This bibliography is intended to offer research paths for geography educators interested in geography learning. It includes research on all three general modes of geographic learning: spatial learning, map learning, and formal geography learning. Chapter 1, "Introduction," contains the following: (1) "What is geography and what is geography learning?" (2) "Structure of the Bibliography"; (3) "Purposes of the Bibliography"; and (4) "What is included in the bibliography and what is not." Chapter 2, "Commentary on Research Paths and Suggestions for Future Research," contains the following: (1) "Spatial learning"; (2) "Map learning"; (3) "Formal geography learning"; and (4) "Affective geography learning." Chapter 3, "Bibliography," lists the following: (1) "Spatial Learning: Research Studies"; (2) "Spatial Learning: Reviews of Research"; (3) "Map Learning: Research Studies"; (4) "Map Learning: Reviews of Research"; (5) "Formal Geography Learning: Research Studies"; (6) "Formal Geography Learning: Reviews of Research"; (7) "Affective Geography Learning"; (8) "Overview: Geography Education"; (9) "Overview: Social Studies Education"; and (10) "Overview: Learning Theory and Educational Strategies." A section titled "A Postscript on Methodology" is included. (EH)
Learning Geography: An Annotated Bibliography of Research Paths

Alfred S. Forsyth, Jr.

Prepared in cooperation with the Committee on Research and External Relations
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Pathways in Geography Series Title No. 11

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How Geographers Learn about How People Learn Geography

Geographers are (supposedly) indefatigable explorers of places. We are people for whom maps are invitations to travel afield and afar. That somewhat romanticized view of who we are and what we do has considerable merit in thinking about research endeavors closer to home. Nothing can be closer to home, nothing more important to us, than helping to foster new generations of geographers.

Al Forsyth's contribution to the PATHWAYS series fits the title exactly: it offers research paths for geography educators interested in geography learning. The pleasure of reading an annotated bibliography is akin to the chance to look over someone's shoulder while he or she is working, to read their research notes, and to say: "Hey, that's interesting. I hadn't seen that before," where that could be a particular source, a novel interpretation of a source you know well, or the provocative juxtaposition of sources that you had not encountered before. For me, Al Forsyth's section headings have already had just that effect: The Affective Learning literature is intriguing. Maybe I should go back and look at...

The annotated bibliography is itself an example of one of his three modes of geographic learning: we can learn from external sources of information during the process of formal education. My only regret is that he did not publish this bibliography two years ago. It would have helped the National Geography Standards writers immensely. It will make all the difference in the future if we are willing to make sure that these do not once again become the road(s) not taken (with apologies to Robert Frost). Learning Geography is a vital piece of scholarship. Pick up Forsyth's challenge and explore a path. As he writes, "the more we know about learning, the more we know about how to educate."

Roger M. Downs
The Pennsylvania State University
Acknowledgements

I would like to thank the National Council for Geographic Education Task Force on Research on Geographic Education, and in particular its chairperson Judith Meyer, for providing me the opportunity to work on this project. In the process of exploring research paths, I have met many wonderful people who have made my travels easier through their kind help. I am particularly grateful to geographers Roger Downs, Sister Madeleine Gregg, Sarah Bednarz, Joseph Stoltman, and David Cole; social science researchers Gaea Leinhardt and Catherine Stainton of the Learning Research and Development Center at the University of Pittsburgh; Connie McCordle at the National Council for Geographic Education; Laurel Singleton at the Social Science Education Consortium; and educational researcher David Lancy of Utah State University. Finally, completing this intellectual journey would not have been possible without the patience and loving support of my wife Kay and children, Cory and Jenna.
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Introduction

As its stature rises within the educational community, geography education increasingly commands local, regional and national attention. Through the work of the Geographic Education National Implementation Project (GENIP), the National Geographic Society Alliances for Geographic Education, National Council for Geographic Education, American Geographical Society, Association of American Geographers, and other efforts, increasing importance is given to geography's place in the curriculum. Recently, geography was named one of the core subjects in the national America 2000 proposal and the subsequent Goals 2000: Educate America Act. It has been a focal subject of the National Assessment for Educational Progress. Geography for Life: National Geographic Standards 1994 is now completed, with its world-class standards.

Geography educators have much to celebrate in the progress that has been made so rapidly. They express concern that further development may be hampered by lack of a solid theoretical foundation and sense of where we are now that permit concerted forward movement in a sensible direction (Downs, 1994). Geography educators are in danger of overleaping our support base of research and data. It is always easier to build the vehicle and decide on the route to take before beginning the journey.

To continue to progress and to improve geography learning for life, those doing research on geography education and geography educators need a baseline, a sense of where we are regarding how young people learn geography. What does the research tell us about how people learn geography? Where is it helpful? Where is it lacking? The principal aim of this bibliography is to provide such a baseline, by presenting a comprehensive view of relevant research on how people learn geography. As the curricular focus evolves from the five fundamental themes (Joint Committee 1984) to the national geography standards, a knowledge of what we know—and do not know—about geography learning may provide some welcome guidance. In choosing paths to follow in geography education, it may help to know the paths the research has already followed.
What is geography and what is geography learning?

For the purposes of this bibliography, I define geography broadly as the study of, or the acquisition of, knowledge of the spatial distribution and interaction of phenomena on or near the surface of the Earth. Geography comprises our understanding of where things are, why they are there, and the importance of those locations relative to others. The distinction between intentional, active study and less structured, sometimes passive acquisition of knowledge hints that geography is something that people learn both directly, in formal instructional settings, and indirectly, outside of school and throughout their lives.

The research indicates that we seem to learn geography in three principal ways, from three information sources. First, we learn from our spatial environment. We are all born geographers. As animals alive and functioning in a spatial environment, we develop a sense of spatial awareness in various ways during our everyday lives. We form mental representations or cognitive maps of real-world space that influence how we get on with the business of living.

Second, we learn by studying and using representations of our spatial environment, principally maps but also photographs and written descriptions and narratives. We learn, therefore, by examining spatial relationships second-hand, vicariously. Whereas in spatial learning we form our individual images of the environment through direct interaction, in map learning we rely on abstract representations of that environment. We interpret information that others structure graphically or verbally.

The third way of learning geography is through formal education, from teachers, textbooks, and instructional activities and materials. This likely involves considerable map learning—and it could even involve spatial learning—but others, principally teachers, prescribe the procedures for gaining knowledge or changing attitudes. Teachers control and guide the various processes of in-school learning.

Structure of the Bibliography

This bibliography includes research on all three general modes of geographic learning. It lists research on spatial learning, how people directly acquire knowledge of their physical environment sufficient for effective functioning. The research examines the formation of mental spatial representations the learner creates from exploring the local environment or from non-formalized learning about distant environments. Spatial learning research examines how cognitive maps of those environments are formed, the nature of those images, and how those images affect other aspects of peoples lives. As subjective environmental perception overlaps considerably with spatial learning, I have also included research on this topic. For the purposes of this bibliography, spatial learning includes conceptions about any aspects of the spatial environment (e.g., weather, the Earth) that children form prior to formal education.

It seems reasonable that learning about one's environment from symbolic representations of that environment made by others might differ in nature from unaided spatial learning. Maps are so important to geography and such a strong, time-honored focus of research that this bibliography lists map learning research separately. The research included in this section focuses on how people learn from maps and how they extract and process information at different developmental stages, rather than on how specific teaching strategies increase map learning skills.
Formal geography learning usually takes place in geography or social studies classes. This bibliography lists research on how young people learn geography from teachers who employ various instructional strategies and materials. In fact, this section presents research focusing on anything in the formal school setting that helps young people learn geography.

Geography learning is more than increased cognition: it involves the effect of such learning (or lack of it) on the attitudes and values of young people. The bibliography, therefore, lists separately the small body of research on affective geography learning, the nature and development of values and attitudes toward other peoples and places.

Each of these major sections of the bibliography is divided into research studies, individual investigations of geography learning that advance our cumulative knowledge base, and comprehensive reviews of research, summarizing the body of work along a particular research path. The latter include, in addition to comprehensive reviews, a small number of particularly elucidative essays or opinion pieces that have firm grounding in relevant research.

Annotations are provided for the research studies in the bibliography but are not given for the reviews of research. In most cases, the focus of a review is evident from its title. Furthermore, the breadth of most reviews makes meaningful, concise annotation impossible.

As the nature of geography learning varies with the characteristics of the learner, it is important to know who the subjects are in research studies in order to increase the generalizability of the findings. Therefore, wherever possible the annotation indicates the research population for the study. (Unless otherwise noted, subjects are from the United States.)

Although each of the major sections of the bibliography—spatial learning, map learning, formal geography learning, and affective geography learning—could be divided into more specific topics, this was not done because so many of the research studies and reviews of research in each section bridge several topics. The confusion caused by such overlapping among studies and topics would reduce the usability of the bibliography. Were this a computer database rather than a written document, perhaps this would not be the case. I further believe that the intellectual synergy gained from inspecting the broad range of studies under the each major heading would be lost if categories were drawn too narrowly.

Following the major substantive sections of the bibliography are three, more general sections. The first, listing the most comprehensive summaries of general geography education research, should aid the researcher in acquiring an overview of the broad field of geography education and help in situating new research endeavors.

Geography in formal education is usually part of the social studies. Reviews of research in social studies education are presented in the next section, therefore, for the light they may shed on geography learning.

Finally, to give the geography researcher a baseline understanding of learning theory and educational strategies in general, helpful background references on these topics are listed.
Purposes of the Bibliography

- **Dimensions**: To reveal the overall breadth and depth of existing research in the field of geography learning.

- **Directions**: To delineate the research paths that have been taken on geography learning.

- **Connections**: By bringing together in one collection research on disparate aspects of geography learning, to point out relationships between kinds of research that might not have been previously associated with each other (e.g., spatial learning and classroom instruction).

Ultimately, the intention of this work is to improve geographic education. The more we know about how young people learn geography, the better we can provide effective education. The more we know about learning, the more we know about how to educate.

What is included in the Bibliography and what is not

- Research that sheds light on how young people learn geography is included; research that surveys how much geography has been learned is not included unless the process involved in that learning is also critically examined. Suffice it to say that many surveys over the years have assessed the amount and nature of geography learning, usually pointing out deficiencies in that learning. Although these efforts provide valuable information for certain purposes in geography education, they do not often enlighten us about how geography learning takes place. In most cases these studies focus on description of end-products, not the means or processes involved in getting there.

- Works such as those delineating geography curricula, new ways of teaching, lesson plans and activities, instructional materials, and methods of assessment, are not included unless they have a firm and clear research basis about how young people learn geography.
Commentary on Research Paths and Suggestions for Future Research

A perusal of the entries in each section of the bibliography gives a general picture of the nature of research on those topics and its current state of health. As a group, the studies are not usually cohesive enough to be called a research agenda, but most point in the same direction. The researchers all seem to be on the same research path. Sometimes alternate routes to the same research goal are evident. Discontinuities along the paths suggest opportunities for future research.

