HYPERMAP REQUIREMENTS FOR A GEOGRAPHY LEARNING ENVIRONMENT

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Abstract

This paper assesses the potential of mapping software and hypermedia toolboxes to meet the needs for undergraduate geography instruction emphasizing active student learning by exploring geographical databases. Based on some experimental uses of software at the University of Maryland it is clear that a better blending of the two approaches is necessary for meeting the pedagogic goals.

1. Motivation - a new learning environment

Current hypermedia resources available at modest price to instructors are not yet very valuable as learning aids for geography students. Commercially available hypermedia authoring software like HyperCard and MetaCard, and the increasingly widespread browsers MOSAIC and Netscape, are not oriented to cartographic uses. For example, for the former, while they allow definition of boxes for mouse click-based selection, they do not cater to irregularly shaped polygons; and, for many World Wide Web browsers, the mouse clicks available for selections follow the traditional hypertext idea of singular clicks to select a (word) object, rather than define a line or polygon. It is the contention of this author that the desirable tools to facilitate active empirically oriented student learning will become available only via cooperative efforts of instructors to design and build them, because pedagogic needs are unlikely in the near future to be a force influencing the design decisions by commercial vendors.

The needs emanate from a desire to create a learning environment for undergraduate geography students that promotes active learning by making it easy to access and use empirical data. For the specific case of a general course on urban geography (at my institution, the course is called The American City) this entails being able to explore and select from hundreds of themes from the Census of Population, at geographic scales from the city block, through block-group, census tracts, or city, to county and state. It means being able to integrate field observations of textual and picture form with maps produced from census data. It may mean being able to make a hypermedia presentation to tell a story about the changing characteristics of a neighbourhood. Or it may mean to do detailed research of the impact of a new transit station or shopping mall on a surrounding area.

One scenario will be described now to provide a tangible example of student activities. Students are asked to select a region of about ten to fifteen adjacent city blocks by clicking on a map displaying the census block units for an entire metropolis. They then examine a list of themes for which data are available at that scale or the next level, that of block-groups, especially being able to get at a data dictionary which provides details of the definitions. Next, they are required to select certain data items that are representative

of major themes characterizing urban areas, that is, household structure, ethnicity, and income level. Exploration of the character of the neighbourhood as revealed by census statistics is then followed by field observations. Putting the location in a historical context is done by trying to predict the age of the neighbourhood from house styles or by relative geographical location in the metropolis. Field observations can be confirmed by looking at housing age data in the census statistics. A formal presentation requires a combination of tabular data, maps, pictures, text, and ancillary information like sources.

2. Resources needed - map display, spatial query, and multimedia presentation tools

These kinds of efforts are facilitated by the provision of good quality, easy-to-use, and robust software tools, appropriate hardware, especially for multimedia, and appropriate qualitative and quantitative data. Because the objectives emphasize content - the course is not a methods course - then it is important that the computer resources be learned and mastered very quickly. In the case of my experimentation in The American City course, at the junior level (third year out of four), I found that only one student in ten had prior use of graphics software, and none had used hypermedia (for example HyperCard), although about one-third had used spreadsheets (for example Excel) or database systems (for example dBase). Even with the use of the new ArcView software that simplifies mapping and spatial queries, some one-third of direct instruction hours in the semester were basic computer tools training, a proportion that is too high for a thematic course.

In one experimental offering of the course, in order to accomplish a task similar to the one I described earlier, students were asked to deal with ten different computer tools. Different products were needed for map making (ArcView), image capture and file format conversion (XV), scanning and customizing images (Photoshop), still video camera image conversion to digital form (SV Scan), hypermedia presentation creation (MetaCard), and visual index creation (Inspiration) in addition to a few basic utilities. Even with the advent of the new release of the ArcView software, the worlds of mapping and hypermedia still have not come together very well, although progress has been made. It is in this context that the possibility of a true hypermap environment via customization of the ArcView software will be discussed after a brief review of the different characteristics of the mapping and hypermedia approaches. A hypermap is defined as multimedia document with geographic location access, generally by mouse clicks.

