INTERVENTION FOR THE COLLABORATIVE USE OF GEOGRAPHIC INFORMATION SYSTEMS BY PRIVATE FOREST LANDOWNERS: A MEANING-CENTERED PERSPECTIVE

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Abstract: Private forest landowners support the stewardship objectives that can be achieved through ecosystems-based management. However, ecosystems-based management is a data intensive approach that focuses upon the broad forest landscape. Intervention by forestry agents or agencies could help neighboring landowners to collaborate with an ecosystems-based approach in pursuit of their stewardship objectives, using Geographic Information Systems as a tool. A typical means of intervention is the information-based approach, but this runs the risk of imposing a tyranny of the elite, where the information is presented as a means of technocratic or political control. Favoring empowerment over control as the preferred intent of intervention, we used a meaning-centered perspective to evaluate the impact of a workshop for private forest landowners featuring GIS collaboration in a role-playing simulation. Surveys and interviews assessed the ingredients for meaningful learning—conceptual background of the learner, motivation, and meaningful materials—and subsequent thinking, feeling, and acting by workshop participants. Meaningful learning occurred as participants understood the conceptual principles used in the role-playing simulation, yet the relevancy of the simulation was in question because landowners did not envision a high likelihood of collaborating with neighboring landowners. Motivations of the learner had the most impact upon the subsequent thinking, feeling, and acting indicative of the empowerment to pursue their objectives. Forestry agents or agencies should ensure that private forest landowners are motivated to learn about GIS, and that a venue for collaboration is set, before assisting with an ecosystems-based management approach.

Ecosystems-based Management for Private Forest Landowners

Ecosystems-based management targets the mosaic of ecosystems within a broad landscape as the appropriate scale for resource management decisions (Franklin 1992; Salwasser, MacCleery et al. 1992; Sample 1994). This scale of management fits well with the mission of resource agencies that manage large tracts of land, such as the Forest Service (Robertson 1992). In contrast, much of the forested Northeast consists of numerous small woodland parcels separately managed by private landowners (Birch 1996). Studies indicate that small private landowners support the stewardship objectives that ecosystems-based management could promote (Birch 1989; Jones, Luloff et al. 1995; Sinclair and Knuth In press). However, the advantages of scale for large agencies turn into problems of scale for private landowners whose management concerns correspond to just a small piece of the broader forested landscape.

An ecosystems-based approach places a large demand upon data that can be used to monitor, model, and map a variety of natural resource and land cover features spatially. A Geographic Information System (GIS) is viewed as an important tool for processing data at the landscape scale to meet this demand (Prevedel, Winn et al. 1993). Among the attributes of GIS suited to the demands of ecosystems-based management are:

- the inventory and classification of natural resources, the ability to use these data to devise management plans, and the ability to monitor management effects (Heit and Shortreid 1991; Franklin 1994);
- combining layers in various ways to generate new layers of data, integrating input into comprehensive output (Flamm and Turner 1994); and
- incorporating scales affecting any size area, projected over any length of time, and reflecting various multiple uses (Bailey and Avers 1993).

Small private forest landowners lack the resources available to large agencies; expecting every landowner to possess and use GIS is unrealistic. Collaboration among landowners would be a practical solution, both in terms of shared resources and the larger area affected by their decision-making. However, one study done in Connecticut (Sinclair and Knuth In press) indicates that landowners have little previous experience collaborating at the landscape scale.

During the Plainfield, Massachusetts Pilot Project GIS was used for collaboration among multiple forest landowners with reported success (Campbell and Kittredge 1996). With assistance through the intervention of university-supported training, participants realized benefits such as sharing ideas, minimizing forest impacts, and minimizing conflicts of objectives. Without this type of intervention private forest landowners will find it hard to collaborate using GIS, and may not be able to best pursue the stewardship objectives they support. Outside intervention, however, is not always welcomed in matters concerning private land ownership. Our study examined the effects of intervention in the collaborative use of GIS from a meaning-centered perspective.