Spatial Learning

This is a prominent and well-trodden research path, highly trodden since the 1970s. In fact, the body of research in this area is so large relative to other aspects of geographic learning that research superhighway is probably a more appropriate term than path. The travelers on this route are mostly cognitive and developmental psychologists, not educators. Much of the research is incremental, with narrowly-focused experimental studies adding minutely to the ever-growing body of findings. The cumulative works of several researchers who investigate spatial learning (e.g., Anooshian, Blaut, Golledge, Herman, and Siegel et al., Liben and Downs, Matthews, Thorndyke, and Goldin, Vosniadou) are cohesive enough to be called research agendas.

Unfortunately for geography education, most spatial learning research is basic research; its intent is to discover how people learn in a particular domain, with little or no concern for the educational applications. Further, the research findings of the psychologists are not being applied to education by curriculum developers or other educators. If more educators engaged in spatial learning research perhaps their research would be more applied, less strictly theoretical. In particular, educators could investigate early spatial learning (e.g., during play in preschool) with an eye to determining how early geographic learning (i.e., the prerequisites for formal education) occurs. In that way findings on spatial learning might be applied to design formal education. Conversely, it is up to geography educators to interpret the findings of the psychologists in order to inform sound educational decisions.
Future research paths in spatial learning might include:

- How can findings about spatial learning be applied to formal geographic education?

- How effective are spatial learning strategies and activities in helping students achieve curricular goals in geography? (A related question is: Should curricular goals for geography include spatial learning goals?)

- Regarding conception studies (e.g., child's conception of weather [Stepans and Kuehn 1985]) and perception studies (e.g., child's perception of rivers [Wilson and Goodwin 1981]), how do children gain these conceptions and perceptions? The few existing studies tend to be descriptive, not explanatory.

- Do memory for spatial location of objects in the near environment and memory for relative locations of places in the larger environment differ? Are they related? Do large-scale and small-scale visuo-spatial memory processes differ?

- How are spatial learning via live exploration and spatial learning learning via simulated exploration (e.g., interactive videodisc) related? How is each affected by the use of maps? Of aerial photographs?

- Is learning in a virtual reality environment different from other spatial learning?

- What is the relationship among proficiency with videogames (often involving simulated travel), spatial ability, and spatial learning?

- What is the nature of learning from different kinds of travel children might engage in (e.g., family vacations, school bus rides, bicycling around a neighborhood)? What are the important variables in this kind of learning?

- Much literature evokes considerable interest in adults' sense of place. What is the nature of children's sense of place and how does it affect spatial learning?

- How are spatial learning and learning about time related? (A related question: How are learning geography and learning history related?)

- Is creative ability or imagination related to spatial learning ability?

- Are psychomotor abilities related to spatial learning ability?

- With all the research on this kind of learning, surprisingly little attention has been paid to individual differences other than gender. How do the results of each of these studies differ with different populations? Related to this, is there any effect of single parent families, increased mobility or other currently prominent sociological variables on spatial learning and sense of place in children?

- A research path is just beginning on the nature and development of expertise in geography (e.g., Downs and Liben 1991): How is expertise in spatial learning attained and how is it different from average competency?
Map learning

This clearly-marked and well-used research path is also traveled by educators and psychologists alike. It is a more meandering path than that of spatial learning research, comprising a mixture of basic and applied, experimental and action or empirical research. Although fewer clear research agendas exist in map learning than in spatial learning, the bodies of work of Blades et al., Kulhavy et al., and (earlier) Towler are impressive.

The preponderance of research in geography education has been on maps and mapping. Research focuses on: characteristics of learners that affect map learning, qualities of maps that either promote or obstruct learning, or procedures or strategies employed by individual learners. Many studies, several recent, have appeared on the relationship between map and text learning. Nearly all studies include implications or suggestions for education, and several report on the effectiveness of training in map learning.

The influence of the work of Piaget is still great: many studies (in both map learning and spatial learning, but more so in the former) are still linked conceptually to his work. Interestingly, a great deal of the research, particularly recently, concludes that children's map reading abilities have been underestimated in the past, that Piaget's developmental framework was too conservative.

Future research paths in map learning might include:

- How can we apply the research findings on map learning in formal geography education?

- What kinds of map learning strategies are most effective for which populations of people? Do different populations have different map learning strategies or patterns of map skill development?

- Many kinds of maps exist, designed for many purposes. How does map learning differ with different kinds of maps (e.g., route maps vs. thematic maps)?

- What is the relationship between spatial learning and map learning? How are spatial learning and graphicacy related? Do children with high spatial ability levels learn map skills more quickly? Do children's play and other spatial learning experiences affect their ability to learn from maps? Is there a relationship between cognitive mapping ability and concrete mapping ability?

- Do personality variables such as self-esteem, egocentrism, and assertiveness correlate with successful learning from maps as opposed to learning from less abstract information sources?

- Is there a relationship between mathematical ability and map learning? Between graphic arts ability and map learning? Between computer literacy and map learning? Between proficiency with videogames (many of which involve representations of space and simulated travel) and map learning?

- How does learning from maps differ from learning from other graphic representations like diagrams or graphs?

- How do learning from aerial photographs, satellite images, and conventional maps differ? Do combinations of these formats promote map learning? How does the
coloring system of satellite images (e.g., false color, color enhancement) affect map learning for students at various levels?

- Concerning the relationship between maps and text, there is some research on how students learn from maps in textbooks and some on how maps affect learning from written text (e.g., Kulhavy in both cases), although such research by educators is lacking. In addition, how do students learn from photographs and pictures in geography texts?

- What are the guidelines for the best use of maps in textbooks to promote learning? What relationship among maps, pictures, and written text is most effective?

- In addition to maps and other graphic representations of spatial relationships, verbal representations of places abound in both written and spoken forms. How do children process and learn from written, non-textbook materials with geographic content and from oral descriptions of places? (The next section addresses textbooks.)

- Are graphics-based learning strategies like concept mapping and knowledge mapping related to geographic map learning? Does practice with concept mapping improve map learning, and vice-versa?

- What is the relationship between graphicacy and literacy? A study of individuals proficient in both, or much stronger in one than the other, might be enlightening.

- How are expert map learners different from average and poor map learners in their learning processes?

- What effect do computer mapping programs have on map learning? Are interactive map programs effective in stimulating map learning?

- How do the results of each of these studies differ with different populations?

Formal geography learning

This research path is discontinuous, more like stones that could be used to cross a stream than a route with clear direction or destination. Most studies compare instructional strategies, although these appear less popular recently, perhaps because they are so difficult to control, fraught with internal and external validity problems. Several studies have sought correlates for place location knowledge, but none recently. Other research foci include mnemonics, use of technology, learning from text-plus-maps, teacher variables, spatial organizers, and text learning.

The kinds of research carried out by psychologists interested in spatial learning or map learning are very different from studies done by geography educators. The former are tight, experimental, incremental studies, often grouped in a sequence, usually clearly tied to larger agendas: the latter are looser, more fragmented, ad hoc, more likely to be empirical action research. Downs (1994) argues that geography education, unlike spatial learning, lacks theories around which to build bodies of research, suggesting a careful consideration of the work of Piaget, Bruner, Vygotsky, and Gardner as starting points in theory construction. Of those, only Piaget appears with any frequency as underpinning geography education research, and his developmental theories are being seriously questioned (Case 1993).
Little research is directly relevant to any of the learning goals represented by the eighteen new standards for geography education (Downs 1993). Considerable geographic learning research stresses skills, predominantly map skills, but not on the goals and objectives represented by the standards. For some of these end-products there have been studies assessing levels of attainment, but no studies have investigated how children learn particular topics or concepts. In this regard, geography differs from other curricular areas like mathematics, where much research exists on how specific topics and concepts are learned (Gregg and Leinhardt 1994). In geography education, the main impetus for research is map skills, not curricular goals that relate to the standards. It is important to know how all content areas in geography are learned, not just maps!

Much of the research in both spatial learning and map learning seeks to identify and understand a developmental sequence of abilities regarding geography learning. There is an assumption that a pattern of normal development exists that proceeds independent of formal instruction. Research on geography education reveals that instruction is sometimes based on research findings on geographic development, but often it is not. Thus most geographic education proceeds, guided by little more than intuition.

Future research paths in formal geography learning might include:

- Although a steady stream of place location studies continues, mostly surveys of place location knowledge, correlating knowledge with certain variables, the question remains, How do children learn place location? What are the cognitive processes involved? Do they differ for different populations? To use a medical analogy, geography educators are becoming quite good at assessing the patient’s current state of health, but we do not know how the body works to a sufficient degree to be able to prescribe preventive measures and cures, to be able to prescribe a healthy lifestyle.

- Psychologists use maps to study human memory and information storage. Should geography educators investigate other applications of maps in education and human learning?

- Is there a relationship between map learning and the use of mapping surrogates, learning and instructional strategies such as concept maps and knowledge maps, in other areas of learning? If the cognitive processes involved in each area are related, what effects, if any, should this have on geography education?

- Although developmental studies exist on spatial learning and map skills, no longitudinal studies of broader geography learning are available. What would such studies reveal about the interactions among spatial learning, map learning, affective learning, and formal education?

- Studies comparing different instructional strategies, learning strategies, or learning environments are no longer common. Difficult as they are to structure, their findings are still valuable. How do various instructional strategies, learning strategies, and learning environments differ in their effects on geography learning?

- Do students who perform well in formal geography education learn in a different manner from those who do not perform well? What different learning strategies are employed?
Learning Geography: A Bibliography of Research Paths

- Some research, mostly from educational psychologists, is available on how students learn from textbooks. It would be useful for geography educators to address how learning from textbooks and non-text instructional materials in geography takes place, especially as the range of such materials continues to expand. How do students learn from geography textbooks? How do they learn from videos? Computer simulations? Some work is appearing on learning from GIS materials, but as more computer-related technologies become available to schools, more research is needed.

- As with the other research paths, not enough attention has been paid in formal geography education research to individual differences. Any research in the future should recognize subject-treatment interactions. Replications with different populations would be valuable.

Affective geography learning

This research path, prominent in Europe in the 1950s and 1960s, has never been popular in this country and now has been virtually abandoned elsewhere. Perhaps it should be resurrected and, like Robert Frost's road not taken, should beckon future researchers. In our shrinking global village, increasingly beset with violent ethnic and racial conflicts, the need to investigate the origin and development of attitudes toward other peoples and countries—and the role for education in those processes—seems critical. Furthermore, it is a research path that parallels nicely the current emphasis on multicultural or diversity education.

Future research paths in affective geography learning might include:

- What stereotypes do young people hold of other peoples and why? After twenty years, replication of earlier descriptive studies might provide useful baseline data.

- What kinds of geography learning activities result in what kinds of attitudes and affective learning outcomes?

- Do popular media affect children's attitudes toward other countries and other peoples?

- How does travel affect peoples attitudes toward other peoples and countries? What are the important variables in educational travel (e.g., traveling companions, duration of trip, intensity of interaction with local population, degree of cultural difference)?

- How does contact with people from other countries (e.g., classroom guest speakers) affect attitudes? What are the critical variables? Do surrogate experiences (e.g., videos) have similar effects?

- What role do peer pressure and the pressure to conform play in developing attitudes toward other peoples and countries?