3. Some observations about the use of HyperCard style tools

Defining hypermedia as the associative linking of chunks of information which may be textual, numeric, graphic, sonic, or image in form, the emphasis is on the structuring of the material not on its multimedia nature. An information manager tool like HyperCard for a Macintosh platform, or a close cousin, MetaCard, for a workstation with the UNIX operating system, allows flexibility in organizing and presenting much material, affording students a relatively easy toolbox to make cognitively structured presentations. With templates for card layout, already-made slider bars for time-line choices, graphics creation tools, and basic scripting students made their own presentations on The New Deal New Town of Greenbelt as a class project. The most obvious limitations were the absence of an easy way to create irregular polygon buttons as would be necessary for selecting particular areal units, absence of map creation tools,

and no straightforward way to do mouse-clicks on parts of images. But then, what does one expect for a few dollars? The similar MetaCard product used by students for an urban transportation project allowed easier use of color images, drag-and-place layout control, but still did not have the important cartographic functionality.

4. A cartographic approach - trials with ArcView

A cartographic approach to geographic learning emphasizes the role of maps in revealing thematic patterns in physical or cultural landscapes. In my explorations in the general undergraduate course The American City, taken by students only rarely having any prior geography course in college or high school, not only is it necessary to acquaint students with the substance of urban geography, it is also necessary to teach students about maps and how to reason spatially. As a practical matter students are expected to make and then make sense of maps of social, economic, and demographic characteristics for hundreds of areal units in a metropolis. A simple electronic atlas is not used as it provides only few tools and little scope for creativity. Accordingly a mapping system or geographical information system software toolbox is desirable, and, as a matter of practice, the chosen software has been the ArcView from the Environmental Systems Research Institute.

In brief, this software system can display maps and geographically referenced images, makes charts of several types; allows tabular queries, statistical summaries, and computations of new data items; dynamically links instances of spatial units shown as table rows, map elements, or chart points; allows display of non spatially-referenced images via "hot-links"; has several spatial analysis functions, and allows map-based selections of map features. Thus it is easy to operate with the interactive maps to make selections of neighborhoods by choosing one block and then running an operation to select all neighbours, or simpler tasks like selecting all instances within a polygon drawn using mouse clicks.

An initial user-satisfaction survey regarding ArcView was administered to about 30 students in the Fall semester 1994. Using a validated instrument, the University of Maryland's Questionnaire for User Interaction Satisfaction, students expressed positive feelings that the software was stimulating but that it was difficult to learn and operate. From an instructor point of view the software appears to hold great promise for productive use by novice students provided the on-line help about the software tools is augmented by pedagogically-oriented learning aids.

5. A purposeful evaluation of ArcView functionality

To this instructor, though, some very desirable features are at this time absent - isoline mapping, cartograms, map animations driven by slider bars, direct manipulation queries, inset maps that provide continual orientation even while the main display is zoomed or panned, polar coordinate mapping to facilitate an understanding of places relative to the location of self, and true hypermap tools.

While rudimentary map making via the ArcView software is easily learned by cartographic novices, this system at this time is unfortunately restricted to only choropleth and proportional symbol maps beyond the basic point, line, or area symbol feature mapping. Isoline maps, dot-density maps, and cartograms are not directly possible using only ArcView tools. Especially important in the context of student learning

by working with tangible real-world elements for local neighbourhoods, polar coordinate maps appear not to be possible. Of course it is not only ArcView that is conditioned by Cartesian coordinate rectangular isotropic space referencing.

In addition, even while classless choropleth or proportional symbol maps are restricted by a limitation on the number of unique values that can be displayed, it is a multistep process to created the categories required for classed choropleth or symbol maps. A frequency table and histogram tool included in a mapping system would be especially valuable for novices. More challenging cartographic mapping such as bivariate or map overlay techniques to make map correlations are left to the sophisticated users to figure out for themselves, and to achieve map animations, valuable for showing change over time for a fixed set of spatial units, requires special effort by programming or calling external programs that have image animation capabilities.

