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THE DEVELOPMENT OF ACTIVITIES FOR TEACHING MAP SKILLS WHICH FACILITATE TRANSITIONS BETWEEN STAGES OF COGNITIVE DEVELOPMENT

The University of Nebraska - Lincoln PH.D. 1985

THE DEVELOPMENT OF ACTIVITIES FOR TEACHING MAP SKILLS WHICH FACILITATE TRANSITIONS BETWEEN STAGES OF COGNITIVE DEVELOPMENT

by

Bill G. Thurmond

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For the Degree of Doctor of Philosophy

Major: Interdepartmental Area of

Administration, Curriculum & Instruction

Under the supervision of Professor F. William Sesow

Lincoln, Nebraska

May, 1985

TITLE

The Development of Activities for Teaching Map Skills Which Facilitate Transitions Between Stages of Cognitive Development

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THE DEVELOPMENT OF ACTIVITIES FOR TEACHING MAP SKILLS

WHICH FACILITATE TRANSITIONS BETWEEN

STAGES OF COGNITIVE DEVELOPMENT

Bill G. Thurmond, Ph.D.

University of Nebraska, 1985

Adviser: F. William Sesow

Numerous studies have displayed a concern related to the elementary school child's inability to use maps commonly associated with the social studies program. There is a need to apply current knowledge about cognitive development to map skills instruction. The purpose of this study was to (1) identify map skills most commonly suggested for inclusion in elementary social studies programs; (2) identify criteria, based on Piaget's theories of cognitive development, which facilitate the transition between stages of development; and, (3) suggest activities for teaching selected map skills which demonstrate characteristics of these Piagetian criteria.

The most commonly suggested map skills of direction, location, scale and symbols were identified through a review of selected literature. Professional literature related to Piaget's theory about how children develop cognitive abilities and how movement between developmental stages (preoperational to concrete and concrete to formal) is facilitated was reviewed. The review revealed that the criteria of concrete experiences, social interaction and exploratory experiences should be displayed in instructional activities to facilitate movement between developmental stages.

Through use of the suggested map skills and the Piagetian criteria suggested for facilitation of transitions between developmental stages, 24 map skill activities were developed. These activities were presented in a matrix of four basic map skills, two transitions, and three Piagetian criteria.

A panel of experts knowledgeable in the application of Piaget's theory to elementary school curriculum and/or experience in the consideration of map skills within the context of Piaget's notions about how children learn was used to determine whether or not the Piagetian criteria were met in the wording of the activities. A Delphi procedure was used to refine the map skill activities and reach an acceptable level of agreement in terms of Piagetian criteria. The activities were revised after the first round using suggestions made by the panel. A second round of applying the Delphi procedure produced the stated goal of 80 percent agreement for each of the activities.

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Finally, a note of thanks to Mrs. L. M. Kenney whose typing ability and positive attitude helped me make the last stages of this project hassle free.

CONTENTS

	Page
LIST OF TABLES	ix
LIST OF FIGURES	x
Chapter	
1. INTRODUCTION	1
Purpose of the Study	8
Significance of the Study	8
Definition of Terms	8
Assumptions	9
Delimitations and Limitations	10
Design of the Study	10
Developmental Section	10
Data Collection Section	11
Reporting Section	12
Organization of the Study	12
2. REVIEW OF RELATED LITERATURE	14
Map Skills in the Elementary School	14
Elements of Piaget's Theory	25
Stages	25
Sensory motor stage	26
Preoperational stage	27
Concrete operational stage	28
Formal operational stage	29
Equilibration	30

Page

Factors for Transition 32

Concrete experiences 32

Social interaction 35

Exploration 36

Spatial Development 38

Stages of spatial development 38

Egocentrism 40

Cognitive development and achievement 42

Reference system 42

Developing the concept of scale 44

Conclusion 45

3. DESIGN OF THE STUDY 47

Development 47

Data Collection 52

Conclusion 54

4. PRESENTATION AND ANALYSIS OF THE DATA 55

Activities for Teaching Map Skills Related to Direction 56

Transition from Preoperational to Concrete/ First Round 56

Concrete experiences 56

Social interaction 58

Exploration 59

Transition from Concrete to Formal/ First Round . . . 61

Concrete experiences 61

Social Interaction 62

Page

Exploration 62

Transition from Preoperational to Concrete/ Second Round 63

Concrete experiences 64

Social interaction 65

Exploration 67

Transition from Concrete to Formal/Second Round . . 68

Concrete experiences 68

Social interaction 69

Exploration 70

Activities for Teaching Map Skills Related to Location 71

Transition from Preoperational to Concrete/ First Round 71

Concrete experiences 71

Social interaction 73

Exploration 74

Transition from Concrete to Formal/First Round . . . 75

Concrete experiences 75

Social interaction 77

Exploration 77

Transition from Preoperational to Concrete/ Second Round 78

Concrete experiences 79

Social interaction 80

Exploration 81

Page

Transition from Concrete to Formal/Second Round . . 81

Concrete experiences 81

Social interaction 82

Exploration 83

Activities for Teaching Map Skills Related to Scale 85

Transition from Preoperational to Concrete/ First Round 86

Concrete experiences 86

Social interaction 87

Exploration 88

Transition from Concrete to Formal/First Round . . . 89

Concrete experiences 89

Social interaction 90

Exploration 91

Transition from Preoperational to Concrete/ Second Round 91

Concrete experiences 91

Social interaction 92

Exploration 93

Transition from Concrete to Formal/Second Round . . 94

Concrete experiences 94

Social interaction 95

Exploration 96

Activities for Teaching Map Skills Related to Symbols 97

Page

Transition from Preoperational to Concrete/ First Round 97

Concrete experiences 97

Social interaction 99

Exploration 100

Transition from Concrete to Formal/First Round . . . 101

Concrete experiences 101

Social interaction 102

Exploration 102

Transition from Preoperational to Concrete/ Second Round 103

Concrete experiences 103

Social interaction 104

Exploration 105

Transition from Concrete to Formal/Second Round . . 106

Concrete experiences 106

Social interaction 107

Exploration 108

Summary 108

5. SUMMARY, FINDINGS AND RECOMMENDATIONS 112

Findings 113

Direction 114

Location 116

Scale 118

Symbols 120

Page

Recommendations 124

Conclusion 126

BIBLIOGRAPHY 127

APPENDIXES

A. ANALYSIS OF LITERATURE ON MAP SKILLS USED IN ELEMENTARY SCHOOL 131

B. LISTS OF PANEL MEMBERS 134

C. SAMPLE LETTERS TO POSSIBLE PANEL MEMBERS 137

D. MATERIALS SENT TO POSSIBLE PANEL MEMBERS 140

E. ORIGINAL ACTIVITIES 145

F. FIRST REVISION OF ACTIVITIES AND ANSWER SHEETS 154

G. INSTRUCTIONS FOR COMPLETING DATA GATHERING INSTRUMENT 163

H. SECOND REVISION OF ACTIVITIES AND COVER LETTER 167

TABLES

Table		Page
1.	Responses of Panel Members to Map Skill Activities Related to Direction	57
2.	Responses of Panel Members to Map Skill Activities Related to Location	72
3.	Responses of Panel Members to Map Skill Activities Related to Scale	85
4.	Responses of Panel Members to Map Skill Activities Related to Symbols	98
5.	Summary of Positive Responses by Panel Members to Map Skill Activities Which Facilitate Cognitive Development	111

FIGURES

Figure Page

1. Research Design 48

Chapter 1

INTRODUCTION

Map skills have long been thought of as important for the educated person to possess. Being able to use a map has always been useful in developing a sense of place or space when confronted with information about the world. These skills are especially important to the child seeking to understand the many-faceted elementary school social studies program.[1] The ability to interpret maps is also beneficial in interpreting the message of magazines, newspapers and even advertisements.[2] Muehrcke addressed the need for individual understanding of maps by stating:

> The forthcoming need for map understanding should be unprecedented in history. Society must pay an intolerable price in accommodating its disoriented members. More than ever before, those responsible for the training of map users will have a special obligation to teach functionalism.[3]

The reality of an increasingly technical world which tends to break down physical and political boundaries is an additional reason for providing instruction in map skills for the elementary age child.

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[1]Lorin Kennamer, "Developing a Sense of Place and Space," Skill Development in Social Studies, ed. Helen M. Carpenter (Washington, D.C.: National Council for the Social Studies, 1963), p. 153.

[2]Linwood Chase and Martha Tyler John, A Guide for the Elementary Social Studies Teacher (Boston: Allyn and Bacon, Inc., 1978), p. 326.

[3]Phillip Muehrcke, "Functional Map Use," Journal of Geography, 67:262, December, 1978.

While recognizing the importance of map skill instruction in the elementary school, this study considered the reality of such instruction today. Several recent studies suggest that deficiencies exist in the map skill development of elementary age children. Schneider found that student performance did not improve when students were exposed to the newer materials used by teachers in map skills instruction.[4] The studies of Giannangelo and Frazee showed that many children were not able to utilize in an effective way the maps they encountered in social studies instruction.[5] Meyer expressed a concern that the present type of instruction may be producing a "rote type of false mastery of skills" rather than a real understanding.[6] A study by Hawkins, which identified massive deficiencies in students' map skills, provided additional evidence of the inadequate student performance in map skills.[7] Bacon presented the following evaluation of student achievement related to map skills:

> National achievement test scores in geography skills have fallen even more precipitously than those in the reading and

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[4]Donald O. Schneider, "The Performance of Elementary Teachers and Students on a Test of Map and Globe Skills," Journal of Geography, 75:326, September, 1976.

[5]Duane M. Giannangelo and Bruce M. Frazee, "Map Reading Proficiency of Elementary Educators," Journal of Geography, 76:63, February, 1977.

[6]Judith M. Meyer, "Map Skills Instruction and the Child's Developing Cognitive Abilities," Journal of Geography, 72:34, September, 1973.

[7]Michael L. Hawkins, "Map and Globe Skills in Elementary School Textbooks," Journal of Geography, 76:265, December, 1977.

> computation skills areas. Reasons for this problem are the failure to incorporate them into appropriate social studies content so that students can really use them; and the attempt to do too much too fast.[8]

An essential consideration, therefore, is what type of instruction is necessary if children are going to learn how to use maps? Most often the map skills instruction that children receive is comprised of systematic map skills presented in a kit, a workbook or a textbook program. The concept of a systematic presentation of map skills is based in part on the work of the Evanston Team which was chaired by Clyde F. Kohn. The work of this team was described in the Twenty-Fourth Yearbook of the National Council for the Social Studies published in 1953. The group of geography educators listed six broad skills which form the foundation for the use of maps.[9] These six broad skills and the accompanying sub-skills have been used as a starting point for the scope and sequence of many map skills instructional programs.

More than ten years ago, Kennamer called for a re-thinking of geographic concepts and their placement in light of the greater attention being given to a sequence of learning. He further stated that "tradition is now a faulty guideline for placement of geographic concepts."[10] Towler addressed the same idea over a decade ago with

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[8]Phillip Bacon, "Geography," Teacher, 98:45, October, 1980.

[9]Clyde F. Kohn, "Interpreting Maps and Globes," Skills in Social Studies, ed. Helen M. Carpenter (Washington, D.C.: National Council for the Social Studies, 1953), p. 146.

[10]Lorin Kennamer, "Emerging Social Studies Curricula: Implications for Geography," Focus on Geography: Key Concepts and Teaching

the following observations about geographic education and map skills programs:

> One of the problems which continues to plague those involved with geographic education is when, how, and what to teach about maps. To be sure, there are a number of map "programs" in use in the schools, but few, if any, have been based on research evidence which might support the efficiency of the program. Indeed much of what is presently available is a result of some suppositions as to what may or may not work with some students, limited successes with isolated cases, and a loose sequence of techniques based on random observations, questionable logic, and the tradition of what we have been doing for years.[11]

In a recent study, Cooke reported that the sequencing of several current elementary social studies textbook series "did not reflect even partially the role of empirical research in giving insight into the conditions which might best foster learning."[12] This position is further supported by Askov and Kamm who found that the current texts ignore the developmental nature of map skills.[13] Hawkins identified "large areas in existing popular social studies textbooks that do not systematically contribute to the development of these [map] skills."[14] Furthermore, Hawkins felt that there needed to be direction for teachers

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Strategies, ed. Phillip Bacon (Washington, D.C.: National Council for the Social Studies, 1970), p. 388.

[11]John Towler, "Egocentrism: A Key to Map Reading Ability," Social Education, 35:893, December, 1971.

[12]Kathleen G. Cooke, "The Relationship Between Spatial Cognitive Developmental Levels and Achievement of Map Skills" (Ph.D. dissertation, New York State University--Albany, 1978), p. 3.

[13]Eunice N. Askov and Karlyn Kamm, "Map Skills in the Elementary School," The Elementary School Journal, 75:115, November, 1974.

[14]Michael L. Hawkins, "Map and Globe Skills in Elementary School Textbooks," Journal of Geography, 76:265, December, 1977.

regarding what map skills should be taught at the various levels in the elementary school.[15]

The concern expressed about the current efforts regarding the instruction of map skills has caused those studying the development of cognitive abilities to consider what contributions can be made from this field to map skills instruction. This reflects Kohn's viewpoint that particular skills need to be developed when a student possesses the mentality for understanding a certain concept.[16] McCartin saw research and theory in cognition as having "reached a point where a natural link should be forged between it and related research in curricular development."[17] She further stated:

> The complexity of the child's conceptual structure will be understood only after much more research, but the importance of children's thinking processes as forming a basis for modification in teaching and curricular changes makes it imperative that we use all available information and get on with the task.[18]

The Commission on the Social Sciences of the National Science Board recommended in 1969 that attention be given to the efforts of researchers of how children learn for the purpose of redesigning the elementary school social science curriculum.[19]

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[15]Hawkins, "Textbooks," p. 264.

[16]Kohn, p. 146.

[17]Rosemarie McCartin, "The Cognitive and Affective Learning of Children," Focus on Geography: Key Concepts and Teaching Strategies (Washington, D.C.: National Council for the Social Studies, 1970), p. 230.

[18]McCartin, p. 229.

[19]National Science Foundation, Knowledge into Action: Improving the Nation's Use of the Social Sciences, Commission on the

The cognitive development theories of Jean Piaget are often considered when cognition is applied to map skills instruction. Application of Piaget's theories to map skills instruction has proceeded in two directions: spatial reasoning and curricular planning. In terms of spatial reasoning, Pufall and Shaw stated that Piaget and his co-workers have "offered a theoretical characterization of changes in the child's ability to conceptualize space they believe necessary to the attainment of adult spatial abilities."[20] Cooke cited several spatial concepts identified by Piaget which had specific connection to map skill achievement. These concepts are perspective ability, concept of nationality, and conservation of distance. She further stated that Piaget defined six spatial concepts within the framework of his developmental theories.[21] Eliot credited Piaget's work as "stimulating research on problems related to the perception of an area, diagonality, perspectives and similar aspects of space."[22] This research has had only limited application to elementary school map skills instruction.

As has been the case in many curricular areas, especially science and math, the cognitive development theories of Piaget may offer

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Social Sciences of the National Science Board (Washington, D.C.: Government Printing Office, 1969), p. 18.

[20]Peter B. Pufall and Robert E. Shaw, "Analysis of the Development of Children's Spatial Reference System," Cognitive Psychology, 5:153, September, 1973.

[21]Cooke, p. 9.

[22]John Eliot, "Some Research Possibilities," Journal of Geography, 71:204, April, 1972.

a foundation for curricular change in the area of map skills instruction. Eliot believed that Piaget's research had "provided educators with several behavior clues with which to bridge the distance between intellectual growth and curriculum."[23] In the past, curricular revision based on Piaget's theories has emphasized the cognitive stages of development. Recent examinations of Piaget's theories, however, has brought a new focus on the process by which children move from stage to stage rather than on the stages. Tomlinson-Keasey stated the difference in focus this way:

> Piaget has never intended to place stages in that kind of spotlight. Stages are more properly seen as heuristic descriptions of structures that emerge as the child interacts with the environment. They are, in a sense, a by-product of the ongoing processes of assimilation, accommodation and equilibration.[24]

This study was designed to help make better application of Piaget's theories to map skills instruction. The most important contribution to map skills instruction from the learning theory of Piaget may be in the suggestions generated from his theories about how children grow in their cognitive reasoning or make the transition between developmental stages. The focus of this study was on how Piaget's criteria for intellectual growth can be applied in teaching selected map skills.

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[23]John Eliot, "Children's Spatial Visualization," Focus on Geography: Key Concepts and Teaching Strategies, ed. Phillip Bacon (Washington, D.C.: National Council for the Social Studies, 1970), p. 268.

[24]Carol Tomlinson-Keasey, "Structures, Functions and Stages: A Trio of Unresolved Issues in Formal Operations," Jean Piaget: Consensus and Controversy, eds. Sohan Modgil and Celia Modgil (New York: Holt, Rinehart and Winston, 1982), p. 144.

Purpose of the Study

The purpose of this study was to (1) identify criteria, based on Jean Piaget's theories of cognitive development, which facilitate the transition between stages of development; and, (2) suggest activities for teaching selected map skills which demonstrate characteristics of these criteria.

Significance of the Study

This study is significant because of the suggestions it makes concerning the application of Piaget's theories to map skills instruction. The work of Piaget, as applied to map skills instruction, has remained in the theoretical description of how children develop spatial understanding with little direct application to the instruction of children. This study offers suggestions for activities, based on Piaget's learning theory, that can serve as a model for educators who want to present map skills in such a way as to better facilitate the intellectual development of students. As a model, the activities may be generalized for use with other curricular areas. For those educators who teach map skills in the elementary school, the activities provide an alternative to the traditional approach to teaching these skills.

Definition of Terms

1. Criteria: Different categories of experiences that bring about transition between stages according to Piaget's theory. The criteria

used in this study were concrete experiences, social interaction and exploration. A fourth criterion is physical maturation.

2. Map Skills: Those skills which allow one to interpret correctly the information found on maps. For the purpose of this study, four skill areas were used: direction, location, scale and symbols.

3. Stages of Cognitive Development: "Identifiable sequential phases in an orderly progression of development that are qualitatively discriminable from adjacent phases and generally characteristic of most members of a broadly defined age group."[25] The stages used in this study were preoperational, concrete and formal.

4. Transition: The movement from one cognitive development level to another brought about by the experiences of the person. Two transitions were considered in this study: from preoperational to concrete and from concrete to formal.

Assumptions

1. Activities for teaching map skills can be developed based on a theory of cognitive development.

2. Presenting map skill activities that are consistent with the learning theories of Piaget is appropriate for instruction in the elementary schools.

3. A panel of experts is an appropriate forum to validate the consistency of the activities to criteria developed from Piaget's learning theories.

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[25]David P. Ausubel, "The Transition from Concrete to Abstract Cognitive Functioning: Theoretical Issues and Implications," Educational

4. The panel of experts used in this study represents a valid sample of experts knowledgeable of Piaget's theories and/or map skill instruction.

Delimitations and Limitations

1. The activities presented in this study relate only to selected map skills.
2. The criteria for conditions which facilitate changes in developmental stages are limited to the interpretation of selected authors who have described the work of Piaget.
3. This study is limited to application of the process for change between developmental stages and does not specifically address learning characteristics within a stage of development.

Design of the Study

This study was divided into three sections: the developmental section (formulation of criteria developed from Piaget's theory, identification of map skills, determination of a panel of experts and development of the research instrument), the data collection section, and the reporting section.

Developmental Section

The criteria were developed through a review of literature which determined the basic elements of Piaget's theory about how children learn in theoretical terms as well as in practical terms. Those statements from the literature which dealt directly with how

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Implications of Piaget's Theory, eds. Irene J. Athey and Duane O. Rubadeau (Waltham, Massachusetts: Ginn-Blaisdell, 1970), p. 48.

movement from developmental stage to stage was achieved provided the basis for the criteria. The map skills used to present the Piagetian criteria were identified through a review of selected literature which addressed the subject of map skills scope and sequence and instruction. From this review, skills common to all the literature were selected for use in this study.

The panel of experts was determined by contacting individuals identified through the literature search as having experience in the application of Piaget's theory to elementary curriculum and/or experience in the consideration of map skills within the context of Piaget's notions about how children learn. These individuals were asked to be panel members and to name up to ten others they were aware of with similar areas of expertise. Those suggested were asked to respond the same way. A total of 50 individuals were contacted and 27 agreed to serve as panel members.

The instrument used with the panel was a matrix which used four map skill areas to describe how the three criteria which lead to the transition from preoperational to concrete and from concrete to formal stages of intelligence are expressed in instruction for children. The instrument was reviewed by Dr. Robert Stoddard and Dr. James Fejfar from the University of Nebraska-Lincoln faculty. Modifications were made based on their observations and suggestions.

Data Collection Section

The data collected for this study were in the form of a consensus of opinion on the part of the panel of experts that the

activities described correctly interpreted Piaget's criteria which lead to the transition from one stage to the other. A modified Delphi method was used to reach consensus with consensus being defined as 80 percent agreement. All new information in terms of comments generated from the instrument were used to modify the activities. These activities were cycled back to the participants until consensus was reached with the second round of responses.

Reporting Section

Following two rounds of correspondence using the data collection instrument, a final report was sent to the panel which described the final results of the modified Delphi. These final results are discussed in Chapters 4 and 5 of this study.

Organization of the Study

The remainder of this study includes a review of the literature (Chapter 2), a description of the design of the study (Chapter 3), a discussion of the findings of the study (Chapter 4) and a summary with conclusions and recommendations (Chapter 5). The topics in the review of literature were map skills instruction in the elementary school, the basic elements of Piaget's learning theory, spatial development and Piaget's theory, and the theory of Piaget as applied to the instruction of children. The design of the study considers how the research instrument was constructed, how the panel of experts was selected and how the data were collected. Chapter 4 presents the panel responses to the activities. Based on the results generated in the

study, the last chapter presents conclusions related to the activities and recommendations for additional study.

Chapter 2

REVIEW OF RELATED LITERATURE

Map skills instruction is prevalent in the education of children and much has been written about how such instruction is to be organized. There has recently been an interest expressed in the literature about how map skills might be sequenced based upon the cognitive development of children. Thus, the developmental theories of Piaget have become an important consideration in the development of map skills in children. Considered in this review of literature were suggestions for map skills instruction in the elementary school and Piaget's theories of cognitive development as they relate to learning by elementary school children.

Map Skills Instruction in the Elementary School

The report of Clyde Kohn and the Evanston Team was reported in the Twenty-Fourth Yearbook of the National Council for the Social Studies. This work was often cited in the literature for its list of skills for map interpretation. The report summarized the map skills as follows:

1. Orient the map and note directions.
2. Recognize the scale of a map and compute distances.
3. Locate places on maps and globes by means of a grid system.
4. Recognize and express relative locations.
5. Read symbols and look through maps to see the realities for which the symbols stand.

6. Correlate patterns that appear on maps and make inferences concerning the association of people and things in particular areas.[1]

Kohn believed that these skills should be presented when the child is mentally capable of understanding a certain concept. He also stated that these skills "should not be conceived as a job to be accomplished wholly in the elementary grades."[2]

A later publication of the National Council for the Social Studies included a discussion of map skills. "Map skills must be taught as and when they are needed by the children" was the basis for suggestions and activities for map reading skills by Witucki. She put special emphasis on the development of the readiness of children for map interpretation.[3] In summary, she suggested that the following skills be emphasized in the primary grades:

1. Learning names of the cardinal directions.
2. Becoming familiar with simple map symbols.
3. Understanding a simple map key.
4. Learning to make a plan of a room.
5. Constructing a map of the neighborhood.
6. Beginning ability to get information from maps.[4]

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[1]Clyde F. Kohn, "Interpreting Maps and Globes," Skills in Social Studies, ed. Helen M. Carpenter (Washington, D.C.: National Council for the Social Studies, 1953), p. 146.

[2]Ibid.

[3]Lillian G. Witucki, "Section Four: Map Reading Skills," Social Studies in Elementary Schools, ed. John U. Michaelis (Washington, D.C.: National Council for the Social Studies, 1962), p. 197.

[4]Witucki, p. 200.

In the middle grades, the following skills were suggested:

1. The use of symbols.
2. The use of the map key.
3. The use of maps to understand climate.
4. The meaning of parallels and their use.
5. Understanding of simple scale.
6. Ability to learn from the maps about the location and distribution of natural and man-made things.[5]

The proper motivation for learning these skills was stressed along with re-teaching and drill.[6]

Maps show certain types of information concerning place and man's relationship with place and space better than any other medium, according to Kennamer. Through an understanding and use of this information, one develops a sense of place and space useful for studying the facts of geography, history and economics.[7] The information which is best presented on maps is: location; size and shape of an area or of a feature; distance; elevation and surface; distribution of natural and cultural features; visualization of areas and patterns; relationships; inferences; interest and change.[8] Kennamer saw the following ideas about globes as basic to map skills: (a) only the globe truly represents the surface of the earth, (b) the globe must be understood by

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[5]Witucki, p. 203. [6]Witucki, p. 198.

[7]Lorrin Kennamer, "Developing a Sense of Place and Space," Skill Development in Social Studies, ed. Helen McCracken Carpenter (Washington, D.C.: National Council for the Social Studies, 1963), p. 153.

[8]Kennamer, p. 150.

children before maps of large areas can be understood, and (c) understanding of parallels and meridians is dependent upon global studies. The function of globe skills is to introduce locational concepts and teach earth movements and relationship to the solar system.[9]

Kennamer further stated that map skills should be presented in a systematic way at a time when the child needs to consult a map for a specific purpose.[10] He saw the following skills, each of which has a developmental aspect, as basic to map understanding:

1. Read direction.

2. Read and use latitude and longitude for locational purposes.

3. Measure distance by use of scale.

4. Recognize and express relative locations.

5. Recognize, interpret, and translate map symbols into reality.

6. Orient a map.

7. Understand merits and demerits and particular uses of different map projections.

8. Use and understand common geographical terms.

9. Correlate patterns that appear on maps and make inferences concerning the association of people and things in particular areas.

