Reexamining the Role of Maps in Geographic Education: Images, Analysis, and Evaluation

James E. Young

James E. Young is an Assistant Professor in the Department of Geography and Planning, Appalachian State University, Boone, NC 28608

The ability to make, understand, and use maps is essential for anyone trying to think about the world around them. Children's failure to make and use maps in a meaningful way contributes to the lack of geographic awareness across the country. The "linguistic map" (a graphic representation of the mental connections between words, sensory images, abstract concepts, and value judgments) is proposed as a model for evaluating maps used in educational materials. An evaluation of social studies textbooks found that the maps failed to promote learning at all three levels proposed by the linguistic model: concrete images, abstract analysis, and value evaluation. Problems with the textbook maps are examined and suggestions developed for using maps in educational materials.

INTRODUCTION

A map is a common and valuable way to show locations, describe places, illustrate distributions, demonstrate the interaction of phenomena, indicate movement between places, or to characterize regions. The ability to make, understand, and use maps is essential for anyone thinking about the world around them (whether a student in the classroom, a social studies teacher, or a professional geographer).

The purpose of this paper is to reevaluate the role of maps in geographic instruction, using the concepts of image, analysis, and evaluation presented in a linguistic model (Gersmehl and Young 1992). This reevaluation will occur in two parts. First, a critical appraisal of how published textbooks treat maps, along with examples of how maps fail to address image-building, analysis, and evaluation needs of students will be presented. This is followed by a description of how maps might be designed and used to overcome the shortcomings of the existing materials.

Children attending school in the United States typically receive little training on how to make and use maps. Teachers neglect the teaching of map skills, often because they share the same map use deficiencies as their students (Muir 1985). This is attributed to a variety of reasons, including educators not having worked out the methods and sequences for teaching map skills; not understanding the ability of individuals at different ages to deal with maps; not using maps as problem-solving tools; and seldom associating maps with topics outside the social studies classroom (Kirman 1988). The maps children see in school often are difficult to understand or are simply boring. These maps (and the skills to use them) have little value in the lives of too many children. Children's failure to make and use maps in a meaningful way contributes to the lack of geographic awareness across the country.

Many factors must come together if students are to learn how to understand and use maps. First, cartographers need to design maps that are suitable for the intended audiences and educational objectives. Publishers have to make available, at reasonable prices, a wide variety and great quantity of maps. Teachers need to develop an understanding of what a map is and to improve their map use skills. Finally, educators need to recognize the value of maps as learning tools, then integrate maps and map skill instruction into the school curriculum.

Educators and geographers in the United States are looking for ways to

improve the quality of geographic education. All too often, maps still have a very limited role in the new curricula. What is needed is a fresh approach to teaching geography, an approach that uses the full potential of maps to excite, entertain, surprise, and inform students of all ages.

The ARGUS Project (Activities and Readings on the Geography of the United States) is an effort to create and test innovative and interesting high school teaching materials.[1] The overall objective of ARGUS is to improve regional geography instruction in the schools. Improving students' abilities to understand and manipulate maps is a primary objective of the ARGUS materials.

What is needed is a fresh approach to teaching geography, an approach that uses the full potential of maps to excite, entertain, surprise, and inform students of all ages.

The model for creating the ARGUS materials uses the idea of a linguistic map (a graphic representation of how words, sensory images, abstract concepts, and value judgments are linked together in a person's mind). The mental connections differ among individuals because linguistic maps are the products of age, gender, ethnicity, and education. Linguistic maps also seem to be strongly related to place– where people are, where they grew up, and where they have been (Gersmehl and Young 1992).

A linguistic model of geographic education assumes that learning about places occurs on three conceptual levels: concrete images, abstract analyses, and value evaluations. At the concrete images level, students focus on what is at a place– associating words with features. At the analysis level, students examine why things are the way they are at a particular place. Finally, at the evaluation level, students form and study opinions about how things ought to be.

Two processes (one "forward" and one "backward") operate at each conceptual level, producing six connections:

1. Forward Images. The student learns words to name features in a place. Geographers have words to label things that they see in the world, words such as lake, mountain, coulee, bayou, or central business district. Children need to learn words to apply to images of places and features within those places. Knowing words makes it easier for children and other novice geographers to see the unique features of a place.

2. Images Backward. Students learn new features to associate with familiar words, because a word can mean different things at different places. For example, a lock in Alton, Illinois, is a large concrete-and-steel structure that allows barges to float around a dam in the Mississippi River. In Miami, the same word means a metal object that can be put on a playground gate to keep drug dealers from using the area at night (Gersmehl and Young 1992, p. 232). Children need to learn words to associate with features they see around them, but they also need to be aware that a familiar word can have more than one meaning.

3) Forward Analysis. Students learn theories to explain why things are the way they are at a particular place. Geographers have developed many theories to explain the presence of features in particular places, and children need to learn the economic, political, cultural, and physical factors that influence the spatial patterns of features. For example, the

[1] Geographers from several universities in the United States are working to produce a textbook, student activities, a teacher's manual, and a book of readings for high school classrooms. The materials cover the cultural and physical geography of the United States. The ARGUS project is part of an effort to develop curriculum exchanges with several countries. A parallel project led by Russian geographers is currently underway to create materials about the geography of Russia. The U.S. and Russian materials will be translated and made available to students and teachers in both countries. Similar exchange programs are planned for the future. The National Science Foundation provided funds for the ARGUS project. The Association of American Geographers is overseeing the project. For additional information, contact Dr. Osa Brand, Educational Affairs Director, Association of American Geographers, 1710 16th Street NW, Washington, DC, 20009.

widespread presence of tobacco fields in North Carolina might be explained by a combination of climate, soil, landforms, political clout in Washington, cultural acceptance of tobacco use, and economic inertia. The explanation for the production of a different crop (corn) in a different state (Iowa) likely are very different.

