

Using Maps for Virtual Collaboration: Implementing a Framework for Visually Enabled Geocollaboration

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ABSTRACT

The purpose of this study is to test whether the use of graphic information interfaces such as maps and simulations can enhance the general public's understanding of scientific data and risk analysis, improve communication and virtual collaboration, and lead to environmental decision making that is less positional and more consensual. The research will be located in upstate New York in the Adirondack Park region, and will focus on land use proposals such as cellular telephone tower installations within and near the Park's Blue Line that have been issues of contention. This design-based research study proposes to investigate the use of geospatial and telecommunications technologies (web-deployed maps and simulations) for presenting scientific data and analyses in a way that balances stakeholders' interests and promotes understanding. The research addresses the need for empirically-based guidelines for presenting the results of scientific inquiry to the public to support rational decision-making. The investigation will result in more effective virtual collaboration between civic leaders, planners and communities, leading to better ways to engage stakeholders on a broad range of environmental and urban planning, resource management, and education issues through leveraging geospatial and telecommunications technologies.

1. INTRODUCTION

The purposes of this study are to develop guidelines for using geospatial technologies such as digital maps, simulations and graphic scripts to present scientific data and analyses in a way that promotes rational decision-making and balances stakeholders' interests; and to improve communication and collaboration between business, government, scientific communities and the public on issues related to scientific inquiry, risk analysis, environmental and community planning, resource management, and education by leveraging geospatial and telecommunications technologies. In addition, this research will further practices of collaborative governance, collaborative problem solving, and collaborative public management. From a pragmatic standpoint, it's expected that this approach will elevate public discourse, reduce litigation and legal actions and contribute to positive conflict outcomes. Finally, this investigation will complement research findings in the field of education that suggest the use of maps, simulations and information visualizations can lead to improved learning outcomes.

2. BACKGROUND

In any problem involving multiple stakeholders there seems to be inevitable conflict. Two ways that ICT can promote understanding and rational decision-making are: improving access to information through telecommunications technologies, and improving the quality of the information made available. This project is an investigation into the use of web-deployed map-based interfaces as a contextualizing medium for virtual collaboration. Questions include: Can geospatial technologies broaden public discourse about land use issues and help resolve conflicts? Can geospatial technologies such as digital maps and simulations help participants better understand scientific data and risk analysis, make better informed decisions, and avoid costly litigation? MacEachren and Brewer call for research into the role of geovisualization as an enabler for needed advances in virtual collaboration "... developments in geographic information science, and in computer graphics and visualization, suggest that we are [also] on the cusp of a substantial increase in the role of maps, images, and computer graphics as mediators of collaboration, in a range of contexts including scientific inquiry, environmental and urban planning, resource management, and education." Palmer and Smardon (1989) discuss the shortcomings of traditional public participation in environmental management. One of these is the lack of timely participation by the majority of citizens. Their research also showed that those who do attend public meetings tend to be more activist and hold more extreme positions than the general public, making issues appear to be more contentious than they are perceived by the majority. Some use misinformation and scare tactics to sway the opinions of others. Without reliable information from trusted sources, people may tend to make decisions that are not based on facts. The reasons that many people don't attend are numerous and include time, transportation, childcare and other resource constraints. Morgan, et al point out that people usually don't become concerned about issues until they perceive a potential threat or risk to themselves or others that they feel connected to. When, after the fact, they become aware of an impact or perceived risk to themselves or others and react, their position is frequently defensive, and based on fear rather than rational thinking. Simply conducting studies and producing research results doesn't mean that the general public is aware of them, can find them, or that they can correctly interpret and understand them when they are available. It's unlikely that when trying to make a decision about leasing mineral rights or using pesticides on their lawn that people will search for and read research articles published in peer-reviewed journals, analyze data or pore over complex formulae. But 68% of people between the ages of 50 to 64, and higher percentages of those under 50, turn to the Internet to get information when they want to

answer a question about health, the environment or other issues (AARP, December 2009).

3. CONCEPTUAL FRAMEWORK

MacEachren and Brewer (2004) define a conceptual framework for studying “geocollaboration”, defined as “visually-enabled collaboration using geospatial information through geospatial technologies”. The three elements of the framework are visualization of data and information, virtual collaboration and the use of map-based interfaces for virtual collaboration.

4. VISUALIZATION

The research purpose is to test geospatial technologies such as GIS, GPS and interactive maps as effective visual media for virtual collaboration. This research is important as we become a more global society and as this leads us to collaborate locally, regionally, nationally and internationally. Ironically, as MacEachren and others call for research on geocollaboration, Jerome Dobson (2007) points out the abysmal level of geographic knowledge possessed by a generation that has not learned to use maps (Dobson, 2007), the lack of geography lessons in K-12 education, and the ongoing loss of geography departments in US colleges and universities as the demand for these skills continues to increase; and calls for us to ‘Bring back Geography!’. Of the vast quantities of digital data being generated today, it has been estimated that as much as 80% of it includes geospatial referencing such as geographic coordinates, addresses or postal codes (MacEachren and Kraak, 2001). Representing this data in a meaningful way for its use in problem-solving, education, and conflict resolution presents a challenge. “Computational and experimental sciences produce and collect ever-larger and complex datasets, often in large-scale, multi-institution projects. The inability to gain insight into complex scientific phenomena using current software tools is a bottleneck facing virtually all endeavors of science” (Aragon et al, 2008). This is an even greater challenge in the effort to enable non-scientists to understand the complexities of scientific phenomena. Although research has shown that data visualization technologies can facilitate comprehension of complex scientific results (Aragon, et al., Dunleavy, et al.), more work is needed.

