basic use of distance concepts. Smith (1972) found significant difference between teaching Bruner's iconic mode and symbolic mode. The results indicated that fourth graders perform better after instruction using the iconic mode rather than the symbolic mode.

Symbols

The symbolic concepts include graphic representations of physical, cultural and hypothetical features found on maps. Bartz (1965) indicated that a symbol must be clearly represented in the key or legend of a map if it is to be read accurately. She observed that many of

her subjects did not refer to the legend before responding to questions. David (1958) found intermediate grade children capable of understanding and using the symbols indicating time zones. McAuley (1962) reported that when specially drawn maps of the immediate environment were used second grade pupils were capable of making observations. Miller (1969) found that if symbols were to be meaningful, they must be accurate and prominently displayed. Savage and Bacon (1969), while working with first grade pupils, reported that if specially drawn maps of cultural and physical features were used, those pupils could learn symbols. Research on the effect of a black line to separate symbolizing zones of value had no significant effect on the performance of fourth grade children (Smith, 1972).

Map Inferences

The section on map interpretation skills appear closest to a concept of spatial visualization for a given place.

However, it often includes deductions made from map comparisons, from other relevant geographic information, from textual materials, and from past experiences or knowledge of geographic factors. Map inference skills range from map-picture associations among pre-school subjects to elaborate comparisons of varying types of maps and sophisticated hypothesizing among older individuals.

Bradford (1932) reported a sample of British secondary students who were unable to visualize regions removed from their own, but did not include the raw data or test items used in his study. Hanna (1963) stressed the need for development of map inference skills, but did not

report research on the topic. McAuley (1962) found second grade students capable of answering questions when presented with map dots on the local environment, but evidently did not study similar ability to make inferences for more distant locations. Weber (1964) found, through interviews, that sixth grade pupils were unable to make inferences about the influences of the environment on man. Again, no maps were presented from which inferences might be made.

The lack of direct investigations over various age and complexity levels leaves the basic topic of map interpretation skills in obvious need of further scientific study. The conflicting evidence now available seems to allow only the basic premise that skills and techniques for adequate map interpretation can be acquired, but they often are neither taught in school nor learned through out-of-school experience. Blaut and Stea (1971) found strong support for the hypothesis that the ability to interpret aerial photograph was fully developed by the age of nine.

CHAPTER III

PURPOSES AND HYPOTHESES

The primary purpose of this study was a comparison of a combination of Bruner's representational modes, with the individual representational modes on the improvement of seventh graders' ability to read and interpret topographical maps. Smith (1972) had compared the three individual modes with a control group. In his study, he found that those students taught using the enactive mode scored higher than those taught using the other mode.

Another major purpose of this study was to provide teachers with a teaching model which would provide the best method for teaching topographical maps. It was hypothesized that results would indicate the combining of modes would be differentially effective for teaching specific skill areas.

Major hypotheses for the study were:

Hypothesis 1. The mean score on the criterion test for the "combination" group will be significantly higher than the mean score of the post test of the enactive, iconic and symbolic groups.

Hypothesis 2. The mean score on the criterion test for the enactive group will be significantly greater than the mean score of the post test for the iconic and symbolic groups.

Hypothesis 3. The mean score on the criterion test for the iconic group will be significantly greater than the mean score for the symbolic group.

Hypothesis 4. Mean scores on the (1) symbols, (2) distance,

(3) direction, and (4) size and shape subscales of the post test will have the hierarchy hypothesis in Hypotheses 1-3.

Hypothesis 5. The mean scores on the criterion test of the items involving 35mm color slides will have the hierarchy hypothesized in Hypotheses 1-3.

Hypothesis 6. The mean scores on the criterion test of females will be significantly higher than criterion post test of males.

CHAPTER IV

RESEARCH DESIGN

I. DESIGN

Testing major hypotheses of the study was accomplished through a two-factor analysis of variance, the factors consisting of sex and treatment group shown below.

S		COMBINED	ENACTIVE	ICONIC	SYMBOLIC
	M				
	F				

Orthogonal Comparison

Hypothesis

1. $C > \frac{E + I + S}{3}$
2. $E > \frac{I + S}{2}$
3. $I > S$
4. Repeat hypotheses 1-3 comparison for each subscale
5. Repeat hypotheses 1-3 for items based on 35mm slides
6. Repeat male vs. female for hypotheses 1-5 comparison

Each group was administered a pretest covering the subscales of direction, size and shape, location, distance and symbols. The pretest was administered during the regular class period on the day previous to the beginning of instruction. The pretest was administered to

ensure uncontaminated samples. A post test was administered one week after the completion of instruction.

II. PROCEDURE

Four heterogeneous groups from the seventh grade classes at Westside Elementary School in Springfield, Tennessee, were selected for this study. The four groups were in Mr. Richard Cannon's social studies classes. They had a mean age of 13.3 with 33% being black and 67% white. (Table I) The mean I.Q. for the students was approximately 98.8 with a range from 72 to 136. The students came from middle and low income homes. Forty-two percent of the students in the study were on the "Free Lunch" program. This is usually indicative of low income families. The groups were approximately equally distributed between male and female. The four groups were randomly assigned to one of the four experimental treatments (enactive, iconic, symbolic, and a combination).

TABLE I

SAMPLE CHARACTERISTICS OF SUBJECTS

Group	N	Sex		Mean Age	Mean I.Q.
		M	F		
Combined	28	13	15	13.1	102.93
Enactive	29	13	16	13.9	97.69
Iconic	28	14	14	12.8	94.78
Symbolic	24	13	11	13.79	100.66

The symbolic treatment group was given five, fifty minute class instructional periods. The material was presented via the use of language and "non-realistic" symbols. The student was expected to garner all information from the presentation by the teacher. The teacher used "verbal" symbols with the exception being that each student had a map of the Youngville Quadrangle of Tennessee. There was no study in the real environment or visual aids used with this group other than the map of the study area.

The instruction for the iconic group included language, use of the Youngville Quadrangle map in Tennessee; symbol sheets for topographical maps; iconic drawings of physiographical features of the environment; and slides of the area. The iconic group made no on-site visits.

The instruction for the enactive group included all of the above but the instruction took place entirely on-site. The group was taken by bus to several locations shown on the Youngville Quadrangle map. Instruction was given at four different locations; beside the road, at the state fish hatchery, at Krisle School (in the bus), and at Beard's Chapel Church.

The combination group received similar in-class instruction as the symbolic and iconic groups, but took a field trip for on-site instruction. This group was given four days of in-class instruction. On the fifth day they were taken to the fish hatchery, Krisle School and Beard's Chapel Church. At each site fifteen minutes of instruction was given. Consequently, each group received five, fifty minute instructional periods.

To monitor teacher reactions and representational mode "overflow"

the classes were video taped. It was not possible to video tape the enactive group because of equipment difficulties.

III. RESULTS

Table II presents a summary of criterion test subscale and total mean scores, by sex and treatment group.