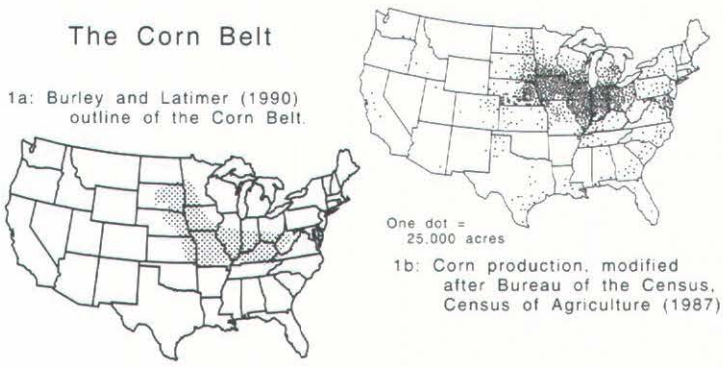


Figure 1: Maps can create different images of a place.

4) Analysis Backward. Students learn what happens when they apply theories in particular places. In addition to the theories and models developed by geographers, people in different regions also develop distinctive causal models. These ideas can influence behavior and create observable differences in human landscapes. For example, people in different regions of the United States have different ideas about taxation and the allocation of tax revenues. These differences result in great regional disparities in spending for schools, roads, welfare, and other public services.

5) Forward Evaluation. Students learn to assess conditions at a place and form opinions. Behavior and activity appropriate in one place often is unacceptable, or even dangerous, in another place. Students should be able form knowledgeable opinions about what occurs in different places. For example, plowing an Iowa field in long, straight rows can make a lot of sense, but doing the same thing up the side of a steep hill in Appalachia likely will have harmful economic and environmental consequences. Students can evaluate human activity in different places and evaluate the value and impact of that activity.

6) Evaluation Backward. Students learn to appreciate that geographic conditions can affect people's opinions. People in different places have different views, and these views influence the variety of human activities that exist in those varied places. Developing an awareness, tolerance, and appreciation of other opinions and lifestyles should be a primary objective of geographic education.

The linguistic model has considerable potential for improving geography education in the United States. If the linguistic model is a valid way of approaching geographic instruction, then maps should generate images of places, aid analysis of those places, and elicit judgments about the places. In short, the maps must help students create the mental connections between words, images, theories, and opinions that are at the very heart of geographic knowledge.

EVALUATION OF TEXTBOOK MAPS

Maps have three general uses: (1) navigating from one place to another, (2) measuring to gather quantitative information about a place or to compare quantitative information about two places, and (3) inferring information from symbols and patterns in order to visualize what a place is like (Board 1978). Maps are sources of information that allow students to generate questions and arguments, evaluate and test hypotheses, appraise the value of the information, and create impressions of places. Unfortunately, few young people learn to use maps for little more than getting from one place to another. They do not know what to look for, where to look, what questions can be asked, nor what kind of conclusions are possible when working with maps (Bartz 1970).

The instruction provided by social studies textbooks contributes to the generally poor map skills among students in the United States. Social studies textbooks are the primary tool for teaching map skills in U.S. classrooms. The textbooks create the curriculum framework for map study and furnish teaching methods and materials. Many educators, however, seriously question the adequacy of map instruction provided by the published materials (Askov and Kamm 1974; Downs, Liben, and Daggs 1988; Hawkins 1977; Petchenik 1985). Criticism of the map instruction focuses on poorly developed skill sequences, a weak understanding of children's perceptual and cognitive development, inadequate map design, and a general disregard for the value of maps.

Most map activities focus on locating and identifying objects, tracing routes, measuring distances, and making simple comparisons. These types of activities treat maps as simple reference tools in which students gather isolated pieces of information. Mapping activities that focus on "where is" questions reinforce the idea that maps primarily serve as spatial dictionaries (Castner 1987), doing little to create the images, analysis skills, or evaluation abilities that are an important part of geographic knowledge. This kind of activity creates a simplistic view of mapping and geography.

Social studies textbooks typically include a large number of maps, drawings, and photographs. The maps and other graphics, however, generally do a poor job of helping students associate words with features (to help create mental images) for a number of reasons.

Inaccurate maps create confusion and interfere with students' ability to associate words with geographic features and places. For example, most geographers would not consider northern Kentucky or West Virginia as part of the Corn Belt (Figure 1a). A student viewing this erroneous map would develop a very different image of the Corn Belt than would a student seeing the dot map of corn production (Figure 1b).

The repetitive use of maps is a second factor interfering with the creation of mental images. Students see some types of maps over and over (e.g., line maps of explorer's routes or iconic point symbol maps of minerals and products in an area), regardless of the textbook publisher. Maps from one publisher often bear a striking resemblance to maps in other textbooks. A single publisher might also use the same map at several grade levels. The end result is that students do not encounter the quantity and variety of maps they need in order to form images. This seems to be changing; some of the more recent textbooks included maps of interesting topics, such as tornado death days, fallout from nuclear testing, Ku Klux Klan membership, a Canadian view of North America (see Figure 8), and acid rain (Figure 2). The dearth of innovative and exciting textbook maps, however, remains a big problem.