The hot-links capability of ArcView suggests that it may be a toolbox suitable for making hypermedia presentations, yet at this time it is not set-up to do this extensively. Hot-links from map elements to picture files or text files are easy to establish, but there is no direct way to continue the hot links by clicks on elements within those documents, and the map layout tools are oriented to the design of single page finished maps, not hypermedia presentations.

Even though there is a graphic user interface, readily customizable by simple scripting using the Avenue language, some of the concepts already robustly tested in several human-factors research computer laboratories are not yet implemented in ArcView, or, for that matter, other commercial products. Among these are slider bars or other devices for direct manipulations, dynamic spatial queries via a moving pointer, retrieving data from tables as the pointer moves, a persistent orientation map as map panning and zooming occurs, a tool to make visual indexes, and a graphic way to select a particular time, space, and theme combination for query from a database.

6. The student perspective - reactions to the learning environment

Notwithstanding the absence of tools to make life even easier, and this is important for improving novice student productivity, in the trials undertaken so far students expressed much appreciation for the data-driven learning environment to which they were subjected. With goals of data exploration and spatial querying rather than finished map creation, students experienced frustrations and pleasures:

"I found this to be a very good class. I learned a number of computer programs, and how to use a number of pieces of computer hardware. It did seem, though, that this class was more focused on teaching the fundamentals of computer presentations, than on American Cities Past and Present."

"By taking this course, the student is able to combine traditional forms of education with high-tech mapping techniques used in many offices across America . . . If one were a geography major, this class would be excellent for future job preparation. If one were just taking an elective, this class would be great at teaching basic skills required for society."

"Attention Professor: I have heard that you are intending to redesign a course to incorporate computer based multimedia, hypermedia, geographic data mapping, and product creation as the learning tools. I suggest you rethink your plans. . . The hours spent

on this class alone were about equal to the total combined hours on all four of my other classes."

"On the whole I enjoyed this class. It was far different from what I expected, but I survived and learned a lot. This was my first encounter with multimedia and census data. It was a very unique way to learn. I feel that one day most classes will be taught this way."

I must agree with students as to the extensive learning required for mastery of numerous computer tools. One challenge for an instructor is to acquire or develop learning aids to substantially reduce the time needed for competence in basic mapping and spatial analysis skills. Another is to convince the software vendors to incorporate directly or otherwise provide tools for the customized development of needed cartographic visualization instruments.

7. Looking to the future

Even as we may endeavour to produce or acquire the desired functionality, assuming we can agree as to what that may be, the convergence of mapping and hypermedia browsing or navigation is slowly occurring. However, notwithstanding that toolboxes for visualization of maps and images may be coming available, pedagogic contexts surely must be where the real attention needs to be directed.

I see several roles for hypermedia in the learning environment represented by the American City course. Examples of how to use software, and models of good maps or procedures, or even what not to do, can be assembled as a hypermedia document and made available via the on-line help (which, incidentally, in ArcView is hypertext based). Secondly, where good scholarship is to be instilled in students, hypermedia tools could be made available for the preparation and presentation, via mouse-clicks on SOURCE buttons, the details of the sources and procedures used to create a map or other information chunk. Thirdly, hypermedia could be used for steering computations or querying, revealing the impact of changes in numeric parameters in classifications or correlations, or in numeric, Boolean, or spatial selections - all these being instruments to support the scientific reasoning in which we expect students to engage.

In general the blending of hypermedia with mapping and geographic information systems toolboxes, a progressive creation of a hypermap learning environment, can be of benefit to many geographic pedagogic purposes, in either formal education or for citizen learning. Fostering reaching higher cognitive levels, providing authentic learning experiences, or simplifying geographic analysis by better interfaces and supporting materials, are goals that can be facilitated by the existence of better software. Perhaps in time one of the most popular items in the local computer store might be a hypermap system for citizens to use to help them with important lifetime decisions like buying a house, choosing a school, or avoiding bad neighborhoods.

A special note: map and hypermedia examples are not available via this print medium; they will be presented when the paper is delivered in person.

Trademarks: acknowledgement is made that the following are commercial trademarks: ArcView, Avenue, dBase, Excel, HyperCard, Inspiration, MetaCard, Netscape, Photoshop, and SV-Scan,