TABLE II

SUMMARY OF CRITERION TEST SUBSCALE AND TOTAL MEAN SCORES

Groups	Sym-bols	Dis-tance	Direc-tion	Loca-tion	35mm Slides	Total
Combined						
Male	1.59	1.84	1.92	7.15	4.15	11.30
Female	1.58	1.93	1.46	6.46	5.00	11.46
Combined	1.58	1.88	1.69	6.81	4.57	11.38
Enactive						
Male	2.07	1.61	2.15	6.53	2.92	9.46
Female	1.68	1.37	2.18	4.81	4.12	8.93
Combined	1.88	1.49	2.17	5.67	3.52	9.19
Iconic						
Male	1.14	1.78	1.64	4.92	3.64	8.57
Female	1.50	2.57	2.42	5.28	3.14	8.42
Combined	1.32	2.17	2.03	5.10	3.39	8.50
Symbolic						
Male	1.30	1.46	2.92	6.00	5.53	11.53
Female	1.81	1.54	1.90	5.90	4.81	10.72
Combined	1.56	1.50	2.41	5.95	5.17	11.13

Total Score Comparisons

Hypotheses 1-3 were tested through analysis of total scores on the criterion test. (See Table III) The sex-by-treatment analysis revealed no significant treatment effect. The hypothesized superiority of the combination group over the enactive, iconic and symbolic groups failed to be supported.

TABLE III

SUMMARY OF ANALYSIS OF TOTAL SCORES

SOURCE	SS	DF	MS	F	P
Total	1751.55	108			
Between	170.61	7	24.37		
A (Treatment)	2.93	3	2.93	0.187	0.6698
B (Sex)	164.02	1	54.67	3.493	0.0181
A x B	3.65	3	1.21	0.077	0.9710
Error (within)	1580.94	101	15.65		

Subscale Comparison

Testing of Hypothesis 4 was accomplished through analyses similar to those used in Hypotheses 1-3. (See Table IV) Each subscale of the criterion measure was treated as a separate test instrument. Inasmuch as each subscale was a part of the total score, an agreement in results would be anticipated. No significant treatment effect was found. The hypothesized superiority of the mean scores for the combination group over the enactive, iconic and symbolic groups on the subscales test failed to be supported.

TABLE IV

SUMMARY OF ANALYSIS OF SUBSCALE SCORES

Analysis for Variable - Symbols

SOURCE	SS	DF	MS	F	P
Total	110.67	108			
Between	9.67	7	1.38		
A (Sex)	0.00	1	0.00	0.002	0.9624
B (Treatment)	4.26	3	1.42	1.421	0.2397
A x B	5.40	3	1.80	1.802	0.1501
Error (within)	101.00	101	1.00		

Analysis for Variable - Direction

Total	247.07	108			
Between	19.81	7	2.83		
A (Sex)	0.71	1	0.71	0.317	0.5814
B (Treatment)	7.31	3	2.43	1.083	0.3599
A x B	11.78	3	3.92	1.745	0.1610
Error (within)	227.26	101	2.25		

Analysis for Variable - Distance

Total	130.67	108			
Between	13.48	7	1.92		
A (Sex)	0.86	1	0.86	0.745	0.6056
B (Treatment)	8.83	3	2.94	2.537	0.0597
A x B	3.78	3	1.26	1.086	0.3587
Error (within)	117.19	101	1.16		

Analysis for Variable - Location

Total	772.64	108			
Between	64.85	7	9.26		
A (Sex)	7.76	1	7.76	1.107	0.2952
B (Treatment)	40.69	3	13.56	1.935	0.1271
A x B	16.40	3	5.46	0.780	0.5105
Error (within)	707.78	101	7.00		

Analysis for Variable - Slides

Total	519.28	108			
Between	79.12	7	11.30		
A (Sex)	1.15	1	1.15	0.264	0.6141
B (Treatment)	59.38	3	19.79	4.542	0.0052
A x B	18.58	3	6.19	1.421	0.2397
Error (within)	440.16	101	4.35		

Testing of Hypothesis 5 was accomplished through analyses similar to those used in Hypotheses 1-4. A significant treatment effect was found. However the hypothesized superiority of the combination group over the enactive, iconic and symbolic groups failed to be supported. Comparisons indicated that: (1) the symbolic group scored higher than the other three on two subscales; (2) the combined group scored higher than the iconic and enactive; (3) the enactive group scored higher than the iconic group. However, only the subscale for slides was significant. (See Table V)

TABLE V

SUMMARY OF SUBSCALE COMPARISON

SUBSCALE	TREATMENT RELATIONSHIP
Symbols	Enactive > Combined > Symbolic > Iconic
Location	Combined > Symbolic > Enactive > Iconic
Direction	Symbolic > Enactive > Iconic > Combined
35mm Slides	*Symbolic > Combined > Enactive > Iconic
Distance	Iconic > Combined > Symbolic > Enactive

* Significantly higher

Hypothesis 6 which predicted higher mean scores for females over males was not supported by the total scores or any of the subscale scores. (See Table III) Mean criterion test scores for all females

was 9.890 and for males was 10.21.

Consequently, although sex was a dimension in the analyses, significant differences were not found.

CHAPTER V

DISCUSSION

Comparison of the three Brunerian's modes of representation and a combination of those modes as the basis of programs for map instruction yielded no really notable results. However, regardless of the mode used, there was a significant improvement in the ability of seventh grade pupils to work with topographic map skills. This seems to confirm Smith's (1972) findings relevant to fourth grade students and extends his findings to seventh graders. Inasmuch as most seventh graders have developed their spatial discrimination skills, the instruction given afforded them an opportunity to effectively use topographic maps. This added knowledge should greatly enhance recreational pursuits in parks and the countryside.

The identification of one Brunerian mode as being superior for teaching map skills was not accomplished. The hypothesized superiority of the combination group was not supported in any of the subscales. It is of interest to note that each group had high mean scores on at least one subscale although only one significantly higher. The one subscale was slides and the group was the symbolic. Inasmuch as the symbolic group had no contact with the slides except during testing makes those subscale scores more revealing. One might surmise that the actual in-class, no distractions instruction combined with higher average I.Q. scores and older age of the symbolic group contributed to their performance. The apparent disparity between the I.Q. scores of the symbolic group and the other three groups was a possible reason

for the higher mean scores. Also whereas combined, enactive and iconic groups had N's of 29, 29, 28 respectively, the symbolic group had an N of 24. The seven students whose scores weren't used had higher mean scores than their parent groups. Inasmuch as I.Q. scores were unavailable for these seven students, it was not possible to use them in the study. Their scores reflect the rest of the group. Consequently a smaller N seemingly was not a contributing factor in the symbolic group's higher mean scores.

Smith (1972) contended that, for fourth graders, the use of on-site observations and iconic devices was justified. However, the evidence indicated that possibly seventh graders may learn as much by abstractions and symbols as by on-site visits. On the basis of this investigation, it is difficult to present an optimum instructional program. However, topographic map symbols can be taught in the classroom through use of maps, symbol sheets, iconic drawings and terrain slides as well as taking the students to on-site visits.