A third shortcoming is the lack of attention given to maps in the written text. The books certainly contain a great number of maps (over 1,850 in the 39 textbooks reviewed), but the maps tend to be poorly integrated into the textbooks (Figure 3). The written text made no mention of over half the maps in the elementary level social studies textbooks that were surveyed. The books made some reference (a simple statement directing the students attention to the map) for 34.7% of the maps. The written text made detailed reference (described the map, provided instructions to help the student interpret the map, or compared the map to another map) for only 10.9% of the maps.

Textbook maps also contribute little toward improving students' abilities to conduct geographic analysis. Geographic analysis requires students to learn and apply theories; maps are valuable tools for this

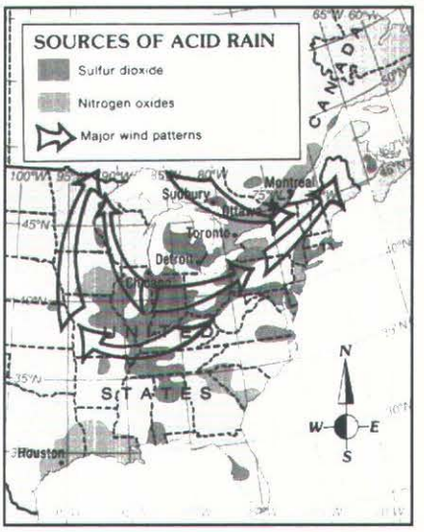


Figure 2: Maps are showing more interesting information (Boehm and Swanson 1992).

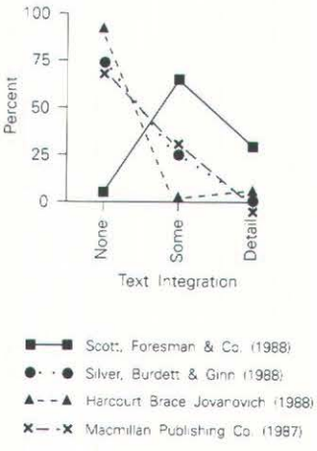


Figure 3: Integration of maps with text, elementary level textbooks.

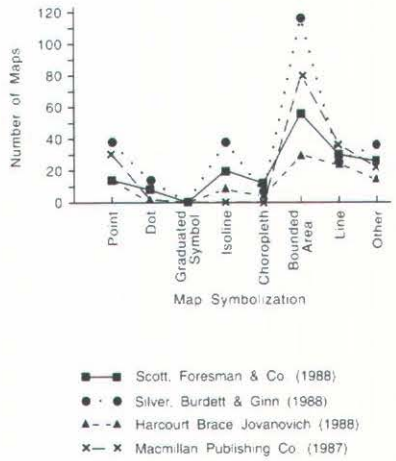
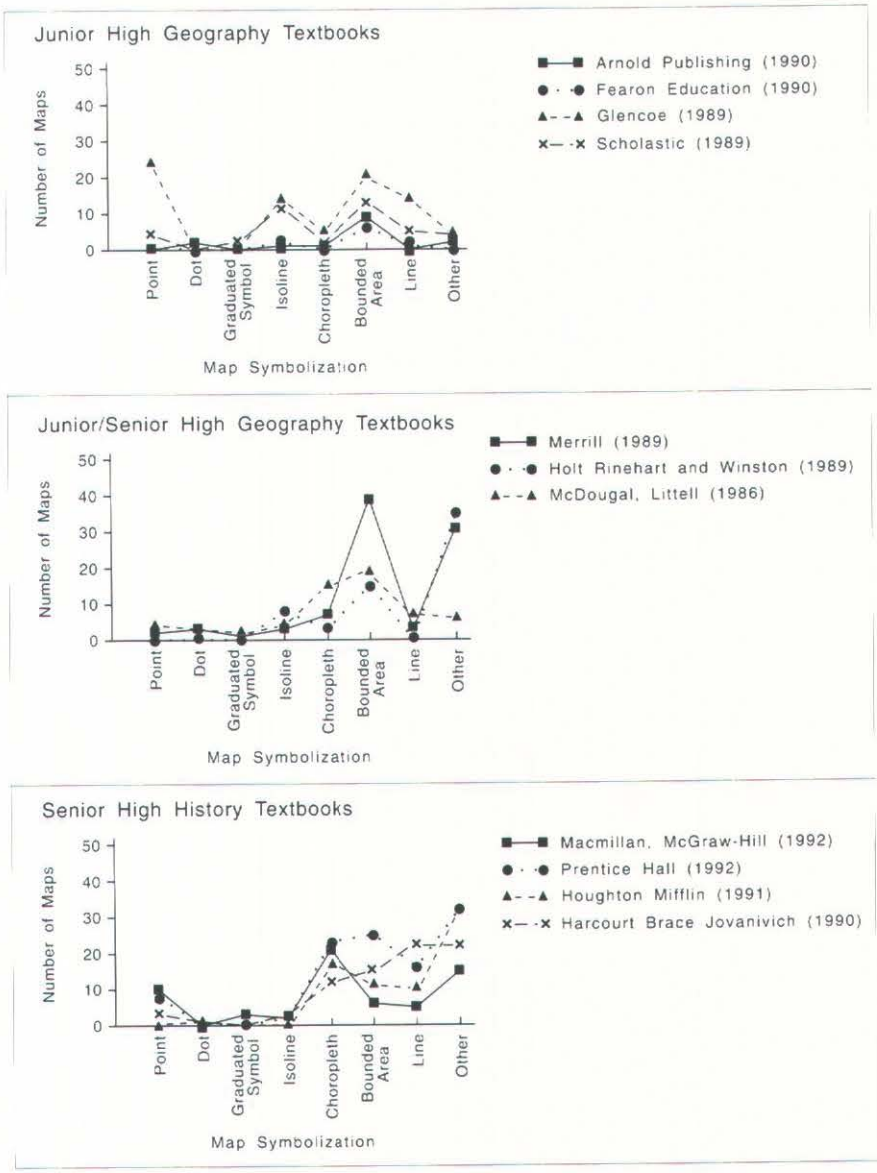