Approaches to Intervention

Sample (1993) reported the results of a workshop which gathered together forest agencies, industries, academics, consultants, and landowners to explore effective means of mixed ownership collaboration towards ecosystems-based management. Three approaches to intervention were discussed. Landowners resented the regulatory-based

approach and were skeptical of the incentives-based approach. Favored by landowners was the information-based approach, regarding which Sample (Sample 1994, pg. 43) concluded, "Providing education and technical assistance to private landowners offers a major opportunity for achieving ecosystem management objectives at low cost."

Information-based approaches are implemented with varying intent and varying effects, not all of which benefit the receiver of information. Unfortunately, approaches involving technology have a history of dubious intent. Other studies have revealed that what we call a tyranny of the elite often accompanied the introduction of sophisticated computer technology for tax assessments and other municipal functions (Danziger, Dutton et al. 1982; Kraemer 1985). These black boxes carried a mysterious aura of technical neutrality, yet the elite managers and/or technocrats that controlled the technology manipulated inputs fed into the black box to achieve outputs of information that fit their agenda. Regarding private forest landowners, GIS represents the black box that could be used by a political or technocratic elite to control a forest management agenda.

Education theories acknowledge intervention as part of the educative act, with the educator serving as intervener, but do not promote control as the motive for intervention. Earlier theories of education this century such as behavioral learning (Skinner 1954) and developmental learning (Piaget 1970) placed an emphasis on processes of learning that were external to the idiosyncrasies of the learner. This way of thinking calls upon experts to develop curriculum and instruction based upon external considerations such as a stimulus-response interaction. The intent of such an approach, driven by the educator in consideration of what is best for the learner, can be viewed as enlightenment.

To what extent does enlightenment differ from control? In the minds of those educators known as critical theorists (Apple 1979), there is little difference. According to their concerns the intent of most educative acts by political institutions, such as the state-sponsored public school system, is to create a citizenry that will support the current political structure and behave in certain ways. Intent to enlighten becomes the same as intent to control. As long as educative acts are designed independently from the idiosyncrasies of the targeted learners, this danger exists. Neither enlightenment nor control has to be the intent of outside intervention in an educative act. Ausubel formulated an assimilation theory of learning which claimed that an educative process starts with what the learner already knows and introduces meaningful materials that can be linked to this knowledge, providing that the learner is motivated to create these linkages (Ausubel, Novak et al. 1978). This idiosyncratic, meaning-centered approach contrasts with the behavioral and developmental approaches to learning.

The internal role of meaning and the idiosyncrasies of a learner's cognitive structure influenced Novak's work on conceptual learning (Novak 1977). Novak claimed that the goal of education was not enlightenment but to empower learners with the ability to link new concepts into their unique cognitive structures, according to their own motivation. An educative event helps learners learn how to learn what they want to learn.

With this view, successful outside intervention with the collaborative use of GIS towards forest management would educate by empowering private forest landowners with how to learn what they need to meet their stewardship objectives. Any forestry agent or agency facilitating collaboration with GIS needs to understand the educative ingredients that lead to empowerment rather than enlightenment.

Study Rationale

What kind of guide can forestry agents or agencies use to determine the educative ingredients necessary for empowering private forest landowners with "learning how to learn?"

Gowin's theory of educating, which draws upon Ausubel's and Novak's work, emphasizes that the intervention of an educative act affects thinking, feeling, and acting in the learner (Gowin 1981). While these three educative outputs together (as opposed to the one output of affecting thinking) provide evidence that an educative act has empowered the learner, we still need to consider the inputs. For example, one could be induced into action through forced rote repetition of a doctrine (i.e., brainwashing). Determining whether learners have "learned how to learn" requires that their cognitive background and motivation allowed for the assimilation of meaningful intervention affecting the three outputs of thinking, feeling, and acting.

In the spring of 1998 a workshop provided to private forest landowners in Connecticut featured the use of GIS towards forest management, including a collaborative role-playing simulation. We examined the effects of this intervention from a meaning-centered perspective, to determine whether such workshops hold the potential for private forest landowners learning how to learn what they need to meet their forest stewardship objectives.