While Smith (1972) found much speculation for the teaching of map skills to fourth graders, the mean scores on the criterion tests for seventh graders afforded no room for speculation. No one mode seemed better or worse. Consequently, theoretical positions holding that map reading instruction is best accomplished through on-site work were not supported. Further research is recommended wherein homogeneous groups (I.Q., academic abilities) could be compared.

REFERENCES

REFERENCES

Blaut, J.M. and David Stea. Studies of Geographic Learning. Annals of the Association of American Geographers, 1971, 61, 217-24.

Brown, T.W. et al. An investigation into the optimum age at which different types of map questions may best be set to pupils in the teaching of Geography. International Geographical Union.

Bruner, J.S. Toward a Theory of Instruction. New York: W.W. Norton & Co., Inc., 1966.

Drumheller, S.J. Conjure up a map--a crucial but much neglected skill. Journal of Geography, 1968, 67, 140-146.

Dury, G.H. Map Interpretation. London: Sir Issac Pitman and Sons, Ltd., 1952.

Fine, B. U.S. college student 'flunk' in knowledge of geography. The New York Times, June 11, 1951.

Greitzer, S.L. Elementary topography and map reading. New York:McGraw-Hill, 1944.

Harris, R.M. Map and globe usage. New York: Rand McNally and Co., 1959.

Howe, G.G. A study of the ability of elementary school pupils to read maps. Chapter 29. The Teaching of Geography, Thirty-Second Yearbook for the National Society for the Study of Education. Bloomington, Ill. Public School Publishing Company, 1933.

Miller, E.E. Map reading abilities of college freshmen compared with those of ninth graders. Journal of Geography, 1965, 64, 367-372.

Miller, J.W. Testing the effectiveness of classroom maps. Office of Education Final Report Project No. 7-D-021. Nashville, Tennessee: George Peabody College, 1969.

Putnam, W.C. Map interpretation with military application. New York: McGraw Hill, 1943.

Robozzi, M.D. Extent of certain geographical skills of latitude and longitude of selected fifth and sixth grade children. Unpublished doctoral dissertation, Pennsylvania State University, 1961.

Sabaroff, R.E. A framework for developing map skills in primary grade social studies. (Doctoral Dissertation, Standford University) Ann Arbor, Mich.: University Microfilm, 1957.

Savage, J.W., & Bacon, P. Teaching topographic symbolic map skills to primary grade children. Journal of Geography, 1969, 68, 491-497.

Smith, W.A. An experiment comparing enactive, iconic, and symbolic approaches to teaching elementary map reading skills. (Doctoral dissertation, George Peabody College, Nashville, Tennessee) 1972.

Sylvester, D. Map and Landscape. London: George Phillip and Son, 1952.

Wood, M. Map reading for schools. London: George G. Harrap, 1939.

MAP REFERENCES

Clarksville, Tennessee. U.S. Geological Survey, Washington, D.C. Scale 1:24,000, 1956.

Nashville, Tennessee. U.S. Geological Survey, Washington, D.C. Scale 1:24,000, 1968.

Topographic Maps. U.S. Geological Survey, Washington, D.C., 1972.

Orlinda, Tennessee. U.S. Geological Survey, Washington, D.C. Scale 1:24,000, 1952.

Youngville, Tennessee. U.S. Geological Survey, Washington, D.C. Scale 1:24,000, 1952.

BIBLIOGRAPHY

BIBLIOGRAPHY

Anderzhon, Manie Louis. Steps in Map Reading: A Map-Reading Workbook. Rand McNally & Co., New York, New York, 1960.

Bartz, Barbara. "Map in the Classroom", Journal of Geography, 1970, 68, 18-24.

Blaut, J.M. and David Stea. Studies of Geographic Learning. Annals of the Association of American Geographers 1971, 61, 217-24.

Bradford, E.J.C. The measurement of prespective in the geographical outlook of secondary school pupils. British Journal of Educational Psychology, 1932, 2, 332-352.

Brown, T.W. et al. An investigation into the optimum age at which different types of map questions may best be set to pupils in the teaching of Geography International Geographical Union.

Bruner, J. S. Toward a theory of instruction. New York: W.W. Norton & Co., Inc., 1966.

Carmichael, D.R. Developing map reading skills and geographic understandings by means of conceptual teaching methods. (Doctoral dissertation, University of California at Berkley) Ann Arbor, Mich.: University Microfilm, 1965.

Crabtree, C.A. Teaching geography in grades 1-3; effects of instruction in the core concept of geographic theory. Los Angeles: U.S. Office of Education, 1968.

Dake, C.L., & Brown, J.S. Interpretation of topographic and geologic maps. New York: McGraw-Hill Book Co., 1925.

Davis, O.L., Jr. Learning about time zones in grades four, five, and six. (Doctoral dissertation, George Peabody College) Ann Arbor, Mich.: University Microfilm, 1958.

Dent, B.O. "Note on the importance of shape in cartogram communication," Journal of Geography, 1972, 71, 393-401.

Dodwell, P.C. "Children understanding of Spatial Concepts," in Logical Thinking in Children ed. by Irving E. Sigel and F.H. Hooper. New York: Holt, Rinehart and Winston, Inc. 1968, 118-139.

Drumheller, S.J. Conjure up a map--a crucial but much neglected skill. Journal of Geography, 1968, 67, 140-146.

Dury, G.H. Map Interpretation. London: Sir Issac Pitman and Sons, Ltd., 1952.

Ebel, R.L. Measuring education achievement. Englewood Cliffs, New Jersey: Prentice-Hall, Inc., 1965.

Edwards, J.H. How well are intermediate children oriented in space? Journal of Geography, 1953, 52, 133-143.

Ellis, A.K. Fourth and sixth grade students' knowledge of geography. The New York Times, June 11, 1951.

Gabler, Robert E. A Handbook for Geography Teachers. Chicago, Ill.: National Council for Geographic Education. 1966.

Greitzer, S.L. Elementary topography and map reading. New York: McGraw-Hill, 1944.

Harris, R.M. Map and globe usage. New York: Rand McNally and Company, 1959.

Howe, G.G. A study of the ability of elementary school pupils to read maps. Chapter 29. The Teaching of Geography, Thirty-Second Yearbook for the National Society for the Study of Education. Bloomington, Ill.: Public School Publishing Company, 1933.

Howe, G.F. A study of children's knowledge of direction. Journal of Geography, 1931, 30, 298-304.

Hutter, H.K. Mistakes made in geography by beginning air corps cadets. Journal of Geography, 1944, 43, 108-111.

Imperatore, W. The conceptual model: a guide to elementary geography content. Journal of Geography, 1967, 66, 414-416.

Lanegran, D.A., Snowfield, J.G., & Lancant, A. Retarded children and the distance and direction. Journal of Geography, 1970, 69, 157-160.

Lord, F. A study of spatial orientation of children. Journal of Educational Research, 1941, 34, 481-505.

McAuley, J.D. Some map abilities of the second grade children. Journal of Geography, 1962, 61, 3-9.