10. Understand and use correctly a variety of different types of maps.

11. Interpret and use map legends.

12. Observe landscape phenomena thoughtfully.

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[9]Kennamer, p. 152. [10]Kennamer, p. 156.

13. Relate maps of different scales.

14. Read descriptive facts about the landscape from regional maps and world distribution maps and interpret their significance.[11]

It was the belief of Kennamer that the skills should be taught at all levels of education from kindergarten through college.[12]

Based on his review of research in map and globe skills instruction, Rushdoony drew conclusions about pre-1960 map skills programs and proposed a gradation of map skills based on research from 1960-1965. Prior to 1960, research findings indicated that (a) there was a grade-to-grade progression in children's ability to read maps, (b) the errors and misconceptions from map reading were in part the result of a lack of systematic instruction in map reading, and (c) there seemed to be more of an emphasis on what had been learned rather than on what children could learn through systematic instruction.[13] The gradated map-reading skills program was built around the following skills: size and shape, orientation and direction, location, distance, symbols on maps and globes, and map inferences.[14]

In a presentation of the map skills program of the Wisconsin Design for Reading Skill Development, Askov and Kamm provided a developmental framework for these skills. This program was based on the assumption that "map skills can best be learned through systematic

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[11]Kennamer, p. 157. [12]Kennamer, p. 168.

[13]Haig A. Rushdoony, "A Child's Ability to Read Maps: Summary of the Research," Journal of Geography, 67:214, April, 1968.

[14]Rushdoony, pp. 215-218.

study of interrelated skills rather than through the incidental presentation of isolated skills."[15] Their program provided for instruction in three strands of map skills: representation, location, and measurement.[16]

Suggestions for the inclusion of map skill instruction in elementary social studies textbooks resulted from the study of three textbook series by Hawkins. In his study, Hawkins found four common elements to all three series:

> 1. Heavy concentration on the skills for locating specific places, identifying map and globe terms, and using the map key to translate symbols and get information.
>
> 2. Almost complete omission of materials on using a map grid in finding directions, finding specific locations on a grid, using maps to determine direction of water flow, and using longitude to compute time differences.
>
> 3. Emphasis on using the map key to translate symbols and get information rather than on using maps to infer, predict, or draw conclusions.
>
> 4. General lack of attention to maintaining skills from grade to grade after their introduction.[17]

In light of these common elements, he called for less emphasis on identification or recall of places and more emphasis on skills which can be transferred in the use of maps. He also believed that textbook authors should pay careful attention to the progression of skills.[18]

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[15]Eunice N. Askov and Karlyn Kamm, "Map Skills in the Elementary School," The Elementary School Journal, 75:117, November, 1974.

[16]Askov and Kamm, p. 117.

[17]Michael L. Hawkins, "Map Reading Skills in Elementary School Textbooks," Journal of Geography, 76:263, December, 1977.

[18]Hawkins, "Textbooks," p. 264.

A later article by Hawkins developed the rationale that map skills are best learned "through an integration of map and globe activities, content and the youngsters' observations of the world about them."[19] Hawkins expanded this idea further when he distinguished between two approaches to teaching map skills. One approach was a systematic presentation of a well-defined sequence of map skills and prerequisites. The second approach introduced map skills as they were needed.[20] In terms of specific map skills instruction, Hawkins saw the primary grades as emphasizing the immediate world of the child, with the instruction becoming less child centered and more skill and content oriented in the intermediate grades.[21] He also stressed the importance of map making in the child developing the ability to understand the information found on maps.[22]

Stoltman identified a four stage sequence in map reading skills which progressed from the simple to the complex. The first stage, which includes the ability to perceive dots, lines, shades and patterns, is described as visualization of the symbols on a map. In the second stage, the child is able to relate the symbols to what they actually represent. The third stage is reached when the child is able to perform the simple mental operations which lead to pattern and relative location recognition. The use of scale to compare

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[19]Michael L. Hawkins, "Teaching Map Skills in the Elementary Schools," Indiana Social Studies Quarterly, 32:33, Winter, 1979, 80.

[20]Hawkins, "Teaching Map Skills," p. 34.

[21]Hawkins, "Teaching Map Skills," p. 36.

[22]Hawkins, "Teaching Map Skills," p. 34.

distances is evidence that a child has reached the fourth stage. An ability which results when these four stages are reached is that of inference.[23] These skills, Stoltman maintained, are very similar to the intellectual development of the child.[24]

Maps and globes used to reinforce the teaching of people and places in a passive manner was a concern in Chiodo's review of map skill instruction. This type of teaching of map skills tended to overemphasize description to the exclusion of a focus on these skills as a part of a problem-solving instructional approach.[25] Chiodo advocated five specific skills: size and shape, orientation and direction, location, scale and distance, and symbols. He believed these should be presented "concretely" based upon the child's experiences. In dealing with the abstractness of maps, he said, "Effectively using the students' own realm of experiences can help them understand and discover the basic ideas."[26]

Bacon identified five basic map skills: location, distance, scale, symbol and projection. He expressed these skills with the questions: "Where is it?, How far is it?, How big is it?, What is it?, and How can a round Earth be shown on a flat piece of paper?".[27]

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[23]Joseph P. Stoltman, "Geographic Skills in the Early Elementary Years," Indiana Social Studies Quarterly, 32:29, 30 Winter, 1979, 80.

[24]Stoltman, "Geography Skills," p. 31.

[25]John J. Chiodo, "New Directions for Map and Globe Skills," Curriculum Review, 19:85, February, 1980.

[26]Chiodo, p. 86.

[27]Phillip Bacon, "Geography," Teacher, 98:45, October, 1980.

He also felt that these skills were closely related to the computational skills of children and should be systematically incorporated into the social studies program.[28]

In their discussion of map skills instruction, Welton and Mallan stressed the similarity of the functions for understanding information found on maps and the decoding skills required in reading instruction. As a result, they called for activities which would help children to map their own observations to assist in their understanding of the one-to-one correspondence of a map.[29] They also emphasized the importance of the child understanding the "bird's-eye" view nature of maps. The initial map-making activities of the child would incorporate both of these notions.[30] Welton and Mallan further emphasized the importance of the skills involved in using scale and longitude and latitude. It was their opinion that both of these skills should be closely coordinated with math instruction.[31]

The most comprehensive listing of a scope and sequence of map skills was found in the 1963 Yearbook of the National Council for the Social Studies. This listing of skills was a part of a section entitled "Skills Which Are the Major Responsibility of the Social Studies."[32] The map skills section was organized around these skills:

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[28]Bacon, p. 45.

[29]David A. Welton and John T. Mallan, Children and Their World (Boston: Houghton, Mifflin Company, 1981), pp. 257, 258.

[30]Welton and Mallan, p. 259. [31]Welton and Mallan, p. 267.

[32]Eunice Johns and Dorothy McClure Fraser, "Social Studies Skills: A Guide to Analysis and Grade Placement," Skill Development

orient the map and note direction, locate places on maps and globes, use scale and compute distances, interpret map symbols and visualize what they represent, and compare maps and draw inferences.[33] In the preface to the chart the authors stated: "Almost no research evidence exists to guide the proper placement of skill instruction."[34] It was the desire of the authors that their guide would stimulate additional research.[35]

A recent publication prepared jointly by the National Council for Geographic Education and the Association of American Geographers established suggested guidelines for geographic education in elementary and secondary schools. In the suggestions for geography in the elementary school, map skill objectives were given for specific grade clusters. For kindergarten through second grade, the child should know and use relative terms for location, direction and distance, recognize a globe as a representation of the earth, understand that models and symbols represent real things, use simple classroom maps, give and follow verbal directions, know the difference between water and land symbols, and relate location on a map or globe to a real location on Earth. During kindergarten through second grade the child should also be asked to interpret map symbols by using a legend, locate his/her community, state and nation on a map and compare maps

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in Social Studies, ed. Helen McCracken Carpenter (Washington, D.C.: National Council for the Social Studies, 1963), p. 311.

[33]Johns and Fraser, pp. 323-325. [34]Johns and Fraser, p. 312.

[35]Ibid.

and pictures of the same area.[36] During grades three and four the child should be asked to use distance, direction, scale and symbols, use maps of different scales and themes, recognize the nature of a map grid system, and locate major geographical features on a map.[37] During grades five and six, the child should be asked to recognize the relationship of maps and globes, work with latitude and longitude, use maps to show data, map trade routes, and recognize distance, direction, scale and map symbols.[38] The authors of these guidelines further emphasized that instruction should also be based on "our knowledge of stages of children's cognitive, psychological and social development."[39]

The review of literature on map skills instruction in the elementary school revealed the static nature of such instruction during the past 30 years. The list of skills remained static due to the unvarying nature of educational objectives for map reading. The basic purpose of studying map skills did not change considerably over the past three decades. There was, however, an ever increasing awareness of the importance of the intellectual readiness of the learner. The following four skill areas were listed by the majority of those who suggested map skills in the literature: direction, scale, location, and symbols. These were used in the development of activities used in the research instrument of this study. A matrix which shows the skill areas included in the literature is found in Appendix A.

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[36]Salvatore J. Natoli and others, Guidelines for Geographic Education (Washington, D.C.: Association of American Geographers, 1984), pp. 11, 12.

[37]Natoli, pp. 13, 14. [38]Natoli, pp. 15-17. [39]Natoli, p. 11.

Elements of Piaget's Theory

Much has been written about the learning theories of Jean Piaget and their application to the education of children. Piaget left the application of his theories to the education of children to those who have studied his notions about how children develop intellectually. As students of Piaget suggested ideas which had application to education, the professional education community sought to apply these ideas to specific curriculum areas. This section of the review examines the perceptions of those who studied the theories of Piaget to determine the important elements of his theories and how they impact on the education of children.

Stages

Piaget viewed the intelligence of the child as passing through several stages or levels with each characterized by a system or method of viewing the environment. Transition from one stage to another was viewed as taking place when the child became aware of the inadequacies of one system or stage and saw the potential another method offered.[40] A consensus of the stages and ages follows:

Sensory Motor (Birth to 2 years old)

Preoperational (2 years old to 7 years old)

Concrete Operations (7 years old to 12 years old)

Formal Operations (12 years old and older)

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[40]Robert G. Underhill, Teaching Elementary School Mathematics (Columbus: Charles E. Merrill Publishing Company, 1972), p. 5.

Labinowicz describes the first two stages as being "preparatory, prelogical stages" and the last two stages as being "advanced, logical thinking stages."[41]

While there is basic agreement of the authorities on the characteristics of Piaget's stages of learning, there are several factors mentioned which determine the stage a child would be functioning in at a given age. Ausubel listed some of those factors as culture, subject area, relevant experiences and difficulty of concept.[42] He further stated that acceleration takes place in the stage of the child and does not bring about skipped stages.[43] The following sections summarize the stages as they were presented in the literature.

Sensory motor stage. According to Piaget, the child begins to develop intellectually through sensory interaction with the environment. The child is able to discover the makeup of the environment by seeing, listening, touching and tasting. According to McCartin, as the environment is explored, the child begins to develop ideas about "space, time, matter, causality and develop the notion of the permanence of an object."[44] The child is able to perceive the way things are in

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[41]Ed Labinowicz, The Piaget Primer (Menlo Park, California: Addison-Wesley Publishing Company, 1980), p. 60.

[42]David P. Ausubel, "The Transition from Concrete to Abstract Cognitive Functioning: Theoretical Issues and Implications," Educational Implications of Piaget's Theory, eds. Irene J. Athey and Duane Rubodeau (Waltham, Massachusetts: Ginn-Blaisdell, 1970), p. 49.

[43]Ausubel, p. 53.

[44]Rosemarie McCartin, "The Cognitive and Affective Learning of Children," Focus on Geography: Key Concepts and Teaching Strategies

reality by direct overt action with the environment.[45]

Preoperational stage. The second stage in the development of cognition was described by Piaget as preoperational because the child is unable to complete mental operations.[46] This stage is characterized by the beginning of symbolic and intuitive thought. As the child progresses through this stage, he/she develops the capacity to represent an object or event through mental images and words.[47] Through trial and error, the child learns intuitively correct relationships. The relationships, however, are limited by the inability to take more than one attribute into account at a time.[48] In reviewing Piaget's description of this stage, Labinowicz stated that it is a period of deferred imitation and symbolic play. Both of these actions call for a form of recall or imitation on the part of the child.[49] He further stated that Piaget presented this as being a time for the emergence and rapid development of language.[50] Building upon Piaget's observations,

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ed. Phillip Bacon (Washington, D.C.: National Council for the Social Studies, 1970), p. 233.

[45]Kathleen G. Cooke, "The Relationship Between Spatial Cognitive Developmental Levels and Achievement of Map Skills" (Ph.D. dissertation, New York State University--Albany, 1978), p. 22.

[46]Rodger W. Bybee and Robert B. Sund, Piaget for Educators (Columbus: Charles E. Merrill Publishing Company, 1982), p. 72.

[47]Richard W. Copeland, How Children Learn Mathematics: Teaching Implications of Piaget's Research (New York: Macmillan Publishing Company, Inc., 1979), p. 21.

[48]Mary Ann Spencer Pulaski, Understanding Piaget (New York: Harper and Row Publishers, Inc., 1971), p. 208.

[49]Labinowicz, p. 67. [50]Labinowicz, p. 69.

Underhill stated that the following characteristics were exhibited during the preoperational stage:

1. Seeing only one point of view (egocentrism)
2. Focusing on one attribute (centration)
3. Cannot easily retrace successive steps
4. Unstable equilibrium
5. Thought limited to concrete experiences
6. Laxity in relating events causally[51]

The preoperational stage of Piaget's theory was summarized as being the development of the "ability to represent action through thought + language."[52]

Concrete operational stage. As the child continues to develop intellectually, he begins to solve problems through logical thought, according to Piaget. While the child is increasingly able to recall past experiences and things physically absent, his thinking focuses on concrete things rather than ideas.[53] Stated another way, Ault said "the concrete operational child cannot divorce himself from the objective world and think about hypothetical propositions."[54] An important development during this stage is a "mobility of thought" which makes it possible for the child to move back and forth between

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[51]Robert G. Underhill, Teaching Elementary School Mathematics (Columbus: Charles E. Merrill Publishing Company, 1972), p. 6.

[52]Labinowicz, p. 60. [53]Labinowicz, p. 86.

[54]Ruth L. Ault, Children's Cognitive Development (New York: Oxford University Press, 1977), p. 72.

his own viewpoint and that of the other person.[55] Bybee and Sund characterized this stage as being one in which children are in transition. They described the transition in terms of three levels:

> The first level is one of direct physical action on objects without mental representation of the actions. At the second level, children are able to mentally represent aspects of the problem but cannot conceptualize the entire problem: they are not able to work with a definite approach. At the third level the student is able to conceptualize the entire problem and demonstrates a reasoning strategy as long as she actually has the materials or objects of the problem.[56]

Sinclair summarized this stage as a preparation for the stage of powerful formal operations which follow.[57]

Formal operational stage. The final stage of Piaget's theory of intelligence, formal operational, is characterized by the ability of the child to reason beyond concrete reality. When a child considers the possibilities for thinking, the solution based on physical reality is only one possibility to be considered along with verbal statements and propositions.[58] Pulaski called this "the ability to reason from a hypcthesis to all its conclusions, however theoretical."[59] When this level is reached, Underhill concluded, the child formulates all

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[55]John L. Phillips, Jr., Piaget's Theory: A Primer (San Francisco: W. H. Freeman and Company, 1981), p. 120.

[56]Bybee and Sund, p. 99.

[57]Hermine Sinclair, "Piaget's Theory of Development: The Main Stages," Critical Features of Piaget's Theory of the Development of Thought, ed. Frank B. Murray (New York: MSS Information Corporation, 1972), p. 76.

[58]Labinowicz, p. 86. [59]Pulaski, p. 208.

possibilities to solving a problem and through "experimentation and logical analysis" is able to determine which are true or real solutions.[60] Most educators in upper elementary, middle and junior and senior high schools will encounter students demonstrating patterns of reasoning that have both concrete and formal elements.[61]

Equilibration

In his explanation of how children learn, Piaget turned to his understanding of the biological adaptation between the organism and the environment. Within this context, he viewed intellectual development as one of the "processes of total organic functioning" which tend toward self-regulation or equilibrium.[62] Bybee and Sund explained the role of equilibrium in intellectual development as follows:

> Intellectual development is an adaptation in response to a discrepancy between the existing cognitive structure and a cognitive referent in the environment. The discrepancy results in a disequilibrium which produces a reconstruction that brings the system back to equilibrium.[63]

The process of equilibration formed the basis for the explanations in the literature about how children move from stage to stage as they develop intellectually.

In Fischer's description of equilibrium, the concepts of assimilation and accommodation were presented:

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[60]Underhill, p. 7.

[61]Rodger W. Bybee and Robert B. Sund, Piaget for Educators (Columbus: Charles B. Merrill Publishing Company, 1982), p. 135.

[62]Ed Labinowicz, The Piaget Primer (Menlo Park, California: Addison-Wesley Company, 1980), pp. 155, 156.

[63]Bybee and Sund, p. 195.

> Assimilation means action of the organism on surrounding objects. Accommodation means action of the environment on the organism. If the assimilation is much stronger than the accommodation, we observe an egocentrism. If accommodation is too strong, we have an excessive imitation. This equilibrium is never stable and we need new adaptations.[64]

The processes of accommodation and assimilation were seen by Bybee and Sund as being components of the process called adaptation. They used adaptation to describe the "tendency of an organism to adjust to the environment" with development resulting from continuous adaptations. Within this context, assimilation was seen as the attempt of the organism to explain reality against the background of what currently makes sense. Accommodation was seen as the operation by which the cognitive structure is changed to embrace new information.[65] Ault's interpretation of these processes was that they occur simultaneously whenever the child "adapts to an environmental stimulus" with the particular balance between assimilation and accommodation varying from situation to situation.[66] Adaptation, as understood by Underhill, must be present or assimilation and accommodation result in disequilibrium.[67] It is equilibration and the accompanying processes which lead to the development of intelligence at higher levels.

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[64]Hardi Fischer, "The Psychology of Piaget and Its Educational Application," Educational Implications of Piaget's Theory, eds. Irene J. Athey and Duane Rubodeau (Waltham, Massachusetts: Ginn-Blaisdell, 1970), p. 254.

[65]Bybee and Sund, p. 36.

[66]Ruth L. Ault, Children's Cognitive Development (New York: Oxford University Press, 1977), pp. 19, 20.

[67]Robert G. Underhill, Teaching Elementary School Mathematics (Columbus: Charles E. Merrill Publishing Company, 1972), p. 4.

Factors for Transition

Several factors which promote transition from one stage to another are connected by the concept of equilibration. The importance of these factors was stated by Almy:

> The heart of Piaget's theory, however, lies not in the elements so far discussed . . . but in its dynamics, the factors involved in the transitions from one level of development to the next.[68]

Almy called these factors "maturation, experience of the environment and action of the social environment."[69] Labinowicz cited physical experiences, social interaction and maturation as factors which move the child to higher cognitive levels.[70] The factors of physical maturation, natural experiences and formal education were listed by Bybee and Sund.[71] Underhill noted the factors of maturation of the nervous system, experience and peer interaction.[72] Maturation is a factor which is influenced more by biological considerations than the educational climate. However, the education process can include the factors of physical experiences with the environment and social interaction. These two factors along with the suggestion that the physical experiences be exploratory in nature provided the criteria which promote transition between stages of development.

Concrete experiences. The notion that learning develops through

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[68]Milly Almy, "The Impact of Piaget on Early Childhood Education," The Impact of Piagetian Theory, ed. Frank B. Murray (Baltimore: University Park Press, 1979), p. 174.

[69]Almy, p. 175. [70]Labinowicz, p. 224.

[71]Bybee and Sund, p. 33. [72]Underhill, p. 4.

interaction with the content in a physical way was paramount to several applications of Piaget's theories to instruction. Piaget and Duckworth stated that "students need to have objects in front of them that are easy to handle, or else visualize objects that have been handled and that are easily imagined without any real effort."[73] Eliot maintained that "initial knowledge of objects and their relationship" is brought about through action upon these objects.[74] Concrete experiences may also be a description of overt action such as the student imitating behavior, directed play and directed projects.[75] Learning was further explained by Piaget as a practice of something or acting out behavior according to Good and Brophy. They further stated that Piaget felt that "the most important part of learning is our tendency to observe and conceptualize our own activities or behavior."[76]

In support of the notion that concrete experiences are needed throughout the elementary school, Underhill said that the starting point of all new learning should be the physical world and the attention given to concrete experiences should vary only in the amount of concrete

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[73]Jean Piaget and Eleanor Duckworth, "Piaget Takes a Teacher's Look," Learning, 2:22, October, 1973.

[74]John Eliot, "Children's Spatial Visualization," Focus on Geography: Key Concepts and Teaching Strategies, ed. Phillip Bacon (Washington, D.C.: National Council for the Social Studies, 1970), p. 271.

[75]John R. Bergan and James A. Dunn, Psychology and Education: A Science for Instruction (New York: John Wiley and Sons, Inc., 1976), p. 92.

[76]Thomas L. Good and Jere E. Brophy, Educational Psychology: A Realistic Approach (Chicago: Holt, Rinehart and Winston, 1977), p. 267.

experiences for a given age or level. These experiences can, therefore, serve as a beginning for development of the next stage.[77] The physical manipulation of objects is appropriate for the introduction of unfamiliar subject matter regardless of the level of cognitive development. Ausubel said that an individual tends to function at a "concrete-intuitive" level when he encounters new concepts even though he/she may generally function in a more abstract mode of cognitive functioning. The reliance on concrete experiences is short lived, however, because he/she possesses the ability "to draw on various transferable elements of his more general ability to function abstractly."[78] To this end, Labinowicz expressed the notion that it is possible to use concrete materials to teach abstract concepts at the child's current level of development.[79]

The literature also addressed the notion that instruction should provide for the transformation of overt actions into mental operations. The process was described by Hilgard and Bower in the following way:

> Hence, all teaching should stress pupil initiative, an active experimentation with the environment in which overt actions gradually become translated into mental operations, with the consequence that eventually less support is needed from external objects.[80]

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[77]Underhill, p. 9.

[78]David P. Ausubel, "The Transition from Concrete to Abstract Cognition Functioning: Theoretical Issues and Implications," Educational Implications of Piaget's Theory, eds., Irene J. Athey and Duane Rubadeau (Waltham, Massachusetts: Ginn-Blaisdell, 1970), p. 51.

[79]Ed Labinowicz, The Piaget Primer (Menlo Park, California: Addison-Wesley Publishing Company, 1980), p. 165.

[80]Ernest R. Hilgard and Gordon H. Bower, Theories of Learning

Underhill described this as "an appropriate instructional sequence" which takes the students on a "concrete-to-abstract continuum."[81] Flavell stated that the teacher's role in this process was to "assist this internalization and schematization process in the classroom by getting the student to perform the requisite action with progressively less and less support from the external givens."[82]

Social interaction. Another criterion in the application of Piaget's learning theory to instruction and which leads to transition is that children need peer interaction to move away from an egocentric point of view. Flavell found this emphasis in a review of Piaget's writings. In these writings, Flavell found peer interaction to be "the principle vehicle by which the child is liberated from his egocentrism." An application of this for instruction, mentioned by Flavell, was to plan for the discussion of overt actions and experiences.[83] Kamii stated that Piaget believed that other children at similar cognitive levels can often help the child move more easily out of egocentric thought processes than the adult.[84] This idea was further supported

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(Englewood Cliffs, New Jersey: Prentice-Hall, Inc., 1975), p. 340.

[81]Robert G. Underhill, Teaching Elementary School Mathematics (Columbus: Charles E. Merrill Publishing Company, 1972), p. 8.

[82]John H. Flavell, The Developmental Psychology of Jean Piaget (Princeton, New Jersey: D. Van Nostrand Company, Inc., 1965), p. 368.

[83]Flavell, p. 369.

[84]Constance Kamii, "Pedogogical Principles Derived from Piaget's Theory: Relevance for Educational Practice," Piaget in the Classroom, eds., Milton Schwebel and Jane Raph (New York: Basic Books, Inc., Publishers, 1973), p. 200.

by Labinowicz's application of Piaget's theory:

> The teacher would allow children to talk to each other, and organize verbal encounters so that children involved in a common activity could share their points of view. A real exchange of thoughts and discussion would inevitably lead children to justify explanations, verify facts, resolve contradictions, or adjust attitudes. The awareness that other children share viewpoints different from their own plays an important role in getting children (or other learners) to rethink their ideas and adjust (accommodate) them to reach a more coherent level of understanding.[85]

Labinowicz also called for the use of activities which allow students to work cooperatively with physical materials to help them decenter their thinking processes.[86]

Stendler-Lavatelli developed the concept of cognitive dissonance within the context of peer interaction. The concept pursues the notion that feedback from a child's peer which is different upsets the views of the child based on the sensual evidence. The challenge to the egocentric viewpoint of the child makes him more receptive to other "cues" that aid cognitive development.[87]

Exploration. Guided and unguided exploration by the student was a third criterion in the application of Piaget's theory to education which leads to transition. The purpose of exploration is to create a situation in which the students acquire a natural equilibrium. Kamii said, "It is often said the child learns more through direct experience, and that he learns even more if this experience is

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[85]Labinowicz, p. 214. [86]Labinowicz, p. 173.