Methods

We conducted a workshop titled "The Use of GIS for Private Forest Management" at the Housatonic Valley Association office in Cornwall Bridge, CT, in April 1998. Invitations were sent to landowners on the mailing lists of the University of Connecticut Cooperative Extension with 25 acres or more of woodlands, and to members of the Housatonic Valley Association residing in Connecticut.

Twenty people were present, including three presenters and seventeen attendees. The first presentation, by a forester from the Cooperative Extension, demonstrated how GIS can be utilized to generate maps for forest management plans. The second presentation, led by a GIS consultant, reported on the use of GIS to classify forest types from satellite imagery. The third presentation, led by a graduate

student in the field of Natural Resources, involved a simulation where participants role-played neighboring forest landowners using GIS to generate forest management zones. In addition to the presentations, attendees received an overview regarding the status of GIS in the state of Connecticut and information regarding how to access digital spatial data over the Internet.

During the role-playing simulation participants used ArcView 3.0a (ESRI 1996) software with a laptop, LCD panel, and 48-inch screen to examine a wooded geographic area in Connecticut. Roads, hydrography, and tax parcel boundaries formed the base map for the area. Other datalayers included critical species, wetlands, trails, scenic roads, and streams, representing a variety of ecological and social interests affected by forest management.

Participants were split into eight groups, each one corresponding to a different forest landowner with a woodland parcel located in the simulation area. Roles were evenly divided between owners of parcels 100 acres or larger and 50 acres or smaller, and between those with mainly an economic interest in their woodland and those with mainly an ecological interest. The groups had to weight the importance of the different natural resource features used in the simulation, and had to assign percentages to how much of the landscape should be placed in each of three zones:

1. preservation;
2. multiple-use with emphasis upon social and ecological interests; and
3. multiple-use with emphasis upon sustainable harvest.

One module prepared for the simulation used the weights assigned to the natural resource features to generate a map of high values in close proximity to highly weighted features, with values decreasing in proportion to the distance away from these features. Another module used these values to generate three management zones, based upon the percentages provided, with the highest value areas of the landscape falling within the preservation zone. Participants witnessed the effect of sample feature weightings and management zone percentages on the resulting value landscape. They subsequently collaborated to generate their own unique landscape of forest management zones.

Fifteen attendees (four of the seventeen attendees were couples) filled out a survey at the beginning of the workshop that assessed their prior knowledge and experience with maps, GIS, forest plans, and collaboration. At the end of the workshop ten attendees filled out an evaluation of the value landscape simulation; some attrition resulted from the workshop lasting longer than advertised.

Three months after the workshop, interviews were conducted with six of the attendees to explore in depth the impact of the workshop, using as a framework Ausubel's theory of meaningful learning and Gowin's theory of educating. Transcripted interview responses were fitted to a matrix with categories generated from the framework theories. Conceptual Background, Motivation, and Meaningful Materials were categories generated from Ausubel's assimilation theory of meaningful learning. Thinking, Feeling, and Acting were categories generated from Gowin's theory of educating. This matrix was analyzed to determine which steps in the educational process were key for empowering the workshop participants towards meeting their forest stewardship objectives (Table 1).

Table 1: Matrix used for analyzing responses to questions assessing the impacts of a GIS workshop upon meaningful learning and educating.

General Background	Conceptual Background	Motivation	Meaningful Materials	Thinking	Feeling	Acting
Landowner 1 Acres Years Owned Land Trust?	Forest plans? Computers? Maps? Collaboration? ?	Stewardship? GIS? Other?	Understanding? Relevancy?	Plan maps? Classifying? Simulation? Data? Technology?	GIS? Collaboration?	GIS? Collaboration?

Results

General Background: Survey Respondents

Attendees at the workshop owned an average of 50 acres, with a range of 10-140 acres, for an average of 19 years, with a range of 4-67 years. Twelve of the fifteen survey respondents were familiar with the term GIS, though only seven had worked with maps and/or images of their woodland and only four had ever considered using GIS for forest management. Eleven respondents had never collaborated with other landowners but might if they had the opportunity; the remaining four had collaborated with other landowners in the past and would do so again. Only three respondents had ever obtained information regarding how the management of other woodlands affected theirs, and only two had obtained information regarding how the management of their woodland affected the surrounding landscape.