McGirr, Mabel L. Junior High Geography: Growing Pains or Arrested Development. Journal of Geography, 1961, 60, 230-35.

Meyer, J.M.W. "Map Skills Instructions and the Child's Developing Cognitive Abilities," Journal of Geography, 1973, 72, 27-35.

Miller, E.E. Map reading abilities of college freshmen compared with those of ninth graders. Journal of Geography, 1965, 64, 367-372.

Miller, J.W. Testing the effectiveness of classroom maps. Office of Education Final Report Project No. 7-D-021. Nashville, Tennessee: George Peabody College, 1969.

Monk, Janice J. and Charles S. Alexander. Developing Skills in a Physical Geography Laboratory. Journal of Geography, 1973, 72, 486-493.

Nunnally, J.C. Psychometric theory. New York: McGraw-Hill Book Co., 1967.

Putnam, W.C. Map interpretation with military application. New York: McGraw-Hill, 1943.

Roberson, B.S. Children's understanding of regional geography. Journal of Geography, 1968, 67, 152-155.

Robozzi, M.D. Extent of certain geographical skills of latitude and longitude of selected fifth and sixth grade children. Unpublished doctoral dissertation, Pennsylvania State University, 1961.

Rushdoony, H.A. Achievement in map readings: an experimental study. Elementary School Journal, 1963, 64, 70-75.

Rushdoony, H.A. "The Geographer, The Teacher, and a Child's Perception of Maps and Mapping." Journal of Geography, 1971, 70, 429.

Sabaroff, R.E. A framework for developing map skills in primary grade social studies. (Doctoral dissertation, Stanford University) Ann Arbor, Mich.: University Microfilm, 1957.

Savage, J.W., & Bacon, P. Teaching topographic symbolic map skills with primary children. Journal of Geography, 1969, 68, 587-598.

Shantz, C.V., & Smock, C.D. Development of distance conservation and spatial coordination system. Child Development, 1966, 37, 943-948.

Smith, W.A. A study of the effects of a black demarcation line on the ability of fourth grade students to work with vertical scale. An Empirical Study, George Peabody College, 1971.

Smith, W.A. An experiment comparing enactive, iconic, and symbolic approaches to teaching elementary map reading skills. (Doctoral dissertation, George Peabody College, Nashville, Tennessee). 1972.

Stoltman, Joseph F. "Territorial Decentration and Geographic Learning," A paper presented to the International Geographical Commission on Geography in Education, 1972.

Sylvester, D. Map and landscape. London: George Phillip and Son, 1952.

Towler, John O. and L.D. Nelson. The Elementary School Child's Concept of Scale. Journal of Geography, 1967, 67, 26-31.

Warman, H.J. Geography in the elementary schools of the United States. Journal of Geography, 1968, 67, 262-273.

Watts, A.R. Conceptual clarification of certain geographical terms. (Doctoral dissertation, University of Oklahoma) Ann Arbor, Mich.: University Microfilm, 1965.

Weber, C.E. A study of sixth grade children's ability to infer the influence of the natural environment upon man. (Doctoral dissertation, University of California, Berkely) Ann Arbor, Mich.: University Microfilm, 1964.

Weinswig, S.E. Evaluation of lessons to teach introductory map skills in grade four. (Doctoral dissertation, Boston University) Ann Arbor, Mich.: University Microfilm, 1962.

Winer, B.J. Statistical principals in experimental design. New York: McGraw-Hill Book Company. 1962.

Wood, M. Map reading for schools. London: George G. Harrap, 1939.

MAP REFERENCES

Clarksville, Tennessee. U.S. Geological Survey, Washington, D.C. Scale 1:24,000, 1956.

Nashville, Tennessee. U.S. Army Map Service, Washington, D.C. Scale 1:250,000, 1956, revised 1969.

Topographic Maps. U.S. Geological Survey, Washington, D.C., 1970.

Orlinda, Tennessee. U.S. Geological Survey, Washington, D.C. Scale 1:24,000, 1956.

Youngville, Tennessee. U.S. Geological Survey, Washington, D.C. Scale 1:24,000, 1952.

APPENDIXES

APPENDIX A

DESCRIPTIONS AND LESSON PLANS FOR FOUR TEACHING MODES COMPARED IN THE STUDY

Four instructional strategies, based on Bruner's modes of representation, were compared in the investigation. The sections which follow provide brief descriptions of each strategy, along with plans for each of the five daily lessons provided subjects instructed through that teaching plan. The strategies of the Enactive, Iconic and Symbolic modes are very similar to those used by Smith (1972).

Enactive Mode: Directions for the Teacher

The basic objective of the following lessons is to teach pupils to read and use topographic maps. Several basic methods have been proposed as the optimum method for student learning; the method to be tested with this class has been carefully developed to represent one of four recommended strategies. The lesson plan outlines must be followed carefully if comparisons are to be meaningful. Therefore, please follow all instructions as best you can, to remain within the limits of the experiment.

The method you will be using consists of teaching map reading on location. The map being studied is the map of the North Central section of Robertson County. The pupils will be studying the skills of map reading in the general areas around Krisle School, State Fish Hatchery and Beard's Chapel Church.

The pupils will be taken by bus to the Krisle School with at least two stops along the highway. There will be five, fifty minute presen-

tations - one on the grounds at Krisle School; one at the Fish Hatchery; one on the grounds at Beard's Chapel; and two in the bus along the highway - for initial work on the map reading lessons.

Enactive Mode: Daily Lesson Plans

Lesson One: Symbols

Materials: Maps for Youngville Quadrangle, Symbol sheets, and maps of Nashville and Clarksville.

1. Discuss and work through the introduction of topographic maps. Illustrate the many uses made of such maps discussed in the text and any other uses the children might suggest. The development and construction of roads and highways is an example of how topographic maps are used. (Reference: Topographic Maps, p.4)

2. Introduce the pupils to the basic ideas of map scale. The text discussion with the maps of Nashville and Clarksville will show that maps differ in the areas shown, and thus differ in scale. The small outline of Tennessee showing the location of the map also will give the children some idea of the large scale map which they are studying, as compared to the whole state. (Reference: Topographic Maps, pp. 4-6)

3. Discuss the basic idea of map symbols with the class (the discussion in the text is quite good). Emphasis on the land symbols is best, since the water symbols are not included in the current study. (Reference: Topographic Maps, pp. 12-15)

4. Work through the first set of map symbols on roads. Discuss which symbols are used for the road near which they are parked. Ask the class to identify the symbols used on the maps they have. Also use examples in the local environment, where the maps and travel have not

provided first hand observation of the symbols being studied. (Reference: Topographic Maps, p. 15)

The bus will be moved now, thus, giving the students a break.

Lesson Two: Symbols (continued)

Materials used will be the same as in the first lesson.