- Are students developing any sense of transnational identification (e.g., citizen of Earth) with the growth in environmental education and awareness?

- What is the effect of education and increased knowledge about other countries and peoples on children's early attitudes and preconceptions (e.g., replications of Stillwell and Spencer, 1974)? Longitudinal studies might be especially valuable.
Learning Geography: A Bibliography of Research Paths

- Stoltman (1972) looked at territorial decentration in children: How might this form of geography learning affect formal geography education? Replications might be elucidating.

- How are spatial learning and map learning related to formation and development of attitudes about local and distant environments? In particular, how does exploration of the near environment affect formation of such concepts as home and neighborhood?

- Research with different populations (e.g., racial and ethnic groups, different socio-economic status, urban/suburban/rural, male/female) seems especially important on these topics, with its interpersonal emphasis.

References


Bibliography

Spatial Learning: Research Studies


Three experiments to assess degree to which familiarity and differentiation affect recall of location of event. Differentiation and foreknowledge significant; familiarity not. (Preschoolers and 8-year-olds)


Two studies testing the hypothesis that development of spatial frames of reference proceed from egocentric to fixed to coordinated. Hypothesis not supported, but support for existence of reference systems and importance of fixed system at this level. (3-, 4-, and 10-year-olds)


Two studies to assess developmental differences in ability to select and use environmental landmarks to determine distance. Adults and children select different landmarks; adults better at judging distances. (2nd-, 5th-graders, and college students)


Assessment of distance and direction knowledge using different methodologies. Distance and direction measures not comparable. (4th-, 6th-, and 8th-graders)
Learning Geography: A Bibliography of Research Paths


Measures of spatial representation closely related to age; landmark knowledge before route-order knowledge before route-scaling knowledge. (Preschoolers)


Assessment of accuracy and consistency in pointing out landmarks in neighborhood from different reference sites. High accuracy for all age levels; improvement with age in accuracy and consistency. Males outperformed females. (1st/2nd-, 4th/5th-, and 7th/8th-graders)


Investigation of how people relate different parts of city to each other and how they place themselves in city. Reveals different schematic methods of structuring city—associational, topological, positional—based on cognitive differences, travel mode, and familiarity. (Adults—Venezuelan)


Assessed ability to recall locations of buildings by pairwise distance judgments and direct mapping. Accuracy equal for both methods, but subjects preferred direct map. (College students)


Study of development of cognitive mapping from sketch maps drawn on third, fifth and sixth day in city. Maps show increased differentiation over time and hierarchical organization. (Adolescents)


Study of ability to combine perspectives of neighborhood. Evidence of unexpectedly early acquisition of projective and Euclidean concepts. Home acts as central reference point. (6-year-olds—Swedish)


Subjects assembled landscape-feature toys into model of a macro-environment, then were asked to describe their environment and routes between points. All subjects were able to represent a cognitive map by a physical model; older children better able to verbalize descriptions. Evidence that cognitive mapping ability precedes Piagetian spatial learning. (3-, 4-, and 5-year olds)


Replication of Piaget and Inhelder’s experiment with modifications to insure age appropriateness of task. Evidence that very young children can understand spatial relations from other person’s perspectives. (3- and 4-year olds)

Analysis of sketch maps of the world. Detail and accuracy increase with age. Home a powerful concept; accuracy diminishes with distance from home. Includes analysis of places most frequently included and analysis of descriptive characteristics of subjects to find explanatory variables. (K-12th graders—many nations)


Analysis of sketch maps of world to examine influence of location on student perceptions. Found strong influence of home, current events, and cultural factors on map accuracy. (K-12th graders and college students—many nations)


Schema expectancy positively correlated with recall and recognition of locations of object in large-scale environment. (College students)


Amount of travel within region positively correlated with accuracy of cognitive map. Female gender positively correlated with confusion about inter-town distances regardless of amount of travel.


Study of estimates of urban distances showed overestimation of length for routes in town center and routes with bends. Estimates by residents of angles between roads at junctions consistently inaccurate. (College students and adults—British)


Comparison of knowledge of familiar urban environment by experts (taxi drivers) and novices (other adults). Experts have larger knowledge base, do not use a hierarchy of base and secondary street systems, do use a hierarchy of neighborhoods and regions.


Study of acquisition of spatial knowledge of a town by a computer travel simulation. Post-test sketch maps showed considerable learning of the town's locational geography. Majority of maps oriented according to initial orientation of computer map. Suggest strong motor component to spatial acquisition. (Adults)

To solve spatial tasks with different reference frames, strategies are selected based on spatial elements embedded in the tasks. (Adults)


Study of components of cognitive maps (paths, nodes, edges, districts, landmarks) of subjects with analog (map) or digital (language) way-finding preferences, from simulated travel (16mm film) and actual travel. No significant differences between way-finding groups. Different cognitive mapping tasks (free map drawing, written description, recognition, probe recall) elicit different aspects of subject's cognitive map. (Adults)


Analysis of distance estimates of locations in a camp setting showed that judgments were made based on ease of travel (functional distance). (9- and 10-year olds and adults)


Series of studies showing children may possess higher level of spatial competence than previously thought. Euclidean knowledge greater from exploration of familiar environments than non-familiar environments. (3- and 4-year-olds—Great British)


Measures of way-finding, landmark, route and configurational knowledge of school campus supported the Siegel and White hierarchical model of cognitive mapping development. Route and configurational measures strongly influenced as well by degree of familiarity with environment. (1st-, 4th-, and 7th-graders)


Comparison of expert wayfinders' (experienced orienteers) and novice wayfinders' use of topographic route maps to find locations and routes showed that experts employ an "enabling," problem-solving strategy with rich mental representations, whereas novices employ a "preventing," problem-seeking way-finding strategy. (Adults—British)


Comparison of sketch maps of new city after living there two weeks and three months showed increasing importance over time of functional landmarks (vs. traditional landmarks) and of routes connecting them. (Adults—wives of military personnel)

Questionnaire study found that subjects distorted state sizes logarithmically in all but eight states. Males more accurate than females in size estimation. Territoriality (distance of state from subjects' home state) not significant factor. (College students)


Using sketch maps, analyzed changes in cognitive maps of novel environment as function of increased environmental experience. Results underscore importance of landmarks and of paths within the landmark network. Basic landmark network does not change with experience, but exact location does. (College students)


Active exploration of environment superior to passive exploration for children at preoperational level as means of locating, and later relocating, object. No difference in children at concrete operational level. (3- and 4-year-olds; 9- and 10-year-olds)


Study of map study vs. navigation for learning two kinds of urban environments (rectilinear grid street pattern and irregular street pattern) showed differences for method, type of environment (rectilinear easier to learn) and gender (males superior).


Comparison of neighborhood route knowledge acquired from actual field experience and from viewing a videotape. Navigation, sketch mapping, and scene recognition tasks showed mode of experience affected only navigation performance (field experience superior). (9- to 12-year-olds)


Experiment examined procedures used to choose routes that minimize total travel distance among locations as function of type of spatial information (numerical distance data vs. map). Map more effective. (College students—Swedish)


Nature of memory of large-scale space (layout or route) depends on purpose of exploration (seeking layout knowledge or route knowledge). No age level differences. (6- and 7-year-olds; 8- and 9-year-olds)


Two studies analyzing memory for spatial location of objects as function of logical or random arrangement of room and of knowledge of spatial operations. Performance superior for logical arrangement and for higher spatial operational level. (3- and 4-year-olds; K-2nd graders)

Series of studies investigated alternative methods for presenting spatial knowledge, differences in individuals' ability to use those methods, and differences in strategies used to acquire knowledge. Concludes that knowledge sources should be selected on the basis of task requirements and individual abilities. (Adults)


Series of five experiments to compare the performance of good and poor cognitive mappers (based on knowledge of home community) on several spatial tasks: learning a novel environment from unaided navigation, from navigation with map, from map alone; map reading and interpretation. Good cognitive mappers were superior in most tasks to poor mappers, suggesting that they encode and retain spatial information better. (Adults)


Compares environmental learning from actual navigation (by bus) and simulated navigation (viewing a film) along an unfamiliar route. Measures of landmark and survey knowledge showed no difference between groups. Supplementary maps enhanced learning from simulated navigation. (College students)


Development of conceptual model of learning about a novel urban environment. Comparison of cognitive configurations of city by newcomer, and intermediate-length resident groups. Use of stress-values as measures of environmental learning over time. (Adults)


Examination of spatial knowledge acquisition via route learning procedures. Difficulties with distance estimation and accurate sketch mapping after successful route navigation suggest different learning procedures for route navigation and spatial knowledge acquisition. (9- to 12-year-olds)


Examination of how route learning in unfamiliar environment via unidirectional or bidirectional presentations provides locational, directional, and layout information. Results show little spatial knowledge acquisition from route learning. No gender differences. (Adults)


Extensive review of literature on spatial cognition; development of conceptual model of acquiring, representing, and using environmental knowledge; testing of model in case study of child acquiring route knowledge in unfamiliar suburban neighborhood. (11-year-old male)

Description of computational process model of spatial navigation that simulates human acquisition of environmental knowledge through navigation. (Young adults)


Comparison of cognitive maps of room showed accurate maps at all age levels, but only college students' maps were accurate when mental rotation or perspective-taking tasks were required. (1st- and 5th-graders and college students)


Classic collection of studies of spatial activity, place knowledge, place values and feelings, and "place-use." Includes case studies of several families. (Many ages)


Analysis of landscape models of the home environment to determine their system of reference (egocentric, fixed, or coordinated) and to relate them to Piaget's stages of spatial development. Extent and nature of environmental exploration deemed important factors. (5- to 8-year-olds)


After passive navigation of a route, subjects were tested on ability to navigate on their own in reverse direction (route-reversal knowledge), on landmark-reversal knowledge, on inference knowledge, and on ability to construct a model of the environment. Found that route-reversal knowledge precedes landmark-reversal knowledge and that inference ability develops last. (3- to 6-year-olds)


Examines relationship between spatial exploration mode (active or passive) and cognitive representations of a museum room and a playhouse. Children who explored actively gained more accurate spatial knowledge. (20- to 28-month-olds and 36- to 44-month-olds)


Three experiments analyzing spatial knowledge gains from directed and free exploration of a model town. Gains greater from directed exploration. Accuracy greater for 3rd-graders. (Kindergarten and 3rd-graders)

Subjects made bearing and distance estimates to neighborhood landmarks, then described routes among them. Found that even 6-year-olds had accurate spatial knowledge, amount of exploration increased with age, boys explored more than girls, sophisticated way-finding strategies not evident. (6-, 8- and 10-year-olds)


Tests of spatial knowledge over time showed that knowledge was very good after only a short period, increased up to three months, then leveled off. Males outscored females in landmark knowledge but not route or configurational.


In the first study, accuracy of cognitive maps increased with repeated navigation of a model town. In the second study, viewing a real town was as effective as walking through it in generating accurate cognitive maps. (Kindergarten and 5th-graders)


Various spatial knowledge measures showed no gender difference in configurational knowledge, males superior in distance estimates.