5. VIRTUAL COLLABORATION

Veinott, Olson, and Fu investigated how virtual teams benefit from video and audio technology vs. audio only in solving problems. Their research showed that visual cues (i.e. seeing each others’ faces) enhance understanding, coordination and teamwork for non-native English speakers trying to work together on fairly complex problem-solving tasks. The following quote is from the abstract: “We compared the performance and communication of people explaining a map route to each other. Half the pairs have video and audio connections, half only audio. Half of the pairs were native speakers of English; the other half were non-native speakers (who presumably would have to negotiate meaning more). The results showed that non-native speaker pairs did benefit from the video; native speakers did not. Detailed analysis of the conversational strategies showed that with video, the non-native speaker pairs spent proportionately more effort negotiating common ground.” In their study, the authors gave maps to each pair that were slightly different, but the pairs could not see each other’s maps. Veinott et al investigated whether seeing facial

expressions could enhance language understanding, but found no benefit except for non-native English speakers. What would the outcome have been if the pairs were tested on their use of the maps they were given as visual cues rather than the faces of their partners? As we look at examples such as the use of email, social networking, and the Internet, there is no doubt that modern telecommunications applications have revolutionized the nature of collaboration. Research has shown that virtual collaboration is regarded as a mixed blessing. When it allows participation, communication and collaboration where it would otherwise be impossible, it’s seen as a benefit; but many people still prefer face-to-face meetings (Beyond Being There, 2008). However, as more and more people become accustomed to using the Internet and telecommunications, these media are increasingly accepted as alternatives to traditional meeting venues.

6. MAPS FOR COLLABORATION

Couclelis and Monmonier (1995) discuss using SUSS, a map-based information system designed to be used as an analysis and communication tool for resolving contentious land use issues. Graphic scripts are visual narratives that use sequenced map displays to present data dynamically (Monmonier, 1996). Interactive scripts allow users to query, zoom, pan or review. The authors define SUSS as a problem structuring system rather than a decision-making (or decision-support) system, i.e. it is meant to be used for understanding complex or contentious problems from multiple perspectives. They propose using a GIS-based system with a political negotiation metaphor as its organizing principle. This study advances Couclelis and Monmonier’s approach to developing map-based interfaces and applies them to test the role of geovisualization in contextualizing problem-based scenarios for virtual collaboration. Risk communication with the public about environmental policy and decision making is often misunderstood, distrusted or rejected because of the use of jargon, probabilistic conditioning of conclusions based on legitimate scientific uncertainties or unexplained references to opposing arguments or positions (Morgan et al, 2002). Decision making that is less positional and more consensual can be achieved by addressing trust issues through the use of tested and verified data and information with thorough documentation (Ury et al, 1991, O’Leary et al, 2003). Based on studies conducted on the use of simulations for teaching and learning (Hakkareinen, 2007, Dunleavy et al, 2008), both teachers and students have reported that the use of information visualizations and simulations in a collaborative problem-solving situation can afford a highly engaging, collaborative learning experience that is compatible with multiple information-seeking and problem-solving styles. The importance of visual cues for achieving cooperation and agreement in collaborative actions, both virtual and face-to-face, is well-documented (Kraut et al, 2003, Veinott et al, 2009).

7. METHODOLOGY

A design-based research approach is planned. Cobb et al (2003) describe design-based research as “pragmatic as well as theoretical in orientation – in that the study of function – both of the design and of the resulting ecology of learning – is at the heart of the methodology.” It is an empirical technique which involves designing interventions with specific goals or objectives, testing them, evaluating the results, then refining or adjusting the intervention. It is particularly appropriate for this study because it

is cognizant of the challenges of multi- and inter-disciplinarity, and because it recognizes the value and importance of context for problem-solving. The design strategy for this study has two components. The first involves designing a problem-based scenario for siting cell phone towers. The second is designing a map-based graphic narrative for presenting the scenario. Graphic scripts will be deployed with the problem-solving scenario in a virtual environment. Participants will use the interactive narrative for virtual collaboration to find out if the use of maps as visual cues can improve virtual collaboration by providing context through the visual presentation of relevant information. Content will be developed based on Monmonier's guidance (Monmonier, 1993, 1996).