Work through the remaining symbols on the symbols sheet. Ask the children to locate on their map the symbols marked on your sheet of Topographic Symbols. Use local examples that the children can see whenever possible. (Church and cemeteries are abundant in this area, indicate different roads, point out nearby sink holes, creeks and springs.) (Reference: Topographic Map, pp. 16-17)

Lesson Three: Distance

Materials used will be the same as in lessons one and two.

1. Use the scale at the bottom of the topographic map as a basis for discussion of the meaning of linear distance on maps. Caution the children to always examine the scale carefully so that they will understand the distances represented. Show that most scales on topographic maps have an "0" in the middle and measure in opposite directions at different units.

2. Pick some points on the map that the students have seen and ask them to measure the distances represented. Use the school as a point of reference.

3. Discuss the difference between direct distance and road distance. Ask the students to measure some road distances as in topic 2 above, and compare them with the direct distances. This will also be done as you drive from Krisle School to the Fish Hatchery.

4. Discuss the barriers formed by rivers and other obstacles--and the relationship they hold to travel difficulty on time required for a trip.

Lesson Four: Direction and Orientation

Materials as used in lessons one - three plus the compass and a sheet showing cardinal directions.

1. Discuss the ways direction can be indicated, with emphasis on the indicator provided on the map furnished each pupil. (Use the compass to illustrate to the class how the map should be oriented to the compass.) Stress that the direction of north is not up (a common belief of many fourth grade students).

2. Distribute the sheets showing the eight cardinal directions. Discuss the letter designates on the sheet and the names on the directions they symbolize.

3. Pose some problems of the direction to hills, buildings, and landmarks that the children can see. Pose like problems for points on the map.

4. Use the Nashville and Clarksville maps to discuss more distant points and the direction to these points.

Lesson Five: Size and Shape

Materials used will be the same as in lesson four.

1. Discuss the use of contour lines on the maps to show how hills, valleys, sinkholes, and other features of the environment are represented. Use the area around the hatchery to show the difference in hills, more level land, creeks, and sinkholes. (Later, as the children work through the bus ride have them identify the features they encounter.)

2. Ask the students to measure the area of some of the land features. Explain the use of square miles as the measure of land. This measure is used in development of many modern activities. Explain the math needed to complete the needed measures. The measurement of the area encompassing the fish hatchery is an excellent assignment.

3. Conduct a field traverse for observation of environmental phenomena. As the students walk around the hatchery ask the students to locate and observe various items. The symbols can be identified, size and shape noted, and the conditions of the landscape observed.

Iconic Mode: Directions for the Teacher

The basic objective of the following lessons is to teach pupils to read and use topographic maps. Several basic methods have been proposed as the optimum method for student learning; the method to be tested with this class has been carefully developed to present one of three recommended strategies. To be effective in comparing the various methods the lessons must be followed carefully. Please follow all instructions as best you can to remain within the limits of the experiment.

The method you will be using is an adaptation of various methods and materials for classroom use. The slides, symbol sheets, and maps are designed to aid you in teaching the desired skills and information. Please read each lesson carefully and following the instructions to the best of your ability.

Iconic Mode: Daily Lesson Plans

Materials: Maps of Youngville Quadrangle (three children per map), sheet of Topographic Map Symbols for each child, and the Nashville and Clarksville maps (hung at the front of the room).

1. Discuss and work through the introduction of topographic maps. Illustrate the many uses made of such maps discussed in the text and any other uses the children might suggest. (Reference: Topographic Map, p. 4)

2. Introduce the children to the basic idea of map scales. The text reference used with the student maps and the map of Nashville will allow them to understand that maps of an area can be quite different. The area shown on the children's map is marked in the lower right-hand corner of your map of Nashville. Also point out to the children the small outline of Tennessee on their maps, and the little black square which indicates where the Topographic Quadrangle is located. (Reference: Topographic Map, pp. 4-6)

3. Discuss the basic idea of map symbols with the class. (The discussion in the text is quite good.) Emphasis on the land symbols is best, since many of the water symbols are not included in the current study. (Reference: Topographic Map, pp. 12-15)

4. Work through the first set of map symbols on the sheet. The road symbols on the maps the children have are marked and should be located by pupils. Illustrate the road symbols to the children by pointing to them and discussing them. The blackboard or overhead projector may be used to illustrate the symbols not on the map, if you feel this would be helpful to the class. Use local examples whenever possible.

Lesson Two: Symbols (continued)

Materials used will be the same as in the first lesson.

Work through the remaining symbols on the symbol sheet. Have the

children locate the symbols shown on the map they are using (the symbols found on the map are marked on your copy of the symbol sheet). Use local examples to illustrate the other symbols selected; however, omit the marked red boundary symbols and the ocean symbols, since they are not included in this study. Feel free to answer all questions the children may raise about the map or symbol sheets.

Lesson Three: Distance

Materials used will be the same as in lessons one and two.

1. Use the scale at the bottom of the topographic map as a basis for discussion of meaning of linear distance on maps. Caution the children to always examine the scale carefully so that they will understand the distances represented. Show that most scales on topographic maps have an "0" in the middle and measure in opposite directions at different units.

2. Pick some points at random and ask the students to measure the distances on their maps. (Enough problems should be posed to insure that a basic concept of map distance has been presented.)

3. Discuss the difference between direct distance and road distance. Ask the students to measure some road distances as in topic 2, above, and compare them with the direct distances.

4. Discuss the barriers formed by rivers and other obstacles and the relationship they hold to travel difficulty or time required for a trip.

Lesson Four: Direction and Orientation

Materials used will be the same as in lessons one - three, plus the compass.

1. Discuss the ways direction can be indicated, with emphasis on the direction indicator provided on the map furnished each pupil. Use the compass to illustrate to the class how the map should be positioned to show the direction indicated by the compass. Stress that the direction of north is not up (a common belief of many fourth grade students).

2. Draw the eight cardinal directions on the board. Use the common letter designates of N, NE, E, SE, S, SW, W, and NW to teach the letter symbols for these directions.

3. Pose some problems of directions for the children to solve with the maps. (Use enough problems to demonstrate the basic concepts to the class.)

4. Use the Nashville and Clarksville maps to discuss the direction of more distant points, in relation to the pupils' home city.

Lesson Five: Size and Shape

Materials used will be the same as in lesson four, plus the 35mm color slides.

1. Discuss the use of contour lines on the map to show how hills, valleys, sinkholes, and other features of the environment are represented. Illustrate on the blackboard the relationship of the distance between the contours and land represented on the map.

2. Draw sketches on the chalkboard to illustrate various features shown on the map. Show vertical and cross sections of the features, as an aid to the pupils in seeing size and shape.

3. Ask the children to measure the area of some chosen locations on their maps. Explain the concept of square miles and show how the scale of miles will allow the measurement of the total area of the map

and any smaller area shown on the map.

4. Use the 35mm color slides to review and illustrate the points of this and the preceding lessons (your map has the location of each slide marked and you may ask the class to attempt to locate the picture area on their map).

Symbolic Mode: Directions for the Teacher

The basic objective of the following is to teach pupils to read and use topographic maps. Several basic methods have been proposed as the optimum method for student learning; the method to be tested with this class has been carefully developed to present one of three recommended strategies. To be effective in comparing the various methods, the lessons must be followed carefully. Please follow all instructions as best you can to remain within the limits of the experiment.