Series of 14 experiments investigating ability to point to landmarks in environment from various orientations found that cognitive maps are not holistic, but rather orientation-specific representations.


Experiment contrasts route knowledge and configurational knowledge acquisition via a map or a slide presentation. Results showed that maps are better for configurational knowledge, that either method works well for route knowledge, and that individual differences were greatest in the slide group.


Four studies of inferred relative locations of cities along a west-east axis from Pacific coast to Atlantic coast. Found that speed and accuracy depended on which coast is specified as the reference point and that distances between cities are subjectively stretched for near-to-home cities. (College students)
Investigation of how children impose order on the concrete and abstract features of their environment by finding meaningful relationships among them. (6- to 7-year-olds)

Found that distance estimates are exaggerated for "segmented" routes through various areas of a school as opposed to "unsegmented" or direct, homogeneous routes; and that the overestimations are a function of developmental age. (2nd-, 4th-, and 6th-graders)

Four studies: 1) sketch maps after route navigation were pictorial, linear, or regional in nature; 2) boys explored more extensively than girls in a board game simulation of environmental exploration; 3) prior cognitive structuring for outdoor exploration, in the form of games, can improve spatial knowledge acquisition; 4) contour maps and photo-based maps have different strengths as preparation for way-finding experiences. (Junior high school and college students)

Upperclassmen outscored freshmen on perspective-taking task involving their campus; no differences on distance and direction tasks. In general, no gender differences. (College students)

Analysis of route navigation and reproduction abilities of blindfolded individuals showed considerable spatial ability in the absence of visual cues. (Adults)

Two studies of sketch drawings of community analyzed for scale, perspective, and abstraction showed increased sophistication of 3rd- and 4th-graders' representations over 1st-graders', but a decrease from 3rd to 4th grade. Small sample sizes. (1st-, 3rd-, and 4th-graders)

Analysis of distance estimations between objects separated by opaque barrier, transparent barrier or no barrier showed that children exaggerate distances if barriers are present more than adults do. (Preschoolers and adults)

Analysis of neighborhood sketch maps and verbal descriptions of neighborhood, housing, and travels showed four main kinds of maps (pictorial, schematic, diagrammatic, and map-like), unrelated to subject differences. Content of "mental maps" provides sociological data. (Adolescents)


Eight experiments involving blind and sighted blindfolded children show that blind children have systems of spatial knowledge with rules and principles for processing geometric information that enable successful navigation. (2-year-olds)


Study of spatial knowledge acquisition abilities of educable mentally retarded and trainable mentally retarded boys showed that distance and direction concepts can be taught and that intelligence appears not to be a controlling factor in most cases. (8- to 17-year-old boys—learning disabled)


Study of reproduction of spatial layout seen from different orientations showed that accurate reproduction is easier when the original and the reproduction are aligned. (Kindergarten-2nd-graders)


Performance in reconstructing layout of classroom was superior with life-sized furniture in actual classroom than with small-scale model. (3- to 5-year-olds and female college students)


Found that sex differences may exist for some types of spatial ability but not others; that large differences are found only for mental rotation tasks; that smaller differences are found for spatial perception tasks; and that sex differences, when found, can be detected across the life span. (All ages)


Study found developmental differences in sophistication of route direction-giving skill. (British)


Comparison of learning a city via direct experience or navigating through it with a map showed that the latter produces a more accurate cognitive map and that location of landmarks was easier with respect to central rather than peripheral reference points. (College students)

Investigated orientation with reference to directions in space, orientation with reference to nearby cities, orientation within the community, and ability to maintain orientation during travel. Found that children do not have a well-generalized knowledge of cardinal directions or accurate sense of orientation in space. (4th- through 8th-graders)


Experiments analyzing time required to determine if statements about relative location or orientation of a learned spatial arrangement (e.g., map of U.S. states) are true or false, as indicators of how locational and orientational information is processed. (College students)


Study of distance and walking time estimates between points in a familiar environment. Results indicate a complex relationship between age and distance perception. (11- to 18-year-olds—British)


Analysis of free-recall maps of home area show gender differences: boys' maps are more complex, more extensive, more accurate and more sophisticated cartographically. (6- to 11-year-olds—British)


Comparison of effect of different spatial representation techniques (free-recall sketching, large-scale plans, aerial photographs) on children's ability to externalize about a familiar environment. Findings suggest that choice of technique depends on purpose of the externalization. (6- to 11-year-olds—British)


Analysis of free-recall maps showed that spatial knowledge acquisition increases with age, but not linearly, and that children learn about different environments in different ways. (6- to 11-year-olds—British)


Comparison of children's descriptions of their journey from home to school by means of free-recall sketch interpretation, map interpretation, aerial photograph interpretation, and unaided. Found that children have well-developed sense of place at an early age. (6- and 7-year-olds—British)

Study of ways in which children represent journey from home to school by free-recall mapping, verbal description, interpretation of large-scale plans, and aerial photographs. (6- to 11-year-olds—British)


Analysis of free-recall maps of home area indicated gender difference in awareness of place and spatial representation ability. Boys' performance superior on most measures. (6- to 11-year-olds—British)


Analysis of sketch maps drawn after visiting an unfamiliar area showed that although "priming" reduced sex differences in performance, boys outperformed girls on more complex tasks. (8- to 11-year-olds—British)


Study of children's "mental pictures" of their world, through map drawings and descriptions, showed home-centeredness of Black children, greater environmental complexity for Anglo children, great variation among Mexican-Americans. (Adolescents)


Investigation of method of mental representation of spatial relations (hierarchical, partially hierarchical, nonhierarchical) by having subjects learn locations of objects in spatial layouts or locations on maps of layouts and then completing item recognition, direction, and distance tasks. Support found for partially hierarchical method. (College students)


Administration of a spatial abilities training program resulted in increases in ability for boys and girls equally. (Kindergarteners)


After studying photographs of a model of an island group, subjects indicated on the model the perspective from which the photograph had been taken. Results support Piagetian spatial developmental theory. (Kindergarteners through 6th-graders)

Study explored relationship between general intelligence scores (verbal reasoning and numerical ability) and spatial relations ability scores and accuracy of sketch maps of a familiar area. Results showed no relationship for intelligence but strong relationship for spatial relations ability. (15- to 19-year-olds)


Subjects of differing mobility levels (airline pilots, college students, coal miners) were asked to draw five kinds of maps (local, town, route between home and work, region, world) which were analyzed for organization, spatial/sequential accuracy, features, and complexity. Found geographical mobility and drawing ability significantly related to cognitive map drawing performance; imaging ability not significantly related. (College students and adults—British)


In general, children's extent of environmental exploration correlates positively with their performance on spatial ability tests. Boys explore more extensively than girls. (5- to 8-year-olds—African)


Replication of Nussbaum (1976). Results suggest that Earth concept develops in steps from egocentric to scientific notions through cognitive accommodation in order to assimilate newly acquired information. (4th- through 8th-graders—Israeli)


From analysis of children's notions of an Earth concept, suggested that several notions exist and that children learn the concept Earth in a series of steps from notion to notion rather than in one conceptual leap. (2nd-graders)


Examination of computer and biological metaphors for spatial cognition in experiments comparing sketchmap performance after simulated and actual wayfinding. No significant differences between methods of wayfinding.


Study of development of mapping as distinct from drawing. Subjects observed model of a town, then made a three-dimensional copy of the model, then made a map of the town. Found wide variation in map-drawing ability among subjects with equal modeling ability. (Kindergarten through 2nd-graders)

Analysis of sketch maps of local community with respect to map features (buildings, landmarks, linear places, areas) and subject characteristics. (Adults—British)


Study concludes that infants use location of mother as a spatial landmark or reference point in addition to egocentrism. (9-month-olds)


Replication of Rand (1973). Findings indicate strong positive correlation between class inclusion abilities and Piagetian geographic stages. Questions accuracy of Piaget’s stage-age level correspondence, with few subjects at proposed transition stage. (6- to 12-year-olds)


Results indicate significant positive correlation between spatial stages and classification-class inclusion abilities, with age the only significant personal variable, supporting Piaget. (6- to 12-year-olds)


After a walking tour of a town, subjects drew sketch maps, then were asked to walk to eight landmarks. Among several variables, sketch map characteristics were the best predictors of way-finding performance. (Adults)


Found that sketch maps of the world are centered in three main ways—Eurocentric, Sinocentric, and Americentric, based on individual’s longitudinal location and lingering European colonial influence. (College students—many nations)


Found age-dependent improvement of memory for location of objects. (5- to 10-year-olds and 4-to 6-year-olds—German)


Investigation of children’s conception of neighborhood by examining territorial dimensions of boundedness, activities, control, social relations and identity. (4th- through 6th-graders)

Survey of children's knowledge of physical geography concepts prior to formal instruction showed partial awareness of most concepts, focused on "striking features," and including concepts beyond the local environment. Boys outscored girls; those with kindergarten experience outscored those without. (1st-graders)


After trips through large-scale model town, subjects constructed large- or small-scale replica. Accuracy increased with developmental level and number of trips. Same-scale replicas were more accurate. (Kindergarteners, 2nd- and 5th-graders)


Subjects constructed three-dimensional models of classroom, scored for absolute accuracy, local relational accuracy, and global relational accuracy. Boys’ models were more accurate than girls'. Provision of landmarks to one group of subjects increased accuracy. (Kindergarteners)


Interview study showed that children acquire Earth’s shape and gravity concepts gradually, through stages, and that verbal ability differences are critical. (3rd-through 8th-graders)


Via semi-structured interviews, drawing tasks and route-finding performance subjects were compared on knowledge of local neighborhood and strategies for learning and retracing routes. (3- and 4-year-olds—British and Iranian)


Interview study showed most children are at a stage of nonreligious finalism in their understanding of weather concepts. (2nd- and 5th-graders)


Four studies found that people have difficulty judging geographical relations between locations that are in different geographical or political units. Proposes model of hierarchical storage of spatial information. (College students)


Test of Piaget's theory of territorial decenteration with American children between ages six and twelve showed later onset of decenteration than Piaget (Swiss) or Jahoda (Scottish) found; significant differences for race; no significant differences for gender or rural-urban residence. (1st-through 6th-graders)
See Stoltman (1971)

Comparison of good and poor cognitive mappers based on accuracy of knowledge about local community. General spatial ability, visualization ability, spatial orientation ability, visual memory, and field independence distinguished good mappers from poor. (Adults)

Study recorded subjects' perceived directions for three distant cities and the North Pole, then categorized seven types of 'imaginary maps' based on data. (College students)

By means of tasks and interviews, study investigates how solution of spatial problems reveals mental organization of spatial knowledge. (12- and 18-year-olds and geography teachers—Dutch)

Structured interviews revealed that children hold inconsistent concepts of the Earth's shape and gravity. Suggests that children construct assimilatory concepts to reconcile information from adults with their own naive empirical evidence. (1st-, 3rd- and 5th-graders)

Both Greek and American children held similar concepts about the Earth and the day/night cycle and both modified concepts to conform to accepted scientific notions in similar fashion. (Elementary students—Greek and American)