[87]Celia Stendler-Lavatelli, Piaget's Theory Applied to an Early Childhood Curriculum (Boston: American Science and Engineering, Inc., 1970), p. 122.

discovered rather than being offered."[88] The activities are designed so that students will have experiences that lead to later conceptual understanding. The teacher's role in his process is that of a facilitator who "sets up situations, activities and demonstrations that will allow the students to learn through their own physical and mental activity."[89] Brainerd stated the role of teachers as being the adoption of "pedagogical strategies designed to make children aware of conflicts and inconsistencies in their belief."[90]

An essential part of the exploration of children to bring about transition between stages is the necessity for the child to be exposed to experiences which are challenging and which "lead to conflicting conclusions regarding phenomena in the environment."[91] Giving the child exposure to problem situations slightly beyond his/her current level of development was a suggestion of Bybee and Sund.[92] Labinowicz discussed the possibility of providing concrete materials that are challenging to children regardless of the level of development.[93] The activities presented by the teacher for exploration should

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[88]Kamaii, p. 207.

[89]Rodger W. Bybee and Robert B. Sund, Piaget for Educators (Columbus: Charles B. Merrill Publishing Company, 1982), p. 207.

[90]Charles J. Brainerd, Piaget's Theory of Intelligence (Englewood Cliffs, New Jersey: Prentice-Hall, Inc., 1978), p. 280.

[91]John R. Bergan and James A. Dunn, Psychology and Education: A Science for Instruction (New York: John Wiley and Sons, Inc., 1976), p. 94).

[92]Bybee and Sund, p. 207. [93]Labinowicz, p. 165.

aim for a level of difficulty or uniqueness which requires a change in the thinking pattern of the students in terms of some accommodation or restructuring.[94]

Spatial Development

Encompassed in Piaget's discussion of intellectual development was his theory about how children develop spatial understanding. The ability to conceptualize space is a late development in the sequential spatial development of a child according to Piaget.[95] This part of the literature review focuses on selected research on the stages of spatial understanding, the effect of egocentrism on spatial understanding, the use of a reference system, the relationship which exists between spatial cognitive levels and levels of achievement of students in map skills and concepts, and the development of the concept of scale. While the material does not deal directly with the main focus of this study, the application of this research will be important to future developments in map skills instruction.

Stages of spatial development. Piaget's theory was the basis for Copeland's stages of development related to spatial understanding. Copeland cited two observations based on the child's map making. With regard to a two-dimensional layout, Piaget found that the child first

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[94]Labinowicz, p. 168.

[95]John Eliot, "Children's Spatial Visualization," Focus on Geography: Key Concepts and Teaching Strategies, ed. Phillip Bacon (Washington, D.C.: National Council for the Social Studies, 1970), p. 269.

located objects by using the concepts of proximity and enclosure. The child "begins to develop reference points and locates items by left, right, in front of and behind" during the second stage which occurs between four and seven years of age. In the third stage the child experienced no difficulty mapping the two-dimensional drawing.[96]

The second observation involved the child reproducing a map layout following the pattern of a model. Following the first stage where the child's map showed only crude approximation, the second stage of development was characterized by the ability to locate items while experiencing difficulty due to a lack of a real reference point. The third stage of development saw the child able to locate all positions, but experiencing difficulty in preserving distance between objects. The establishment of correct distances by actual measurements is an ability the child had toward the end of the third stage. Characteristic of the child in the formal operational level of mental development, the child in the fourth stage had the ability to establish abstract coordinates leading to the correct reproduction of the model of a map without concrete measuring devices.[97]

In Stoltman's discussion of his study of territorial relationships, he recounted Piaget's observations about the process children go through as they develop territorial decentration. In the first stage, children showed no logical understanding of the relationship

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[96]Richard W. Copeland, How Children Learn Mathematics: Teaching Implications of Piaget's Research (New York: Macmillan Publishing Company, Inc., 1979), p. 285.

[97]Ibid.

between a hometown and nation although they were aware of both. The second stage is characterized by confusion of the spatial relationship of the hometown and nation with a third territory. In the third stage the child exhibited the correct territorial relationship.[98]

Egocentrism. Piaget described the inability to take another's viewpoint as egocentric thought. Eliot summarized Piaget's views this way.

> Piaget, when he described the child's construction of space in 1956, argued that a child evolved from a perceptually-dominated space to the achievement of a conceptualized space. In elaborating upon his theory of intelligence, he distinguished between a static, perceptual space and a transformable or conceptual space--the latter being achieved when the child discovers that he has a point of view.[99]

Piaget and Inhelder further stated:

> To discover one's own point of view is to relate it to other viewpoints, to distinguish it from and to coordinate it with them. Now perception is quite unsuited to this task, for to become conscious of one's own viewpoint is to liberate oneself from it. To do this requires a system of true mental operations, that is operations which are reversible and which are capable of being linked together.[100]

The egocentric thought process of the child creates problems in spatial understanding. Towler saw the degree of egocentrism as being directly related to map reading ability. He further stated that "the more egocentric a child is, the more difficult it is likely to be for him to understand not only his world, but representations of it as shown

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[98]Joseph P. Stoltman, "Children's Conception of Space and Territorial Relationships," Social Education, 41:142, February, 1977.

[99]Eliot, p. 265.

[100]Jean Piaget and Barbel Inhelder, The Child's Conception of Space (London: Routledge and Kegan Paul, 1956), p. 193.

by maps."[101] Pufall and Shaw described the organization of representational space of the child in terms of a self-reference system while that of the adult is an objective reference system.[102] Egocentric thought is the first attempt of the child to organize relationships which previously had been unordered. At some point the egocentric viewpoint becomes incorporated into an understanding of projective relations.[103] Piaget's contention that "a child cannot coordinate his egocentric viewpoint with other viewpoints into a projective view of space" has been supported by other research.[104] Towler concluded:

> It seems clear that the development of the ability to coordinate perspectives is related to intelligence and chronological ages--progression from egocentrism to an accurate coordination of perspectives does follow a sequential pattern which requires the child to take a series of mental operations into consideration simultaneously and to utilize these relations as an operating system of reference.[105]

Therefore, the child's ability to move out of an egocentric frame of reference seems to be an important development in spatial understanding.

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[101]John Towler, "Egocentrism: A Key to Map Reading Ability," Social Education, 35:898, December, 1971.

[102]Peter B. Pufall and Robert E. Shaw, "An Analysis of the Development of Children's Spatial Reference System," Cognitive Psychology, 5:153, September, 1973.

[103]Pufall and Shaw, p. 153.

[104]Judith M. W. Meyer, "Map Skills Instruction and the Child's Developing Cognitive Abilities," Journal of Geography, 72:28, September, 1973.

[105]Towler, "Egocentrism," p. 897.

Cognitive development and achievement. Research by Cooke sought to see what relationships exist between spatial cognitive development and the level of achievement of students in map skills and concepts. Her study tested the understanding of children of the concept of left and right, the coordination of perspective, and system of reference. Cooke made use of measurement instruments developed by Towler, Laurendeau, and Pinard to ascertain the level of Piagetian cognitive development regarding spatial concepts.[106] The results of her study indicated that the notion of a stratified, or spiral, curriculum consistent with Piaget's theory "allows each learner to interact with the curriculum at the point where the amount of cognitive dissonance promotes learning."[107] The results also supported Piaget's idea that learners at lower levels of cognitive development will not be able to understand and operate with complex concepts as well as children with higher cognitive levels and that instruction does not improve a student's performance if the concept presented is too difficult for the cognitive level.[108]

Reference system. The child who is egocentrically oriented is going to experience difficulty trying to use an objective reference system. Piaget referred to the concepts of vertical and horizontal as he considered the child's development of a system of reference for

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[106]Kathleen G. Cooke, "The Relationship Between Spatial Cognitive Development Levels and the Achievement of Map Skills" (Ed.D. dissertation, State University of New York at Albany, 1978), p. 10.

[107]Cooke, p. 94. [108]Cooke, p. 88.

organizing space. He considered the abilities of conservation of distance and spatial order as prerequisites for understanding a Euclidean reference system.[109]

Pufall and Shaw described Piaget's theory on the child's development of a system of reference. The child in the first stage of this otogenetic cycle designates location by topological relations. The concepts of distance and direction help the child order relations in the second stage. The child is still the origin of the reference system. This developmental change was described this way:

> However, the second stage reference system provides the child with an imperfect representational space since it is lacking in two important respects: it does not coordinate both asymometric axes so as to allow for a recursive application of coordinates, nor does it allow the child to compensate for perspective differences since self is the only reference point around which all coordinate projections can be defined.[110]

The third stage is characterized by the child beginning to discover that other objects can be used as reference points.[111] The mark of the third stage is the development of the child's use of "property intrinsic to the space and these properties are multiplied over themselves."[112] These properties are basically two kinds: (a) perceptually topological features such as color and form; and, (b) abstract geometric relations such as edges, corners and diagonals.[113]

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[109]Celia Stendler-Lavatelli, Piaget's Theory Applied to an Early Childhood Curriculum (Boston: American Science and Engineering, Inc., 1970), p. 122.

[110]Peter B. Pufall and Robert E. Shaw, "An Analysis of the Development of Children's Spatial Reference System," Cognitive Psychology, 5:157, September, 1973.

[111]Ibid. [112]Pufall and Shaw, p. 158. [113]Ibid.

A summary of Piaget's tests to determine the development of an artificial and natural reference system was included in Towler's report of similar testing. In his summary of the artificial axis system, the following stages were indicated:

> Stage I/the tests were ineffectual.
>
> Stage II/(6 years, 2 months to 7 years, 2 months) characterized by a preoccupation with perceptual features without any attempt to use a reference system.
>
> Stage III/(8.3 years to 9.1 years) the subjects began to use a reference system with attempts to consider relative position and location; the subjects did not have the ability to coordinate relative distances and true locations.
>
> Stage IV/(after the age of 12) conventional reference systems are developed by the child and the subjects can compare positions and distances simultaneously.[114]

Regarding the development of a natural axis system, Piaget's study indicated a natural axis system develops in stages beginning at about 3 1/2 years of age and concluding at about the age of eight.[115]

Developing the concept of scale. Another facet of spatial development, the concept of scale, was discussed by Towler and Nelson. Their findings indicated that most children did not develop a concept of scale until about grades five or six.[116] The subjects in the study were classified into Piaget's developmental stages. Those students

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[114]John O. Towler, "The Elementary School Child's Concept of Reference Systems," Journal of Geography, 69:92, February, 1970.

[115]Towler, "Reference Systems," p. 92.

[116]John O. Towler and L. D. Nelson, "The Elementary School Child's Concept of Scale," Journal of Geography, 67:27, January, 1968.

at the Stage I level "appeared to have little or no concept of scale."[117] The Stage II level response showed the child able to grasp the concept but not in such a way as to make application. A third stage response demonstrated a working knowledge of the concept of scale. The results of this study correlated very closely with similar work of Piaget. The ages of the stages were somewhat later than those of Piaget, but close to the findings of others studying the development of the concept of scale in children.[118]

In summary, the cognitive developmental theories of Piaget provide numerous clues and helpful insight into how children learn. This section of the review of literature provided a basis for structuring learning situations for children. Specific to this study were the three criteria of concrete experiences, social interaction, and exploration which help the child make transitions between cognitive levels. Also presented was a sample of the research which considered how a child develops spatial understanding.

Conclusion

The content of the literature reviewed in this chapter indicated that an important consideration in children learning map skills is the cognitive development of the child. The theory of Piaget offered a framework for consideration of cognitive development in teaching map skills from the standpoint of developmental stages, factors which lead to transition between stages, and spatial understanding.

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[117] Towler and Nelson, p. 26. [118] Towler and Nelson, p. 27.

While research continues in the areas of spatial understanding, the suggestions for cognitive growth determined by studying Piaget's theories offer a relevant approach for presenting instruction. The literature appeared to provide a consensus of four map skills upon which numerous subskills can be derived as indicated by the 1963 listing of the National Council for the Social Studies.

Chapter 3

DESIGN OF THE STUDY

The purpose of this chapter is to describe the procedures that were used in this study. The research design consisted of a developmental section and a data collecting section. Central to the developmental section was the review of literature from which map skills were identified, Piagetian criteria were established, and potential panel members for the study were identified. The review of literature was developed from computer searches of journals, educational documents, and dissertations related to the topics. The data were collected by using the Delphi method for reaching agreement. A panel of 27 authorities in the areas of elementary school social studies instruction, map skills instruction and the developmental theories of Jean Piaget decided whether or not map skill activities met Piagetian criteria. The data-gathering instrument consisted of 24 activities and pages for responses. The data collected were used to modify the suggested instructional activities until 80 percent agreement was reached on all activities. A flow chart which displays the research design is presented in Figure 1.

Development

Literature related to map skills instruction was reviewed with an emphasis on what skills were basic to elementary school map skills instruction. The review considered information written in the past

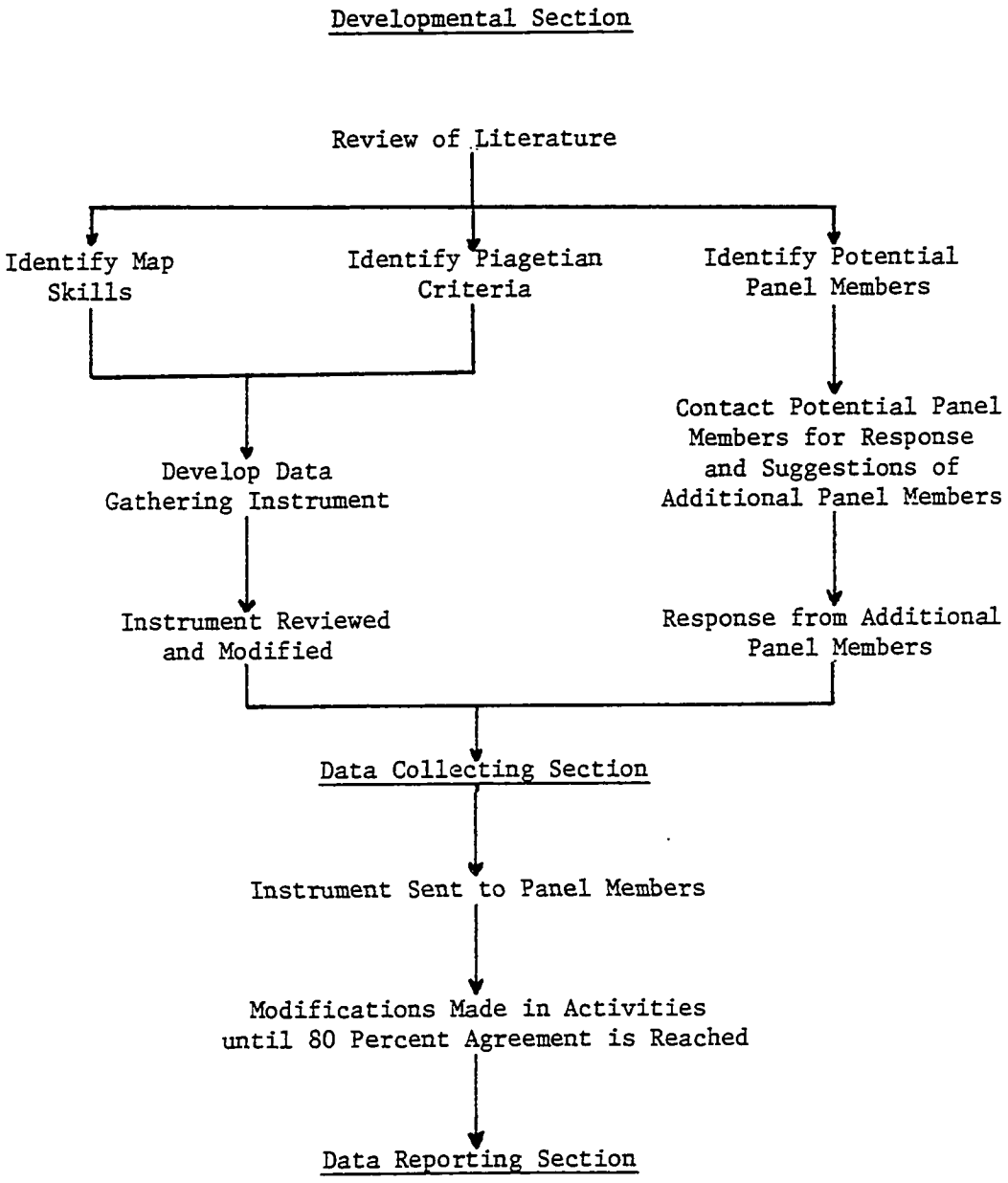

Figure 1

Research Design

30 years beginning with the 1953 report by Clyde Kohn presented in the 24th Yearbook of the National Council for the Social Studies.[1] The material included in this part of the review dealt with the developmental aspects of map skills instruction rather than activities for teaching map skills. Thirteen references were cited in this part of the developmental section of the research. Of these 13 references, 9 proposed map skill areas which should be included in the elementary school map skills program. An analysis in the form of a grid (Appendix A) was made of these 9 references, and it was determined that four broad skills areas included in the majority of the references would be used to develop the activities for this study. The four skills areas are direction, location, scale and symbols. A recent 1984 listing of map skills from the National Council for Social Studies, which included the same four skills areas, is a tenth reference cited on the grid.[2] The sub-skills taken from the 1963 listing of map skills by the National Council for the Social Studies were arbitrarily chosen for the activities in this study because of the specificity of the listing.[3] The sub-skills for each map skill area were chosen as

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[1]Clyde F. Kohn, "Interpreting Maps and Globes," Skills in Social Studies, ed. Helen M. Carpenter (Washington, D.C.: National Council for the Social Studies, 1953), pp. 146-177.

[2]"In Search of a Scope and Sequence for Social Studies, Report of the National Council for the Social Studies Task Force on Scope and Sequence, November 1, 1983," Social Education, 48:260, April, 1984.

[3]Eunice Johns and Dorothy McClure Fraser, "Social Studies Skills: A Guide to Analysis and Grade Placement," Skill Development in Social Studies, ed. Helen M. Carpenter (Washington, D.C.: National Council for the Social Studies, 1963), pp. 323-325.

examples and were not meant to be comprehensive.

Piagetian criteria were determined through a review of the literature related to the basic elements of Piagetian theory as interpreted by educators and psychologists. The time frame for the literature review was from the 1960's to the present time. In the discussions of the elements of Piagetian theory, four criteria which facilitate cognitive growth became apparent. Three of the criteria became the foundation for the educational experiences described in the activities of this study. The three criteria were to provide concrete experiences, to provide social interaction and to provide exploratory experiences. The fourth criterion, physical maturation, was not used as a part of the study since the formal education of a child, in terms of learning experiences, has little impact on this area. In addition to the four criteria which facilitate cognitive growth, the literature presented the elements descriptive of the process which results in the transitions between cognitive stages. From this review, the three criteria and two transitions used in the data gathering instrument were selected.

From the authors of articles used in the review of the literature, an initial group of authorities was identified. These 13 individuals appeared to be knowledgeable in the application of Piaget's theory to elementary school curriculum and/or how this theory can be applied to map skills instruction. The 13 were chosen because of the nature of their writings and research in one or more of these areas. A list of these individuals is provided in Appendix B. Each member of this group was asked to be a part of the panel which would respond to

the activities and to suggest as many as 10 other authorities whom they would recommend for inclusion as panel members. Nine of the 13 responded positively to the request to be panel members, and 10 returned suggestions for other panel members. As a result of these lists, another 37 individuals were contacted and asked to respond in the same manner as the initial group. An additional 18 individuals agreed to serve as panel members to bring the total number to 27. Four of the 18 indicated they would participate after the first round of the Delphi method had been completed. The names of the 27 who agreed to serve as panel members are provided in Appendix B. Examples of the letters sent to prospective panel members are provided in Appendix C. The information provided to the prospective panel members is included in Appendix D.

After the map skill areas were identified and the Piagetian criteria were developed, activities were written to demonstrate the Piagetian criteria by using selected map sub-skills. Twenty-four activities were written and included in a matrix using four broad areas of map skills, three criteria, and two transitions of cognitive development. The two transitions, from preoperational to concrete and from concrete to formal, were selected because these stages represent those in which elementary school children most often are found. For each map skill area (direction, location, scale, and symbols) an activity was written to demonstrate concrete experiences, social interaction and exploration for each transition. The matrix presented six activities for each map skill area. The original activities, found in Appendix E, were reviewed and critiqued by Dr. Robert Stoddard,

Professor of Geography, and Dr. James Fejfar, Professor of Education, at the University of Nebraska-Lincoln. Based on their comments, revisions were made in both the text of the activities and the format. The revisions, which constituted the first draft sent to the panel members, are included in Appendix F.

Data Collection

The Delphi method was used in this study because of the descriptive nature of the product which was produced. The Delphi method is a procedure for reaching consensus in those situations which "do not lend themselves to precise analytical solutions."[4] Once a panel of experts is selected for a study, the members are asked to respond to a particular problem or situation. The responses are collected and feedback is given to the panel members. Each panel member is then asked to revise his or her opinion based upon the feedback given. The responses usually are anonymous. When a stated level of agreement is reached or when responses stabilize, the judgment of the group is reported.[5] The procedure used for this study was based upon a review of material related to the Delphi method as well as other studies using this method.[6] The Delphi process varied from the traditional

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[4]Bernard J. Dodge and Richard E. Clark, "Research on the Delphi Technique," Educational Technology, 17:58, April, 1977.

[5]Dodge and Clark, pp. 58, 59.

[6]A computer search produced descriptions of 23 studies from various curriculum areas which used the Delphi technique. The descriptions provided insights into the process.

method with regard to the anonymity of the panel members. The modification used allowed prospective panel members to suggest other possible panel members. This allowed for a broader base of expertise.

The panel members were asked to respond to activities presented in the data gathering instrument previously described. Directions for completing the response sheet included the questions by which the activities were evaluated. The directions are provided in Appendix G. The first set of activities was mailed to 23 panel members during April and May, 1984. A copy of these activities is provided in Appendix F. Seventeen panel members returned their responses to the first set of activities during May and June, 1984.[7] A summary of the returned data gathering instruments, which includes anecdotal responses, is provided in Chapter 4. The activities were revised during June and July, 1984. The revised set of activities was sent to 26 panel members on July 15, 1984. One of the 27 had declined further participation after the first set of activities was sent out. The revised set of activities is given in Appendix H. The responses from 16 panel members were returned during September, 1984. The responses to this set of activities are provided in Chapter 4.

Consensus at the 80 percent level proved to be an appropriate goal for the data collection section of this study. The panel members

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[7] A review of the use of the Delphi technique reported attrition rates between 38 and 68 percent. Seventeen of 23, or 74 percent, of those who agreed to participate, took part in the first round of the Delphi. Sixteen of 26, or 64 percent, of the panel members participated in the second round. Both percentages fall within the reported attrition rates.

believed that the activities written for direction map skills met the criteria by percentages ranging from 81 percent to 94 percent on the second round of the Delphi procedure. The second round responses also produced agreement levels above 80 percent for the activities using location map skills. The specific percentages ranged from 81 percent to 100 percent agreement. For those activities which provide experiences for understanding scale, second round agreement levels ranged from 88 percent to 100 percent. Finally, agreement ranging from 81 percent to 94 percent was achieved in the second round of the Delphi for the activities for using symbols.

Conclusion

The review of literature and the use of the Delphi method provided the data needed to meet the purpose of this study. The data are presented and discussed in Chapter 4. Chapter 5 provides an additional look at the results as they relate to the findings, discussion and recommendations based on this study.

Chapter 4

PRESENTATION AND ANALYSIS OF THE DATA

The purpose of this study was to identify criteria based on Piaget's theory of cognitive development which facilitate the transition, or movement, between stages of development. These stages, as defined in this study, represent a sequence of distinct phases that are characteristic of an age group of children. The study also suggested activities for teaching selected map skills which demonstrate characteristics of the criteria. The criteria, or those experiences that bring about transition between stages, identified in the review of relevant literature were concrete experiences, social interaction, and exploration. Map skills used in this study were direction, location, scale, and symbols.

Twenty-four activities were validated through a Delphi process which included a panel of authorities in the areas of elementary school social studies instruction, map skills instruction, and the cognitive development theories of Piaget. The members of the panel were asked to draw from their experiences and understanding of Piaget's theories to determine if the map skills activities demonstrated the characteristics of one of the three criteria which bring about transition between cognitive stages. They were also asked to make any comments relative to ways the activities could better reflect the criteria. Two rounds of the Delphi method were needed to reach consensus among the panel members at the stated goal of 80 percent agreement. The remaining

sections of this chapter provide the results and comparisons of the two rounds of the Delphi method. The results are organized by the four map skill areas.

Activities for Teaching Map Skills Related to Direction

With respect to activities for teaching map skills related to direction, the responses of the panel members on the first round of the Delphi method produced agreements ranging from 59 to 82 percent. The second round activities produced agreement above the 80 percent goal on all activities. In the development of the activities for this skill area, the following sub-skills, listed by Piagetian criteria, were used:

> Concrete Experiences: Use Cardinal Directions; Relative Directions; Orient a Map Correctly
>
> Social Interaction: Use Cardinal Directions; Relative Directions; Use a Compass to Determine Direction
>
> Exploration: Relative Directions; Use the North Arrow on the Map

The complete results from both transitions and rounds of the Delphi process are provided in Table 1.

Transition from Preoperational to Concrete/First Round

Concrete experiences. The first map skill activity to demonstrate the criteria of concrete experiences resulted in an agreement level of 82 percent of the panel members. Following is the activity as it was sent to the panel members in the first round of the Delphi method:

Table 1

Responses of Panel Members to Map Skill Activities Related to Direction

Transition: Preoperational to Concrete

Criteria	Round of responses	Criteria met	Criteria not met	Other responses	Percentage of agreement	Number of anecdotal responses
Concrete Experiences	1	14	1	2	82%	8
	2	13	3	0	81%	8
Social Interaction	1	10	5	2	59%	5
	2	15	1	0	94%	4
Exploration	1	11	3	3	65%	9
	2	15	1	0	94%	4

Transition: Concrete to Formal

Criteria	Round of responses	Criteria met	Criteria not met	Other responses	Percentage of agreement	Number of anecdotal responses
Concrete Experiences	1	13	2	2	76%	5
	2	15	1	0	94%	4
Social Interaction	1	14	2	1	82%	4
	2	14	2	0	88%	4
Exploration	1	13	3	1	76%	5
	2	15	1	0	94%	5

Map Skill: Direction
Transition: Preoperational to Concrete
Piagetian Criterion: Concrete Experiences
Sub-skill: Relative Directions

The student is asked to position himself at a point in the room and determine a direction to face. The student is asked to name objects and/or people in the room. The student is given the relative terms right and left. Using these terms, the student expresses the relative location of the objects and/or people in relation to himself. On a poster-board size map of the room, the teacher can write in the relative direction of the objects and/or people to the student as the student states those directions.