The method you will be using is an adaptation of limited materials with careful verbal presentation of the concepts and skills. Please explain all of the symbols and concepts to the fullest without the use of any aids other than the maps provided. Do not use the board to draw the real world vision of the symbolic materials.

Symbolic Mode: Daily Lesson Plans

Lesson One: Symbols

Materials: Maps of the Youngville Quadrangle and Nashville, hung at the front of the classroom.

1. Explain to the children the basic meaning of topographic maps as described in the text. Explain that the map being used is the Youngville Quadrangle of Tennessee. Discuss the uses for topographic maps found in the text and any additional uses suggested by the students.

(Reference: Topographic Maps, pp. 4-6)

2. Discuss the meaning of scale as related to the size of the area shown on the maps. Use the maps provided to point to the fact that the small marked area in the corner of the Nashville map is the total area shown on the Youngville Quadrangle. At this point in the instructional sequence it is best to explain the concept of scale in terms of the area shown rather than in terms of measured distance.

3. Discuss the general and specific uses of symbols as presented in the text--the section on symbols on the shore lines and oceans of the continent may be omitted since they are not included in the current study. Provide the children as complete a description as possible of the concepts discussed in the text. (Reference: Topographic Maps, pp. 12-15)

4. Discuss the first group of road and trail symbols on the sheet. Use verbal examples of these symbols as found in the children's environment to illustrate the meaning of the various roads included on the sheet. Point to the maps when the appropriate symbol is shown on them. (Reference: Topographic Map, p. 15)

Lesson Two: Symbols (continued)

Materials used will be the same as in the first lesson.

First, work through the remaining symbols on the sheet, using the maps to indicate the symbols that appear on them. Use verbal illustrations for the symbols and local examples where these are available. Omit the marked red boundary lines and the ocean symbols since they are not included in this study. Provide as complete discussion of the symbols as is possible and feel free to answer any questions the

children may raise.

Lesson Three: Distance

Materials used will be the same as in lessons one and two.

1. Use the scale at the bottom of the topographic map to discuss the basic meaning of linear distance on maps. Caution the students to always examine the scale on a map carefully to make certain that they understand the distances represented. Explain that most scales on topographic maps have an "0" in the middle and measure in opposite directions at different units.

2. Pick some points at random and demonstrate to the class the use of the scale in measuring distance on the maps. Provide enough examples to show the basic ideas of direct distance on the maps.

3. Discuss the difference between road distance and direct distance. Pick some road distances, measure the mileage, and thereby illustrate the differences in direct and road distance.

4. Discuss the barriers formed by rivers, and other obstacles--and the relationship they hold to travel difficulty or time required for a trip.

Lesson Four: Direction and Orientation

Materials used will be the same as in lessons one - three, plus the compass.

1. Discuss some of the ways direction can be indicated on maps, with emphasis on the system used on the topographic maps. Explain the compass readings to illustrate how a map should be oriented for use in the class. Stress that the maps hanging in front of the room do not point to north but point up.

2. Explain the eight cardinal directions commonly used. Explain to the class the use of the letters of N, NE, E, SE, S, SW, W, and NW to provide abbreviations for the directions which they symbolize. Point to the appropriate direction in the room for each of the eight cardinal directions.

3. Pose some problems of direction related to the maps hanging in the room. Illustrate the use of the direction indicator in the solution to the problems.

4. Use the Nashville and Columbia maps to discuss the direction of more distant points in relation to the pupils' home city.

Lesson Five: Size and Shape

Materials used will be the same as in lesson four.

1. Explain the use of contour lines on the maps to show hills, valleys, sinkholes, and other features of the environment. Discuss the relationship of the distance between the contour lines and the slope of the land. The understanding of a series of concentric circles as a hill or a sinkhole, elongated "V's" as a valley, and contours close together as a cliff will depend on good verbal descriptions.

2. Explain how the contour lines would appear from a cross sectional view of a topographic map. The horozontal lines and their relationship to the curved lines on the map is a key to making the third dimension understandable. The size and shape of the various features are represented by the contour lines.

3. Explain the use of the scale of miles to determine the area of various parts of the map. Discuss the idea of square miles and the uses in planning roads, parks, land sales, and urban development

it has. Pose some problems on the map and solve the problems for the class. You may use the chalkboard for illustration of the math involved.

4. Explain that even irregular shapes may be measured to an appropriate degree by the use of a nearest square method with the scale of miles.

Combined Mode: Directions for the Teacher

The basic objectives of the following lesson is to teach pupils to read and use topographic maps. Several basic methods have been proposed as the optimum method for student learning: the method to be tested with this class has been carefully developed to represent one of four recommended strategies. The lesson plan outlines must be followed carefully if comparisons are to be meaningful. Therefore, please follow all instructions as best you can, to remain within the limits of the experiment.

The method you will be using consists of teaching map reading in the classroom and on location. It will be a combination of the symbolic, iconic and enactive representational modes. The map being studied is the map of the North Central section of Robertson County in Tennessee. The pupils will be studying the skills of map reading in the general areas around Krisle School, the State Fish Hatchery and Beard's Chapel Church.

There will be five (5) fifty minute presentations - three (3) presentations in the classroom and two (2) presentations on location at the Fish Hatchery and Beard's Chapel Church. The in-class presentations will involve a combination of the Iconic and Symbolic representational modes. The pupils will be taken by bus to the Fish Hatchery and Beard's Chapel.

Combination Mode: Daily Lesson Plans

Lesson One: Symbols

Materials: Maps of Youngville Quadrangle, Symbol sheets, and maps of Nashville and Clarksville.

1. Discuss and work through the introduction of topographic maps. Illustrate the many uses made of such maps discussed in the text and any other uses which the children might suggest. (Reference: Topographic Maps, p. 4)

2. Introduce the pupils to the basic idea of map scale. The text reference used with the student maps and the map of Nashville should enable them to understand that maps of an area can be quite different. The area shown on the children's map is marked in the lower right-hand corner of the map. Also, direct the children's attention to the small outline of Tennessee on their map, as well as the little black square which indicates where the Youngville Quadrangle is located. (Reference: Topographic Maps, pp. 4-6)

3. Discuss the basic idea of map symbols with the class. Emphasis on the land symbols is best, since many of the water symbols are not included in the present study. (Reference: Topographic Maps, pp. 12-15)

4. Introduce all the map symbols. The road symbols on the children's map are marked and should be located by pupils. Through use of the blackboard and/or overhead projector, those symbols not on the map could be illustrated. Use local examples as much as possible.

Lesson Two: Distance

Materials used will be the same as in lesson one.

1. Use the scale at the bottom of the topographic map as a basis

for discussion of meaning of linear distance on maps. Warn the children to always examine the scale carefully so that they will understand the distances represented. Show that most scales on topographical maps have an "0" in the middle and measure in opposite directions at different units.