Figure 4: Map types in elementary school textbooks.

undertaking. Students see a variety of map symbolization in the textbooks, but generally have repeated experience with only a few types (Figures 4 and 5). Children in elementary school view bounded area maps (maps that show the actual area over which a phenomenon occurs) most frequently (40% of thematic maps) (Figure 6). Young children have little exposure to dot maps (dots or other point symbols show the distribution pattern of the phenomenon), isoline maps (line symbols connect places of equal value), or choropleth maps (area symbols applied to enumeration units such as counties or census tracts). Bounded area maps remain the most common form in junior and senior high geography textbooks (34% of the thematic maps). Choropleth maps, however, are most numerous in senior high history texts (bounded area symbolization fell to 18% of maps, choropleth maps accounted for 23% of the total). Almost all the books contained map skill lessons that introduced students to a wide variety of map types, but students seldom saw many of the map types outside of the skill lessons. The textbooks simply failed to use several map types on a regular basis. Consequently, students did not learn about the many map types available to help them understand and apply geographic theories.

Figure 5: Map types in junior and senior high school textbooks.



The textbook publishers' heavy reliance on a few map types (particularly, bounded area symbolization) might be due to the relative difficulty of mapping quantitative data. Quantitative data is often difficult to obtain, requires the cartographer to have a strong knowledge of data characteristics and data manipulation, and involves complicated design decisions. These are problems a graphics designer can avoid by using qualitative information. A few textbooks did use quantitative data widely (Backler and Lazarus 1986; Boehm and Swanson 1989; and Harper and Stoltman 1989 most notably), but overall, only about 18% of the maps depicted quantitative data (Figure 7). Maps of qualitative information certainly can be a valuable component of geographic analysis (Figure 8). However, qualitative information does restrict the possible types of analysis, and the map user must be aware of the limitations of these maps. Maps of quantitative data provide students with opportunities to undertake a wider variety of analysis procedures, to test a

greater range of theories, and to more closely approximate what geographers actually do.

In many ways, the issue about data types is somewhat of a non-issue, because the textbooks do a poor job teaching students about map analysis skills. Students encounter a limited number of analysis techniques. Typically these basic skills are: reading specific map types, location, scale, distance, direction, elevation, listing information found on a map, locating places on a map, and making visual comparisons. The same skills are repeated at many grade levels and seldom do older students learn any of the sophisticated procedures available to working geographers. Even geographic information systems, currently one of the most widespread analysis technologies, received little mention in the textbooks.

The textbook maps do little to help students learn how to evaluate information or places. The written text, skill activities, and maps seldom require students to do more than make simple comparisons or learn facts about a place. The maps encourage acquisition of geographic tidbits, not analysis and evaluation of the places under study. Students do not learn how to integrate information from maps in order to create an opinion of a place.

Learning to evaluate maps as sources of information is an important component of geographic education that the textbooks typically overlook. Trained geographers and cartographers are aware of the many problems associated with showing spatial information on maps. Most students (as well as teachers and textbook publishers) simply assume that maps are accurate and they do not recognize potential problems. There exists a need to train map users how to recognize problems, and outright lies, on maps (Monmonier 1991).

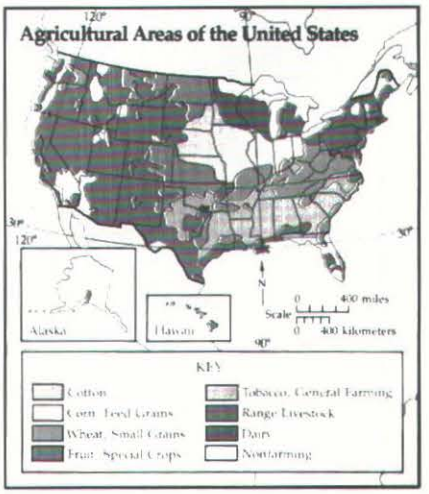


Figure 6: Bounded area maps such as this one are the most common textbook maps (Harper and Stoltman 1988).

DISCUSSION AND RECOMMENDATIONS

Textbook maps have a multitude of problems: inaccurate and repetitive maps, a limited number of map types, a scarcity of quantitative data, an absence of even simple map analysis techniques, and low expectations of what students should do with maps. These problems make it difficult for students to learn words for features (the concept of forward images), learn how words and features can vary between places (images backward), learn theories to explain what is in a place (forward analysis), apply theories in places (analysis backward), assess conditions and form judgments (forward evaluation), and examine how conditions affect opinions (evaluation backward). Despite the large number of maps, the textbooks give little attention to maps, treating them as isolated items rather than as tools of geographic analysis. Given the many problems of the textbooks, it should come as no surprise that many students consider maps to be boring and irrelevant to their lives.