As displayed in Table 1, 14 panel members agreed that the activity met the criterion of providing concrete experiences. One respondent believed the criterion was not met and two did not make a "YES" or "NO" response. Eight comments were made to explain the "YES" and "NO" responses. These anecdotal responses were as follows:

I do not understand last sentence. The rest of the objective would fit. I can't understand what the teacher would write . . . "writes in the relative direction?"

Have students do the "writing" or "drawing."

Omit the final sentence or add "those relative directions."

Give an example of a point in the room.

"Determine a direction to take. . . ." Do they name it or just face somewhere! Otherwise OK.

"To the students" in the last line . . . somewhat confusing.

I'm not sure that the use of the poster-board map will help at this point.

Language per se is confounding variable. Why not have child construct landscape map and score for accuracy of direction.

Social interaction. Data presented in Table 1 display that 59 percent of the panel members concluded that the following first round

activity met the criterion of providing social interaction.

> Map Skill: Direction
> Transition: Preoperational to Concrete
> Piagetian Criterion: Social Interaction
> Sub-skill: Use Cardinal Directions
>
> Prepare four cards each for several groups of four with each group having a different color. Each color should have a card which corresponds to one of the cardinal directions. Hand the cards out randomly and have the students gather in groups by color. After they are in groups, ask them to (1) have each member go to the wall labeled with the direction they have; (2) have each member of the group say all four directions to the others in their group; and, (3) have the group write in the cardinal directions on a poster-board size map of the room.

In addition to the 10 panel members who responded positively, 5 felt the activity did not meet the criterion and 2 panel members provided other responses.

> Part 3 is not concrete--the map is symbolic. I cannot understand this activity. Example for rewriting IA2: Prepare a set of four cards, all of the same color, each marked "north," "south," "east," or "west." Make additional sets using different colors until there are as many cards as there are pupils. Shuffle the cards and distribute randomly. . . .
>
> It is my understanding that social interaction involves reciprocity--mutual give and take. Most of your social interaction activities seem to lack this. Also, several activities are too teacher-directed and not open-ended enough, "Saying" or "telling" does not constitute social interaction.
>
> Task is too abstract. Have you tried this with students?
>
> Color of the cards is as arbitrary and abstract as the cardinal directions. Further, just stating the directions in a group setting isn't social interaction. I suggest having groups of students making classroom maps and discussing relative directions.
>
> Have student describe his position relative to other objects--not another child's position.

Exploration. The third activity for the transition from preoperational to concrete cognitive stages produced comments from

nine panel members and a 65 percent agreement that it provided an exploratory activity. The activity was as follows:

> Map Skill: Direction
> Transition: Preoperational to Concrete
> Piagetian Criterion: Exploration
> Sub-skill: Relative Directions
>
> In groups of two, the students will take turns telling the other one the direction they should take to move between two points. Have students assist you in recording all the directions given. Ask each person to indicate which directions were the hardest to understand and which directions were the most useful.

Eleven panel members agreed that the criterion was met, three panel members did not agree and three made other responses. The anecdotal responses were:

> This would be a good social interaction activity.
>
> Directions are unclear (if the goal is to have each of a group of teachers conduct a common activity). Therefore, the activity might or might not fit Piagetian thought.
>
> I think this is great for concrete to formal.
>
> By directions do you mean "north, south--right, left," etc. Would be too difficult, I think.
>
> I do not understand "any two points" in the description. This may be an appropriate preoperational to concrete but needs more specific information for me to tell.
>
> Looks good. (Left-right; North-South?) Have students develop their own "trails" or points of travel.
>
> The first activity is OK. The students are not ready to proceed past the first sentence in this activity.
>
> What kind of directions will be given?
>
> Why not provide a progressively more complex series of mazes and have students pair off and one tell the other how to <u>draw</u> the mazes.

Transition from Concrete to Formal/First Round

Concrete experiences. The activity written to provide a concrete experience for the transition from concrete to formal produced an agreement of 76 percent, as displayed in Table 1. Thirteen panel members agreed that the activity met the criterion, two panel members thought it did not meet the criterion and two panel members made other responses. The activity, as it was presented in the first round of the Delphi method, follows:

> Map Skill: Direction
> Transition: Concrete to Formal
> Piagetian Criterion: Concrete Experiences
> Sub-skill: Orient a Map Correctly
>
> Show the students a map which indicates the location of items in the room as well as a north arrow. Have the students place several three dimensional items on a piece of paper which corresponds in shape to the room and is the same size as the map of the room. Place the items at positions designated on the piece of paper. Have the students position the map in such a way that it is oriented the same way as the piece of paper.

The concern of the anecdotal responses was that the activity did not appear difficult enough for the transition from concrete to formal levels of cognitive development. The specific responses follow:

> The second to last sentence should be stated earlier, I believe . . . "Which corresponds in shape"--to which does this refer? items? paper?
>
> My interpretation is that the formal operation would be more abstract.
>
> Actual interpretation of a map is needed.
>
> Perhaps more concrete than at the point of transition from concrete to formal. At the transitional phase they could be working with maps of areas beyond the classroom.
>
> Uncomfortably simple.

Social interaction. The response to the first presentation of the activity to provide social interaction displayed an agreement of 82 percent. The text of the first activity follows:

> Map Skill: Direction
> Transition: Concrete to Formal
> Piagetian Criterion: Social Interaction
> Sub-skill: Use a Compass to Determine Direction
>
> Give each student a magnetic compass. In groups, have the students spend several minutes with the compass observing how the needle reacts as they move about a playground. Ask each group to indicate the direction the needle points. Ask each group to state possible reasons the needle pointed the same way.

As presented in Table 1, the specific responses from the first round of the Delphi method were 14 "YES" responses, 2 "NO" responses and 1 response that was not positive or negative. The anecdotal responses raised questions with regard to the degree of social interaction. The anecdotal responses were as follows:

> Technically YES. Implies reasons are acceptable if agreed upon (needle always points to Wicked Witch of the North, e.g.). Note that minor changes in wording might eliminate the objection, but forcing an interaction activity into a factual learning situation often creates artificial problems for a teacher.
>
> Good application of formal thinking.
>
> The problem with this is that although students are involved with manipulatures, true social interaction and dialogue isn't encouraged enough. Have groups of students develop hypotheses and methods to test the hypotheses.
>
> Not hypothetical enough. Give students malfunctioning compasses and tell them to figure out which one is accurate on playground.

Exploration. The last activity in the map skill area of direction was intended to demonstrate the criterion of providing exploratory experiences. Thirteen "YES" responses from the panel members indicated

an agreement level of 76 percent. The activity follows:

> Map Skill: Direction
> Transition: Concrete to Formal
> Piagetian Criterion: Exploration
> Sub-skill: Use the North Arrow on the Map
>
> Give the students copies of several maps and ask them to find information on the map that would indicate a direction or directions. (Possible answers might include the use of a compass rose, north labeled on the map and the numbering system of parallels and meridians.)

Four panel members believed the criterion was not met, with three "NO" responses and one other response. Several anecdotal comments provided specific suggestions for changes. Those responses follow:

> I believe this is still concrete--but asking to do something would move it to formal. Find something in a NE quadrant, for example.
>
> Maps selected at random might or might not provide exploration: should the variety of information be specified?
>
> Good application of formal thinking.
>
> According to Bloom's taxonomy, I would rate this as a "low level" objective; one that doesn't encourage true exploration. Suggestion: take children outside with no cardinal directions and have them determine the directions from the environmental stimuli.
>
> Give students maps without symbols and ask them to determine correct orientation of map of local area.

Transition from Preoperational to Concrete/Second Round

The changes found in the activities for the second round of the Delphi method reflected the anecdotal comments of the panel members. For most of the Piagetian criteria, the basic concept of the first round activity was kept the same with modifications to better express the criterion. An exception to this was in the concrete experiences

and social interaction activities for the transition from preoperational to concrete for the direction map skill. These activities were completely changed from the first round. The writer believed that the second round activities better represented the criteria and the judgment of the panel members as disclosed in the first round comments relative to concrete experiences and social interaction. The changes produced agreement from the panel members at levels consistent with or better than the first round activities.

Concrete experiences. The second round activity to demonstrate the criterion of concrete experiences follows:

> Map Skill: Direction
> Transition: Preoperational to Concrete
> Piagetian Criterion: Concrete Experiences
> Sub-skill: Use Cardinal Directions
>
> Prepare a set of four cards all of the same color. Mark each card with either "north," "south," "east" or "west." Using different colors, make additional sets until there are as many cards as there are pupils. After the cards are randomly distributed, have the students gather in groups by color. Have the students observe the cards of the other group members. Ask each student to (1) name the four directions found on the colored set of his/her group, and (2) go to the wall that is labeled with the direction that corresponds to the card he/she was handed when the cards were randomly distributed.

As displayed in Table 1, the suggestion that this revised activity could meet the criterion of providing concrete experiences was approved by 13, or 81 percent, of the panel members. Three panel members thought the activity did not meet the criterion. The activity also generated eight anecdotal responses. Those responses were:

Unless the sun, shadow, or compass is used, the activity has

no transfer of training; thus, the described activity has no force in teaching.

Action itself is essence of activity--it results from abstraction and is not a manipulation. Try color matching all cards of same direction.

A qualified "yes" as this concept itself is perhaps too abstract for the preoperational child's transition to concrete operations. I don't think this skill is very appropriate for the developmental level. Maybe at a later stage.

". . . gather in groups by color" -- This doesn't sound possible because of this statement -- ". . . different colors, make additional sets until there are as many cards as there are pupils."

However, the cards should be one color and coded by letter or number. Color may be a major cue rather than direction.

I am distracted by reference to colored cards. Is this to discount color? If so, this is a "formal task." To simply match symbols is all you want here--or, do I misunderstand your task?

What is the connection between groups of colors and merely looking at a group's color and direction. Somewhat formal thought?

What Piagetian aspect of operativity is exemplified by this task?

Even though the anecdotal comments suggest possible revisions for this activity, the stated criterion of 80 percent agreement was achieved during the second round of the Delphi method.

Social interaction. With respect to the social interaction activity, in the second round of the Delphi method the poster-size map of the room was eliminated as well as the relative directions as originally called for in the first round. Discussions of the relative directions, exchanging roles, and repetition of the tasks were additions made to the activity. The text of the activity as presented in the second round is as follows:

Map Skill: Direction
Transition: Preoperational to Concrete
Piagetian Criterion: Social Interaction
Sub-skill: Relative Directions

Ask the student to position himself/herself at a location in the room and choose a direction to face. Ask the student to name several objects he/she can see from that location to another student. Using the relative direction terms of left and right, have the student express the direction of the objects relative to his/her location to another student. Ask the two students to discuss the directions that are stated. Have the students move to a new location which would change the relative direction of the objects to the student and again express the direction of the objects relative to his/her location. Have the directions discussed by the two group members, exchange roles and repeat the tasks.

As displayed in Table 1, the level of agreement was 94 percent when 15 panel members agreed that the activity met the criterion of providing social interaction. One "NO" response was based on possible confusion of the relative terms of "left" and "right." The anecdotal responses, which follow, seem to reflect the increased percentage of agreement.

"Relative terms" are actually comparison and attribute words and adjectives. You are asking them to demonstrate their ability to use/understand these terms, but you must be sure they "have" the vocabulary before asking them to transfer it to this situation.

Great idea. I hope egocentrism isn't too strong at this level.

Activity is complex to write up but seems simple enough to do.

My concern here is that so many young children confuse left and right (don't remember which is which) until 8 or even 9. Of course, they need to practice . . . but I'd expect some confusion here.

The second round responses imply that this activity does not need further revision.

Exploration. For the second round of responses, the directions for the exploration activity were modified based on the first round anecdotal comments. The revised activity added the opportunity for the students to use relative directions to move through a "trail" on the playground or in the classroom. Following is the revised activity for the second round:

> Map Skill: Direction
> Transition: Preoperational to Concrete
> Piagetian Criterion: Exploration
> Sub-skill: Relative Directions
>
> Divide your class into groups of two. Using relative directions given by one of the students, have the other student move between two locations on the playground or classroom. After both students have given directions, have the students move through a "trail" set up on the playground or classroom. As each group of students walks through the "trail," have them state the direction they move in terms relative to the environment.

The data presented in Table 1 display that the revised activity met the criterion at the 94 percent level. Only one of the sixteen panel members perceived the activity as not meeting the criterion. The anecdotal responses were as follows:

> Although it can get confusing as in IA2; dependent on the directions a child chooses to give.
>
> Nothing at all exploratory in the way I see this.
>
> Add opportunities or criteria for student feedback as they move.
>
> Good activity. First, however, I'd have "teacher-made" treasure maps as criterion.
>
> This activity could be simplified without a "trail."

Student feedback as they move through the "trails," as suggested, would provide additional opportunities to explore the use of relative

directions. It seems the teacher-made treasure map would limit the opportunity for exploration.

Transition from Concrete to Formal/Second Round

Concrete experiences. The goal of the revision of the activity to demonstrate concrete experiences was to raise the difficulty level of the activity while still meeting the criterion.

> Map Skill: Direction
> Transition: Concrete to Formal
> Piagetian Criterion: Concrete Experiences
> Sub-skill: Orient a Map Correctly
>
> Show the students a map which indicates the location of items on a playground. Take the students to the playground and by using a magnetic compass, have each student determine a northerly direction. Have each student orient the map of the playground and have him/her indicate "north" through the use of a compass rose.

As displayed in Table 1, 15 out of 16 panel members believed the revised activity met the criterion of providing concrete experiences. This provided agreement at the 94 percent agreement level. The anecdotal responses were:

> Good.
>
> What you want is for students to orient themselves to an "area" from a given location in reference to "items." I think "items" should be replaced by "landmarks" (e.g., trees rather than hidden things) and students should be "given" one or more specific places to stand.
>
> This is a good activity. I am assuming it is for junior high children.
>
> Also fits IB2.

The nature of the specific comments indicates that the revision succeeded in increasing the level of difficulty. The suggestions to replace "items" with "landmarks" and to have the students stand at a given specific place is germane to the objective and purpose of the activity.

Social interaction. The principal addition to the revised wording of the social interaction activity was the condition that members of the group notice the procedures used by other group members as well as comparing others' hypotheses. Eighty-eight percent of the panel members responded positively to the following revision:

> Map Skill: Direction
> Transition: Concrete to Formal
> Piagetian Criterion: Social Interaction
> Sub-skill: Use a Compass to Determine Direction
>
> Give each student a magnetic compass. In groups of no more than four, have the students spend several minutes with the compass observing how the needle reacts as they move about a playground. Have each group determine that each member of the group is using the same procedure for reading the compass. Have each group indicate the direction the needle points and have students develop a hypothesis as to the reason the needles pointed the same way. Have the groups compare their hypotheses with each other.

Fourteen panel members agreed that the activity met the criterion. Two believed the criterion was not met. The anedcotal responses, which follow, were not explicit with regard to changes needed in the wording.

> My only reservation here concerns their ability to give this explanation--the atomic theory involved--is this what you want or do you refer to a lower level explanation?
>
> First part also fits IB3.

Sort of. I'm not sure this is enough student direction to elicit possible hypotheses and thus sufficient group instruction. Discussion guidelines may be helpful.

More formal than transition to formal?

From the comments received, the activity would benefit from more information being provided to the children relative to the process of using a compass and determining directions.

Exploration. The revisions in the exploration activity called for specific maps to be used and asked the students to use external stimuli to determine the cardinal directions. The revision met the criterion according to 15 of the panel members. One panel member felt the revision, which follows, did not provide an exploratory experience.

Map Skill: Direction
Transition: Concrete to Formal
Piagetian Criterion: Exploration
Sub-skill: Use the North Arrow on the Map

Give students copies of maps of several local areas (school building, playground, immediate neighborhood) which show no directional symbols. Have them determine the cardinal directions from the external stimuli. Have them place the North Arrow on each map. Provide feedback through a large group discussion or through peer interaction.

The phrase "external stimuli" created some difficulty according to two of the five anecdotal responses. Those responses, as well as the other three, follow:

External stimuli?

Why not "mix up" or vary the task--some cities/places; some coordinates--to demonstrate reversibility/comprehension?

What external stimuli would be available--street sign that said North 1st or East Pine? This bothers me a little but perhaps

this is the "exploration experience"? If no external signs exist, why not have them orient the maps to real life and then fill in the directions.

Great idea.

The clarification of the meaning of external stimuli seems to be needed for this activity. From one of the comments, it also appears that additional work with maps would be appropriate.

Activities for Teaching Map Skills Related to Location

While all of the activities of the second round of the Delphi method surpassed the 80 percent agreement goal only one of the first round activities did so. The following map sub-skills, listed by Piagetian criteria, were used in the development of the activities for this skill area:

> Concrete Experiences: Use Relative Terms of Location; Learn to Make Simple Sketch Maps to Show Location; Identify on a Globe the Equator, the Prime Meridian, Lines of Latitude and Lines of Longitude
>
> Social Interaction: Use Relative Terms of Location; Locate Places Using a Number-and-Key System
>
> Exploration: Use Relative Terms of Location; Learn to Make Simple Sketch Maps to Show Location; Use Longitude and Latitude in Locating Places on a Wall Map

Data presented in Table 2 provide the complete results from both transitions and two rounds of the Delphi method.

Transition from Preoperational to Concrete/First Round

Concrete experiences. As displayed in Table 2, six panel members did not respond in a positive way, resulting in a level of

Table 2

Responses of Panel Members to Map Skill Activities Related to Location

Transition: Preoperational to Concrete

Criteria	Round of responses	Criteria met	Criteria not met	Other responses	Percentage of agreement	Number of anecdotal responses
Concrete Experiences	1	11	3	3	65%	4
	2	15	1	0	94%	5
Social Interaction	1	11	5	1	65%	8
	2	16	0	0	100%	2
Exploration	1	10	4	3	59%	6
	2	14	2	0	88%	2

Transition: Concrete to Formal

Criteria	Round of responses	Criteria met	Criteria not met	Other responses	Percentage of agreement	Number of anecdotal responses
Concrete Experiences	1	11	4	2	65%	7
	2	15	0	1	94%	4
Social Interaction	1	14	2	1	82%	5
	2	15	1	0	94%	3
Exploration	1	10	4	3	59%	6
	2	16	0	0	100%	3

agreement of 65 percent for the activity which developed the criterion of providing concrete experiences. The activity follows:

> Map Skill: Location
> Transition: Preoperational to Concrete
> Piagetian Criterion: Concrete Experiences
> Sub-skill: Use Relative Terms of Location
>
> Show the students a map of the room that uses drawn representations of objects to show their locations. Describe the location of the objects by having such relative terms as near, far, across from, etc. Have the students stand by the objects as you describe the location using the relative terms.

Eleven positive responses, three negative and three other responses were supported by the four anecdotal responses. The responses seemed to indicate some difficulty in understanding the nature of the activity. Those responses were as follows:

> I am ambivalent about this one. I wonder if actual classroom shouldn't be used rather than map; it would bring this activity more in line with other two--or would it?
>
> See Elementary School Journal, 67 (1969), 146-153. Are the students in the room or elsewhere when the "map of the room" is shown? If so, yes. If not, no. Clarify this.
>
> I wouldn't worry about map scale at this level other than through allowing students to construct their own maps (or pictures of the environment).
>
> Students need manipulation of concrete objects not drawn objects.

Social interaction. The activity employed to demonstrate social interaction for the location map skill generated responses from panel members that produced a 65 percent agreement figure. Eleven responses affirmed the notion that the activity met the criterion. Five other responses were negative with regard to whether or not the

criterion was met and one response did not take a position. The activity was worded as follows:

> Map Skill: Location
> Transition: Preoperational to Concrete
> Piagetian Criterion: Social Interaction
> Sub-skill: Use Relative Terms of Location
>
> Have students use such relative terms as near, far, across from, etc. to describe the location of objects in the room to other objects. Have a student move around the room and stand by different objects. Have another student describe the location of the student relative to other objects.

The eight anecdotal responses focused on the meaning of interaction and the need for students to describe locations relative to other objects and not to other students. The list of anecdotal responses follows:

> Can the interaction be improved by having first student describe and second student (upon hearing description) move to the object?
>
> Excellent! I disagree with your use of "relative"; prepositions are "environmental"--many are related to direction, not location.
>
> No social interaction.
>
> Interaction means 2 way communication among members of a group about an issue, not merely saying something to a group.
>
> Ties in with declining egocentrism.
>
> Have student describe his position relative to location of objects in room. Not describe another student's location.
>
> Have the students describe to each other the location of the student relative to other objects.
>
> Try IIB2 here.

Exploration. The exploration criterion specified in the location activity involved the use of relative terms of location. As

displayed in Table 2, 10, or 59 percent, responded "YES," 4 "NO" and 3 other responses.

Map Skill: Location
Transition: Preoperational to Concrete
Piagetian Criterion: Exploration
Sub-skill: Use Relative Terms of Location

Have the students play a variation of "20 Questions" by guessing what object in the classroom you are thinking of. First, have them guess by only naming the object. Then have them guess using relative terms such as near, far, across from, etc. Discuss with them which method may have been easier.

Two of the anecdotal responses raised questions relative to the instructions. Another response suggested a change in the wording of the activity. There were also questions relative to appropriateness of the activity with regard to the cognitive abilities of the students. The list of anecdotal responses follows:

Good.

Have students name and stand by the different objects (as in IIA2).

Somewhat more precise instructions might be necessary if each of several teachers are to conduct essentially the same activity.

"Variation of 20 Questions" is too abstract; clarify.

"So-So." This may be too verbal. You might ask them to read "Treasure Maps" and then develop their own "Treasure Maps" of the room, playground, etc.

I don't think they can deal with the business of guessing how near or far something is from the object being guessed.

Transition from Concrete to Formal/First Round

Concrete experiences. The activity written for the concrete

experiences criterion was approved by 65 percent, or 11, of the panel members. Two of the panel members made other responses and four said the criterion was not met. The activity was worded the following way:

> Map Skill: Location
> Transition: Concrete to Formal
> Piagetian Criterion: Concrete Experiences
> Sub-skill: Identify on a Globe the Equator, the Prime Meridian, Lines of Latitude and Lines of Longitude
>
> Have the student look at a globe which identifies the lines of latitude and longitude. Ask the following questions: (1) What is the line labeled 0° latitude called? (2) What is the line labeled 0° longitude called? (3) What happens to the numbers on the lines of latitude as they move away from 0°?

The seven anecdotal responses revealed lack of agreement on whether or not this activity met the criterion. The responses included contradictory comments relative to the level of difficulty and the nature of the tasks required of the children. There were also suggestions for modification of the activity which would require more and different kinds of responses from children. The following were the specific anecdotal responses:

> Use of a globe is formal, not transitional between concrete and formal.
>
> I believe these remain concrete.
>
> Locate objects using these identifiers; use rather than identify.
>
> I'll say yes, but I am less certain about this one. I wonder if younger children could do this. The fact that they must work with a grid system moves me to say yes.
>
> "Sort of." Have students build their own models and discover the need to use arbitrary reference points such as latitude and longitude.
>
> Perhaps a better question would be: (1) Why is the line labeled

0° latitude called the equator? and (2) Why is the line labeled 0° longitude called the International Date Line?

Uncomfortably simple. Give students several different map projections and ask how to develop a locational system common to all projections.

Social interaction. The activity designed to meet the social interaction criterion, as displayed in Table 2, was accepted by 82 percent of the panel members on the first round of the Delphi method. The activity was worded as follows:

Map Skill: Location
Transition: Concrete to Formal
Piagetian Criterion: Social Interaction
Sub-skill: Locate Places Using a Number-and-Key System

Have students play a variation of "20 Questions" by guessing what object in the classroom they are thinking of. Have the classroom marked off in a letter-number grid. In groups of two, have a student guess what object the other one is thinking of by giving the location in terms of a letter-number combination.

Among the panel members, 14 thought the activity met the criterion, 2 did not and 1 made another response. The anecdotal responses, which follow, provided suggestions for improvement of the activity.

Unclear if grid is on classroom walls or a map of classroom. Suggest former first--latter as follow-up.

I believe use of coordinate system (number-key) is concrete while latitude and longitude is formal.

Simplify.

Sounds good.

Give number grid with curved lines or contour lines.

Exploration. The last activity for the first round of the Delphi method and the location map skill did not meet the criterion for

exploratory experiences according to the panel members. Fifty-nine percent, or 10, of the panel members gave a "YES" response to the following activity:

> Map Skill: Location
> Transition: Concrete to Formal
> Piagetian Criterion: Exploration
> Sub-skill: Use Longitude and Latitude in Locating Places on a Wall Map
>
> Have the students look at a map, or even a globe, and ask them to describe the location of a place to another student. After several minutes ask questions that will elicit thought. Two examples are: (1) How did you describe the location? and (2) Was there a consistent item or marking to describe the locations?

The four "NO" responses and the three other responses were indicative of the concern about this activity expressed in the anecdotal responses. The focus of the responses was on how to make it more indicative of the criterion of exploration. The anecdotal responses were:

> This is exploration only if it precedes instruction on latitude and longitude and in that case isn't particularly efficient. Again the problem is imposing an exploration activity on content for which the activity is not well suited.
>
> Using latitude and longitude/describe the location.
>
> Perhaps it would be more exploratory if students were asked to locate. You might also provide coordinates of a storm center and then have the movement plotted on the map.
>
> I haven't a glimmer.
>
> This seems to be a concrete item and not a transition to formal.
>
> Using aerial photos, ask students to impose imaginary latitude and longitude grid and find features.