Conceptual Background: Interviewees

Of the six interviewees, half owned woodland of 90 acres or more and half owned woodland of 35 acres or less. Interviewees had some experience with at least two of the following categories: forest management plans, computers, maps, or collaboration with other landowners. All had previous experience with maps, while only one had previous experience with collaboration.

Motivation: Interviewees
Regarding motivation for attending the workshop, five interviewees referred to their stewardship values and a desire to seek out any information that might help them manage their woodlands better, while four specifically referred to their interest in the technological and/or cartographic aspect of the workshop. These four interviewees will be referred to as the "GIS-motivated." One interviewee confided he attended mainly to gather whatever "freebies," including free consultations, might be made available.

Meaningful Materials: Survey Respondents
Out of the ten respondents completing the evaluation of the role-playing simulation, eight agreed somewhat or strongly that GIS displays information in a manner that they could easily understand, whereas two disagreed somewhat. Eight of the ten agreed somewhat or strongly that they understood how ecological and social features were used to determine forest value in the simulation, and how landowner preferences for different forest management goals were used to determine forest management zones from a landscape of forest values. Seven respondents agreed somewhat or strongly that GIS is a tool that can help landowners collaborate regarding forest management. Only four agreed somewhat or strongly that GIS could provide information relevant to their forest management goals. Four also agreed somewhat or strongly that their willingness to collaborate with others would increase if GIS was used as a tool.

Meaningful Materials: Interviewees
All the interviewees found the information presented at the workshop understandable. Three of the GIS-motivated found the information relevant to their forest management interests, while the fourth stipulated that his woodland was too small and his neighbors not interested enough to make the information relevant at his scale. The other two did not find the GIS presentations relevant to their forest management goals.

Thinking: Interviewees
When prompted for their thinking regarding the workshop presentations, all the interviewees recalled something they found of interest at the workshop. Everyone was interested in the use of GIS to make maps of their woodlands, and all but one was interested in how GIS could be used to make forest classifications based upon satellite imagery. Only the four GIS-motivated recalled with interest the use of GIS for forest management collaboration. Three of these four also suggested forest management objectives for GIS use that were not emphasized at the workshop. These objectives included establishing wildlife corridors, plotting trails, managing witch hazel, and modeling defoliation.

Feeling: Interviewees
Three of the GIS-motivated interviewees indicated personal felt-significance to the use of GIS; one thought it would be valuable for mapping his woodland (including orchards), one thought it could assist him in expressing his forest management objectives succinctly; and one cited personal objectives for his woodland that he thought would benefit from the use of GIS. The rest felt that GIS would be valuable for objectives encompassing a large forested landscape, as might be the purview of a Land Trust or large landowner, but that their own woodland parcels were too small and their neighbors too disinterested to warrant the use of GIS in their own situations.

Acting: Interviewees
Three of the four GIS motivated had taken some subsequent action regarding GIS. Two of these three visited the Internet to access GIS-related sites. One mentioned that GIS now enters into his conversation with others regarding forest management. The fourth GIS-motivated interviewee indicated he needed more time before subsequent action. The remaining two interviewees had taken no subsequent GIS actions, nor had they any intention of doing so.

GIS Concerns: Interviewees
All interviewees were asked about their possible fear that the use of GIS for forest management could come under the control of an agent or agency that would use it to impose their agenda and subvert the forest management objectives of the interviewees. All six responded that the use of GIS could only be a positive, with four countering that GIS would more likely prevent anyone from being able to impose their agenda upon others.

Discussion

Meaningful learning occurs if learners have the conceptual background necessary to assimilate new concepts, and the motivation to do so. Pre-workshop surveys indicated a minority of private forest landowners had previous experience working with maps or images, but almost all were familiar with the term GIS before the workshop, and all had experience working with computers. Though only a small minority had obtained data regarding the effects of forest management across ownership boundaries, all were receptive to collaborating with other forest landowners. Thus, the conceptual background and motivation existed for meaningful learning to occur regarding GIS collaboration.