Interviews with subjects revealed inconsistent conceptualizations, yielding five alternative mental models of the Earth. Transitions among models occur as children accommodate their notions to newly-acquired information. (1st-, 3rd- and 5th graders)

Data on indicated direction of origin from blindfolded subjects driven on a circuitous bus trip suggests an innate sense of direction, with females outperforming males and accuracy increasing with age. (Young children through adult—Australian)

Subjects were given several direction-giving tasks and scored on use of cardinality, relational terms, mention of landmarks, mention of distance, and omission and commission errors. Males used more cardinal directions and distance indicators and committed fewer errors than females. (College students)


Males were found to have larger home range and more complete home area cognitive maps than females. However, no differences were found in cognitive maps of more limited areas to which both sexes had equal exposure. (British)


Assessed cognitive maps of an unfamiliar area after route navigation by analyzing sketch maps for range and accuracy and by having subjects point to five landmarks from three reference points ("triangulation"). Boys showed superior performance to girls on all measures. (8-year-olds—British)


Data analyzed included words to describe a river, detailed drawings of a river, completion of paired word sets related to rivers, and descriptive words for a local river. Comparison of responses of younger and older subjects. Generally subjects perceived rivers positively and as natural features unaltered by people. (10- and 12-year-olds—Australian)


(Australian)

Spatial Learning: Reviews of Research


Map Learning: Research Studies

Study examined the effect of three kinds of reference maps on learning from written and aural prose. Learning was greatest from maps with pictorial features directly related to accompanying text, suggesting a mnemonic function for maps. (5th- and 6th-graders)

Experiment 1: below-average readers who studied a map with features represented by mimetic drawings recalled significantly more related text than those who used a map with labels or symbols and labels. Experiment 2: no effect of type of map on text recall for good readers. Results support the conjoint retention hypothesis (dual coding of spatial and verbal information). (5th- and 6th-graders)

Study, follow-up study and replication all showed cognitive gains for subjects who had undergone an instructional program to teach map- and globe-related concepts. (4- and 5-year-olds)

Study of how children look at pictures with geographic content. (7- and 11-year-olds—British)

Found that males had more accurate knowledge of basic location geography but that there was no difference in acquisition or retention of locations from study of an unfamiliar map. (College students)
Learning Geography: A Bibliography of Research Paths


Assessment of route descriptions from maps on the basis of accuracy and content indicated that those older than ten years had no difficulty. Younger children relied on landmarks and vague direction indicators. (6-, 8-, 10-, 12-year-olds and adults)


Series of studies requiring subjects to use map to locate places in a room, indicate their position on a scale model of a room, walk routes, and navigate through mazes. Indicate children as young as three can use maps. (4- to 6-year-olds)


Investigated whether young children could use a map to follow a route in order to navigate a maze. Five- and six-year-olds performed better than chance. (4- to 6-year-olds)


Reviews research on young children’s successful learning from aerial photographs. Experiment investigating young children’s ability to identify symbols on a large-scale map revealed considerable success by the age of six. (4- to 6-year-olds)


When asked to use a map with several examples of the same landmark symbol to locate a path, only subjects older than six were successful. (4- to 8-year-olds)


Baseline study of children’s ability to identify features from oblique and vertical aerial photographs and to remember content well enough to draw a route from memory. Feature identification was high; the majority successfully completed the route-drawing task. No differences between groups. (1st-graders—American and Puerto Rican)


Investigated the ability of young children to indicate the location of an object in a room from reading maps aligned in various ways. Found that even the youngest subjects succeeded with a map aligned with the room but ability to comprehend a rotated map did not appear until age five. (3- to 5-year-olds)


Study of the developmental differences in ability to interpret an aerial photograph by demonstrating seven map reading skills. Found major developmental transitions after preschool and after third grade. (Preschoolers to 9th-graders)
Learning Geography: A Bibliography of Research Paths


Study of topographic map-reading abilities before and after instruction. Instruction successful for all subjects. Correlations with spatial ability suggest that spatial abilities are "suppressed if not extinguished" as children move through elementary school. (4th- through 6th-graders—Canadian)


Study 1: Almost all subjects accurately identified relief features from anaglyph. Study 2: Accurate recognitions were greater from an anaglyph than from a two-dimensional aerial photograph of the same scene. (4th- through 6th-graders; 2nd-, 5th- and 8th-graders—Canadian)


Experienced topographic map readers used shorter and more numerous eye fixations in studying a topographic map and performed better than inexperienced readers on questionnaire about relative heights. (College students)


Analysis of responses to map interpretation questions from reference maps, topographic maps, and a street map showed better performance for males than females and better performance for Taiwanese than Americans. (College students—American and Taiwanese)


Study of place location knowledge showed negative correlation with exposure to world history and low correlation with exposure to current events news. (High school students)


Results of a test of coordination of perspectives and a test of map conceptualization showed that subjects who have difficulty coordinating perspectives also have difficulty conceptualizing spatial relations of symbols on maps. (Kindergarteners through 6th-graders)


Study found that complexity of map or map test item, rather than item content affected achievement; that map skill achievement increased as Piagetian spatial skills development increased; and that map skill instruction was only effective for subjects at mid-range cognitive development. (4th-graders)

Found that experts and novices employ different strategies for determining location from a topographic map. The former focus on macrorelief, reducing the "area of uncertainty," while the latter focus on microrelief. (Adults—Marine Corps infantrymen)


Investigation of children's recognition of features from a map vs. an aerial photograph showed better performance on the latter and better for familiar areas than unfamiliar. (7- through 11-year-olds—British)


Experiment 1: Subjects who drew a map while learning a passage exhibited greater retention than those who did not. Experiment 2: Subjects who were forced to study a map while learning a passage retained significantly more than those who were merely instructed to study and those given no map. (College students)


Study comparing very young children's ability to extract information from a scale model vs. a photograph found better performance from the latter if it depicted a familiar area. (2- to 3-year-olds)


Investigation of link between cartographic and cognitive developmental theory in understanding development of map comprehension. Presents and interprets data from perspective-taking map tasks. (3- to 8-year-olds)


Comparison of simplified and conventional maps for use by children in locating points; estimating size, shape, and distance; determining direction; and making inferences. Conclusions: simplified map preferable for most tasks especially for younger children; no gender differences; inference-making difficult. (5th- and 6th-graders)


Investigation of relation between graphic organization of a map and operations of human memory for spatial data (chunking) via an experiment testing short-term and long-term recall of map information. Found that graphic organization affects nature of chunks but not nature of spatial memory process. (College students)

Study of encoding strategies for interpreting maps (conceptual categories, spatial clusters, spatial movement, mnemonics), which were then taught to other subjects. Concludes that map learning strategies can be successfully taught. (College students)


Study of relationship of spatial ability, symbolization, and metacognitive skills to reading of route maps (mimetic or itinerary) and whether those skills can be successfully taught. Results are encouraging. (4- to 6-year-olds)


Study testing Piagetian spatial development theory, found significant developmental transitions between 9- and 10-year-olds and between 10-12-year-olds and 13-14-year-olds. No gender differences.


Case study of two boys over two years, analyzed many assessments of geographical skills, knowledge and ability. (7-8-year-olds—Australian)


Study tested children for understanding of verbal definition of map, orthogonal view, arrangement, distance, direction, spatial reference systems, cartographic language, and map-reasoning ability. Findings emphasize difficulty with proportion, scale, and (in younger children) abstract cartographic language. (6- to 8-year-olds—Australian)


Found that careful implementation of Logo Microworld computer program, involving alternative frames of reference and giving directions involving angles and rotations, can result in transfer of spatial skills to map reading. (2nd- and 4th-graders)


Results indicated that subjects who were given the most explicit instruction in successful metacognitive strategies in learning features and locations from a map of a small town significantly outperformed other groups on a recall test. (College students)

Comparison of memory performance and map-reading strategies of high-skill vs. low-skill map readers with contour maps and planimetric maps found superiority of high-skill readers with contour map but not with planimetric. (College students)


Found that both immediate and delayed recall of information from a text passage were enhanced when a map accompanied the text. No gender difference for the text-plus-map group. (College students—Canadian)


Comparison of recall of spatial and non-spatial information from text with maps and without maps (subjects instructed to form mental images) found that maps and mental images were equally effective in information recall and that males outperformed females in the text-with-map group. (College students)


Five map-use experiments investigate the validity for geography learning of findings by psychologists of male superiority in spatial abilities. Findings were supported for children but refuted for college students. (4th-graders and college students)


Gender differences were explored in interpreting Landsat images, envisioning Landsat areas, road map interpretation, and drawing the route to school. Results indicate significantly higher male performance on Landsat tasks. Concludes that spatial ability correlates too weakly with mapping to generalize for mapping tasks. Questions validity of map-drawing tasks as indicators of mapping ability. (6th- through 8th-graders)


Focuses on strategies employed in solving a cartographic problem. Found strong relationship between type of strategy used and performance. Argues for recognition of different strategies by map designers and map-use instructors. (College students—Australian)


Study to discover developmental stages of skills for generalizing information from and comparability between pairs of maps, pictures, and photographs. Found strong association of performance with age. (8- to 14-year-olds—British)
Learning Geography: A Bibliography of Research Paths


Three experiments examined the effect of altering labels attached to points on the memory for spatial locations from maps. Found that semantic clustering of labels can produce mental clustering that aids memory for locations. (College students)


Comparison of effectiveness of several map scales in estimating distances between points. Urges consideration of students' mathematical abilities in designing maps. (7th-graders)


Subjects were asked to locate points on world maps of different projections after being shown the point on a globe. Performance increased with age; no differences among map projections. (2nd-, 4th- and 6th-graders)


Investigated how people remember contour maps (information processing) by comparing experimental group that received priming about contours with control group that received priming about distances. After interval, both groups were asked to identify the map they had been studying from five maps. Significantly better performance by experimental group. (13- to 15-year-olds—British)


Overall recall of details and main ideas from text reading greater for subjects who read the passage and drew a map based on it than for students who read alone. However, map group fared poorer on recall of abstract, non-map-related ideas. (10th-graders—Canadian)


Landsat image interpretation test results at the end of a teaching unit showed that students had significant degree of difficulty interpreting images. Suggests use of images in motivating students. (4th-, 5th- and 6th-graders—Canadian)


Showed that if the teacher is knowledgeable and students are well instructed, third-graders can interpret selected elements of black-and-white satellite images. (3rd-graders—Canadian)
Data from study of children’s preferences in drawing house symbols on a sketch map reveals that boys orient all houses to top of map while girls orient houses perpendicularly to street. Suggests relation to other gender-based spatial ability differences. (Canadian)

Results show that sixth-graders can derive geographic information from a computer image of Landsat digital imagery after initial training. (Canadian)

Study of children’s understanding of digital data showed that sixth-graders can work with digital data. (Canadian)

Experiment 1: Subjects who wrote a narrative description about a simple reference map remembered more map information than those who wrote a geographic description. Experiment 2: Subjects who viewed a map they had drawn remembered more from listening to a story taking place in that map space than those who did not. (5th-graders)

Comparison of recall from maps with or without mimetic drawings showed that presence of drawing increased amount or type of information recalled only at short exposure times. (College students)

Experiment 1: Recall of features from a map with a grid was less but location of features was greater than from a map without a grid. Experiment 2: Subjects recall features from a map in the same sequence in which they saw them. (College students)

Experiment 1: Recall of locations from viewing labels-only, labels-plus-mimetic drawings, or labels-plus-geometric symbols maps was greatest when features were semantically congruent with the label referent. Experiment 2: Subjects were able to recognize more interfeature comparisons from a three-quarter reduction than from a full-scale reference map. (College students)

In two experiments, subjects who learned a map and text later recalled more text events when cued by the original map than when cued by a reorganized version of the original map. (College students)


In two experiments, memory for structural properties of the map predicted the recall of text events for subjects who studied a city map then heard a narrative involving the map features. (College students)


Case study of a blind child with no previous map-use experience and control data from sighted children showed that by age four children can use a two-symbol map to guide navigation and locate objects, and can do so when the map is aligned with any cardinal direction. (4-year-olds)


Investigation of the relationship among understanding maps, symbol comprehension, and logical reasoning. Data showed considerable misunderstanding of symbols.