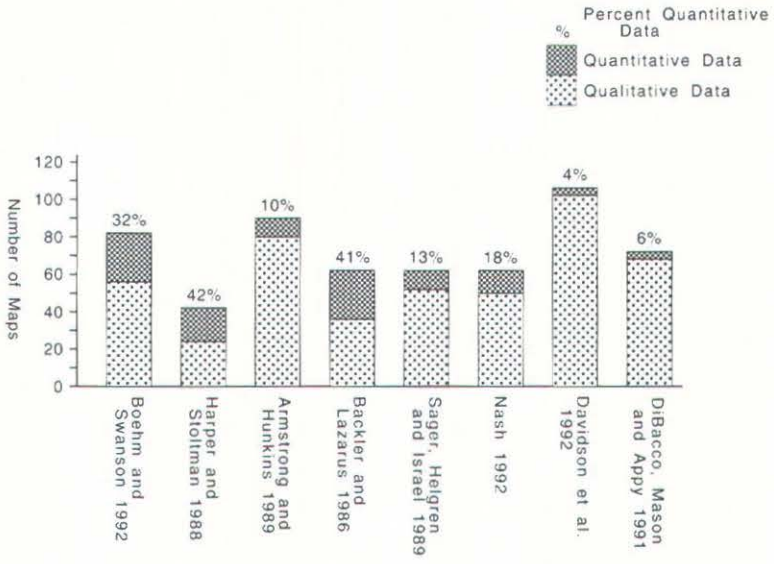


Figure 7: Data used for secondary level textbook maps.

The role of maps in geographic education is changing. In general, the textbook maps reviewed had many problems, but there were signs of improvement. The more frequent use

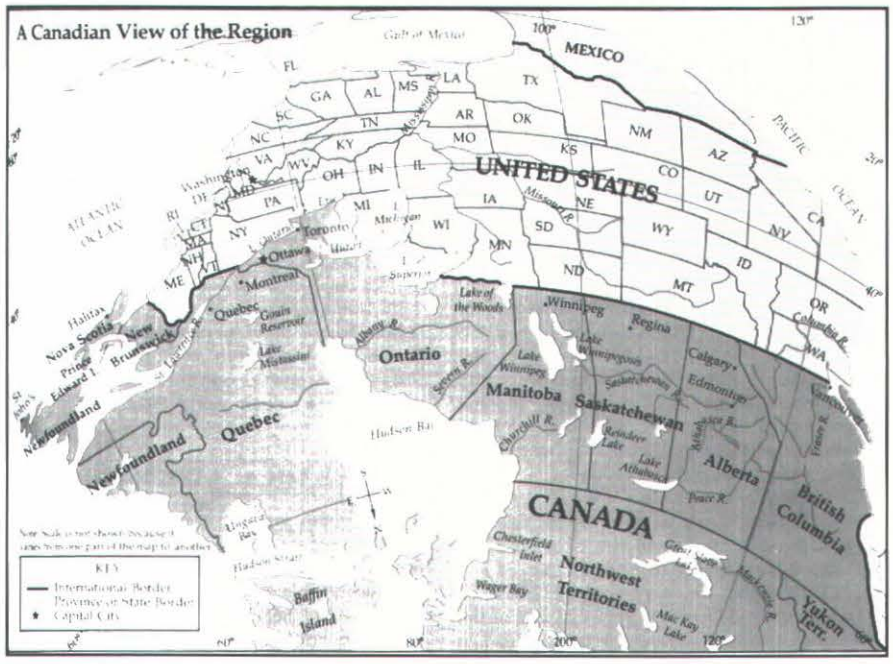
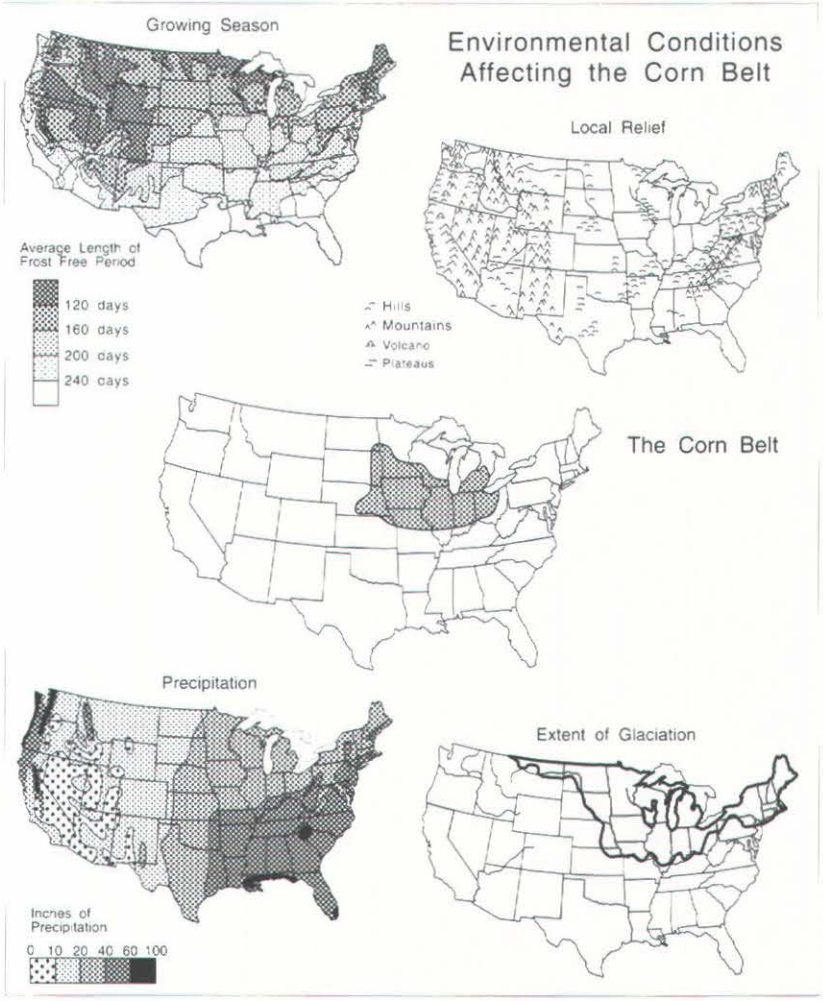