2. Discuss the difference between direct distances and road distances.

3. Discuss the barriers formed by rivers and other obstacles with emphasis on the relationship they hold to travel difficulty or time required for a trip.

Lesson Three: Direction, Orientation, Size and Shape

Materials used will be the same as in lessons one and two plus 35mm color slides and a compass.

1. Discuss the ways direction can be indicated, with emphasis on the direction indicator provided on the map furnished. Use the compass to illustrate to the pupils how the map should be positioned to show the direction indicated by the compass.

2. Draw the eight cardinal directions on the board. Use the common letter designates of N, NE, E, SE, S, SW, W, and NW to teach the letter symbols for these basic directions.

3. Discuss the use of contour lines on the maps to show how hills, valleys, sinkholes, and other features of the environment are represented. Illustrate on the blackboard the relationship of the distance between the contours and land represented on the map.

4. Use the chalkboard or overhead projector to draw sketches illustrating various features shown on the map. Present vertical and

cross sections of the features to aid the pupils in seeing size and shape.

5. Use the 35mm color slides to review and illustrate the points of this and the other lessons (your map has the location of each slide marked and you may ask the class to attempt to locate the picture area on their map).

Lesson Four and Five: On-site presentations of Symbols, Distance

Materials needed will be the same as in the preceding lessons with the exception of the 35mm color slides.

1. Give the students certain symbols to identify as the bus is moving and when stopped.

2. Identification of topographic symbols which would determine where a house, road or bridge could be built.

3. Have students measure distance by rod from where they are parked (Krisle School) to where they will be next (Fish Hatchery). Compare their answers to those shown on the bus's speedometer.

4. Pose some problems of the direction to hills, buildings and landmarks that the children can see. Pose similar problems for points on the map.

5. Conduct a field traverse for observation of environmental phenomena. As the students walk down the road from Beard's Chapel, ask them to locate and observe various items. The symbols can be identified, size and shape noted and the condition of the landscape observed.

DIRECTIONS TO THE PUPIL: Place a letter of the correct symbol in the space before each symbol description.

			R.T.	R.S.	SUB SCALE
A	_____	TRAIL	.50	.58	1
B	_____	WOODLAND	.42	.53	1
C	_____	MARSH	.25	.40	1
D	_____	BRIDGE	.47	.56	1
E	_____	DWELLING OR BUSINESS BUILDING	.48	.57	1
F	_____	IMPROVED LIGHT DUTY ROAD	.46	.51	1
G	_____	DEPRESSION CONTOURS	.59	.63	1
H	_____	POWER TRANSMISSION LINE WITH LOCATED TOWER	.38	.45	1
I	_____	CHURCH	.30	.34	1
J	_____	BARN OR OUT BUILDING	.50	.57	1
K	_____	HARD SURFACE, HEAVY DUTY ROAD	.48	.51	1

R.T. = Item correlation with Total Sample
R.S. = Item correlation with the Subscale
Subscale = Item Subscale Membership

DIRECTIONS TO THE PUPIL: Please underline the correct answer to the following questions. The numbers on the slide pictures are to help you to find the places in the questions on your map. The number after the place in the questions is where you should look on the map.

	R.T.	R.S.	SUB SCALE
1. By the road, how far is it from Cross Plains (1) to the Robertson County and Sumner County line (2)? 3.8 4.1 3.6 4.2	.36	.39	2
2. What direction is Covington Hill (5) from Cross Plains (1)? N NE E SE S SW W NW	.49	.65	3
3. What direction is Orlinda (10) from East Robertson High School (6)? N NE E SE S SW W NW	.14	.28	3
4. What direction is Orlinda (10) from Pleasant Hill (3)? N NE E SE S SW W NW	.08	.17	3
5. What direction is Choate Hollow (8) from Cross Plains (1)? N NE E SE S SW W NW	.55	.66	3
6. How many miles by road is Orlinda (10) from Cross Plains (1)? 5.4 5.0 4.6 4.2	.18	.55	2
7. What is the direct distance from Pleasant Hill Church (3) to East Robertson High School (6)? 3.6 3.0 2.7 3.3	.31	.44	2
8. What direction is Jones Hill (2) from Covington Hill (6)? N NE E SE S SW W NW	.15	.33	3

		R.T.	R.S.	SUB SCALE
9.	What direction is Eden Corner (13) from Mt. Carmel Church (11)? N NE E SE S SW W NW	.48	.62	3
10.	What direction is Payne Hill (8) from Cross Plains (1)? N NE E SE S SW W NW	.43	.57	3
11.	By road, how far is it from Mt. Carmel Church (11) to Brooke Cemetery (4)? 4.6 5.2 5.0 4.8	.18	.37	2
12.	What is the direct distance from Friendship School (12) to Cross Plains (1)? 2.3 2.5 2.7 2.1	.21	.49	2
13.	At (1) is _____. flat land, a hill, a cliff, a canyon	.20	.43	4
14.	At (11) is _____. wooded area, flat land, rolling hills, wooded flat land	.24	.66	4
15.	At (7) is _____. a hard surface medium duty road, an improved dirt road, a hard surface heavy duty road, several houses	.34	.68	4
16.	At (5) is _____ft. above sea level. 745 750 740 735	.12	.51	4

R.T. = Item correlation with Total Sample
R.S. = Item correlation with Subscale
SUBSCALE = Item Subscale Membership

DIRECTIONS: Before you are two slides, one is a picture of scenery on a map. The numbers on the map tell where to look for possible locations of the scene. Place the number of the map at which you think the picture was taken. Use your maps to study what it is at the number.

		R.T.	R.S.	SUB SCALE
1.	_____	.28	.26	5
2.	_____	.26	.44	5
3.	_____	.52	.63	5
4.	_____	.27	.42	5
5.	_____	.40	.44	5
6.	_____	.25	.40	5
7.	_____	.46	.57	5
8.	_____	.37	.43	5
9.	_____	.34	.44	5
10.	_____	.40	.52	5

R.T. = Item correlation with Total Sample
R.S. = Item correlation with the Subscale
SUBSCALE = Item Subscale Membership

APPENDIX C

BASIC DATA

TABLE VI

BASIC DATA USED IN ANALYSES -- SYMBOLIC GROUP

S No.	Sex	IQ	Age	Subscale					Tot. Test
				Sym-bols	Dis-tance	Direc-tion	Size & Shape	Slides	
001	F	097	13	5	3	3	2	8	21
002	F	116	12	11	2	0	2	5	20
003	M	100	13	8	1	2	3	4	18
007	F	082	14	4	2	0	3	5	14
008	M	093	13	6	1	5	1	8	21
009	F	096	12	4	2	6	2	2	18
010	F	106	13	7	0	3	3	5	18
011	M	108	13	6	1	3	3	7	19
014	F	125	12	9	1	1	1	8	20
015	M	097	13	7	2	4	0	7	20
016	F	102	13	7	3	0	2	6	18
017	M	101	12	7	2	4	0	3	16
018	M	109	12	4	2	4	0	3	13
019	M	074	13	2	1	2	2	3	10
022	M	087	13	8	1	0	1	4	14
023	M	106	13	10	3	4	1	8	26
024	M	124	12	10	0	4	1	10	25
025	F	110	13	4	3	3	1	6	17