Subjects placed arrow stickers on map of classroom to show location and orientation of adult at various positions in the room, first with map aligned with classroom then with map rotated 180 degrees. Performance was better with aligned map and boys outperformed girls. Results suggest geometric (spatial) rather than representational (symbolic) difficulty in children's use of maps. (5-to 12-year-olds)


Interview study found that young viewers of landscape and townscape pictures miss much of their physical geography content and that they exhibit little curiosity about formation of features, even man-made ones. (9- and 10-year-olds—British)


Subjects copied a weather map diagram onto a blank country map, then produced a drawn recall weather map. Results showed that meteorologists have superior recall and that they used different information-processing and map-drawing strategies than nonmeteorologists. (Adults—Australian meteorologists and nonmeteorologists)
Learning Geography: A Bibliography of Research Paths


Experiment to study spatial knowledge acquisition from maps where segmentation strategies are used to provide a developmental sequence similar to environmental knowledge acquired from behavior in the environment. Found segmentation strategy emphasizing routes made learning easier. Support for dual coding hypothesis. (Male college students)


Revealed that second-graders can use picture maps of the local area to extract relative distance and direction information, that they can use maps to visualize a different environment, and that they can transfer oral instructions to comparison problems.


Concludes that fourth-graders can acquire map skills integrated into a social studies unit, that maps can help them improve understanding of social studies concepts, and that map learning in school should supplement environmental learning out of school.


Found that intelligence and field independence contributed most to performance on two aerial photograph interpretation tests. Gender differences on only one test. (16- to 90-year-olds)


Interview study showed that symbol recognition from topographic maps and aerial and satellite photographs increases with age, the largest change between six and eight years old. (6-, 8-, and 10-year-olds)


Results of two experiments of recognition priming and distance estimation from maps indicated that psychological distance in cognitive maps depends largely on route distance not Euclidean distance. (College students)


Results showed greater readability for nonstandard maps for all subject groups. (4th- through 6th-graders)


Subjects' responses to questions requiring interpretation of one of four experimental maps—traditional physical-political, traditional pattern with limited modifications, two-color locator map, and map with highly-contrasting colors—showed that certain maps are preferable for certain tasks and that certain tasks are more difficult for children. Suggestions for map design included. (4th- through 6th-graders)

Study of effectiveness of training in map use to improve comprehension of text. Investigated effects of individual differences, reading ability, and visual modal preference. (16- and 17-year-olds—Australian)


Comparison of expert and novice orienteers’ map interpretation skills showed use of experiential knowledge and internal spatial knowledge representation differences for experts. (Adults)


Analysis of children’s sketch maps of the environment supports Piaget’s stages of spatial ability development and other previously established sequences of graphic spatial representations. (1st-through 6th-graders)


Comparison of map learning performance of novices and experts using logical and nonlogical maps showed that logical or non-logical spatial organization affected only the experts. Knowledge of principles of spatial organization judged an integral factor in map learning. (College faculty and students)


Subjects made a smaller model from a three-dimensional model of a town, then drew a map of the town. The maps showed a decrease in detail, an increase in accuracy of spatial arrangement and orientation of map symbols, an increased concern for proportion, and a shift in construction perspective to the vertical from the oblique. (Kindergarteners through 2nd-graders)


Maps of school were read either inside or outside the space shown, aligned with the space or rotated 90 or 180 degrees. Subjects extracted information from map to guide search to target. Found younger children made egocentric errors with rotated maps and target-to-landmark distance errors. (Kindergarteners and 2nd-graders)


Analysis of map-reading performance in terms of map-aerial photograph correlation, symbol translation, and view identification. Results indicate performance depends on learning style and sex of subject and the type of map-reading task. (14-year-olds)

Subjects studied a map and read a related expository passage. Effects of stimulus order (map-text vs. text-map) were investigated, showing that map-first order resulted in greater recall of text information. (College students)


Study extended previous small-scale environment research by asking very young children to use a map to find an object in a large-scale maze. Performance improved significantly with age and depended on the location of the hiding place in the maze.


Study investigated the effect of instruction in "geographic lexemes" and years of geographic instruction on map use performance. Found strong relationship between instruction/experience and performance on higher level tasks of map interpretation. (College students—Canadian)


Study confirms usefulness of school atlas in teaching and argues for analysis of free search map learning, especially of scanning, as ways to improve atlas map design. (British)


Analysis of intercorrelations between several psychological variables (conceptual, spatial, perceptual) and mapwork performance tests underscore importance of perception and spatial abilities. (14- and 15-year-olds—British)


Examination of how students use maps in history and social studies classes. Reports effectiveness of map-comprehension training program. (11th-graders)


Subjects used a time zone map and text on the topic "time and date" to a answer series of questions. Analysis of information processing by the Thinking Aloud Method revealed that successful learners did not retrieve more information but concentrated more on relevant information and adapted better to mental-model construction demands. (College students)


Study tested predictive strength of element and array rotation and shift from direction perception of an array to recall in effectiveness of map use for wayfinding. (4- to 7-year-olds)

Investigated retention of map features and their locations from sixteen experimental maps whose semantic and spatial properties were systematically varied according to familiarity. Results discussed in terms of schema theory and text-map retention research. (College students)


Experiment in which subject listened to a narrative accompanied by a map with features located spatially, a map-outline with features listed next to it, or just an outline found recall performance greatest for map group. Ability of subject to reconstruct spatial relations on the map correlated significantly with recall scores. (College students)


Study of two procedures for encoding map features by clustering: according to semantic attributes or according to spatial relationship. Interaction effects between encoding style and gender and cognitive style were also explored. (College students)


Found that field dependence-independence and figural creativity were significant determinants of spatial recall as assessed through a map reconstruction task and that verbal ability was a factor only for the high school students. (High school and college students)


Study argues that the concept of an upward direction has been extended to represent various horizontal directions (e.g., north on a map). Data from two experiments showed that interpretation of turns on a map becomes increasingly difficult as the direction of the line entering the turn departs from upright. (College students)


Study of responses to questions about a map after studying it and drawing it from memory showed that local relations are learned before large-scale relations, that different types of map information should be presented simultaneously, and that reading a story related to a map is more effective in promoting recall than copying the map. (College students)


Regression analysis revealed that vocabulary and mathematical aptitude test results were significant predictors of map-reading ability, whereas visual-spatial ability and hemisphericity were not. Suggests importance of verbal-analytic ability to map reading. (College students—ROTC)

Study of demographic and cognitive factors possibly related to topographic map interpretation skills and assessment of the effects of two types of instruction on topographic map skills. (College students)


Reanalysis of data from studying effects of instruction on map-drawing skills in order to explore relationship between reasoning levels and developmental change. (5th-graders)


Study of children’s ability to extrapolate lines from coordinate markers to locate the correct point from an array of points showed that children may have a stronger grasp of Euclidean spatial relationships than is often suggested. (4- to 6-year-olds)


A pilot study and a main study investigated the ability of young children to interpret aerial photographs and maps, whether it was related to age and intelligence, and what types of features are most easily recognized. (5- to 11-year-olds and 3- to 4-year-olds—British)


Study identified six effective map learning procedures—partitioning, imagery, memory-directed sampling, pattern encoding, relation encoding, and evaluation. Found visual spatial ability highly correlated with recall of spatial attributes. High ability subjects benefited more from the use of study procedures than low-ability subjects. (College students)


First study to determine to what extent young children can interpret aerial photographs of four communities including their own. Results showed success in identifying features; no differences in identification scores for photographs of one’s own community vs. others; better success for urban middle-class vs. rural subjects. Second study showed increased identification ability with age, leveling off after fourth grade. (Kindergarteners; 2nd-, 4th- and 6th-graders—Puerto Rico)


Found significant interaction for task (list or draw elements from study of maps) and task by map (number of elements on map). Suggested that number of elements on map is critical if task involves successive processing but that subjects will use a chunking strategy to compensate for numerous elements on a simultaneous processing task. (College students)

Found age group differences in visual memory of landmarks and locations from map study and a decrease in performance with age. (Adults)


Study provides a link between spatial learning and map learning. Proposes models of spatial knowledge acquisition from maps and navigation. Experiment testing the models showed that map learning is superior for learning location and straight-line distances; navigation is superior for orientation and estimating route distances. (Adults and college students)


Experiment 1: Comparison of experienced and novice map users found that the former use different spatial encoding techniques and have a better understanding of their own learning process. Experiment 2: Evaluated effectiveness of various prescribed procedures derived from Experiment 1. (Adults and college students)


Study questioned findings of little relationship between measures of spatial ability and map reading for route selection. Experiment investigated effect of lateral preference on map reading; no relationship found.


Study of perspective-taking testing Piaget's stages of development. Found subjects are generally in advance of Piaget's stages and that egocentrism weakens earlier. (Kindergarteners through 6th-graders)


Administered investigator’s Test of Four Spatial Concepts, focusing on two tests dealing with rotation of axes and the concept of a natural axes system. Observed four stages in development of reference system; comparison with Piaget. (6- to 11-year-olds—Canadian)


Investigated understanding of scale by having subjects draw a map from a three-dimensional model of a farm, choosing appropriate symbols from a list of different-sized symbols representing different-sized objects in the model. Performance increased with age. Concludes that concept of scale is fully developed by fifth or sixth grade. Comparison with Piaget. (1st- through 6th-graders—Canadian)

Found strong relationship between visual-spatial ability and map-reading skills for less-experienced (in geography) subjects, no relationship for more experienced subjects. (15- and 17-year-old girls—British)


Two experiments showed that all older subjects and many younger ones could learn the layout of a large playhouse by memorizing a map, and that map memorization facilitated route learning and navigation. Suggests preschoolers are more capable than previously thought. (4- to 7-year-olds)


Study combining qualitative and quantitative measures found that students are object-oriented and do not think in spatial or areal patterns. Consequently they have difficulty applying procedural knowledge (as opposed to declarative knowledge). (7th through 10th-graders—Dutch)


Success of children in combining several map skills to solve a map-using problem suggests map understanding appears quite early. (British)


Study related map drawing abilities from free recall sketch maps of two familiar areas to ten demographic variables. Found a positive relationship with verbal and non-verbal intelligence and reading age; no relationship with age or sex. Concludes that sketch maps are valid for identifying and predicting map reasoning development. (Australian)


Study based on Piaget found that intelligence (verbal and non-verbal), reading age, and map skills scores predicted sketch map accuracy whereas socioeconomic status, sex, and age (within year levels) did not. Proportion was found to be the most difficult map element to work with. (3rd-, 5th-, and 7th-graders)

Examined familiarity and number of elements in maps and diagrams, the way they were represented (labeled drawing or squares), and subjects' ability as factors in subjects' performance in recalling features or locations from study of maps and diagrams. Drawings were remembered better than squares for low-ability subjects; no difference for high ability. High-ability subjects used different study strategies. (High school students)


Found strong relationship between spatial ability scores and map understanding test scores. Higher map reading scores for males. (College students)

**Map Learning: Reviews of Research**


**Formal Geography Learning: Research Studies**


Found that programmed instruction improves performance of low achievers in geography and that attitudes toward programmed instruction were positive.