For this study, approximately 160 (40 groups of two to four) participants will be recruited from various stakeholder groups concerned with proposals for land use in locations within and around the Adirondack Park Blue Line. Participants will work in randomly assigned groups of two to four people. The sessions will be virtual collaborations rather than face-to-face. Participants will be instructed to work in their groups to understand the information provided, answer questions about the issue, and report on any agreement reached. All participants will have access to the online maps and information and will be able to communicate with each other, but will not be co-located and will not be able to see each other. The graphic interface will serve as the visual context for problem-solving within each group, and each group will negotiate discussion among themselves. Sessions will be recorded to capture audio, and screen capture will be used to record text-based communications, time frames, navigation and group actions. Participants will be asked to complete an initial short questionnaire to collect demographic data such as gender, age, race, education, etc., their position on or interest in the issue, and self-assessments of their experience with and understanding of maps prior to the session. The sessions will be designed to last around one and a half hours in all. Participants will receive a small incentive (\$20 value) upon completion.

The sessions will be evaluated on the basis of quantitative and qualitative measures of the participants' use of the information provided, and the outcomes of the collaborations. Participants will be asked to complete a short follow-up questionnaire about their perceptions of the process and its outcome. Selected participants may be asked for follow-up interviews, or may attend a debriefing meeting if they wish.

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9. REFERENCES

- [1] AARP Bulletin, December 2009, Vol. 50, No. 10, pp. 4.
- [2] Aragon, C., Bailey, S., Poon, S., Runge, K. and Thomas, R. "Sunfall: a collaborative visual analytics system for astrophysics", Proceedings of SciDAC, 2008.
- [3] "Beyond being there", Final Report from the Workshop on Building Effective Virtual Organizations, May 2008.

- [4] Cobb, P., Confrey, J., diSessa, A., Lehrer, R., Schauble, L. "Design Experiments in Educational Research", Educational Researcher, Jan-Feb 2003, Vol. 32, No. 1, pp. 9-13.
- [5] Couclelis and Monmonier, "Using SUSS to Resolve NIMBY: How Spatial Understanding Support Systems Can Help With The "Not In My Back Yard" Syndrome", Geographical Systems, 1995, Vol. 2, pp. 83-101.
- [6] Design-based Research Collective. "Design-based Research: An Emerging Paradigm for Educational Inquiry", Educational Researcher, Vol.32, No. 1, pp. 5-8.
- [7] Dobson, J. "Bring Back Geography!", ArcNews Online, Spring 2007, ESRI.
- [8] Dunleavy, M., Dede, C. and Mitchell, R. "Affordances and Limitations of Immersive Participatory Augmented Reality Simulations for Teaching and Learning", Springer Science+Business Media LLC, 2008.
- [9] Garrard, S., Turner, K. and Bateman, I. Environmental Risk Planning and Management, Edward Elgar Publishing, LTD, Cheltenham, UK, 2001.
- [10] Gersmehl, P. Teaching Geography, 2nd edition, Guilford Press, New York, NY, 2008.
- [11] Gersmehl, P. and Gersmehl, C. "Wanted: A Concise List of Neurologically Defensible and Assessable Spatial Thinking Skills", Research in Geographic Education 8:5-38, 2006.
- [12] Hakkareinen, P. "Designing and Implementing a Problem-Based Learning course on educational digital video production: Lessons learned from a design-based research". Association for Educational Communications and Technology, 2007.
- [13] Jacobson, D. "Doing Research in Cyberspace", Field Methods, Vol. 11, No. 2, Nov. 1999, pp. 127-145.
- [14] Kraak, J. and Ormeling, F. Cartography: Visualization of Geospatial Data, 2nd edition. Pearson Education Prentice Hall, Harlow, England, 2003.
- [15] Kraut R., Fussell S., and Siegel J. "Visual Information as a Conversational Resource in Collaborative Physical Tasks".
- [16] MacEachren, A. and Brewer, I. "Developing a conceptual framework for visually-enabled geocollaboration", Int. J. of GIS, Vol. 18, No. 1, 2004, pp. 1-34.
- [17] MacEachren, A. and Kraak, J. "Research challenges in geovisualization", Cartography and GIS, Vol. 28, No. 1, 2001, pp. 1-11.
- [18] Monmonier, M. How to Lie With Maps, 2nd edition, University of Chicago Press, Chicago, IL, 1996. Monmonier, M.
- [19] Mapping It Out: Expository Cartography for the Humanities and Social Sciences, University of Chicago Press, Chicago, IL, 1993.
- [20] Morgan, M., Bostrom, B., Fischman, A. and Atman, C. Risk Communication: A Mental Models Approach, Cambridge University Press, 2002.
- [21] O'Leary, R. and Bingham, L. The Promise and Performance of Environmental Conflict Resolution, Resources for the Future Press, 2003.

- [22] Palmer, J. and Smardon, R. "Measuring Human Values Associated with Wetlands: Comparing Public Meetings and Sample Surveys", in Intractable Conflicts and Their Transformation, edited by Louis Kriesberg, Syracuse University Press, 1989.
- [23] Tufte, E. "The Visual Display of Quantitative Information", Ch. 4, Graphics Press, Cheshire, CT.
- [24] Ury, W., Fisher, R. and Patton, B. Getting to Yes, 2nd edition, Houghton-Mifflin, New York, NY, 1991.
- [25] Veinott, B., Olson, J.S., Olson, G.M., & Fu, X. "Video helps remote work: Speakers who need to negotiate common ground benefit from seeing each other", Proceedings of CHI 1999, pp. 302-309.