TABLE VI (continued)

S No.	Sex	IQ	Age	Subscale: Symbols	Distance	Direction	Size & Shape	Slides	Tot. Test
026	M	078	13	2	1	0	0	5	8
027	F	086	13	3	1	2	0	6	12
028	F	095	12	2	1	0	2	1	6
030	F	112	12	5	3	3	1	2	14
031	M	124	13	9	1	4	4	7	25
032	M	093	13	3	1	2	1	2	9

TABLE VII

BASIC DATA USED IN ANAYLSES -- ICONIC GROUP

S No.	Sex	IQ	Age	Subscale					Tot. Test
				Sym-bols	Dis-tance	Direc-tion	Size & Shape	Slides	
102	F	082	14	7	2	1	3	4	17
103	F	099	12	7	1	2	3	2	15
104	F	125	12	10	2	2	4	5	23
105	F	106	12	5	2	6	1	1	15
106	F	082	13	3	1	2	2	2	10
107	F	106	12	5	2	2	2	6	17
108	M	136	13	7	1	3	2	6	19
109	F	105	12	5	2	4	1	3	15
110	F	080	13	5	0	1	1	4	11
112	F	107	13	8	2	3	4	1	18
113	M	094	12	4	0	1	2	3	10
114	F	103	13	3	2	5	4	5	19
115	M	094	14	7	0	1	2	3	13
116	M	104	12	7	3	1	2	6	19
117	F	105	13	9	2	3	2	5	21
118	F	083	13	4	2	1	3	2	12
119	M	074	14	0	0	0	1	4	5
120	M	085	13	3	2	3	0	4	12
121	M	078	13	8	2	4	3	4	21
122	M	091	13	3	2	1	3	1	10
123	M	107	13	7	2	2	1	1	13

TABLE VII (continued)

S No.	Sex	IQ	Age	Subscale					Tot. Test
				Sym-bols	Dis-tance	Direc-tion	Size & Shape	Slides	
124	F	080	14	1	1	0	3	3	8
125	M	089	12	6	2	1	2	3	14
126	M	096	13	4	1	1	1	4	11
127	F	072	14	2	0	2	3	1	8
128	M	096	13	2	0	0	3	3	8
129	M	092	13	6	0	3	0	5	14
131	M	083	12	5	1	2	3	4	15

TABLE VIII

BASIC DATA USED IN ANALYSES -- ENACTIVE GROUP

S No.	Sex	IQ	Age	Subscale					Tot. Test
				Sym-bols	Dis-tance	Direc-tion	Size & Shape	Slides	
201	F	096	14	8	1	0	3	4	16
202	F	101	13	8	2	1	2	9	22
203	F	115	12	10	0	2	3	8	23
204	F	087	12	9	3	1	2	8	23
205	F	099	12	6	3	0	3	7	19
206	M	100	13	8	2	2	4	4	20
207	F	102	13	10	0	2	4	6	22
208	M	087	13	8	2	2	2	3	17
209	M	103	13	10	2	1	2	9	24
210	F	095	12	6	3	1	1	5	16
211	M	097	12	10	2	4	2	4	22
212	F	101	12	6	2	0	1	2	11
213	M	095	13	5	0	3	0	2	10
215	M	115	13	9	2	2	2	4	19
216	F	115	12	2	1	1	3	5	12
217	F	106	13	6	1	5	0	2	14
218	M	097	13	11	2	0	2	6	21
219	F	093	12	1	1	2	1	3	8
220	F	111	13	10	2	4	1	2	19
221	M	104	13	4	1	2	3	4	14
222	M	083	12	9	2	1	3	2	17

TABLE VIII(continued)

S No.	Sex	IQ	Age	Subscale					Tot. Test
				Sym-bols	Dis-tance	Direc-tion	Size & Shape	Slides	
224	F	081	13	5	0	2	2	5	14
226	M	082	14	3	3	3	0	2	8
227	M	100	12	4	0	1	2	1	8
228	F	101	13	6	0	1	2	7	14
229	M	107	12	8	2	3	2	9	24
230	F	075	13	4	1	0	1	2	8
231	M	090	13	4	4	1	0	4	13

TABLE IX

BASIC DATA USED IN ANALYSIS -- COMBINED GROUP

S No.	Sex	IQ	Age	Subscale					Tot. Test
				Sym-bols	Dis-tance	Direc-tion	Size & Shape	Slides	
301	M	085	13	7	1	1	1	2	12
303	F	075	13	4	3	2	3	4	16
304	M	104	13	9	3	0	3	4	19
305	F	105	12	3	2	3	1	4	13
306	M	078	14	1	4	5	0	1	11
307	F	111	13	7	2	4	2	4	19
308	M	100	13	7	0	2	1	5	15
309	F	085	13	3	2	1	1	5	12
310	F	104	12	5	2	2	2	8	19
311	M	120	12	6	2	2	2	2	14
312	F	102	12	6	3	1	1	4	15
313	M	102	13	5	1	1	0	6	13
314	F	102	13	7	1	3	3	7	21
316	F	089	13	3	0	1	1	3	8
317	M	112	12	6	3	3	2	1	15
318	M	130	12	8	3	3	2	1	17
319	F	127	12	7	1	2	1	3	14
320	M	073	14	1	2	0	2	3	8
321	M	093	14	7	1	3	2	3	16
322	M	112	12	9	2	4	1	6	22
323	F	097	12	3	2	1	1	4	11

TABLE IX (continued)

S No.	Sex	IQ	Age	Subscale					Tot. Test
				Sym-bols	Dis-tance	Direc-tion	Size & Shape	Slides	
324	M	089	13	8	1	1	2	3	15
326	M	092	12	11	4	3	3	1	22
327	F	130	12	8	2	6	1	4	21
328	F	079	12	2	1	1	0	1	5
329	F	094	13	6	2	3	2	5	18
330	F	073	14	1	1	0	0	3	5
331	F	124	12	8	1	2	2	5	18
332	F	095	12	4	2	3	1	2	12

VITA

Adolphus Hayward Pelley was born in Corner Brook, Newfoundland, Canada, on January 3, 1942. He received his early education in that city and emigrated to Calhoun, Tennessee, in 1954. He was graduated from Bradley Central High, Cleveland, Tennessee in 1960. The following September he entered Tennessee Wesleyan College and after two quarters "dropped out" of school. After one and one-half years of travel, he enlisted in the U.S. Navy and served four years, three months and twenty-eight days. In the fall of 1966 he again enrolled in Tennessee Wesleyan College and was graduated in 1969. He was employed by the Robertson County Board of Education. While employed he earned the Master of Science degree in Education in 1974 at the University of Tennessee at Nashville.

He is married to the former Catherine Anne O'Donnell of San Francisco, California and has one daughter, Jill Ann.