Educational materials become meaningful if they are understandable and relevant to the learner. The role-playing simulation at the workshop was our strategy for making the use of GIS for private forest landowner collaboration understandable. Our post-simulation survey indicated that most participants understood the process of how GIS was used to generate forest value and forest management zones, which implies that the use of GIS for forest management collaboration escapes the enigma of the black box.
The maps produced from an input of spatial data are less mysterious than, for example, assessment values produced from an input of numeric data.

However, the post-simulation results also indicated that the use of GIS would not be relevant to the participants in the pursuit of their own forest management goals. The lack of relevancy may relate to the perceived value of GIS for private forest management, the value of collaboration, or

both. This became a question that the post-workshop interviews helped to address.

All six of the people interviewed found the materials presented at the workshop understandable, and all thought GIS could only be a positive tool if brought into a forest management situation that involved collaboration. However, all indicated little prior experience and slim future prospects of collaborating with others across a larger forest landscape, even though they were willing to do so. Two interviewees mentioned that collaboration might be a possibility only if an agency such as a local Land Trust was involved. GIS appears to be a legitimate tool for ecosystem-based management in the eyes of private forest landowners, but its relevancy is diminished because of limited opportunities for collaboration.

The six people interviewed all had the potential for meaningful learning to occur, based upon their previous background with forest management plans, maps, computers, and/or collaboration. All indicated that meaningful learning did occur. However, motivations differed regarding attendance at the workshop, which had a distinct effect upon their subsequent thinking, feeling, and acting. Those interviewed who were motivated to attend because of the technological aspects of the workshop had thought about the unique applications of GIS relevant to their own particular interest, felt that GIS could assist them with their own small woodland parcels, and had taken GIS-related action subsequent to the workshop.

The workshop educated the GIS-motivated as evidenced by the positive effects upon thinking, feeling, and acting. Intervention led to empowerment, in the sense that those motivated to learn more about GIS came away with an enhanced ability to pursue and benefit from the use of GIS. Such empowerment did not occur for those whose attendance was not motivated by learning more about GIS.

Implications

At the time that the Forest Service proclaimed Ecosystem Management to be their new operating philosophy (Robertson 1992) many thought that a Unix workstation was needed to accommodate the data storage and processing associated with GIS. The software was expensive and required the knowledge of hundreds of commands. If private forest landowners wanted to pursue stewardship objectives through the data intensive practice of ecosystems-based management, they might have easily succumbed to the tyranny of the elite. Even an information-based approach to intervention could be a means to control the decisions of landowners wholly dependent upon the resources of those with a technocratic or political agenda.

Since then, readily available PC hardware has become sufficiently powerful, and GIS software sufficiently user-friendly, to make GIS accessible for use by small private forest landowners. Our findings indicate that the conceptual background of private forest landowners, their motivations, and their ability to understand GIS output all contribute to meaningful learning that could empower their use of GIS as a tool for their objectives.

However, private forest landowners find little motivation or relevancy in determining how their woodland relates to the larger forested landscape, or in collaborating with others. Without this ingredient for meaningful learning GIS becomes an impractical tool for ecosystem-based management regardless of its accessibility. Rectifying this problem still calls for some form of information-based intervention.

In order that GIS intervention escapes the tyranny of the elite and empowers private forest landowners to meet their own objectives, our findings suggest the following:

- the motivation for learning how to apply GIS to forest management situations must be established prior to providing hands-on experience; and
- the relevancy of GIS collaboration must be evident, mainly in regards to feasibility, for pursuit of objectives.

These suggestions result from evaluating the impact of intervention from a meaning-centered perspective, applying theories of meaningful learning and educating to determine the potential for information-based intervention to empower rather than control. We recommend this approach for agents and agencies responsible for the guidance of stakeholders in natural resource management.

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Acknowledgments

We would like to thank the University of Connecticut's Cooperative Extension for helping to organize a GIS workshop, and the Housatonic Valley Association for hosting the event. In particular we would like to thank Tom Worthley, a forester with Cooperative Extension, and John Mickelson, a GIS consultant, for their presentations at the workshop. We thank, as well, those forest landowners who attended.