Found that instruction (map construction vs. field use) and verbal ability were significant factors in learning to read maps, but that interactions occurred among particular map skills, instruction, and subject characteristics. (Kindergarteners)


Concluded that teaching strategy (expository/lecture vs. inquiry/discovery-based) produced no difference in attainment or retention of the concept of spatial diffusion. (College students)


Investigated behaviors of experts and novices when interacting with a GIS program (ArcView). Found three problem-solving styles.

Small sample size. Findings support value of active student response in learning basic geography facts (state capitals) for this population. (10- and 11-year-olds)


Observation study of six subjects showed creative associations of geography facts and personal interests (e.g., pet names) by four subjects. (6-year-old girls)


Proposes an attentional hypothesis to account for males' superior performance on test of place location knowledge acquisition from map study. Suggests difference may be caused by the fact that women have less active control over travel in their lives. (College students)


Content analysis of a 4th-grade geography text sequence and a 5th-grade history sequence. Problems in the topic sequences include unclear content goals, assumed background knowledge, and inadequate explanations.


Found that use of keyword mnemonic devices, especially in combination with the attention-enhancing device of repeated test-like practice (and to a lesser extent cooperative learning) significantly improve place location learning. (6th- and 9th-10th-graders)


Investigated the relationship of map skills to spatial concepts and map skills and spatial concepts sequencing in curricula vis-à-vis Piaget's stages of development. Found strong relationship and later development of spatial concepts than indicated by Piaget. (Kindergarteners, 2nd- and 5th-graders)


Found a strong correlation between travel and geographic skill and knowledge in map skills, place name location, physical geography, and human geography. (College students)


Two experiments investigated the educational value in geography teaching of a computer simulation program modelling effects of erosion on agriculture. (High school students)

Found that subjects at all levels gained from instruction involving concrete activities such as building and drawing solids made of cubes. (5th- through 8th-graders)


Results showed that integration of geography concepts into literature units can enhance learning in both subjects. (8th-graders)


Discovered significant gender differences in frequency with which learning difficulties were experienced and in preferences for particular learning activities and topics. (4th-graders—British)


Findings indicated that recall of location is significantly enhanced by use of keyword mnemonic devices, that mnemonics did not enhance recall of events, and that locations were more frequently recalled than events. (Middle school students)


Results showed that computerized GIS programs can enhance geography learning for students of different academic performance levels. (7th-graders)


Field test data support the assertion that the teacher-prepared video can serve as an effective instructional medium, increasing student learning and improving student attitudes toward map reading.


Comparison with the direct instruction teaching method showed that the Type I incidental learning paradigm was more effective (though not significantly so) in teaching place location. (Elementary students)


Found that students taught by conceptual teaching methods (vs. expository methods) showed significantly greater achievement in geographic understandings, greater (short of significance) achievement in map-reading skills, and were more highly motivated and self-directed. (Elementary school students)

Investigation of students' notetaking found that a notetaking schema can positively affect students' encoding and recall of geographic information. (8th-graders—Taiwanese)


Case study of computer database and simulation use in teaching economic geography found increased student learning and positive attitudes. (16- and 17-year-olds—Canadian)


Study of the relationship of various factors and geographical knowledge found a negative correlation between knowledge and exposure to world history instruction and current events news exposure. (High school students)


Study of learning from an urban geography simulation game under four conditions: simulation on computer, students working in pairs; computer simulation, students working individually; paper and pencil simulation, pairs; paper and pencil, individual. ANOVA showed significant gains for pair learning and greatest gains for the paired paper and pencil condition. Subjects preferred computer and pair conditions.


Found that logical thinking accounted for more variation in achievement than type of instruction. (8th-graders)


Study and replication of learning from a computer-assisted instructional system accompanied by an interactive map display, a static labeled map, or an unlabeled map. Showed significantly greater learning with the interactive map. (High school students; college students)


Results showed that knowledge of current events had a strong effect on place location knowledge whereas previous geography coursework had none. (College students)


Found that curriculum-based assessment increased student skill achievement rates in locating countries on a blank map and matching names of countries with their capital cities. Small sample size. (12- to 14-year-olds)

Found that instruction directed to students' verbal and spatial abilities had no significant effect on performance compared to traditional instruction. Teaching via textbook and whole-group instruction resulted in larger learning gains than teaching with materials directed toward different learning styles and abilities. (High school students)


Found that subjects retained spatial location information from a simulated-travel computer game better with an accompanying labeled (or label-plus-drawings) map. No gender differences found. Follow-up showed long-term retention. (4th- and 5th-graders)


Assessment of the degree to which subjects misperceive relative locations of continents, states, and ocean sizes revealed that misperceptions persist but decrease in frequency across all educational levels, and that gender difference favoring males decreased with age.


Study investigated student planning and production of informative interactive laserdisc programs on the topic of weather for their peers.


Content analysis of teaching activities and instructional materials related to thematic map use for evidence of learning style accommodation and thinking skills instruction, conducted at a summer institute for geography teachers (Tennessee Geographic Alliance/National Geographic Society). Found that, in general, activities and materials accommodated learning styles and promoted higher-order thinking skills. (4th- through 12th-grade teachers)


Survey of international geography educators assessed their understanding of the concept of technology, attitudes toward technology, knowledge and ability to use different technologies, access to and use of technology in their teaching, and perceived effects of technology on their teaching. Includes data in the form of respondents' drawings and diagrams. Presents baseline for future technology education of geography educators.
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Found that both immediate and delayed recall of information from a text passage were enhanced when a map accompanied the text. No gender difference for the text-plus-map group. (College students—Canadian)


Results indicated that use of daily behavioral objectives as an integral component of geography instruction facilitates increased test achievement. (College students)


Geography content analysis of secondary school U.S. and European Advanced Placement history lessons found that 75% of references to geographic content were "passing references," not "substantive references." (High school)


Naturalistic study of conservative constructionist and traditional didactic map-reading and map-interpretation lessons found that active map-makers learned more than passive map-readers, especially among low-knowledge students. (7th-graders)


Data from an analysis of geographic references in *The New York Times* was "aligned" with a content analysis of elementary textbooks and a survey of elementary teachers' goal statements to reveal gaps in education for geographic literacy and to yield recommendations for geography curriculum design. (Elementary)


Investigation of two methods of instruction (discovery and expository) and two cognitive styles (analytic and global) for their effect on lower-order and higher-order geography learning. Found no significant main effects or interactions, but several second-order interactions. (9th-graders)


Results showed that the situated cognition group performed significantly better than the traditional instruction group on a map skills performance test. (4th-graders)

Assessed the effects of organizing a physical geography course according to the General Theory of Systems to encourage students to think more holistically about the environment. Enhanced learning for more committed, achievement-oriented students; negatively affected learning for students with nonacademic orientation and poor study habits. (College students)


Found that place location knowledge varied with subject's socioeconomic status and mobility, in addition to age and gender. (4th- through 6th-graders)


Results indicated a positive relationship between overall mathematics performance and overall geography performance. However, subjects with lower mathematics performance had lower scores on some but not all of the geography measures, hinting at the influence of a common, non-mathematical factor. (3rd- through 6th-graders)


Found that the conventional lecture method was the most successful, that the lecture-laboratory method was successful for a heterogeneous class with regard to achievement levels and learning styles, and that programmed instruction can be used effectively with the lecture method for over-learning.


Found that cognitive theory-based exercises and instructional materials do enhance place location knowledge at this level.


Study of three learning disabled students in which videotaped segments from a world geography textbook were used to provide modeling, rehearsal, and directed feedback in question asking and answering. Results indicated that the training procedures were effective in improving the generalization of target skills. Follow-up showed long-term retention of question asking and answering skills. (9th-graders--learning disabled)


Results of a case study indicate that performance test administration and scoring were no more complicated than for traditional testing.

Factor analysis study to determine how teachers view map-related topics in terms of importance in classroom instruction yielded five prominent factors: context (e.g., interpreting relations, locating boundaries), structure (e.g., symbols, scale, legends), function (direction and orientation, location learning), Earth relations and itinerary construction (navigation activities).


Results showed that subjects taught by demonstration strategies scored significantly higher on the immediate retention measure than those taught by the directed discovery strategy. There was no difference found for measures of delayed retention, immediate or delayed transfer. (3rd-graders)


Large survey study (N=3300) of geography knowledge in three areas (skills and tools, physical geography, cultural geography) using the optional geography component of the International Assessment of Educational Progress. Found positive relationship between scores and books in home, family size, and leisure reading. Students performed best on map and chart reading. (13-year-olds—many nations)


Found that both general reasoning ability and domain-specific knowledge were significant in affecting students’ ability to solve decision-making problems in geography. Performance was higher for gifted than for non-gifted students. No gender difference was found. Revealed inadequate problem-solving strategies, in general. (High school students)


Study examined effects of interactive video vs. traditional text instructional methods, in computer lab and classroom settings, on boys and girls.


Examined effects of three treatments (active excursion, passive excursion, no excursion) on learning and retention of geographical facts and skills from fieldwork. Found that excursion treatments were more successful than no excursion for initial learning and that active excursion was superior for retention. (8th- and 9th-graders)


Study in which subjects received instruction in writing to reinforce textbook learning. Showed significantly more idea units in post-treatment writing samples for experimental group and greater retention but no increase in writing skills. (10th-graders)

Two studies compared effect on recall of information from hearing a prose passage preceded or followed by study of a spatially organized map or a list map. Results indicated that the spatially organized map was superior to the list map regardless of when it was presented, and that subjects in prior presentation conditions and subjects using a spatially organized map scored significantly better than those in other conditions. (Junior high school)


Found that immediate and delayed post-treatment scores were significantly higher for subjects receiving mnemonic-based instruction than for those receiving traditional instruction. (Elementary school students—mildly handicapped)


Results indicated that subjects scored higher on items taught mnemonically than on items taught traditionally, regardless of whether the items required forward or backward association. Found significant correlations between performance and particular mnemonic strategy used. (Junior high school students—learning-disabled)


Regression analysis indicated that gender, race, and travel were significant predictors of geographic literacy as measured by a geography-based competency test. Males and Caucasians were found to have greater knowledge of geographic concepts than females and Blacks.