Figure 8: Different perspectives can add interest (Harper and Stoltman 1988).

Figure 9: Maps can aid the formation of mental images.



of quantitative data, a wider variety of map symbolization (including choropleth maps and cartograms), different projections and perspectives (Figure 8), and activities focusing on data categorization are positive developments. Several of the recent books, both in geography and history, made some effort to discuss the five themes of geography: 1) Location– Describing the absolute and relative position of a place; 2) Place– The physical and human characteristics at a location. The special features that distinguish one location from another; 3) Human-Environment Interactions– The relationships within a place. How people interact with and change their environments; 4) Movement– The mobility of people, goods and ideas. The interactions between people at different places; and 5) Regions– Areas defined by unifying physical or human characteristics. How regions form and change.

However, much more can be done to improve the role of maps in geographic instruction. Careful handling of data will help assure map accuracy, which, in turn, will help students create better images of places. It is also possible to add map information that will increase the richness of the images. For example, maps showing features that define the Corn Belt borders would add to students' mental images of the region (Figure 9). Cartographers should keep in mind the simple fact that maps can tell a story about a place. Judicious selection of maps can provide a wealth of information about a place (Figure 10), as well as help students see the differences between places.

The use of a greater variety of map symbolization is a simple step toward improving students' map analysis abilities. Students need to learn about the many ways to

show specific information on a map. Textbook maps also need to make greater use of quantitative data. However, a wider variety of maps and greater use of numerical data will not increase geographic abilities unless students learn how to perform analysis techniques. Students should learn analysis methods early and should use the skills often. A one-time exposure to a map type or analysis technique will have little impact on a student, but repeated application of maps and skills (at increasing levels of complexity) will improve students' abilities for geographic analysis.

The maps in Figures 9 and 10 are examples of the graphics included in the ARGUS materials. The ARGUS creators envisioned maps as a crucial part of the materials, and maps appear in all ARGUS components. Students see maps in the textbook and work extensively with maps in the activities. The teacher sees additional maps in the teacher's guide, along with information for interpreting and using the maps. Maps in the readings book reinforce images of the places and regions studied in the vignettes and activities. A preliminary count of ARGUS textbook maps indicated the presence of many map types (Figure 11); students working with the ARGUS materials will see a greater variety of map symbolization than they would find in a typical geography textbook. There is some variation in how often the different map types appeared, and some effort has been made to increase the number of underrepresented map forms (i.e., the number of isoline maps). Additional maps, using the many forms of cartographic symbolization, also appear in the activities. Students have the opportunity to work with and make all types of maps.