Transition from Preoperational to Concrete/Second Round

The second round activities for the location map skill

produced agreement levels ranging from 88 percent to 100 percent. The changes in the activities were designed to reflect the first round anecdotal comments. As a result, the map sub-skill for the concrete experiences and exploration activities and transition from preoperational to concrete level was changed from "Use Relative Terms of Location" to "Learn to Make Simple Sketch Maps to Show Location."

Concrete experiences. As displayed in Table 2, 94 percent of the panel members believed that the second round activity did demonstrate the concrete experiences criterion for the transition from preoperational to concrete. The activity follows:

> Map Skill: Location
> Transition: Preoperational to Concrete
> Piagetian Criterion: Concrete Experiences
> Sub-skill: Learn to Make Simple Sketch Maps to Show Location
>
> As students stand in a room, give them a copy of a map of the room which shows the location of an object. Using this object as a point of reference, ask the students to construct a map which shows the location of other subjects in the room.

Only one panel member made a "NO" response to the activity. Five anecdotal responses reflected the high level of agreement:

> I think mapping like this is hard for children, but, again, it seems set up in an appropriate way.
>
> Great.
>
> More advanced. Have them extend on original map to locate predetermined objects.
>
> Not especially clear as stated—simple and appropriate--Have students add to (original) criterial map other objects in the same room.
>
> Good. Nice and simple and stated in common language.

The general nature of the responses seems to indicate that the activity should not be changed. The extension indicated in one of the anecdotal responses would provide a natural continuation of the activity.

Social interaction. The second round activity for the social interaction criterion increased the number of interactions between students from that of the first round activity. Another difference was the use of relative terms with regard to the location of objects. As displayed in Table 2, this activity received a 100 percent affirmative response from the 16 panel members.

> Map Skill: Location
> Transition: Preoperational to Concrete
> Piagetian Criterion: Social Interaction
> Sub-skill: Use Relative Terms of Location
>
> Using terms such as near, far, across from, etc. have the students describe the location of various objects in the room. In groups of two, have one student describe to a second student, using these terms, the location of an object. The second student should move to the object. After moving to the object, have the second student describe his position relative to the first student and at least one object. Have them discuss how each used the terms. Repeat the procedures with the students switching roles.

Only two anecdotal responses resulted from the second round. The two responses were:

> Using blocks--children can make "maps" and discuss use of those terms.
>
> The teacher role will be difficult--total classroom management.

The first anecdotal response could provide the basis for another activity using relative terms of location.

Exploration. The exploration activity, presented in the second round, was as follows:

> Map Skill: Location
> Transition: Preoperational to Concrete
> Piagetian Criteria: Exploration
> Sub-skill: Learn to Use Simple Sketch Maps to Show Location
>
> Have students make "Treasure Maps" for the other class members. These maps will show pictures of representations of objects in the room except for an "X" which denotes the location of one object in the room. The students are asked to determine the missing object on the basis of the location of the other subjects.

With fourteen positive responses, as displayed in Table 2, 88 percent of the panel members believed the second round activity met the criterion for exploratory experiences. The two negative responses follow:

Deals more with memory than exploration.

I don't understand objective of the activity. Too general.

Based only on the anecdotal responses, it would seem that further revision would not be pursued.

Transition from Concrete to Formal/Second Round

Concrete experiences. The second round activity for providing concrete experiences for this transition differed from the first round activity with regard to the student tasks. The activity, as displayed in Table 2, received a 94 percent level of agreement from the panel members.

> Map Skill: Location
> Transition: Concrete to Formal
> Piagetian Criterion: Concrete Experiences
> Sub-skill: Identifying on a Globe the Equator, the Prime Meridian, Lines of Latitude and Lines of Longitude

> Ask the students to draw two lines on some form of smooth, unmarked sphere (ball or balloon). One line would divide the sphere in half horizontally; the other would divide the sphere in half vertically. Using a globe as a model, have them label the horizontal line as the Equator and the vertical line as the Prime Meridian. At this point, ask each student to describe a location in one of the quadrants formed by the two lines. Have them look at the globe again to demonstrate the use of additional lines as a tool for location. Have them put additional lines on their spheres and ask them to again describe the location in one of the quadrants. Using a globe as a model, use the terms latitude and longitude to describe the additional lines used in location.

As revealed in Table 2, 15 out of 16 panel members concluded that the criterion of providing concrete experiences was met. The one panel member not in agreement questioned the use of certain terminology and suggested rewriting the activity. Other responses expressed concerns about the fine motor skills of the students and the verbal responses asked of the children. The four anecdotal responses were as follows:

> Globe . . . OK if it doesn't bother you or confuse those who know that the International Date Line is half of what you've designated as Prime Meridian. I'd re-write this one.
>
> Definitely good transition.
>
> This one still seems a bit "forced" but meets the criteria. The concern is whether children will draw additional lines with sufficient accuracy so as not to result in the activity serving a negative effect. Maybe they are more coordinated than I was at that age.
>
> Why is learning terms a reasoning task? Why isn't this more a verbal than spatial learning?

Any additional revisions to this activity should probably address the issues of the International Date Line and the nature of the student tasks.

Social interaction. The data presented in Table 2 display that 94 percent of the panel members agreed that the following activity

met the criterion for providing social interaction for the transition from concrete to formal.

Map Skill: Location
Transition: Concrete to Formal
Piagetian Criterion: Social Interaction
Sub-skill: Locate Places Using a Number-and-Key System

> In groups of two, have the students play a variation of "20 Questions." Mark off the classroom in a letter-number grid. Have the students take turns guessing what object in the room their partner is thinking of by giving the location in terms of a letter-number combination. The student who is guessing continues until he/she guesses the location of places on a map using lines of latitude and longitude.

The one negative response of the 16 responses was based on an incorrect wording in the activity. The anecdotal response was one of three, and the only one making a suggestion for revising the activity. The anecdotal responses were:

> Guesses the "name" of the object--the location was already given.
>
> Great.
>
> Fine.

The wording of the last sentence needs to be changed to "guesses the object their partner is thinking of."

Exploration. The second round activity for the exploration criterion made use of several recommendations from the first round activity.

Map Skill: Location
Transition: Concrete to Formal
Piagetian Criterion: Exploration
Sub-skill: Use Longitude and Latitude in Locating Places on a Wall Map

> After introducing the concept of latitude and longitude, have students look at a map or globe and ask them to describe the location of any place to another student. Then give the students a list of coordinates using latitude and longitude and ask them to identify the locations by name. Finally, give the students a list of locations by name and ask them to give the approximate coordinates using latitude and longitude.

The 16 panel members were unanimous in their agreement that the criterion was met by the second round activity. The lack of anecdotal responses by most panel members reflects this agreement. The three anecdotal responses that were made follow:

> Good.
>
> A rather weak use of exploration . . . perhaps using weather maps and the movement of storm centers would be more "exploratory."
>
> But, this skill needs a lot of practice.

The use of weather maps, as was mentioned in the anecdotal responses, would provide a natural extension of the activity.

Activities for Teaching Map Skills Related to Scale

Out of the four map skill areas of direction, location, scale, and symbols, the highest levels of agreement reached by the panel members were those for activities related to scale. The first round activities were approved by the panel members with percentages ranging from 59 percent to 94 percent. The second round percentages ranged from 88 percent to 100 percent. A complete summary of the percentages of agreement for the two rounds is presented in Table 3. The following map sub-skills were used in the development of the activities to demonstrate the three Piagetian criteria:

Table 3

Responses of Panel Members to Map Skill Activities Related to Scale

Transition: Preoperational to Concrete

Criteria	Round of responses	Criteria met	Criteria not met	Other responses	Percentage of agreement	Number of anecdotal responses
Concrete Experiences	1	14	0	3	82%	4
	2	15	1	0	94%	3
Social Interaction	1	12	4	1	71%	5
	2	15	0	1	94%	5
Exploration	1	14	2	1	82%	3
	2	14	0	2	88%	3

Transition: Concrete to Formal

Criteria	Round of responses	Criteria met	Criteria not met	Other responses	Percentage of agreement	Number of anecdotal responses
Concrete Experiences	1	10	5	2	59%	7
	2	15	0	1	94%	3
Social Interaction	1	13	3	1	76%	7
	2	16	0	0	100%	2
Exploration	1	16	0	1	94%	0
	2	16	0	0	100%	1

Concrete Experiences: Make Large-Scale Maps of a Familiar Area, such as a Classroom, Neighborhood

Social Interaction: Compare the Actual Size of an Item with its Map Size; Compare Maps of Different Areas to Note that a Smaller Scale Must Be Used to Map Larger Areas

Exploration: Compare the Actual Size of an Item with its Map Size; Compare Maps of Different Areas to Note that a Smaller Scale Must Be Used to Map Larger Areas

Transition from Preoperational to Concrete/First Round

Concrete Experiences. The activity written to demonstrate the criterion of concrete experiences for the transition from preoperational to concrete in the first round of the Delphi method was agreed upon by 82 percent of the panel members. The 14 positive responses were the result of the following activity:

Map Skill: Scale
Transition: Preoperational to Concrete
Piagetian Criterion: Concrete Experiences
Sub-skill: Make Simple Large Scale Maps of a Familiar Area, such as a Classroom, Neighborhood

Divide a room in half. Have several objects at different locations around one-half of the room. On the other half of the room, have the shape of the objects marked on the floor at the corresponding location and size of the real object. Give the students a map drawn to scale of the one-half room. Have the students compare the map with both halves of the room.

Three of the panel members responded neither positively or negatively. One of the anecdotal responses raised the issue of the appropriateness of exposing children to map scale at this level. The other anecdotal responses addressed directions relative to the tasks of the activity. The list of anecdotal responses follows:

I wouldn't worry about map scale at this level other than through allowing students to construct their own maps or (pictures) of their environment.

I think this activity may be appropriately placed. I think the directions lack enough clarity for me to be sure.

I do not understand "corresponding location"--shapes duplicate some locations? Which one-half does map represent?

I have no problem with the principle. If you divide a room in half and use the other half to map the first half, you are drawing actual size not to scale.

Social interaction. As displayed in Table 3, the social interaction activity developed for the first round of the Delphi method received an approval of 71 percent from the panel members.

Map Skill: Scale
Transition: Preoperational to Concrete
Piagetian Criterion: Social Interaction
Sub-skill: Compare the Actual Size of an Item with its Map Size

In groups, have the students measure items in the room in decimeters. Have the objects drawn on paper to scale in centimeters. Have the students measure the drawn objects. The students can compare results and discuss the reason the actual measurements in decimeters and the map measurement in centimeters have the same numeral.

Twelve of the panel members believed the activity met the criterion, four panel members believed it did not meet the criterion and one panel member chose to make another response. The anecdotal responses focused on the measurement tasks asked of the children.

Not ready for standard measurements; direct comparisons would be more appropriate.

Or inches/Unfortunately student may not know metrics.

This seems a moderately difficult activity. Do you need to get into decimeters and centimeters to do it?

Measurement may be too difficult in preoperational period. It would be more helpful to let students make 3-dimensional maps and develop the basic concept of scale without making specific ratios.

Children don't have well enough developed counting skills; they have difficulty with large-larger, let alone centimeters/decimeters.

Exploration. The first round exploration activity was as follows:

Map Skill: Scale
Transition: Preoperational to Concrete
Piagetian Criterion: Exploration
Sub-skill: Compare the Actual Size of an Item with its Map Size

Prepare several maps of areas in the school building which show the correct location and correct size of objects to scale. Show the students the objects and have them notice the size of the object on the map. Have them compare the actual size with the map size. Ask the following questions: How would you describe the map size of an object compared to its actual size?

As presented in Table 3, 14 positive responses of the panel members created an agreement of 82 percent. There were two negative responses and one other response by the panel members. The following were the anecdotal responses:

Prepare 1 map of the area--compare the map to actual size. After exposing them to photo of person compared to size of real person. Photo of auto with size of real auto.

Or give them the maps and let them find the real objects by themselves. Your statement makes it appear that you are teaching them to the real object.

An appropriate activity but not an example of exploration.

Transition from Concrete to Formal/First Round

Concrete experiences. The first round activity for concrete experiences and the transition from concrete to formal received 10 positive responses from the panel members. Those responses, along with five negative and two other responses, resulted in an agreement of 59 percent.

> Map Skill: Scale
> Transition: Concrete to Formal
> Piagetian Criterion: Concrete Experiences
> Sub-skill: Make Simple Large Scale Maps of a Familiar Area such as a Classroom, Neighborhood
>
> In a room or enclosed area, place a box which is 1 m in length and 1 m wide in a marked-off area that is 5 m wide and 5 m long. Have the students measure the dimensions of the box and marked-off area. Give the students a map which shows a square that is 10 cm long and 10 cm wide and a marked-off area which is 50 cm long and 50 cm wide. Tell the students that the map represents the box and marked-off area.

The seven anecdotal responses, which covered a myriad of concerns, were as follows:

> Have the students determine their own scale of an area they are to map.
>
> Then have the students "build" their map.
>
> Metrics?
>
> (Technically correct, perhaps) If formal operations begin at about age 12, this seems too simple and obvious.
>
> The paper and pencil map props in this activity remain concrete.
>
> In the other activities and I think as Piaget would have seen it, there are elements of discovery based on knowledge. This is a "telling" activity and I really do not see what it accomplishes.
>
> Ask them if the map is an adequate representation.

Social interaction. As displayed in Table 3, 76 percent of the panel members agreed that the first round social interaction activity met the criterion. The activity was worded as follows:

> Map Skill: Scale
> Transition: Concrete to Formal
> Piagetian Criterion: Social Interaction
> Sub-skill: Determine Distance on a Map by Using a Scale of Miles
>
> Show the students how distance can be found using a scale. Have the students work in groups to determine distance on a map using a scale of miles. Have them check the computations of the other members of the group. Repeat using other points on the map with the students taking turns determining the correct distance.

Thirteen of 17 panel members believed the criterion was met. Three of the four other responses stated the criterion was not met and one response was neither a "YES" nor a "NO." Seven anecdotal responses were made during the first round of the Delphi method. These responses follow:

> If a map such as a road map is used.
>
> Three to seven in a group only.
>
> The activity really isn't social other than an occasional verbal verification. Perhaps pairs of students could make maps according to their own scale. The dialogue between students would make the effort more "social."
>
> Seems vague; I think this is properly classified. However, I think the teaching instructions should be more precise.
>
> Knowledge or application?
>
> Scale does not mean "scale-of-miles" (distance), it means "size." This activity is unrelated to the map skill (III).
>
> Change scale by drawing map of map using different proportions/ ratios.

Exploration. The exploration activity for the transition from concrete to formal and scale produced 16 "YES" responses and one other response for a 94 percent agreement. The activity follows:

Map Skill: Scale
Transition: Concrete to Formal
Piagetian Criterion: Exploration
Sub-skill: Compare Maps of Different Areas to Note that a Smaller Scale Must Be Used to Map Larger Areas

Give the students a map of Nebraska, a map of the North Central United States, the United States and North America. Ask the students how the size of Nebraska changed from map to map. Use a statement of scale to express the scale of each map. Ask the students what they notice about the statement of scale.

No anecdotal responses were made by the panel for this activity.

Transition from Preoperational to Concrete/Second Round

Concrete experiences. The second round activity for the transition from preoperational to concrete and the concrete experiences criterion was approved by 94 percent, or 15 out of 16, of the panel members. An attempt was made to clarify the tasks in the wording of the activity. The activity follows:

Map Skill: Scale
Transition: Preoperational to Concrete
Piagetian Criterion: Concrete Experiences
Sub-skill: Make Simple Large Scale Maps of a Familiar Area, such as a Classroom, Neighborhood

Divide a room into halves. Leave objects in one half and label it half "A". Place the outline of several objects found in half "A" on the floor of the second half and label it half "B". Give the students a piece of paper, at least 11" x 18", and have them draw a map of half "A". Have them compare their maps with half "B" and ask them what they notice about the size of the objects.

The one negative response and the anecdotal responses to the second round activity raised the issues of clarity of task and appropriateness which were also raised in the responses to the first round activity. The specific responses follow:

> Not stated clearly.
>
> Clarify the point of asking about size? Do you expect other than relative size and distance? Object is to construct a map of "A" that looks like a small representation of "B".
>
> They could do this--but?? I tried it with some of my children today at our lab school and found it somehow "complex." Wouldn't it be better for the children to make the outline shapes first?

The one specific suggestion could be included in possible future revisions of this activity.

Social interaction. As displayed in Table 3, the second round activity for social interaction was approved by 94 percent, or 15 of the panel members. One panel member varied from the other 15 by selecting a response other than "YES" or "NO." The activity follows:

> Map Skill: Scale
> Transition: Preoperational to Concrete
> Piagetian Criterion: Social Interaction
> Sub-skill: Compare the Actual Size of an Item with its Map Size
>
> Show a class of students a room with several objects in it, a smaller section of the room with smaller 3-dimensional representations of the objects and a map (11" x 18" in size) of the room showing representations of the objects. In groups no larger than four, have the students discuss the relationship between the items in the room, the 3-dimensional representations and the items shown on the map.

While the percentage of agreement that the activity met the criterion of providing social interaction was high, the anecdotal responses of

the panel members indicated that some problems existed with the activity. The problems stated in the anecdotal responses were vagueness of directions and too much dependency upon verbal responses. The specific responses were:

> Why a "smaller section of the room"? Why not 3-D representation of whole room?
>
> Seems vague still.
>
> A little weak--again. Discussing guidelines would be helpful.
>
> Good activity. Again limited only by the extent of their vocabularies and the experience they represent.
>
> Discuss relationship--poor for concrete activity; use manipulatives.

Any future revision of the activity would (a) address the issue of the way the directions are worded, (b) possibly add tasks which would temper the requirements for verbal responses, and (c) allow additional work with manipulatives.

Exploration. For the second round activity which demonstrates exploration for the transition from preoperational to concrete, the following wording was used:

> Map Skill: Scale
> Transition: Preoperational to Concrete
> Piagetian Criterion: Exploration
> Sub-skill: Compare the Actual Size of an Item with its Map Size
>
> Prepare a map of an area in the school building that shows the correct location and size to scale of several objects. Give a copy of the map to each student and have him/her locate the objects in the building. After observing the objects, ask the students the following question: How does the map size of an object compare with its actual size? Show the students another area of the building and ask the students to draw a map of the area and place certain objects on their maps. Ask the same question of the students when they finish: How does the map size

of an object compare with the actual size?

As displayed in Table 3, 88 percent of the panel members agreed that the second round activity met the criterion. Specifically, responses included 14 "YES" and two other responses. The following three anecdotal responses suggested the use of real objects in the activities:

> Why not use scale toys to explore scale. Concrete activities ought to use manipulatives, three dimensional sources and have a meaning to the child.
>
> How, also, do objects on the map compare in size to each other--as do the "real" objects?
>
> Weak--Perhaps having them bring models of real things such as model trains, planes, dolls, etc. . . . then move to your activity.

The use of models and/or toys in the student tasks would be explored for any revision of the activity.

Transition from Concrete to Formal/Second Round

Concrete experiences. The second round activity for the transition from concrete to formal and the criterion of concrete experiences attempted to make the tasks more student oriented than the first round activity.

> Map Skill: Scale
> Transition: Concrete to Formal
> Piagetian Criterion: Concrete Experiences
> Sub-skill: Make Simple Large-Scale Maps of a Familiar Area, such as a Classroom, Neighborhood.
>
> In a room or enclosed area, place a box which is 1 m long and 1 m wide in a marked-off area that is 5 m wide and 5 m long. Have the students measure the dimensions of the box and marked-off area. Have the students build a map of the box and marked-off

area which is drawn to scale. The students need to determine an appropriate scale.

Only one panel response, that being a comment, was not in agreement with the 15 positive responses. As displayed in Table 3, this produced a 94 percent level of agreement. Two of the three anecdotal responses reflected the high level of agreement. The one other comment provided no insight for improvement of the activity. Following are the specific anecdotal responses:

> Good--Box is not as interesting as some other rectangle--like a football field, inside a "parking lot." Ice rink (Stands, etc.).
>
> Excellent.
>
> I am ambivalent about this one because it appears to be a complex of pointless activity. Perhaps I am misunderstanding the activity and its intent.

Additional revisions could make use of the idea for creating more interest in the activity as suggested in the anecdotal response.

Social interaction. As displayed in Table 3, 100 percent of the panel members agreed that the second round activity to demonstrate social interaction for the transition from concrete to formal met the criterion. Following is the activity:

> Map Skill: Scale
> Transition: Concrete to Formal
> Piagetian Criterion: Social Interaction
> Sub-skill: Determine Distance on a Map by Using a Scale of Miles
>
> Show the students one of the various methods of determining the real distance of a line or space between objects on a map. Divide the class into groups of 2 and ask each of the students to construct a map to scale. Give them the actual dimensions of the area to map and ask them to determine a scale to use when

representing the area. (1) Have them compare their maps and discuss the scale used and the relative size. (2) Have each student place two dots on the map at random lcoations. Using the scale that was established when they drew the map, have each student determine what the actual distance would be between the two spots. Have him/her show the other member of his/her group how the distance was determined.

The three anecdotal responses to this activity follow:

Sounds like it would be difficult for some students and may need simplification for them.

Show one of the various methods--I'd be happier with more specificity or less--e.g., "Give each student a ruler"--or "a piece of string"--and let them invent the scale and tool.

Be more specific in terms of activity--there are 3 distinct activities in this lesson.

The anecdotal responses presented above could be the basis for minor changes in the wording of the activity to simplify the terminology.

Exploration. The wording of the second round activity for the exploration criterion continued to be the same as that in the first round. One hundred percent of the panel members agreed that the activity met the criterion on the second round also.

Map Skill: Scale
Transition: Concrete to Formal
Piagetian Criterion: Exploration
Sub-skill: Compare Maps of Different Areas to Note that a Smaller Scale Must Be Used to Map Larger Areas

Give the students a map of Nebraska, a map of the North Central United States, the United States and North America. Ask the students how the size of Nebraska changed from map to map. Use a statement of scale to express the scale of each map. Ask the students what they notice about the statement of scale.

One anecdotal response, which follows, was given on the second round.

> Could, as well, begin with a map of the school--compare with map of city and map of state.

This response would provide for an extension of the activity.

Activities for Teaching Map Skills Related to Symbols

The fourth area of map skills used in the development of the activities for this study was that involving the use of symbols. The following sub-skills were used in the six activities:

> Concrete Experiences: Learn to Use Legends on Different Kinds of Maps
>
> Social Interaction: Understand that Real Objects Can Be Presented by Pictures or Symbols on a Map; Learn to Use Legends on Different Kinds of Maps
>
> Exploration: Understand that Real Objects Can Be Presented by Pictures or Symbols on a Map; Learn to Use Legends on Different Kinds of Maps

The percentage of agreement that the activities met the criterion ranged from 76 percent to 94 percent on the first round of responses and on the second round from 81 percent to 94 percent. A complete summary of the percentages of agreement is provided in Table 4.

Transition from Preoperational to Concrete/First Round

Concrete experiences. The first round activity for the concrete experiences criterion met with the approval of 82 percent of the panel members. The activity was stated as follows:

Table 4

Responses of Panel Members to Map Skill Activities Related to Symbols

Transition: Preoperational to Concrete

Criteria	Round of responses	Criteria met	Criteria not met	Other responses	Percentage of agreement	Number of anecdotal responses
Concrete Experiences	1	14	2	1	82%	2
	2	15	1	0	94%	5
Social Interaction	1	16	0	1	94%	1
	2	15	1	0	94%	3
Exploration	1	13	3	1	76%	2
	2	13	1	2	81%	3

Transition: Concrete to Formal

Criteria	Round of responses	Criteria met	Criteria not met	Other responses	Percentage of agreement	Number of anecdotal responses
Concrete Experiences	1	14	1	2	82%	4
	2	15	1	0	94%	2
Social Interaction	1	13	2	2	76%	3
	2	15	0	1	94%	2
Exploration	1	13	1	3	76%	2
	2	15	0	1	94%	2

Map Skill: Symbols
Transition: Preoperational to Concrete
Piagetian Criterion: Concrete Experiences
Sub-skill: Learn to Use Legends on Different Kinds of Maps

Take pictures of items in a classroom and attach the photographs to the item. Have the students note those items as they move about the room. After all students have observed all objects, have them remove the photographs from the object and place them next to the appropriate name on a piece of poster-board labeled "LEGEND". Prepare a map large enough to include photographs in the approximate location of the items in the legend. Place corresponding numbers by the object on the map and by the photographs in the legend.

Fourteen panel members agreed that the criterion was met. Of the remaining three responses, two agreed the criterion was not met and one made another response. Two anecdotal responses were made by the panel members. The responses follow:

I do not believe this step is necessary--children can use non-photographic symbols at a preoperational stage.

Good idea, but students are not interacting enough with materials. It appears that there is too much looking and inactive participating

Social interaction. As displayed in Table 4, a high level of agreement, 94 percent, was reached on the first round activity for the social interaction criterion for the transition from preoperational to concrete and symbols. The activity was approved by 16 or 17 panel members. The activity follows:

Map Skill: Symbols
Transition: Preoperational to Concrete
Piagetian Criterion: Social Interaction
Sub-skill: Understand that Real Objects Can Be Presented by Pictures or Symbols on a Map

In groups, have the students draw pictures of objects found in a

photograph. Make a map of the area included in the photograph and have the students take turns placing their pictures on the map. After all the pictures of the objects have been placed on the map, the group should look at the pictures and point out similarities and differences of each of the sets of pictures.