Study found that instruction using mnemonics was more effective than traditional lecture (i.e., listen/discriminate) method and that the combination of mnemonics and test-like practice was particularly effective in enhancing learning of place location. (5th-graders—50 percent Black)


Content analysis of secondary geography textbooks from Australia, Greece, Japan, Sweden, and the U.S., focusing on verbo-visual content. Found that American textbooks were the largest but had the least information, few maps, and an average number and size of pictures.

Study examined the effects of presence vs. absence of reader-generated map-like representations (spatial organizers) on subjects' delayed recall of a narrative passage. Results indicated that low ability students were negatively affected by map construction while the performance of high ability students was enhanced. (College students)


Study investigating effects on learning geography facts and problem solving of topical instruction vs. relationship instruction found no difference regarding factual learning and greater ability of the relationships instruction group to juxtapose concepts and principles. (10th-graders)


Study of learning concepts via the "reception learning" model found that children receiving the audio-tutorial instruction attained a concept development level more advanced than the relevant concept development of older children instructed by conventional means.


Study investigated use of media and pictures in teaching geography by teachers in five countries (Australia, Greece, Japan, Sweden, and the U.S.). Results revealed that there was great variation in use of media by individual teachers, that chalkboard and textbook are the predominant media, that wall maps are used weekly in the U.S. (less frequently than in Japan), and that print media was used far more than audio-visual media.


Results of five experiments showed that technical content that lends itself to presentation as an illustration will be comprehended better as an illustration than as text, and best when presented in both forms. (9th- through 12th-graders—Australian)


Results indicated that children's classification-class inclusion abilities are not related to geographic knowledge, but that gender (boys outsored girls), community (urban outperformed rural), and socioeconomic status (higher outperformed lower), and age are significant factors. (Elementary school students)

Study investigates the teaching of cartography as a second language, with its own lexicon and syntax. (College students—Canadian)


An investigation of the relationship between spatial abilities (as measured by Piagetian tasks) and geography knowledge showed a significant positive correlation, with no significant gender differences. (4th-graders)


An experiment comparing two methods of teaching map symbols (manipulating concrete objects vs. abstract level instruction) found no significant difference between treatments. Subjects evinced no difficulty learning from abstract level instruction. (1st-graders)


Reports results of a very large survey (N=12,500) of place location knowledge of students from 13 countries, using The World Basic Place Vocabulary Test. Students from developed countries scored higher than students from developing countries. Boys scored higher than girls. (13-year-olds)


Study of effectiveness of training on ability to use accompanying maps to increase recall of history textbook passage showed higher scores for map-training group than no-map group on all recall measures. (High school students—Australian)


Study identified and classified misconceptions and analyzed their frequency with regard to several personological variables. Significant differences found for gender, race, educational level, and location. (5th-, 8th-, and 11th-graders and adults)


Assessment of the effectiveness of the lecture method ("instruction") vs. experiential learning ("practice") found that both methods raised subjects' topographic map reading skills, but that the latter was clearly more effective. (College students)


Study comparing two instructional methods, drill vs. varied activities in teaching place vocabulary found that drill was more effective. (8th-graders)
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Study found that interest in the "man-land" approach to geography education decreased with age, and that field-based learning experiences were seen as necessary to preserve interest. (4th-through 6th-graders)


Results indicated that the conceptual approach was more effective than serial approaches in teaching compass and navigation skills, with no significant differences in achievement between boys and girls. (10-year-olds)


Results of study indicate that students taught with advance organizers score significantly higher on a geography achievement test than students taught without. (5th- and 6th-graders)


Test of a developmental map skills curriculum showed significant differences vis-à-vis the traditional curriculum on a standardized map skills test.


Results of two experiments indicated a gender difference (favoring males) regarding ability to label state outlines correctly on a blank map but no difference in ability to list state names. (College students)


Study involved a computer simulation about volcanoes in an earth science class. Analysis of effects of teacher role (content and computer expert/facilitator vs. uninvolved monitor) during the simulation showed that learning was the same for both groups but that student attitudes were more positive with the helpful teacher. (8th-graders)


Study showed that students at this level could learn effectively about natural resources from GIS.


Study investigated the effect of computer use on learning map projections and on attitude toward map projection learning, as well as time and cost factors involved with computer instruction. (College students)

Results of study show no significant effect of teaching method and no gender difference with regard to geography achievement. (9th-graders)

Formal Geography Learning: Reviews of Research


Saveland, R. N. (1983). Map skills around the world; How to test and diagnose place vocabulary capabilities. *Social Education, 47*(3), 206-211.
Learning Geography: A Bibliography of Research Paths


Affective Geography Learning


Review of research presents a developmental sequence for national concepts related to general cognitive and affective development. (British)
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Study found no significant relationship between factual knowledge of a foreign culture area and attitude toward that area; in fact, no single variable or set of variables was found to predict attainment of positive attitudes toward other peoples or countries.


Investigation of words and phrases generated by young people that characterize foreign countries (Australia, U.S., France, South Africa). (13- to 16-year-olds—British)


Survey study generated words and phrases that characterize developing countries in the minds of young people. Also surveyed subjects' suggested ways to improve developing countries' standards of living (most commonly mentioned: more doctors). (12- to 15-year-olds—British)


Investigation of children's recognition and understanding of national symbols of home country (Scotland) and neighboring countries (England, Ireland), categorized into "geographical stages," showed great increases with age. (6- to 11-year-olds—Scottish)


Survey study of random sample (stratified by social class, age and gender) to assess the degree of emergence of national identification. Proposed four "geographical stages" in this development. Employed a test of spatial representation of geographical relationships among city, region, and country. (6- to 11-year-olds—Scottish)


Replication of Piaget (1951). Study refuted Piaget's assertion that development proceeds from comprehension of spatial relations to comprehension of nationality; rather, the two developmental sequences are overlapping and partially concurrent. (6- to 11-year-olds—Scottish)


Study consisted of interviews of subjects to assess their attitudes toward a foreign people (Africans) followed by an educational intervention (visit by foreign person/interpersonal interaction) to change any negative attitudes or misconceptions. Results indicate that the intervention strategy was largely successful. (11- to 15-year-olds—British)


Study found a curvilinear relationship between preferences for and knowledge about other nations, although subjects knew more about countries they liked a lot than those they disliked a lot. (7- to 11-year-olds—British)
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Knight, C. L. (1982). An international study of relationships between geographic knowledge of students and their attitude to other nationalities. Doctoral dissertation, University of Georgia.

Survey study found no significant relationship between attitudes toward countries in the Americas and geographic knowledge about them. However, it did find a strong relationship between attitudes and country of residence, sex, and educational expenditure per capita. (Secondary school students—13 countries)


Experimental study using random sample stratified on age, gender, and social class, found that children's preference for their own country and ability to adopt the point of view of others both increase with age, but that this perspective-taking ability is affected by children's attitudes toward peoples from other countries. Also found strong relationship between social class and attitudes toward one's own and other countries. No gender differences. (7- to 11-year-olds—British)


Interview study concluded that the child's discovery of homeland and understanding of other countries is a process of transition from egocentricity to reciprocity. (4- to 5-year-olds and 14- to 15-year-olds—Swiss)


Extensive survey study showed clear age and gender differences in interests (which countries respondents would like to visit, study, live in), knowledge, and attitudes/perceptions. Includes survey of teachers to assess perceptions of items greatly influencing students' attitudes and opinions toward other countries and peoples. Provides comprehensive baseline data for future studies. (4th-, 8th-, and 12th-graders)


Summary of 30 years of data collected on students' knowledge and misconceptions about Africa. (College students)


Study analyzed students' reactions to a photograph of an Indian village, based on the theory of constructive alternativism. (British)


Survey study found that respondents knew very little about their world environment and that those who knew more tended to be less chauvinistic.

Study results suggest a linear relationship between preferences for other nations and knowledge about them. After a week of informal exposure to educational wall displays about countries, knowledge of both disliked and liked countries increased significantly, although both before and after the treatment students' knowledge was greater for countries they liked. (8- to 9-year-olds—British)


Test of Piaget's theory of territorial decentration and consequent development of a more inclusive world view between ages six and twelve showed later onset of decentration than Piaget (Swiss) or Jahoda (Scottish) found; significant differences for race; no significant differences for gender or rural-urban residence. Offers cultural differences as explanation of discrepancy. (1st- through 6th-graders)


See Stoltman (1972)


Study investigated attitudes toward foreign countries, affiliation with own country, perception of similarities and differences of foreign countries, and perception of relations between nationals and foreign countries. (6- to 12-year-olds—several nations)


Survey study examined development of concept of nationality in four areas: geographic stages, nationality stages, country stages, and foreignness stages. Data analysis supports Piaget's developmental stages. Also investigated respondents reasons for liking or disliking a country. (6-, 9- and 11-year-olds—Canadian)


Descriptive study of which parts of the world are better known to which subgroups of children than others, with possible explanations. (7- to 11-year-olds—British)
Overview: Geography Education


Downs, R. M. (1994b). The need for research in geography education: It would be nice to have some data. *Journal of Geography, 93*(1), 57-60.


National Council for Geographic Education (1967). Research needs in geographic education: Suggestions and possibilities (Geographic Education Series No. 7). Normal, IL: NCGE.


**Overview: Social Studies Education**


Overview: Learning Theory and Educational Strategies


Postscript on Methodology

The compilation process for this bibliography began with a thorough examination of the best existing bibliographies on research in geography education, namely those of Stoltman (1991), Gregg and Leinhardt (1994), and Downs (1988, 1994). The structure of this bibliography became evident from that examination: the preponderance of references fell into the categories of spatial learning, map learning, formal classroom learning, and affective learning. Those excellent bibliographies also led me to other sources with useful reference lists.

Concurrent with following the branches on the research tree in that manner, I began a thorough search of the computer databases ERIC, Psychology Abstracts, and Dissertation Abstracts. These provided valuable references and abstracts.

The third method used to gather references was personal correspondence via mail and modem. In addition to prominent geography educators in this country, I contacted several international geography education organizations that provided several useful references.

Once lists of titles had been accumulated and categorized, the process of locating the articles, reading and annotating them, began. Computer software designed for the creation of bibliographies was invaluable in this process.

Arriving at the final bibliography involved a good deal of redefining categories (for example, distinguishing between reviews of research in formal geography learning and general geography education works) and closely examining criteria for inclusion. In particular, it was difficult to decide whether to include many narrowly-focused, psychology-based studies of spatial learning and studies related to learning in the social studies but not in geography specifically. I found many studies that were primarily surveys of geographic knowledge levels but which could also conceivably cast light on the learning process: most of these were not included.
In conclusion, let me say that, though the author may be exhausted, this bibliography is not exhaustive. My aim was to make as complete a survey as possible of research relevant to how people learn geography. Gaps remain, for which I take full responsibility. My hope is that this work is substantial enough to be of use to anyone sincerely interested in geography education. Comments from readers are welcomed.

References