The maps in the ARGUS textbook make extensive use of

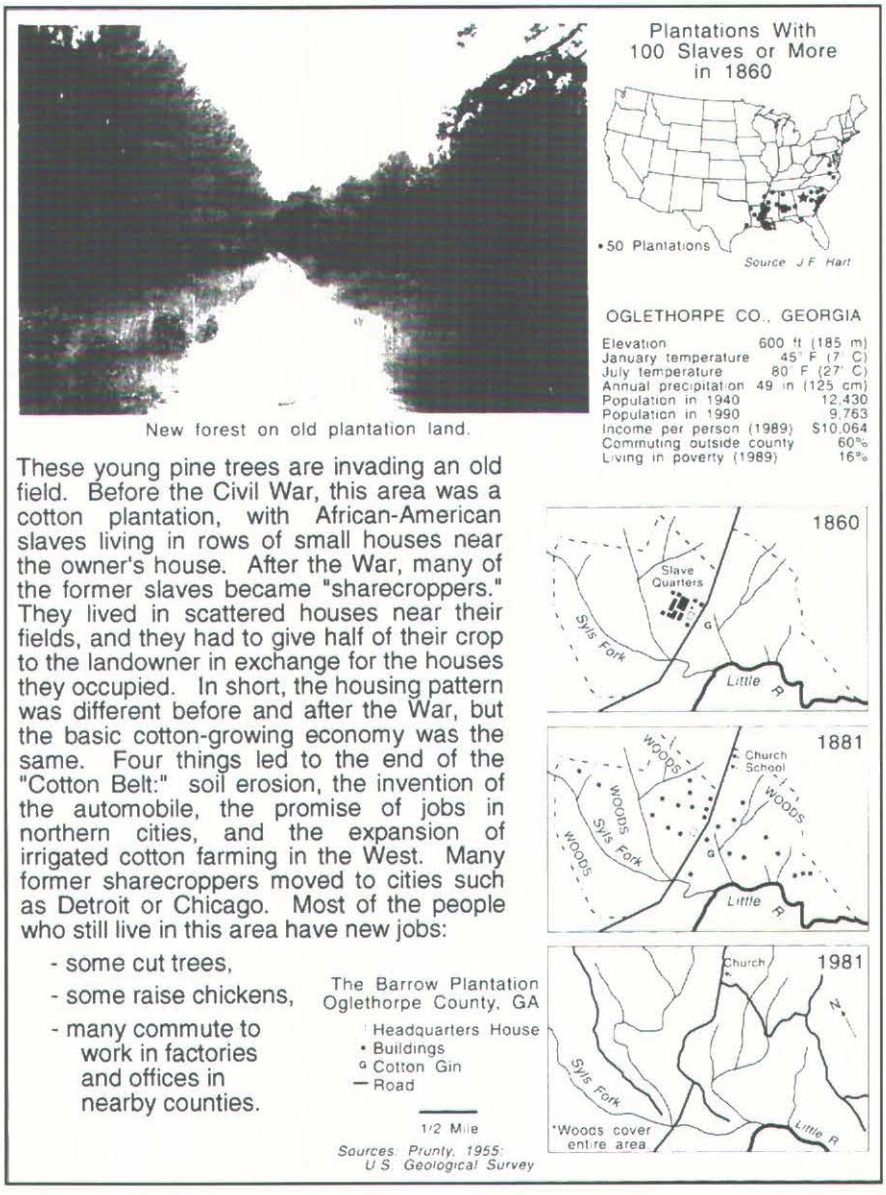


Figure 10: Telling a story about a place – an example of an ARGUS vignette.

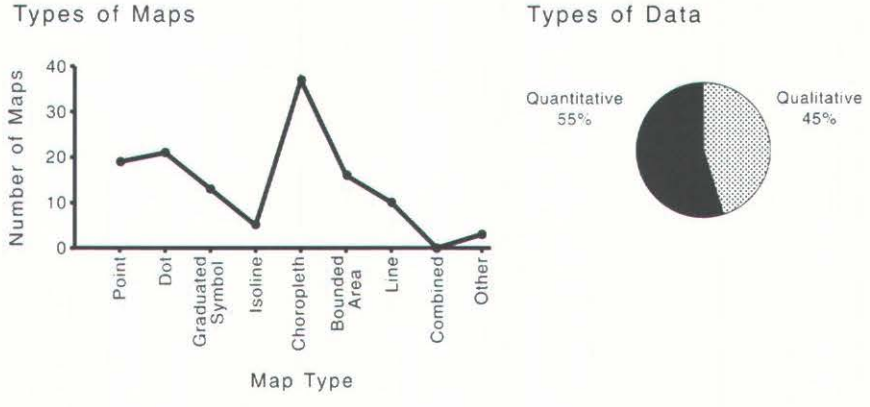


Figure 11: Thematic maps in the ARGUS textbook.

quantitative data (Figure 11). In the preliminary count of the ARGUS textbook, 55% of the maps used quantitative data, compared to an overall 18% of the maps in the surveyed junior and senior high school textbooks. Another important difference between the ARGUS materials and other geography materials is the repetition of the map skills. The students work with the different map types at many points in the ARGUS textbook and activities (not just once, as is the case with most social studies textbooks), each time increasing their levels of map understanding and skill.

The ARGUS materials provide students with opportunities to learn and apply geographic theories and methods. Among the many activities, students will compare maps (both visually and statistically), measure areas, develop and use sampling procedures, plan routes, use air photographs to draw land use maps, work with a model of agricultural planning, weight values to generate a locational index, divide an area into market regions, calculate a connectivity index between places, construct a profile of a landscape, construct maps to help support an opinion, and use a simple geographic information system. The students make use of a wide variety of map use and map making skills as part of their efforts to analyze and evaluate places.

Solutions such as using maps to tell a story, adding support information to a map, using quantitative data, increasing the quantity and variety of maps, and making frequent use of analysis techniques all play a part in helping students evaluate places.

Solutions such as using maps to tell a story, adding support information to a map, using quantitative data, increasing the quantity and variety of maps, and making frequent use of analysis techniques all play a part in helping students evaluate places. Students also need to understand how data is collected and manipulated, how maps are created, and how analysis techniques can be applied and manipulated. This means that students need to see and work with a lot of maps, to study and evaluate maps, to collect and map data, and learn how maps can be used to argue and state an opinion.

The suggested remedies put forth here seem very straightforward, but have considerable potential for improving geographic education. Existing textbooks generally treat maps as a minor part of geography (despite text statements to the contrary). The linguistic model provides a basis for giving maps the prominent place they deserve. The ARGUS materials attempt to redress many of the problems associated with existing social studies books and materials. Maps are at the very core of the ARGUS activities and readings. The ARGUS materials treat maps as important geographic tools. If handled well, maps can aid the formation of mental images, can increase the power of analysis performed, and can form and change opinions. In short, maps can help students of all ages think geographically.

REFERENCES

Askov, E.N., and Kamm, K. 1974. Map skills in the elementary school. *Elementary School Journal*. 75:112-121.

Bartz, B. 1970. Maps in the classroom. *Journal of Geography*. 69:18-24.

Board, C. 1978. Map reading tasks appropriate in experimental studies in cartographic communication. *Canadian Cartographer*. 15:1-12.

Castner, H.W. 1987. Education through mapping/ A new role for the school atlas? *Cartographica*. 24(1):82-100.