The panel member who did not agree that the activity met the criterion made the only anecdotal comment:

Photographs of what? Can you give a couple examples?

Exploration. The lowest level of agreement was reached on the exploration activity for the transition from preoperational to concrete and symbols. As displayed in Table 4, 13 panel members, or 76 percent, agreed that the activity met the exploration criterion. Three panel members did not believe the criterion was met and one panel member chose to make another response.

Map Skill: Symbols
Transition: Preoperational to Concrete
Piagetian Criterion: Exploration
Sub-skill: Understand that Real Objects Can Be Presented by Pictures or Symbols on a Map

Present to the students flannel board stars which are placed on a flannel board map of the room where different items in the room would be found. Identify an item as a point of reference and ask the students to identify the items represented by the stars. Once identified, have the students make a new symbol to represent each item on the map.

The anecdotal responses provided two suggestions for ways the activity could be revised. Following are the two anecdotal responses:

Stay with a manipulatable object or a drawing of the object as a symbol.

Awkwardly written but a fine activity.

Transition from Concrete to Formal/First Round

Concrete experiences. The activity written to illustrate concrete experiences for the first round of the Delphi procedure and the transition from concrete to formal produced an 82 percent level of agreement.

> Map Skill: Symbols
> Transition: Concrete to Formal
> Piagetian Criterion: Concrete Experiences
> Sub-skill: Learn to Use Legends on Different Kinds of Maps
>
> Give each student a map showing objects found in the school building and a symbol to correspond with each object. The symbol should retain some similarities with the real objects. On a map of the school, which has the name of the objects written at appropriate locations, have the children place the symbols at the appropriate places on the map. Have the students compare the maps of each other and discuss the differences.

As displayed in Table 4, the panel members responded the following way: 14 "YES" responses, 1 "NO" response and 2 "OTHER" responses. There were also four anecdotal responses to the activity. Each response had a unique feature. The specific responses were:

> Too similar--diversity.
>
> Both IVB1 and IVB2 below seem a little "childish" if this transition does in fact occur at about age 12 as Piaget commonly is interpreted. They do seem to me appropriate for the many American children who (I think) begin to exhibit formal processes at earlier age, often considerably earlier.
>
> Similarity of symbol to the real item may present a problem.
>
> Sentence 3 repeats "On a map . . . on the map." Sentence 4--"each other's maps"?

Social interaction. The activity to demonstrate the social interaction activity for the transition from concrete to formal was approved by 76 percent of the panel members participating in the first round of the Delphi procedure. The data presented in Table 4 display that 13 of the 17 panel members agreed that the following activity met the criterion for social interaction.

> Map Skill: Symbols
> Transition: Concrete to Formal
> Piagetian Criterion: Social Interaction
> Sub-skill: Learn to Use Legends on Different Kinds of Maps
>
> Give the students a list of symbols that correspond to objects found in the school building. The symbol should not be similar in appearance to the real object. On a map of the school, which has the name of the objects written in at various locations, have the children place the symbols at the appropriate place on the map. Have the students compare the maps of each other and discuss any differences on the maps.

In addition to the two panel members who responded "NO" to the activity, there were two members who gave other responses. Two of the anecdotal responses gave suggestions for the revised activity while one raised questions as to whether or not social interaction would take place. The specific responses follow:

> The symbol should retain characteristics of what it represents.
>
> I don't see any assurance that social interaction is guaranteed.
>
> "Have the students compare the maps of/with each other and discuss any differences on the map."

Exploration. Thirteen panel members responding to the exploration activity for the transition from concrete to formal and symbols agreed that the criterion was met. The following activity also received

one negative response and three other responses:

Map Skill: Symbols
Transition: Concrete to Formal
Piagetian Criterion: Exploration
Sub-skill: Learn to Use Legends on Different Kinds of Maps

Present to the students several maps which present different information and use many abstract symbols. Cover the legend and ask the students to suggest possible meanings for the symbols which appear on the map. After students suggest meanings for the symbols, have the students look at the legends to determine the actual meaning of the symbols.

Two anecdotal responses gave suggestions for improvements that could be made in the wording. The specific responses follow:

Have students suggest symbols. Compare students' suggested symbols with real symbols.

So-so. This is OK, but it doesn't ensure very much exploration. How about this--students are given a map with symbols. They must then develop a map of their own using symbols on the map they have been given.

Transition from Preoperational to Concrete/Second Round

Concrete experiences. The result of the panel responses for the second round activity for the concrete experiences criterion and the transition from preoperational to concrete was a 94 percent agreement. As displayed in Table 4, 15 out of 16 panel members agreed that the following activity met the concrete experience criterion.

Map Skill: Symbols
Transition: Preoperational to Concrete
Piagetian Criterion: Concrete Experiences
Sub-skill: Learn to Use Legends on Different Kinds of Maps

Take two photographs of items in a classroom and attach the photographs to a designated set of objects in a classroom. As the

> students move about the room, have them note the pictures of the objects. Have each student draw pictures of the designated set of objects and have them attach the pictures to the objects when finished. After all the students have drawn all the objects, place the photographs on a piece of poster-board labeled "LEGEND". Prepare a map large enough to include the second set of photographs in their approximate location. Have the students take turns placing their drawings on the photographs attached to the map.

Three of the five anecdotal responses were complimentary in nature while the other two gave suggestions for improvement. The specific responses follow:

> Pictures are not three-dimensional. Why not select scale items used in doll houses?
>
> Good activity--Need not be described as a "group activity"; i.e., "after all have finished."
>
> Excellent prototype--should be your #1 activity.
>
> Looks good.
>
> It might be worthwhile to consider involving the students in the picture taking.

Further revision would be based on the suggestions made in the anecdotal responses.

Social interaction. The second round activity for the transition from preoperational to concrete, which was written to demonstrate social interaction, was as follows:

> Map Skill: Symbols
> Transition: Preoperational to Concrete
> Piagetian Criterion: Social Interaction
> Sub-skill: Understand that Real Objects Can Be Represented by Pictures or Symbols on a Map
>
> In groups, have the students draw pictures of objects found in a photograph of your classroom or school playground. Make a map of

the area included in the photograph and have the students take turns placing their pictures on the map. After all the pictures of the objects have been placed on the map, the group should look at the pictures and point out similarities and differences of each of the sets of pictures.

As displayed in Table 4, 15 of the panel members agreed that the criterion was met. One panel member did not believe the criterion was met. While the agreement level was the same as the first round activity, 96 percent, the second round activity produced three anecdotal responses. These responses were:

Limited social interaction--How about having them create a "model city" or "model school" in groups of two or three.

Spell out reason for comparing each set of pictures—e.g., "for the purpose of . . . or with emphasis on demonstrating . . ."

Again, why photos, which have 1 dimension?

The anecdotal responses provided suggestions for further revision of the activity?

Exploration. The agreement level for the second round exploration activity was 81 percent. Two panel members chose to respond neither positively nor negatively, 1 responded negatively, and 13 responded positively. Following is the second round activity:

Map Skill: Symbols
Transition: Preoperational to Concrete
Piagetian Criterion: Exploration
Sub-skill: Understand that Real Objects Can Be Represented by Pictures or Symbols on a Map

Mark off a portion of the floor in a room to be used as a map of the room. Place a star at various points around the map to represent real objects found in the room. Take pictures of these objects. Identify one of the objects as a point of reference and put a picture of the object where the star had been. Ask

> the students to identify other objects in the room and to place the picture where the star had been.

The suggestions from the three anecdotal responses centered on the use of some form of manipulative object. The responses follow:

> Fine, but requires (as in previous activities) a lot of camera work. Sand tables and representation of the street in front of school or on which they live can produce graphic concrete experience using milk cartons for houses, etc.
>
> Use miniatures of objects in the room.
>
> Not clear.

Further revisions might include the use of three-dimensional objects or representations of three-dimensional objects.

Transition from Concrete to Formal/Second Round

Concrete experiences. The responses to the second round activity for concrete experiences and the transition from concrete to formal resulted in an agreement level of 94 percent. Fifteen panel members agreed that the criterion was met. One panel member did not agree. Following is the wording of the activity:

> Map Skill: Symbols
> Transition: Concrete to Formal
> Piagetian Criterion: Concrete Experiences
> Sub-skill: Learn to Use Legends on Different Kinds of Maps
>
> Give each student a map showing objects found in the school building and a symbol to correspond with each object. The symbol should retain some similarities with the real objects. On a map of the school building have the children place the symbols at the appropriate places.

Two anecdotal responses were made. One suggested an extension of the

activity while the other stated a question regarding the purpose of the activity. The responses follow:

> Have them also make the map.
>
> I don't think you are doing what you propose--"teach to use legends in different kinds of maps." To do this you would use color, relief and symbols which "retain some similarities."

The ideas mentioned in the anecdotal responses would be the basis for further revision of this activity.

Social interaction. According to the data presented in Table 4, 94 percent of the panel members agreed that the criterion was met in the second round activity to demonstrate social interaction. The activity was worded the following way:

> Map Skill: Symbols
> Transition: Concrete to Formal
> Piagetian Criterion: Social Interaction
> Sub-skill: Learn to Use Legends on Different Kinds of Maps
>
> In groups of no more than four, have the students determine symbols that correspond to a predetermined set of objects found in the school building. The symbols may or may not be similar in appearance to the real object. Have each group place the symbol for each object at an approximate correct location on a map of the school building. As the groups compare symbols, have them discuss the reasons for similarities and differences between choices of symbols.

Neither of the anecdotal responses gave suggestions for revision. They pointed out other considerations to observe with regard to the activity.

> Why is it important to discuss reasons for similarities and differences between choices? The question for focus should be clarity of correspondence and accuracy of placement; perhaps precision of representation.

> Depends on the nature of the symbol-object relationship and nature of groups.

Based on the responses, any further revision of the activity would be minimal.

Exploration. Ninety-four percent of the panel members agreed that the second round activity met the exploration criterion. As displayed in Table 4, this level of agreement was based on 15 "YES" responses and one other response. The anecdotal responses did not give specific suggestions for changing the wording of the activity.

> Map Skill: Symbols
> Transition: Concrete to Formal
> Piagetian Criterion: Exploration
> Sub-skill: Learn to Use Legends on Different Kinds of Maps
>
> Present to the students a map of a real or imaginary place that is void of symbols with numbers to indicate the location of certain phenomena on the map. Give each student a numbered list of the phenomena (a city, park, historical marker, etc.). Have each student create a symbol for each phenomenon and place it by the correct number. After the various symbols are compared, have each student draw a map and include symbols selected from those created by the class members.

Two anecdotal responses came from the second round responses:

> I'm not certain of the objective matching the activity.

> Good. More abstract would be to read a story about or describing a location and have them map it--what symbols? scale? how different? more than one? Perhaps all are correct—which is most accurate or readable?

Based on these responses, the activity would not be revised.

Summary

The Delphi method used in this study created the data necessary for the validation of the activities developed. The first round of the

Delphi method produced agreement for two of the activities relative to the direction map skill at the stated goal of 80 percent. There were also 36 anecdotal responses given by the panel members which provided the basis for the revisions of the second round. At least 80 percent of the panel members who responded to the second round activities related to direction agreed that the Piagetian criterion was met in all six activities. The percentage of agreement ranged from 81 percent to 94 percent.

Only one of the first round map skill activities related to location was believed to have met the Piagetian criterion by the panel members. Based on the 36 anecdotal comments made by the panel members, the second round activities were written. The panel members indicated that the second round activities met the Piagetian criterion. The level of agreement for the second round activities ranged from 88 percent to 100 percent. The social interaction activity for the transition from preoperational to concrete and the exploration activity for the transition from concrete to formal received a percentage of agreement at the 100 percent level.

The first round percentages of agreement for the activities related to scale ranged from 59 percent to 94 percent. The 26 anecdotal responses provided the basis for the second round activities. The panel members believed all of the second round activities met the criterion. The percentages of agreement were all above the 80 percent goal of the study. The social interaction and exploration activities were approved by 100 percent of the panel members.

One-half of the first round map skill activities related to symbols were approved by at least 80 percent of the panel members. The percentages of agreement ranged from 76 percent to 94 percent. While only 14 anecdotal responses were generated from the first round activities, these provided clues for the writing of the second round activities. The panel members approved the second round activities with percentages ranging from 81 percent to 94 percent.

As displayed in Table 5, the final results of the second round of the Delphi technique produced at least an 80 percent agreement on all activities. Because this figure was the goal for the study, the work with the panel members ended with the second round. The anecdotal responses, which produced the information for revision of the activities, will be the basis for any additional revisions which would come after the formal study is finished. The entire listing of the activities is found in Chapter 5 on pages 114-122.

Table 5

Summary of Positive Responses by Panel Members to Map Skill Activities Which Facilitate Cognitive Development

Map Skills and Transitions	Piagetian Criteria					
	Concrete Experiences		Social Interaction		Exploration	
	Percent and Number of Positive Responses		Percent and Number of Positive Responses		Percent and Number of Positive Responses	
	First Round	Second Round	First Round	Second Round	First Round	Second Round
Direction: Preoperational to Concrete	82% / 14	81% / 13	59% / 10	94% / 15	65% / 11	94% / 15
Direction: Concrete to Formal	76% / 13	94% / 15	82% / 14	88% / 14	76% / 13	94% / 15
Location: Preoperational to Concrete	65% / 11	94% / 15	65% / 11	100% / 16	59% / 10	88% / 14
Location: Concrete to Formal	65% / 11	94% / 15	82% / 14	94% / 15	59% / 10	100% / 16
Scale: Preoperational to Concrete	82% / 14	94% / 15	71% / 12	94% / 15	82% / 14	88% / 14
Scale: Concrete to Formal	59% / 10	94% / 15	76% / 13	100% / 16	96% / 16	100% / 16
Symbols: Preoperational to Concrete	82% / 14	94% / 15	94% / 16	94% / 15	76% / 13	81% / 13
Symbols: Concrete to Formal	82% / 14	94% / 15	76% / 13	94% / 15	76% / 13	94% / 15

Chapter 5

SUMMARY, FINDINGS AND RECOMMENDATIONS

A review of current professional literature seems to indicate that students and educators are deficient in their abilities to use the maps encountered in the elementary school social studies program. Also, the literature seems to display that few new approaches designed to alleviate this deficiency have been proposed. Most often the traditional scope and sequence of map skills, with little discussion about how these skills should be presented to elementary school children, are put forth whenever map skills instruction is discussed.

An examination of how children develop cognitive abilities may provide part of the answer to the lack of map reading abilities. It is most often the cognitive development theories of Jean Piaget that are considered when the study of cognition is applied to curriculum revision. The traditional direction for the application of Piagetian thought in curriculum development has been on the stages of cognitive development. The age of children at various stages of development has been a concern for those involved with curriculum revision and development. This approach has produced an awareness of the characteristics of children at the different stages of development. Educators have written learning activities which are based on the supposed characteristics of a learner at a given stage of development. Recent examinations of Piaget's theories, however, have brought a new focus on the process by which children move from stage to stage rather

than on the stages. Tomlinson-Keasey concluded that the stages are "structures that emerge as the child interacts with the environment."[1] The child who is interacting with the environment will be involved in the processes which result in cognitive development and movement from stage to stage will be the result.

This study attempted to produce map skill activities which would facilitate cognitive growth while improving map skill instruction. One element of the study was to identify Piagetian criteria which lead to a higher developmental stage of cognition. Included in the study was the identification of those map skills most often considered as a part of the elementary school curriculum. These included direction, location, scale and symbols. Also, a major outcome of the study was the identification of concrete experiences, social interaction, and exploration as three Piagetian criteria. Based on the identified skills and criteria, 24 map skill activities were written and validated. A modified Delphi procedure was used to validate the activities. A panel of experts used in the Delphi method expressed their opinions as to whether or not the activities met the criteria.

Findings

The stated purpose for the study was to develop activities consistent with criteria, determined from a review of literature, which help produce growth in cognitive development according to Piagetian

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[1]Carol Tomlinson-Keasey, "Structures, Functions and Stages: A Trio of Unresolved Issues in Formal Operations," Jean Piaget: Consensus and Controversy, eds. Sohan Modgil and Celia Modgil (New York: Holt, Rinehart and Winston, 1982), p. 144.

thought. At least 80 percent of the panel members who responded to the second round of activities developed for this study agreed that each of the activities met the stated criteria. The activities represent a major finding of the study in that the appropriateness of the activities has been validated by recognized authorities in the fields of map skills instruction and/or the application of Piagetian thought to the instruction of elementary school children. The activities, as approved by at least 80 percent of the panel members who responded on the second round of the Delphi process, follow, grouped according to the four map skill areas of direction, location, scale and symbols.

Direction

Map Skill: Direction
Transition: Preoperational to Concrete
Piagetian Criterion: Concrete Experiences
Sub-skill: Use Cardinal Directions

Prepare a set of four cards all of the same color. Mark each card with either "north," "south," "east," or "west." Using different colors, make additional sets until there are as many cards as there are pupils. After the cards are randomly distributed, have the students gather in groups by color. Have the students observe the cards of the other group members. Ask each student to (1) name the four directions found on the colored set of his/her group, and (2) go to the wall that is labeled with the direction that corresponds to the card he/she was handed when the cards were randomly distributed.

Second round agreement of 81 percent.

Map Skill: Direction
Transition: Preoperational to Concrete
Piagetian Criterion: Social Interaction
Sub-skill: Relative Directions

Ask the student to position himself/herself at a location in the room and choose a direction to face. Ask the student to name several objects he/she can see from that location to another

student. Using the relative direction terms of left and right, have the student express the direction of the objects relative to his/her location to another student. Ask the two students to discuss the directions that are stated. Have the students move to a new location which would change the relative direction of the objects to the student and again express the direction of the objects relative to his/her location. Have the directions discussed by the two group members, exchange roles and repeat the tasks.

Second round agreement of 94 percent.

Map Skill: Direction
Transition: Preoperational to Concrete
Piagetian Criterion: Exploration
Sub-skill: Relative Directions

Divide your class into groups of two. Using relative directions given by one of the students, have the other student move between two locations on the playground or classroom. After both students have given directions, have the students move through a "trail" set up on the playground or classroom. As each group of students walks through the "trail," have them state the direction they move in terms relative to the environment

Second round agreement of 94 percent.

Map Skill: Direction
Transition: Concrete to Formal
Piagetian Criterion: Concrete Experiences
Sub-skill: Orient a Map Correctly

Show the students a map which indicates the location of items on a playground. Take the students to the playground and by using a magnetic compass, have each student orient the map of the playground and have him/her indicate "north" through the use of a compass rose.

Second round agreement of 94 percent.

Map Skill: Direction
Transition: Concrete to Formal
Piagetian Criterion: Social Interaction
Sub-skill: Use a Compass to Determine Direction

Give each student a magnetic compass. In groups of no more than four, have the students spend several minutes with the compass

observing how the needle reacts as they move about a playground. Have each group determine that each member of the group is using the same procedure for reading the compass. Have each group indicate the direction the needle points and have them develop a hypothesis as to the reason the needles pointed the same way. Have the groups compare their hypotheses with each other.

Second round agreement of 88 percent.

Map Skill: Direction
Transition: Concrete to Formal
Piagetian Criterion: Exploration
Sub-skill: Use the North Arrow on the Map

Give students copies of maps of several local areas (school building, playground, immediate neighborhood) which show no directional symbols. Have them determine the cardinal directions from the external stimuli. Have them place the North Arrow on each map. Provide feedback through a large group discussion or through peer interaction.

Second round agreement of 94 percent.

Location

Map Skill: Location
Transition: Preoperational to Concrete
Piagetian Criterion: Concrete Experiences
Sub-skill: Learn to Make Simple Sketch Maps to Show Location

As students stand in a room, give them a copy of a map of the room which shows the location of an object. Using this object as a point of reference, ask the students to construct a map which shows the location of other objects in the room.

Second round agreement of 94 percent.

Map Skill: Location
Transition: Preoperational to Concrete
Piagetian Criterion: Social Interaction
Sub-skill: Use Relative Terms of Location

Using terms such as near, far, across from, etc. have the students describe the location of various objects in the room. In groups of two, have one student describe to a second student, using these

terms, the location of an object. The second student should move to the object. After moving to the object, have the second student describe his position relative to the first student and at least one object. Have them discuss how each used the terms. Repeat the procedures with the students switching rolls.

Second round agreement of 100 percent.

Map Skill: Location
Transition: Preoperational to Concrete
Piagetian Criterion: Exploration
Sub-skill: Learn to Use Simple Sketch Maps to Show Location

Have the students make "Treasure Maps" for the other class members. These maps will show pictures or representations of objects in the room except for an "X" which denotes the location of one object in the room. The students are asked to determine the missing object on the basis of the location of the other objects.

Second round agreement of 88 percent.

Map Skill: Location
Transition: Concrete to Formal
Piagetian Criterion: Concrete Experiences
Sub-skill: Identify on a Globe the Equator, the Prime Meridian, Lines of Latitude and Lines of Longitude

Ask the students to draw two lines on some form of smooth, unmarked sphere (ball or balloon). One line would divide the sphere in half horizontally; the other would divide the sphere in half vertically. Using a globe as a model, have them label the horizontal line as the Equator and the vertical line as the Prime Meridian. At this point, ask each student to describe a location in one of the quadrants formed by the two lines. Have them look at the globe again to demonstrate the use of additional lines as a tool for location. Have them put additional lines on their spheres and ask them to describe again the location in one of the quadrants. Using the globe as a model, use the terms latitude and longitude to describe the additional lines used in location.

Second round agreement of 94 percent.

Map Skill: Location
Transition: Concrete to Formal
Piagetian Criterion: Social Interaction
Sub-skill: Locate Places Using a Number-and-Key System

In groups of two, have the students play a variation of "20 Questions." Mark off the classroom in a letter-number grid. Have the students take turns guessing what object in the room their partner is thinking of by giving the location in terms of a letter-number combination. The student who is guessing continues until he/she guesses the location of the object. Use the same format to find the location of places on a map using lines of latitude and longitude.

Second round agreement of 94 percent.

Map Skill: Location
Transition: Concrete to Formal
Piagetian Criterion: Exploration
Sub-skill: Use Longitude and Latitude in Locating Places on a Wall Map

After introducing the concept of latitude and longitude, have students look at a map or globe and ask them to describe the location of any place to another student. Then give the students a list of coordinates using latitude and longitude and ask them to identify the locations by name. Finally, give the students a list of locations by name and ask them to give the approximate coordinates using latitude and longitude.

Second round agreement of 100 percent.

Scale

Map Skill: Scale
Transition: Preoperational to Concrete
Piagetian Criterion: Concrete Experiences
Sub-skill: Make Simple Large-Scale Maps of a Familiar Area, such as a Classroom, Neighborhood

Divide a room into halves. Leave objects in one half and label it half "A". Place the outline of several objects found in half "A" on the floor of the second half and label it half "B". Give the students a piece of paper, at least 11" x 18", and have them draw a map of half "A". Have them compare their maps with half "B" and ask them what they notice about the size of the objects.

Second round agreement of 94 percent.

Map Skill: Scale
Transition: Preoperational to Concrete
Piagetian Criterion: Social Interaction
Sub-skill: Compare the Actual Size of an Item with its Map Size

Show a class of students a room with several objects in it, a smaller section of the room with smaller 3-dimensional representations of the objects and a map (11' x 18" in size) of the room showing representations of the objects. In groups no larger than four, have the students discuss the relationship between the items in the room, the 3-dimensional representations and the items shown on the map.

Second round agreement of 94 percent.

Map Skill: Scale
Transition: Preoperational to Concrete
Piagetian Criterion: Exploration
Sub-skill: Compare the Actual Size of an Item with its Map Size

Prepare a map of an area in the school building that shows the correct location and size to scale of several objects. Give a copy of the map to each student and have him/her locate the objects in the building. After observing the objects, ask the students the following question: How does the map size of an object compare with its actual size? Show the students another area of the building and ask the students to draw a map of the area and place certain objects on their maps. Ask the same questions of the students when they finish: How does the map size of an object compare with the actual size?

Second round agreement of 88 percent.

Map Skill: Scale
Transition: Concrete to Formal
Piagetian Criterion: Concrete Experiences
Sub-skill: Make Simple Large-Scale Maps of a Familiar Area, such as a Classroom, Neighborhood

In a room or enclosed area, place a box which is 1 m long and 1 m wide in a marked-off area that is 5 m wide and 5 m long. Have the students measure the dimensions of the box and marked-off area which is drawn to scale. The students need to determine an appropriate scale.

Second round agreement of 94 percent.

Map Skill: Scale
Transition: Concrete to Formal
Piagetian Criterion: Social Interaction
Sub-skill: Determine Distance on a Map by Using a Scale of Miles

Show the students one of the various methods of determining the real distance of a line or space between objects on a map. Divide the class into groups of two and ask each of the students to construct a map to scale. Give them the actual dimensions of the area to map and ask them to determine a scale to use when representing the area. (1) Have them compare their maps and discuss the scale used and the relative size. (2) Have each student place two dots on the map at random locations. Using the scale that was established when they drew the map, have students determine what the actual distance would be between the two spots. Have them show the other member of their group how the distance was determined.

Second round agreement of 100 percent.

Map Skill: Scale
Transition: Concrete to Formal
Piagetian Criterion: Exploration
Sub-skill: Compare Maps of Different Areas to Note that a Smaller Scale Must Be Used to Map Larger Areas

Give the students a map of Nebraska, a map of the North Central United States, the United States and North America. Ask the students how the size of Nebraska changed from map to map. Use a statement of scale to express the scale of each map. Ask the students what they notice about the statement of scale.

Second round agreement of 100 percent.

Symbols

Map Skill: Symbols
Transition: Preoperational to Concrete
Piagetian Criterion: Concrete Experiences
Sub-skill: Learn to Use Legends on Different Kinds of Maps

Take two photographs of items in a classroom and attach the photographs to a designated set of objects in a classroom. As the students move about the room, have them note the pictures of the objects. Have each student draw pictures of the designated set of objects and have them attach the pictures to the objects when finished. After all the students have drawn all the objects,

place the photographs on a piece of poster-board labeled "LEGEND". Prepare a map large enough to include the second set of photographs in their approximate location. Have the students take turns placing their drawings on the photographs attached to the map.

Second round agreement of 94 percent.

Map Skill: Symbols
Transition: Preoperational to Concrete
Piagetian Criterion: Social Interaction
Sub-skill: Understand that Real Objects Can Be Represented by Pictures or Symbols on a Map

In groups, have the students draw pictures of objects found in a photograph of your classroom or school playground. Make a map of the area included in the photograph and have the students take turns placing their pictures on the map. After all the pictures of the objects have been placed on the map, the group should look at the pictures and point out similarities and differences of each of the sets of pictures.

Second round agreement of 94 percent.

Map Skill: Symbols
Transition: Preoperational to Concrete
Piagetian Criterion: Exploration
Sub-skill: Understand that Real Objects Can Be Represented by Pictures or Symbols on a Map

Mark off a portion of the floor in a room to be used as a map of the room. Place a star at various points around the map to represent real objects found in the room. Take pictures of these objects. Identify one of the objects as a point of reference and put a picture of the object where the star had been. Ask the students to identify other objects in the room and to place the pictures where the star had been.

Second round agreement of 81 percent.

Map Skill: Symbols
Transition: Concrete to Formal
Piagetian Criterion: Concrete Experiences
Sub-skill: Learn to Use Legends on Different Kinds of Maps

Give each student a map showing objects found in the school building and a symbol to correspond with each object. The symbol should

retain some similarities with the real objects. On a map of the school building have the children place the symbols at the appropriate places.

Second round agreement of 94 percent.

Map Skill: Symbols
Transition: Concrete to Formal
Piagetian Criterion: Social Interaction
Sub-skill: Learn to Use Legends on Different Kinds of Maps

In groups of no more than four, have the students determine symbols that correspond to a predetermined set of objects found in the school building. The symbols may or may not be similar in appearance to the real object. Have each group place the symbol for each object at an approximate correct location on a map of the school building. As the groups compare symbols, have them discuss the reasons for similarities and differences between choices of symbols.

Second round agreement of 94 percent.

Map Skill: Symbols
Transition: Concrete to Formal
Piagetian Criterion: Exploration
Sub-skill: Learn to Use Legends on Different Kinds of Maps

Present to the students a map of a real or imaginary place that is void of symbols with numbers to indicate the location of certain phenomena on the map. Give each student a numbered list of the phenomena (a city, park, historical marker, etc.). Have each student create a symbol for each phenomenon and place it by the correct number. After the various symbols are compared, have each student draw a map and include symbols selected from those created by the class members.

Second round agreement of 94 percent

Related to the activities as a finding of the study were the anecdotal responses of the panel members. Guidelines for the development of additional activities consistent with the Piagetian criteria came from the review of literature relative to the qualities of the

Piagetian criteria. In the responses relative to concrete experiences, the notion that children need to be involved in the making and building of their own maps seemed to be the strongest statement of the panel members. They also believed that children should be making their own models or representations of real items which might be shown on a map. These representations would be even better if they were three-dimensional. One idea from the review of literature suggested that the objects children use in their concrete experiences should be easily handled and capable of being visualized after the experience is over. Another idea from the review of literature was that overt action such as imitating behavior and directed play are examples of concrete experiences. A word of caution presented in the anecdotal responses was not to place too much emphasis on verbal responses following the interaction with the materials.

Several suggestions relative to the criterion of social interaction were made by the panel members in their anecdotal responses. Most panel members suggested a mutual give-and-take on the part of the students. Verbs used to describe this process were "describe," "make," "compare," "discuss," and "create." The panel also indicated that the size of the group should not exceed seven. One panel member warned that the interaction should be more than verbal verification. Another word of caution was that interaction should not be forced into a factual learning situation. Suggestions from the review of literature called for the social interaction to be between students at similar cognitive levels and should include such things as justifying explanations, verifying facts, resolving contradictions, and adjusting attitudes.

The panel members suggested several ideas for ways to pursue exploration in teaching map skills. One notion was to put students into positions where they have to use environmental clues and develop their own strategies for using these clues for spatial tasks. The panel also believed that asking children to compare maps and other aspects of the environment was a form of exploration. Asking students to use materials they normally did not use was exploration, according to the panel members. Another important aspect of exploration, according to the panel, was to make the experiences progressively complex. From the review of literature, it was determined that the teacher's role in the providing of exploratory activities is that of facilitator. A second thought from the literature was that the exploratory experiences need to be increasingly challenging.

Recommendations

In addition to the findings of the study, additional questions and follow-up studies pertaining to map skill instruction would seem appropriate. The consideration of these questions and studies would provide natural recommendations based on the purpose and findings presented in this study.

The most logical recommendation would be to use the Piagetian criteria identified in the review of the literature as the basis for other activities. These activities could make use of other map sub-skills or might be used to develop other activities for the sub-skills used in this study. The specific comments made by the panel members and those gleaned from the review of literature offer suggestions

for the wording of additional activities as well as providing principles which would be adhered to in order to reflect the Piagetian criteria.

A second recommendation would be to validate further the activities developed in this study with another set of panel members. The validation of the activities in this study could reinforce the findings of this study that the activities do in fact meet criteria. The attempt to validate the activities further should also reveal additional characteristics of the Piagetian criteria and further verify those characteristics previously identified. Since the panel members for this study came from groups of geographic and social studies educators and/or authorities in the application of Piaget's theories to elementary school instruction, the selection of an additional panel could be from only one of the sub-groups of the original study. With the panel members from only one of the sub-groups, the concerns of a specific group could be identified more easily. All the sub-groups could be used in this manner.

An additional recommendation for further study would be for the activities to be one element of a map skills program which also includes tests to determine the cognitive level of a child. This would increase the effectiveness of the experiences provided for the students because the test would suggest which of the two transitions should be focused on. The tests would also produce a means of determining the ultimate growth relative to cognitive stages.

A final recommendation would be to study which of a myriad of sub-skills, under the four map skills identified in the review of the

literature, are basic to a child learning how to read and use maps. Many of the sub-skills seem to be an application of another sub-skill. The identification of these sub-skills would provide direction for additional map skill areas in which activities could be developed.

Conclusion

Map skills instruction continues to be an important part of the elementary school social studies curriculum. In practice, however, there has been little change in the type of instruction and scope and sequence of map skills during the past 30 years. This study addressed the question of what can be done to increase the abilities of students to use maps. The results of this study seem to indicate that activities can be written, using map skill areas, which are consistent with Piagetian criteria that lead to cognitive growth. It would seem that an end result of these activities would be a better understanding of the map skill being presented. The child can also benefit from the activity being presented in such a way as to provide a learning experience which leads to cognitive growth. Until such time as the research on spatial understanding and growth results in classroom activities for teaching map skills, efforts similar to this study will be needed to help create greater understanding of maps.

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APPENDIX A

ANALYSIS OF LITERATURE ON MAP SKILLS USED IN ELEMENTARY SCHOOL

REFERENCES	MAP SKILLS:	Direction	Scale	Location	Symbols	Map Making	Map Projections	Compare Maps
"Interpreting Maps and Globes" (Kohn)		X	X	X	X			
"Map Reading Skills" (Witucki)		X	X	X	X	X		
"Social Studies Skills" (Johns and McClure)		X	X	X	X	X	X	X
"Developing a Sense of Place and Space" (Kennamer)		X	X	X	X		X	
"A Child's Ability to Read Maps" (Rushdoony)		X	X	X	X			
"Map Skills in the Elementary School" (Askov and Kamm)			X	X	X			
"Geography" (Bacon)			X	X	X		X	

REFERENCES	MAP SKILLS:	Direction	Scale	Location	Symbols	Map Making	Map Projections	Compare Maps
"New Directions for Map and Globe Skills" (Chiodo)		X	X	X	X			
"In Search of a Scope and Sequence for Social Studies" (NCSS)		X	X	X	X			X
"Guidelines for Geographic Education" (Natoli)		X	X	X	X	X		X

APPENDIX B

LISTS OF PANEL MEMBERS

POSSIBLE PANEL MEMBERS/First 13 authorities contacted

Phillip Bacon, University of Houston

*Richard W. Copeland, Florida Atlantic University

*John Eliot, University of Maryland

*Bruce M. Frazee, Trinity University

*Duane M. Giannangelo, Memphis State University

*Michael L. Hawkins, University of Georgia

Ed Labinowicz, California State University-Northridge

*Sharon Muir, Oklahoma State University

Haig A. Rushdoony, California State College, Stanislaus

*Joseph P. Stoltman, Western Michigan University

*Cynthia Sunal, West Virginia University

Robert G. Underhill, Virginia Tech University

*Dave W. Van Cleaf, University of Texas-Arlington

* These authorities agreed to participate in the study as panel members.

ADDITIONAL PANEL MEMBERS

Charles Berryman, University of Georgia

R. G. Brown, Florida Atlantic University

Ron Carswell, University of Calgary

Kathryn Castle, Oklahoma State University

Tom Chalkus, Yost School, Portor, Indiana

Helen Neely Cheeck, Oklahoma State University

Sandra DeCosta, University of West Virginia

Judith Finkelstein, University of Northern Iowa

Cy Hawn, University of Georgia

Wayne Herman, University of Maryland

Gary A. Manson, Michigan State University

George W. Maxim, West Chester State University

Gary Moore, University of Wisconsin-Milwaukee

Les Richards, University of Saskatchewan

Mark Schug, University of Wisconsin-Milwaukee

David Shea, University of Wisconsin-Milwaukee

Thomas Turner, University of Tennessee

Hubner M. Walsh, University of Missouri-St. Louis

APPENDIX C

SAMPLE LETTERS TO POSSIBLE PANEL MEMBERS

February 29, 1984 138

Dr. Michael L. Hawkins
Department of Social Sciences
University of Georgia
Athens, GA 30602

Dear Dr. Hawkins:

Several years ago I became interested in the performance of elementary school children in their application of map and globe skills. As a result of that initial interest, I am currently studying this subject for my doctoral dissertation at the University of Nebraska. In my dissertation, I am attempting to apply current thinking on the cognitive development of children to map skills instruction. I am focusing on the application of the developmental theory of Jean Piaget in the development of activities which will help children learn to use and make maps.

Through a review of the literature on the subject of my dissertation, I became aware of your interest in the developmental theory of Piaget and/or map skills instruction in the elementary school. For that reason, I am writing to you seeking your assistance in the formulation of a panel of authorities to react through a modified Delphi study to the activities that I am developing. First, I would ask you to be a part of the panel of authorities. I would also like for you to suggest as many as ten individuals whom you are aware of that have studied either map skills instruction or the application of Piaget's theory to elementary school instruction. From those names that are suggested, I hope to draw additional panel members.

It is my hope that you will be able to assist me in this study. Should you be interested in being a member of my panel, I will send you more information regarding the study and the activities by April 1. If you are not able to be a part of my panel, your suggestions for additional panel members will be appreciated. If you have any questions regarding this request, please write or call me collect at 402-435-2037. I hope you will be able to help in this endeavor.

Sincerely,

Bill Thurmond

Several years ago I became interested in the performance of elementary school children in their application of map and globe skills. As a result of that initial interest, I am currently studying this subject for my doctoral dissertation at the University of Nebraska. In my dissertation, I am attempting to apply current thinking on the cognitive development of children to map skills instruction. I am focusing on the application of the developmental theory of Jean Piaget in the development of activities which will help children learn to use and make maps.

You have been identified to me as an authority in the area of the application of Piaget's theory to elementary school instruction by others who have an interest in this area. I am sending this note, a copy of the activities and instructions for the completion of the instrument to you in hope that you will be able to be a part of a panel of experts in map skills instruction and/or the application of Piaget's theory to elementary school instruction. As a panel member your committment involves participation in a Delphi study to determine the agreement of the activities with Piagetian thought.

If you can be of assistance, please return the response sheets to me as soon as you can. My wish is to have the activities revised, based on suggested changes, by May 15. I hope you can participate in this project.

Thank you very much.

Bill Thurmond
703 South 37th
Lincoln, NE 68510
402-435-2037

OTHER PANEL MEMBERS AS OF APRIL 17, 1984

Tom Chalkus, Porter, Indiana
Helen Cheek, Oklahoma State University
Gary Moore, University of Wisconsin--Milwaukee
Dave Van Cleaf, University of Texas--Arlington
Michael Hawkins, University of Georgia
Richard Copeland, Florida Atlantic University
Bruce Frazee, Trinity University
John Eliot, University of Maryland
Duane M. Giannangelo, Memphis State University
Sharon Muir, Oklahoma State University
Joseph Stoltman, Western Michigan University
Cynthia Sunal, University of West Virginia
Ron Carswell, University of Calgary

APPENDIX D

MATERIALS SENT TO POSSIBLE PANEL MEMBERS

The purpose of the panel is to respond to the activities as they are presented in the instrument. A Delphi method of reaching consensus will be used and the instrument will be modified as the responses from the panel members are received. The modified instrument will be re-submitted to the panel members until consensus is reached. Your participation would require your responding to 24 original activities and the revisions. I have attached a sample page (showing 3 activities) for you to see what form the instrument is in.

March, 1984

SAMPLE SAMPLE SAMPLE SAMPLE SAMPLE SAMPLE SAMPLE SAMPLE

MAP SKILL: Direction	
Piagetian Criteria	Transition from Preoperational to Concrete
I. Concrete Experiences	IA (Relative Directions) The student is asked to position himself at a point in the room and determine a direction to face. The child is asked to name objects and/or people in the room. The student is given the relative terms right and left. Using these terms, the child expresses the relative location of the objects and/or people in relation to the child. On a map of the room, the teacher can write in the relative direction of the objects and/or people to the child as the child states those directions.
II. Social Interaction	IIA (Use Cardinal Directions) Prepare four cards each for several groups of four with each group having a different color. Each color should have a card which corresponds to one of the cardinal directions. Hand the cards out randomly and have the students gather in groups by color. After they are in groups ask them to (1) have each member go to the wall labeled with the direction they have; (2) have each member of the group say all four directions to the others in their group; and, (3) have the group write in the cardinal directions on a map of the room.
III. Exploration	IIIA (Relative Directions) In groups of two, the students will take turns telling the other one the direction they should take to move between any two points. Record all directions given. Ask each person to indicate which directions were the hardest to understand and which directions were the most useful.

IA Does this activity provide concrete experiences consistent with your understanding of concrete experiences within the context of Piaget's cognitive development theory? YES NO

If NO, what changes in the activity would make it consistent? _____

_____

IIA Does this activity provide social interaction consistent with your understanding of social interaction within the context of Piaget's cognitive development theory? YES NO

If NO, what changes in the activity would make it consistent? _____

_____

IIIA Does this activity provide exploratory experiences consistent with your understanding of exploratory experiences within the context of Piaget's cognitive development theory? YES NO

If NO, what changes in the activity would make it consistent? _____

_____

POSSIBLE PANEL MEMBERS

Name: _____

Position: _____

Address: _____

Phone Number: _____

Area of Interest: Piaget-Elementary School Map Skills-Piaget
(Circle one or both)

****

Name: _____

Position: _____

Address: _____

Phone Number: _____

Area of Interest: Piaget-Elementary School Map Skills-Piaget
(Circle one or both)

****

Name: _____

Position: _____

Address: _____

Phone Number: _____

Area of Interest: Piaget-Elementary School Map Skills-Piaget
(Circle one or both)

RESPONSE SHEET FOR PARTICIPATION IN THE DELPHI STUDY

_____ I will be able to participate in the study.

_____ I will not be able to participate in the study.

_____ I will not be able to participate in the study, but will make suggestions for other panel members.

NAME: _____

If you are going to participate in this study, please fill out the following information:

Address: _____

Phone Number: _____

Position: _____

APPENDIX E

ORIGINAL ACTIVITIES

MAP SKILL: Direction	
Piagetian Criteria	Transition from Preoperational to Concrete
I. Concrete Experiences	IA1 (Relative Directions) The student is asked to position himself at a point in the room and determine a direction to face. The child is asked to name objects and/or people in the room. The student is given the relative terms right and left. Using these terms, the child expresses the relative location of the objects and/or people in relation to the child. On a map of the room, the teacher can write in the relative direction of the objects and/or people to the child as the child states those directions.
II. Social Interaction	IIA (Use Cardinal Directions) Prepare four cards each for several groups of four with each group having a different color. Each color should have a card which corresponds to one of the cardinal directions. Hand the cards out randomly and have the students gather in groups by color. After they are in groups ask them to (1) have each member go to the wall labeled with the direction they have; (2) have each member of the group say all four directions to the others in their group; and, (3) have the group write in the cardinal directions on a map of the room.
III. Exploration	IIIA (Relative Directions) In groups of two, the students will take turns telling the other one the direction they should take to move between any two points. Record all directions given. Ask each person to indicate which directions were the hardest to understand and which directions were the most useful.

IA Does this activity provide concrete experiences consistent with your understanding of concrete experiences within the context of Piaget's cognitive development theory? YES NO

If NO, what changes in the activity would make it consistent? _____

IIA Does this activity provide social interaction consistent with your understanding of social interaction within the context of Piaget's cognitive development theory? YES NO

If NO, what changes in the activity would make it consistent? _____

IIIA Does this activity provide exploratory experiences consistent with your understanding of exploratory experiences within the context of Piaget's cognitive development theory? YES NO

If NO, what changes in the activity would make it consistent? _____

MAP SKILL: Direction	
Piagetian Criteria	Transition from Concrete to Formal
I. Concrete Experiences	IB (Orient a Map Correctly) Show the students a map which indicates the location of items in the room as well as a north arrow. Have the students place several three dimensional items on a piece of paper which corresponds in shape and size to the room. Place them at positions designated on the piece of paper. Have the students state the position of the items relative to each other using cardinal and intermediate directions.
II. Social Interaction	IIB (Use a Compass to Determine Direction) Give each student a magnetic compass. In groups have the students spend several minutes with the compass observing how the needle reacts as they move about a playground. Ask for each group to indicate the direction the needle points. Ask each group to state possible reasons the needle pointed the same way.
III. Exploration	IIIB (Use the North Arrow on the Map) Give the students copies of several maps and ask them to find information on the map that would indicate a direction or directions. (Possible answers might include the use of a compass rose, north labeled on the map and the numbering system of parallels and meridians.)

IB Does this activity provide concrete experiences consistent with your understanding of concrete experiences within the context of Piaget's cognitive development theory? YES NO

If NO, what changes in the activity would make it consistent? _____

_____

IIB Does this activity provide social interaction consistent with your understanding of social interaction within the context of Piaget's cognitive development theory? YES NO

If NO, what changes in the activity would make it consistent? _____

_____

IIIB Does this activity provide exploratory experiences consistent with your understanding of exploratory experiences within the context of Piaget's cognitive development theory? YES NO

If NO, what changes in the activity would make it consistent? _____

_____

MAP SKILL: Location	
Piagetian Criteria	Transition from Preoperational to Concrete
I. Concrete Expreiences	IA (Use Relative Terms of Location) Show the students a map of the room that uses drawings of an object to show its location. Describe the location of the objects using such relative terms as near, far, across from, etc. Have students stand by the objects as you describe the location using the relative terms.
II. Social Interaction	IIA (Use Relative Terms of Location) Have students use such relative terms as near, far, across from, etc. to describe the location of objects in the room to each other. Have the students move around the room and stand by other objects. Have another student describe their location relative to the objects.
III. Exploration	IIIA (Use Relative Terms of Location) Have the students play a variation of "20 Questions" by guessing what object in the classroom you are thinking of. First, have them guess by asking the name of a specific object. Then have them guess using relative terms such as near, far, across from etc. Discuss with them which method may have been easier.

IA Does this activity provide concrete experiences consistent with your understanding of concrete experiences within the context of Piaget's cognitive development theory? YES NO

If NO, what changes in the activity would make it consistent? _____

IIA Does this activity provide social interaction consistent with your understanding of social interaction within the context of Piaget's cognitive development theory? YES NO

If NO, what changes in the activity would make it consistent? _____

IIIA Does this activity provide exploratory experiences consistent with your understanding of exploratory experiences within the context of Piaget's cognitive development theory? YES NO

If NO, what changes in the activity would make it consistent? _____

MAP SKILL: Location	
Piagetian Criteria	Transition from Concrete to Formal
I. Concrete Experiences	IB (Identify on a Globe the Equator, the Prime Meridian, Lines of Latitude and Lines of Longitude) Have the student look at a globe which identifies the lines of latitude and longitude. Ask the following questions: (1) What is the line labeled 0° latitude called? (2) What is the line labeled 0° longitude called? (3) What happens to the numbers on the lines of latitude as they move away from 0°?
II. Social Interaction	IIB (Locate Places Using a Number-and-Key System) Have students play a variation of "20 Questions" by guessing what object in the classroom you are thinking of. Have the classroom floor marked off in a letter-number grid. In groups of two, have a the students guess what object the other one is thinking of by giving the location in terms of a letter-number combination.
III. Exploration	IIIB (Use Longitude and Latitude in Locating Places on a Wall Map) Have the students look at a globe or map and ask them to describe the location of a place to another student. After several minutes ask the following questions: (1) How did you describe the location? and, (2) Was there a consistent item or markings to describe the locations?

IB Does this activity provide concrete experiences consistent with your understanding of concrete experiences within the context of Piaget's cognitive development theory? YES NO

If NO, what changes in the activity would make it consistent? _____

IIB Does this activity provide social interaction consistent with your understanding of social interaction within the context of Piaget's cognitive development theory? YES NO

If NO, what changes in the activity would make it consistent? _____

IIIB Does this activity provide exploratory experiences consistent with your understanding of exploratory experiences within the context of Piaget's cognitive development theory? YES NO

If NO, what changes in the activity would make it consistent? _____

MAP SKILL: Scale	
Piagetian Criteria	Transition from Preoperational to Concrete
I. Concrete Experiences	IA (Make Simple Large-Scale Maps of a Familiar Area, such as a Classroom, Neighborhood) Divide a room in half. Have several objects at different locations around ½ of the room. On the other half of the room have the shape of the objects marked on the floor at the corresponding location and size of the real object. Give the students a map of the ½ room drawn to scale while they look at the ½ room where the objects are marked and the ½ room where the objects are located.
II. Social Interaction	IIA (Compare the Actual Size of an Item with its Map Size) In groups have the students measure items in the room in decimeters. (Make the items so that the measurements are an exact decimeter.) Also, have them measure the room. Have the objects drawn on paper to scale in centimeters. Have the students measure the drawn objects. The students can compare results and discuss the reason the measurements are the same.
III. Exploration	IIIA (Compare the Actual Size of an Item with its Map Size) Prepare several maps of areas in the school building which show the correct location and correct size of objects to scale. Show the students the objects and have them notice the size of the object on the map. Have them compare the actual size with the map size. Ask the following question: How would you describe the map size of an object compared to its actual size?

IA Does this activity provide concrete experiences consistent with your understanding of concrete experiences within the context of Piaget's cognitive development theory? YES NO

If NO, what changes in the activity would make it consistent? _____

_____

IIA Does this activity provide social interaction consistent with your understanding of social interaction within the context of Piaget's cognitive development theory? YES NO

If NO, what changes in the activity would make it consistent? _____

_____

IIIA Does this activity provide exploratory experiences consistent with your understanding of exploratory experiences within the context of Piaget's cognitive development theory? YES NO

If NO, what changes in the activity would make it consistent? _____

_____

MAP SKILL: Scale	
Piagetian Criteria	Transition from Concrete to Formal
I. Concrete Experiences	IB (Make Simple Large-Scale Maps of a Familiar Area such as a Classroom, Neighborhood) Place a box which is 1m in length and 1m wide in a marked-off area of the room that is 5m wide and 5m long. Have the students measure the dimensions of the box and marked-off area. Give the students a map which shows a rectangle that is 10cm long and 50cm wide. Tell the students that the map represents the box and marked-off area.
II. Social Interaction	IIB (Determine Distance on a Map by Using a Scale of Miles) Show the students how the scale can be marked on paper or the distance between two points can be marked on paper and measured against the scale. Have the students work in groups to determine distance on a map using a scale of miles. Have them check the computations of the other members of the group. Repeat using other points on the map with the students taking turns determining the correct distance.
III. Exploration	IIIB (Compare Maps of Different Areas to Note that a Smaller Scale Must be used to Map Larger Areas) Give the students a map of Nebraska, a map of the North Central United States, the United States and North America. Ask the students how the size of Nebraska changed from map to map. Use a statement of scale to express the scale of each map. Ask the students what they notice about the statement of scale.

IB Does this activity provide concrete experiences consistent with your understanding of concrete experiences within the context of Piaget's cognitive development theory? YES NO

If NO, what changes in the activity would make it consistent? _____

_____

IIB Does this activity provide social interaction consistent with your understanding of social interaction within the context of Piaget's cognitive development theory? YES NO

If NO, what changes in the activity would make it consistent? _____

_____

IIIB Does this activity provide exploratory experiences consistent with your understanding of exploratory experiences within the context of Piaget's cognitive development theory? YES NO

If NO, what changes in the activity would make it consistent? _____

_____

MAP SKILL: Symbols	
Piagetian Criteria	Transition from Preoperational to Concrete
I. Concrete Experiences	IA (Learn to Use Legends on Different Kinds of Maps) Take pictures of items in a classroom and attach the photographs to the item. Have the students note those items as they move about the room. After all students have observed all objects, have them remove the photographs from the object and place them next to the appropriate name on a piece of posterboard labeled "LEGEND." Prepare a map large enough to include photographs in the approximate location of the items in the legend. Place corresponding numbers by the object on the map and by the photographs in the legend.
II. Social Interaction	IIA (Understand That Real Objects can be Presented by Pictures or Symbols on a Map) In groups, have the students draw pictures of objects found in a photograph. Make a map of the area included in the photograph and have the students take turns placing their pictures on the map. After all the pictures of the objects have been placed on the map, the group should look at the pictures and point out similarities and differences of each of the sets of pictures.
III. Exploration	IIIA (Understand That Real Objects can be Presented by Pictures or Symbols on a Map) Present to the students flannel board stars which are placed on a flannel board map where different items in the room would be found. Identify a point of reference and ask the children to identify the items represented by the stars. Once identified, have the students make a new symbol to represent the item on the map.