Downs, R.M., Liben, L.S., and Daggs, D.G. 1988. On education and geographers: The role of cognitive developmental theory in geographic education. *Annals of the Association of American Geographers*. 78:680-700.

Gersmehl, P.J., and Young, J.E. 1992. Images, analysis, and evaluation: A linguistic basis for a regional geography course. In *International perspectives on geographic education*, ed. A.D. Hill, pp. 229-240. Boulder, CO: Center for Geographic Education.

Hawkins, M.L. 1977. Map and globe skills in elementary school textbooks. *Journal of Geography*. 76:261-265.

Kirman, J.M. 1988. Integrating geography with other school subjects: A view from an education faculty member. *Journal of Geography*. 87:104-105.

Monmonier, M. 1991. *How to lie with maps*. Chicago: University of Chicago Press.

Muir, S.P. 1985. Understanding and improving student's map reading skills. *The Elementary School Journal*. 86:206-216.

Petchenik, B.B. 1985. Value and values in cartography. Essay 1: Maps, markets, and money. *Cartographica*. 22(3):7-19.

TEXTBOOKS SURVEYED FOR THIS STUDY

Elementary Textbooks

Harcourt Brace Jovanovich, Publishers. 1988: *Families; Neighborhoods; Communities; States and Regions; The United States: Its History and Neighbors; The World: Past and Present.*

Macmillan Publishing Co. 1987: *People and Neighbors; Communities: People and Places; The Earth and Its People; The United States; World Neighbors.*

Scott, Foresman and Company. 1988: *My World; Families and Neighbors; Neighborhoods and Communities: Communities Near and Far; Geography: Our Country and Our World; America: Yesterday and Today; Our World: Yesterday and Today.*

Silver, Burdett and Ginn. 1988: *Families and Their Needs; Communities and Their Needs; Our Country's Communities; Geography of States and Regions; The United States Yesterday and Today; The World Yesterday and Today; The Western Hemisphere Yesterday and Today; The Eastern Hemisphere Yesterday and Today.*

Secondary Textbooks

Armstrong, D.G,. and Hunkins, F.P. 1989. *World geography: People and places*. Columbus, OH: Merrill.

Backler, A., and Lazarus, S. 1986. *World geography*. Evanston, IL: McDougal, Littell and Company.

Boehm, R.G., and Swanson, J.L. 1992. *World geography: A physical and cultural approach*. Mission Hills, CA: Glencoe Publishing.

Burley, T., and Latimer, J. 1990. *A geography of Canada and the United States*. Edmonton: Arnold Publishing.

Davidson, J.W., Lytle, M.H., and Stoff, M.B.. 1992. *American journey: The quest for liberty (Since 1865)*. Englewood Cliffs, NJ: Prentice Hall.

Davidson, J.W., and Underwood, K. 1992. *American journey: The quest for liberty (To 1877).* Englewood Cliffs, NJ: Prentice Hall.

DiBacco, T.V., Mason, L.C., and Appy, C.G. 1991. *History of the United States.* Boston: Houghton Mifflin.

Harper, R.A., and Stoltman, J.P. 1988. *World geography.* New York: Scholastic, Inc.

Lefkowitz, W. 1990. *United States Geography.* Belmont, CA: Fearon Education.

Nash, G.B. 1992. *American odyssey: The United States in the twentieth century.* Lake Forest, IL: Macmillan McGraw-Hill.

Sager, R.J., Helgren, D.M., and Israel, S. 1989. *World geography today.* Austin, TX: Holt Rinehart and Winston.

Todd, L.P., and Curti, M. 1990. *Triumph of the American nation.* Orlando: Harcourt Brace Jovanovich.

EDITOR'S NOTE

This paper won first place in the 1993 Association of American Geographers Cartography Specialty Group Student Paper competition.

RESUMEN

La habilidad de hacer, entender y usar mapas es esencial para aquellas personas que piensan en el mundo y sus alrededores. La falta de algunos niños de no hacer o usar mapas contribuye de manera significativa a la falta de conocimiento geográfico en el país. El "mapa lingüístico" (representación gráfica de las conecciones mentales entre palabras, imágenes sensoriales, conceptos abstractos y valores) es propuesto como modelo para evaluar mapas usados en materiales educativos. Una evaluación de textos de estudios sociales encontró que los mapas no promueven el aprendizaje en los tres niveles propuestos por el modelo lingüístico: imágenes concretas, análisis abstracto y evaluación de valores. Se examinaron problemas con los mapas de los textos y se hicieron sugerencias para usar mapas en materiales educativos.

RESUME

La capacité à élaborer des cartes, à les comprendre et à les utiliser est essentielle à tous ceux qui s'efforcent de réfléchir au monde qui les entoure. Le manque de connaissance de la géographie dans le pays découle du fait que les enfants ne savent pas dessiner les cartes ni s'en servir intelligemment. La "carte linguistique" (une représentation graphique des connexions mentales entre les mots, les images sensorielles, les concepts abstraits et les jugements de valeur) est proposée comme modèle pour l'évaluation des cartes utilisées dans les écoles. Une évaluation du manuel d'études humaines note que les cartes manquent de promouvoir la connaissance aux trois échelons proposés par le modèle linguis-tique : images concrètes, analyse abstraite et évaluation des valeurs. Les problèmes posés par les cartes du manuel ont été examinés; des suggestions ont été développées pour l'emploi des cartes dans le matériel éducatif.