IA Does this activity provide concrete experiences consistent with your understanding of concrete experiences within the context of Piaget's cognitive development theory? YES NO

If NO, what changes in the activity would make it consistent? _____

IIA Does this activity provide social interaction consistent with your understanding of social interaction within the context of Piaget's cognitive development theory? YES NO

If NO, what changes in the activity would make it consistent? _____

IIIA Does this activity provide exploratory experiences consistent with your understanding of exploratory experiences within the context of Piaget's cognitive development theory? YES NO

If NO, what changes in the activity would make it consistent? _____

MAP SKILL: Symbols	
Piagetian Criteria	Transition from Concrete to Formal
I. Concrete Experiences	IB (Learn to Use Legends on Different Kinds of Maps) Give the students a list of objects found in the school building and a symbol to correspond with each object. The symbol should retain some similarities with the real objects. On a map of the school which has the name of the objects written in various locations on the map, have the children place the symbols at the appropriate places on the map. Have the students compare the maps of each other and discuss any differences.
II. Social Interaction	IIB (Learn to Use Legends on Different Kinds of Maps) Give the students a list of symbols that correspond to objects found in the school building. The symbol should not be similar in appearance to the real object. On a map of the school, which has the name of the objects written in at various locations, have the children place the symbols at the appropriate place on the map. Have the students compare the maps of each other and discuss any differences on the maps.
III. Exploration	IIIB (Learn to Use Legends on Different Kinds of Maps) Present to the students several maps which present different information and use many abstract symbols. Cover the legend and ask the students to suggest possible meanings for the symbols which appear on the map. After suggesting meanings for the symbols, have the students look at the legends and have them determine the meaning of the symbols.

IB Does this activity provide concrete experiences consistent with your understanding of concrete experiences within the context of Piaget's cognitive development theory? YES NO

If NO, what changes in the activity would make it consistent? _____

_____

IIB Does this activity provide social interaction consistent with your understanding of social interaction within the context of Piaget's cognitive development theory? YES NO

If NO, what changes in the activity would make it consistent? _____

_____

IIIB Does this activity provide exploratory experiences consistent with your understanding of exploratory experiences within the context of Piaget's cognitive development theory? YES NO

If NO, what changes in the activity would make it consistent? _____

_____

APPENDIX F

FIRST REVISION OF ACTIVITIES AND ANSWER SHEETS

MAP SKILL: DIRECTION

Piagetian Criteria	Transition from Preoperational to Concrete	Transition from Concrete to Formal
Concrete Experiences	IA1 (Relative Directions) The student is asked to position himself at a point in the room and determine a direction to face. The student is asked to name objects and/or people in the room. The student is given the relative terms right and left. Using these terms, the student expresses the relative location of the objects and/or people in relation to himself. On a poster-board size map of the room, the teacher can write in the relative direction of the objects and/or people to the student as the student states those directions.	IB1 (Orient a Map Correctly) Show the students a map which indicates the location of items in the room as well as a north arrow. Have the students place several three dimensional items on a piece of paper which correspond in shape to the room and is the same size as the map of the room. Place the items at positions designated on the piece of paper. Have the students position the map in such a way that it is oriented the same way as the piece of paper.
Social Interaction	IA2 (Use Cardinal Directions) Prepare four cards each for several groups of four with each group having a different color. Each color should have a card which corresponds to one of the cardinal directions. Hand the cards out randomly and have the students gather in groups by color. After they are in groups, ask them to (1) have each member go to the wall labeled with the direction they have; (2) have each member of the group say all four directions to the others in their group; and, (3) have the group write in the cardinal directions on a poster-board size map of the room.	IB2 (Use a Compass to Determine Direction) Give each student a magnetic compass. In groups have the students spend several minutes with the compass observing how the needle reacts as they move about a playground. Ask each group to indicate the direction the needle points. Ask each group to state possible reasons the needle pointed the same way.
Exploration	IA3 (Relative Directions) In groups of two, the students will take turns telling the other one the direction they should take to move between any two points. Have students assist you in recording all the directions given. Ask each person to indicate which directions were the hardest to understand and which directions were the most useful.	IB3 (Use the North Arrow on the Map) Give the students copies of several maps and ask them to find information on the map that would indicate a direction or directions. (Possible answers might include the use of a compass rose, north labeled on the map and the numbering system of parallels and meridians.)

MAP SKILL: LOCATION

Piagetian Criteria	Transition from Preoperational to Concrete	Transition from Concrete to Formal
Concrete Experiences	IIA1 (Use Relative Terms of Location) Show the students a map of the room that uses drawn representations of objects to show their locations. Describe the location of the objects by using such relative terms as near, far, across from, etc. Have the students stand by the objects as you describe the location using the relative terms.	IIB1 (Identify on a Globe the Equator, the Prime Meridian, Lines of Latitude and Lines of Longitude) Have the student look at a globe which identifies the lines of latitude and longitude. Ask the following questions: (1) What is the line labeled 0^{o} latitude called? (2) What is the line labeled 0^{o} longitude called? (3) What happens to the numbers on the lines of latitude as they move away from 0^{o}?
Social Interaction	IIA2 (Use Relative Terms of Location) Have students use such relative terms as near, far, across from, etc. to describe the location of objects in the room to other objects. Have a student move around the room and stand by different objects. Have another student describe the location of the student relative to other objects.	IIB2 (Locate Places Using a Number-and-Key System) Have students play a variation of "20 Questions" by guessing what object in the classroom they are thinking of. Have the classroom marked off in a letter-number grid. In groups of two, have a student guess what object the other one is thinking of by giving the location in terms of a letter-number combination.
Exploration	IIA3 (Use Relative Terms of Location) Have the students play a variation of "20 Questions" by guessing what object in the classroom you are thinking of. First, have them guess by only naming the object. Then have them guess using relative terms such as near, far, across from etc. Discuss with them which method may have been easier.	IIB3 (Use Longitude and Latitude in Locating Places on a Wall Map) Have the students look at a map, or even a globe, and ask them to describe the location of a place to another student. After several minutes ask questions that will elicit thoughts. Two examples are: (1) How did you describe the location? and, (2) Was there a consistent item or markings to describe the locations?

MAP SKILL: SCALE

Piagetian Criteria	Transition from Preoperational to Concrete	Transition from Concrete to Formal
Concrete Experiences	IIIA1 (Make Simple Large-Scale Maps of a Familiar Area, such as a Classroom, Neighborhood) Divide a room in half. Have several objects at different locations around ½ of the room. On the other half of the room, have the shape of the objects marked on the floor at the corresponding location and size of the real object. Give the students a map drawn to scale of the ½ room. Have the students compare the map with both halves of the room.	IIIB1 (Make Simple Large-Scale Maps of a Familiar Area such as a Classroom, Neighborhood) In a room or enclosed area, place a box which is 1m in length and 1m wide in a marked-off area that is 5m wide and 5m long. Have the students measure the dimensions of the box and marked-off area. Give the students a map which shows a square that is 10cm long and 10cm wide and a marked-off area which is 50cm long and 50cm wide. Tell the students that the map represents the box and marked-off area.
Social Interaction	IIIA2 (Compare the Actual Size of an Item with its Map Size) In groups, have the students measure items in the room in decimeters. Have the objects drawn on paper to scale in centimeters. Have the students measure the drawn objects. The students can compare results and discuss the reason the actual measurements in decimeters and the map measurement in centimeters have the same numeral.	IIIB2 (Determine Distance on a Map by Using a Scale of Miles) Show the students how distance can be found using a scale. Have the students work in groups to determine distance on a map using a scale of miles. Have them check the computations of the other members of the group. Repeat using other points on the map with the students taking turns determining the correct distance.
Exploration	IIIA3 (Compare the Actual Size of an Item with its Map Size) Prepare several maps of areas in the school building which show the correct location and correct size of objects to scale. Show the students the objects and have them notice the size of the object on the map. Have them compare the actual size with the map size. Ask the following questions: How would you describe the map size of an object compared to its actual size?	IIIB3 (Compare Maps of Different Areas to Note that a Smaller Scale Must be used to Map Larger Areas) Give the students a map of Nebraska, a map of the North Central United States, the United States and North America. Ask the students how the size of Nebraska changed from map to map. Use a statement of scale to express the scale of each map. Ask the students what they notice about the statement of scale.

MAP SKILL: SYMBOLS

Piagetian Criteria	Transition from Preoperational to Concrete	Transition from Concrete to Formal
Concrete Experiences	IVA1 (Learn to Use Legends on Different Kinds of Maps) Take pictures of items in a classroom and attach the photographs to the item. Have the students note those items as they move about the room. After all students have observed all objects, have them remove the photographs from the object and place them next to the appropriate name on a piece of poster-board labeled "LEGEND." Prepare a map large enough to include photographs in the approximate location of the items in the legend. Place corresponding numbers by the object on the map and by the photographs in the legend.	IVB1 (Learn to Use Legends on Different Kinds of Maps) Give each student a map showing objects found in the school building and a symbol to correspond with each object. The symbol should retain some similarities with the real objects. On a map of the school, which has the name of the objects written at appropriate locations, have the children place the symbols at the appropriate places on the map. Have the students compare the maps of each other and discuss any differences.
Social Interaction	IVA2 (Understand That Real Objects can be Presented by Pictures or Symbols on a Map) In groups, have the students draw pictures of objects found in a photograph. Make a map of the area included in the photograph and have the students take turns placing their pictures on the map. After all the pictures of the objects have been placed on the map, the group should look at the pictures and point out similarities and differences of each of the sets of pictures.	IVB2 (Learn to Use Legends on Different Kinds of Maps) Give the students a list of symbols that correspond to objects found in the school building. The symbol should not be similar in appearance to the real object. On a map of the school, which has the name of the objects written in at various locations, have the children place the symbols at the appropriate place on the map. Have the students compare the maps of each other and discuss any differences on the maps.
Exploration	IVA3 (Understand That Real Objects can be Presented by Pictures or Symbols on a Map) Present to the students flannel board stars which are placed on a flannel board map of the room where different items in the room would be found. Identify an item as a point of reference and ask the students to identify the items represented by the stars. Once identified, have the students make a new symbol to represent each item on the map.	IVB3 (Learn to Use Legends on Different Kinds of Maps) Present to the students several maps which present different information and use many abstract symbols. Cover the legend and ask the students to suggest possible meanings for the symbols which appear on the map. After students suggest meaning for the symbols, have the students look at the legends to determine the meaning of the symbols.

MAP SKILL: Direction

Transition from Preoperational to Concrete	Transition from Concrete to Formal
IA1 YES NO Comments:	IB1 YES NO Comments:
IA2 YES NO Comments:	IB2 YES NO Comments:
IA3 YES NO Comments:	IB3 YES NO Comments:

RESPONSE SHEET

MAP SKILL: Location

Transition from Preoperational to Concrete	Transition from Concrete to Formal
IIA1 YES NO Comments:	IIB1 YES NO Comments:
IIA2 YES NO Comments:	IIB2 YES NO Comments:
IIA3 YES NO Comments:	IIB3 YES NO Comments:

RESPONSE SHEET

MAP SKILLS Scale

Transition from Preoperational to Concrete	Transition from Concrete to Formal
IIIA1 YES NO Comments:	IIIB1 YES NO Comments:
IIIA2 YES NO Comments:	IIIB2 YES NO Comments:
IIIA3 YES NO Comments:	IIIB3 YES NO Comments:

RESPONSE SHEET

MAP SKILL: Symbols

Transition from Preoperational to Concrete	Transition from Concrete to Formal
IVA1 YES NO Comments:	IVB1 YES NO Comments:
IVA2 YES NO Comments:	IVB2 YES NO Comments:
IVA3 YES NO Comments:	IVB3 YES NO Comments:

RESPONSE SHEET

APPENDIX G

INSTRUCTIONS FOR COMPLETING DATA GATHERING INSTRUMENT

TO ALL PANEL MEMBERS:

Thank you for agreeing to be a part of the panel for my study. Following is more information about my study and information about responding to my instrument.

The first phase of the study consisted of a review of the literature to determine what map skills should be taught in the elementary school and what experiences, besides physical maturation, should children have to help them develop to a higher cognitive level according to Piagetian thought. In the second phase of the study, I have taken the results of the review of literature and have written activities for teaching map skills which I believe express the characteristics of those experiences which bring about cognitive growth.

The role of the panel is to validate the activities using a Delphi method for reaching consensus. You are asked to comment on the activities as to whether or not they reflect Piagetian thought and develop understanding of map skills. Your comments will be used in revising the activities which will then be sent to you for your consideration. Consensus will be reached when 80% of the panel members agree on the wording of each activity. The number of revisions will be contingent upon the comments received.

Responding to the Instrument

1. The instrument makes use of a matrix which will indicate four map skills:

   - Direction (I)
   - Location (II)
   - Scale (III)
   - Symbols (IV)

   Two transitions of cognitive development:

   -Transition from Preoperational to Concrete (A)
   -Transition from Concrete to Formal (B)

   Three experiences which lead to transition according to Piagetian thought:

   - Concrete Experiences (1)
   - Social Interaction (2)
   - Exploration (3)

2. The map skills listed in parentheses are sub-skills taken from the 1963 list of map skills published by the National Council for the Social Studies.

3. Completing the response sheet:

   - The YES or NO questions relate to agreement with Piagetian thought. If you answer any question NO, I would like for you to suggest ways to bring it into agreement with your understanding of Piagetian thought.

   - The COMMENT section allows for your thoughts about both Piagetian thought and map skills instruction. Please do not feel you must limit your comments to the space available.

   - The response sheet is coded to the activities through the numbers and letters.

4. Return only the response sheet. I will plan on you being able to refer to the original after you receive the revision.

5. The target date for the return of your evaluation and comments for the activities is May 1. This time span is necessary because I have not yet heard from all prospective panel members. My plans are to have the revisions to you on or about May 15. If your address on May 15 will be different, please indicate this by giving me your change of address.

6. If you have questions which must be answered before you can respond to the activities, please feel free to call me collect at 402-435-2037.

7. Thank you for your assistance!

AN ADDITIONAL NOTE ABOUT THE RESPONSE SHEET:

The activities accompanying each criteria should be evaluated with regard to your understanding of that specific criteria. The following statements explain what I mean:

The following question is appropriate for all activities which end with the numeral 1 (IA1, IB1, IIA1, IIB1, etc.):

> Does this activity provide concrete experiences consistent with your understanding of concrete experiences within the context of Piaget's cognitive development theory?

The following question is appropriate for all activities which end with the numeral 2 (IA2, IB2, IIA2, IIB2, etc.):

> Does this activity provide social interaction consistent with your understanding of social interaction within the context of Piaget's cognitive development theory?

The following question is appropriate for all activities which end with the numeral 3 (IA3, IB3, IIA3, IIB3, etc.):

> Does this activity provide exploratory experiences consistent with your understanding of exploratory experiences within the context of Piaget's cognitive development theory?

APPENDIX H

SECOND REVISION OF ACTIVITIES AND COVER LETTER

July 15, 1984

TO ALL PANEL MEMBERS:

Warm greetings from the nation's midlands! From your responses, many of you have had interesting summer activities. I thank you for taking the time to assist in this effort.

After receiving the last response in mid-June, I began the revision process. You will find attached the revisions of the activities. The responses you have me were quite helpful in creating activities more consistent with the criteria. All comments were considered and 23 of the 24 activities were changed to some extent. As a result of your responses, about half of the activities exceeded or came close to meeting the 80% agreement which is the goal for the activities.

The instructions for this round of responses are the same. My timeline is for these to be returned by September 15. If I have all responses by then, I can realistically return the third, and perhaps last, set of activities to you by October 1. If there is a change in your address, please indicate that to me on your response sheet.

Thank you again for your assistance. I look forward to receiving your responses.

Bill G. Thurmond
703 South 37th
Lincoln, NE 68510
402-435-2037

MAP SKILL: DIRECTION

Piagetian Criteria	Transition from Preoperational to Concrete	Transition from Concrete to Formal
Concrete Experiences	**IA1 (Use Cardinal Directions)** Prepare a set of four cards all of the same color. Mark each card with either "north," "south," "east," or "west." Using different colors, make additional sets until there are as many cards as there are pupils. After the cards are randomly distributed, have the students gather in groups by color. Have the students observe the cards of the other group members. Ask each student to (1) name the four directions found on the colored set of his/her group, and (2) go to the wall that is labeled with the direction that corresponds to the card he/she was handed when the cards were randomly distributed.	**IB1 (Orient a Map Correctly)** Show the students a map which indicates the location of items on a playground. Take the students to the playground and by using a magnetic compass, have each student determine a northerly direction. Have each student orient the map of the playground and have them indicate "north" through the use of a compass rose.
Social Interaction	**IA2 (Relative Directions)** Ask the student to position himself/herself at a location in the room and choose a direction to face. Ask the student to name several objects he/she can see from that location to another student. Using the relative direction terms of left and right, have the student express the direction of the objects relative to his/her location to another student. Ask the two students to discuss the directions that are stated. Have the students move to a new location which would change the relative direction of the objects to the student and again express the direction of the objects relative to his/her location. Have the directions discussed by the two group members, exchange roles and repeat the tasks.	**IB2 (Use a Compass to Determine Direction)** Give each student a magnetic compass. In groups of no more than four, have the students spend several minutes with the compass observing how the needle reacts as they move about a playground. Have each group determine that each member of the group is using the same procedure for reading the compass. Have each group indicate the direction the needle points and have them develop a hypothesis as to the reason the needles pointed the same way. Have the groups compare their hypotheses with each other.
Exploration	**IA3 (Relative Directions)** Divide your class into groups of two. Using relative directions given by one of the students, have the other student move between two locations on the playground or classroom. After both students have given directions, have the students move through a "trail" set up on the playground or classroom. As each group of students walk through the "trail," have them state the direction they move in terms relative to the environment.	**IB3 (Use the North Arrow on the Map)** Give students copies of maps of several local areas (school building, playground immediate neighborhood) which show no directional symbols. Have them determine the cardinal directions from the external stimuli. Have them place the North Arrow on each map. Provide feedback through a large group discussion or through peer interaction.

MAP SKILL: LOCATION

Piagetian Criteria	Transition from Preoperational to Concrete	Transition from Concrete to Formal
Concrete Experiences	**IIA1 (Learn to Make Simple Sketch Maps to Show Location)** As students stand in a room, give them a copy of a map of the room which shows the location of an object. Using this object as a point of reference, ask the students to construct a map which shows the location of other objects in the room.	**IIB1 (Identify on a Globe the Equator, the Prime Meridian, Lines of Latitude and Lines of Longitude)** Ask the students to draw two lines on some form of smooth, unmarked sphere (ball or balloon). One line would divide the sphere in half horizontally; the other would divide the sphere in half vertically. Using a globe as a model, have them label the horizontal line as the Equator and the vertical line as the Prime Meridian. At this point, ask each student to describe a location in one of the quadrants formed by the two lines. Have them look at the globe again to demonstrate the use of additional lines as a tool for location. Have them put additional lines on their spheres and ask them to again describe the location in one of the quadrants. Using a globe as a model, use the terms latitude and longitude to describe the additional lines used in location.
Social Interaction	**IIA2 (Use Relative Terms of Location)** Using terms such as near, far, across from, etc. have the students describe the location of various objects in the room. In groups of two, have one student describe to a second student, using these terms, the location of an object. The second student should move to the object. After moving to the object, have the second student describe his position relative to the first student and at least one object. Have them discuss how each used the terms. Repeat the procedures with the students switching roles.	**IIB2 (Locate Places Using a Number-and-Key System)** In groups of two, have the students play a variation of "20 Questions." Mark off the classroom in a letter-number grid. Have the students take turns guessing what object in the room their partner is thinking of by giving the location in terms of a letter-number combination. The student who is guessing continues until he/she guesses the location of the object. Use the same format to find the location of places on a map using lines of latitude and longitude.
Exploration	**IIA3 (Learn to Use Simple Sketch Maps to Show Location)** Have the students make "Treasure Maps" for the other class members. These maps will show pictures or representations of objects in the room except for an "X" which denotes the location of one object in the room. The students are asked to determine the missing object on the basis of the location of the other objects.	**IIB3 (Use Longitude and Latitude in Locating Places on a Wall Map)** After introducing the concept of latitude and longitude, have students look at a map or globe and ask them to describe the location of any place to another student. Then give the students a list of coordinates using latitude and longitude and ask them to identify the locations by name. Finally, give the students a list of locations by name and ask them to give the approximate coordinates using latitude and longitude.

MAP SKILL: SCALE

Piagetian Criteria	Transition from Preoperational to Concrete	Transition from Concrete to Formal
Concrete Experiences	IIIA1 (Make Simple Large-Scale Maps of a Familiar Area, such as a Classroom, Neighborhood) Divide a room into halves. Leave objects in one half and label it half "A". Place the outline of several objects found in half "A" on the floor of the second half and label it half "B". Give the students a piece of paper, at least 11" x 16", and have them draw a map of half "A". Have them compare their maps with half "B" and ask them what they notice about the size of the objects.	IIIB1 (Make Simple Large-Scale Maps of a Familiar Area, such as a Classroom, Neighborhood) In a room or enclosed area, place a box which is 1m long and 1m wide in a marked-off area that is 3m wide and 3m long. Have the students measure the dimensions of the box and marked-off area. Have the students build a map of the box and marked-off area which is drawn to scale. The students need to determine an appropriate scale.
Social Interaction	IIIA2 (Compare the Actual Size of an Item with its Map Size) Show a class of students a room with several objects in it; a smaller section of the room with smaller 3-dimensional representations of the objects and a map (11" x 16" in size) of the room showing representations of the objects. In groups no larger than four, have the students discuss the relationship between the items in the room, the 3-dimensional representations and the items shown on the map.	IIIB2 (Determine Distance on a Map by Using a Scale of Miles) Show the students one of the various methods of determining the real distance of a line or space between objects on a map. Divide the class into groups of 2 and ask each of the students to construct a map to scale. Give them the actual dimensions of the area to map and ask them to determine a scale to use when representing the area. (1) Have them compare their maps and discuss the scale used and the relative size. (2) Have each student place two dots on the map at random locations. Using the scale that was established when they drew the map, have each student determine what the actual distance would be between the two spots. Have them show the other member of their group how the distance was determined.
Exploration	IIIA3 (Compare the Actual Size of an Item with its Map Size) Prepare a map of an area in the school building that shows the correct location and size to scale of several objects. Give a copy of the map to each student and have them locate the objects in the building. After observing the objects, ask the students the following questions: How does the map size of an object compare with its actual size? Show the students another area of the building and ask the students to draw a map of the area and place certain objects on their maps. Ask the same questions of the students when they finish: How does the map size of an object compare with the actual size?	IIIB3 (Compare Maps of Different Areas to Note that a Smaller Scale Must be Used to Map Larger Areas) Give the students a map of Nebraska, a map of the North Central United States, the United States and North America. Ask the students how the size of Nebraska changed from map to map. Use a statement of scale to express the scale of each map. Ask the students what they notice about the statement of scale.

MAP SKILLS: SYMBOLS

Piagetian Criteria	Transition from Preoperational to Concrete	Transition from Concrete to Formal
Concrete Experiences	**IVA1 (Learn to Use Legends on Different Kinds of Maps)** Take two photographs of items in a classroom and attach the photographs to a designated set of objects in a classroom. As the students move about the room, have them note the pictures of the objects. Have each student draw pictures of the designated set of objects and have them attach the pictures to the objects when finished. After all the students have drawn all the objects, place the photographs on a piece of poster-board labeled "LEGEND." Prepare a map large enough to include the second set of photographs in their approximate location. Have the students take turns placing their drawings on the photographs attached to the map.	**IVB1 (Learn to Use Legends on Different Kinds of Maps)** Give each student a map showing objects found in the school building and a symbol to correspond with each object. The symbol should retain some similarities with the real objects. On a map of the school building have the children place the symbols at the appropriate places.
Social Interaction	**IVA2 (Understand That Real Objects can be Represented by Pictures or Symbols on a Map)** In groups, have the students draw pictures of objects found in a photograph of your classroom or school playground. Make a map of the area included in the photograph and have the students take turns placing their pictures on the map. After all the pictures of the objects have been placed on the map, the group should look at the pictures and point out similarities and differences of each of the sets of pictures.	**IVB2 (Learn to Use Legends on Different Kinds of Maps)** In groups of no more than four, have the students determine symbols that correspond to a predetermined set of objects found in the school building. The symbols may or may not be similar in appearance to the real object. Have each group place the symbol for each object at an approximate correct location on a map of the school building. As the groups compare symbols, have them discuss the reasons for similarities and differences between choices of symbols.
Exploration	**IVA3 (Understand That Real Objects can be Represented by Pictures or Symbols on a Map)** Mark off a portion of the floor in a room to be used as a map of the room. Place a star at various points around the map to represent real objects found in the room. Take pictures of these objects. Identify one of the objects as a point of reference and put a picture of the object where the star had been. Ask the students to identify other objects in the room and to place the picture where the star had been.	**IVB3 (Learn to Use Legends on Different Kinds of Maps)** Present to the students a map of a real or imaginary place that is void of symbols with numbers to indicate the location of certain phenomena on the map. Give each student a numbered list of the phenomena (a city, park, historical marker, etc.). Have each student create a symbol for each phenomena and place it by the correct number. After the various symbols are compared, have each student draw a map and include symbols selected from those created by the class members.