ELSEVIER

COMMUNICATING WITH CITIZENS: THE POWER OF PHOTOSIMULATIONS AND SIMPLE EDITING

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There is considerable evidence that Environmental Impact Statements (EIS) may be failing in one of their chief aims—communicating information about proposed environmental changes to citizens. This paper proposes and tests two relatively simple techniques for making EISs accessible to members of the general public. We presented three versions of the project description portion of an EIS for flood control measures on the Hickory Creek in Joliet, Illinois, US, to 373 Joliet citizens. After reading the materials, each citizen answered a number of questions about the proposed project and its environmental consequences. The original project description yielded almost no understanding, but the two modifications had consistently positive and substantial effects on understanding. These findings, in combination with the low cost of the techniques, offer considerable hope for more effective public participation in the EIS process, and therefore, more viable public projects. © *1997 Elsevier Science Inc.*

Introduction

There is considerable evidence that Environmental Impact Statements may be failing in one of their chief aims—communicating information about proposed environmental changes to citizens. Despite the best intentions of the agencies preparing these statements, the authors (often expert, very experienced engineers) appear to consistently overestimate the general public's ability to comprehend technical material and technical language.

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While complaints of the unreadability of EISs have filled the literature for decades (Diehl and Mikulecky 1981; Gallagher and Jacobson 1993; Hopkins 1973; Hyman 1984; Killingsworth and Steffens 1989; Orloff 1978; Weiss 1989), it was only recently that Gallagher and Patrick-Riley (1989) undertook to document and quantify systematically the extent of the problem. The results were grim: analyzing the reading levels of 23 federal land management plans, they found that the documents were "written for people with three to six years of college education, far beyond the reading ability of the average person." More recently, we attempted to quantify the consequences for citizens attempting to read an EIS for a local project. Although the EIS material we examined was written at a far lower reading level than the documents in Gallagher and Patrick-Riley (1989), we found citizens' understanding to be next to nil; on two of three measures of understanding, most (70%) readers performed at a level no better than chance, or blind guessing (Sullivan et al. 1996). If EISs are written at reading levels comparable to those of federal land management plans, EISs may be failing to convey even the most fundamental project information to citizens.

What might agencies do to make EISs comprehensible to citizens? This paper proposes and tests two possible techniques for making EISs accessible to members of the general public. Before introducing the techniques, however, it may be helpful to review briefly the importance of making EISs accessible.

A Problem Worth Solving

What are the consequences of an inaccessible EIS? An inaccessible EIS blocks or slows citizen participation. In producing an inaccessible EIS, an agency loses the opportunity to tap into the knowledge and experience of local citizens—knowledge which might be very valuable and difficult to obtain otherwise. It has been observed repeatedly that more viable and innovative alternatives to a project emerge when citizens participate more fully in the EIS process (Bendix 1984; Jain et al. 1993; Weiss 1989). Moreover, according to Jain et al. (1993), "the diverse perspectives citizens provide could otherwise be obtained only through extensive fieldwork by the agency sponsoring the project." Because fieldwork is often tremendously expensive, information about local resources and limitations that may affect the proposed project must come from citizens. An inaccessible EIS makes it less likely that citizens will come forward with the information the agency needs to generate a viable project.

Another consequence of an inaccessible EIS is that citizens lose the opportunity to learn about a proposed project from the agency's own perspective. When citizens do not understand the material presented in an EIS, they often rely on other sources of information—newspapers, consultants, special interest groups—to learn about the proposed project. For a variety of

reasons, these alternative sources may not convey an accurate or complete understanding of the proposed project, leaving the agency to grapple with the fallout associated with citizens' misunderstandings and misinterpretations of the project. A sequence of events in which citizens learn about projects through the filter of interpreters, with their own vested interests, clearly works against the agency and against the public participation process.

Finally, an agency that produces an inaccessible EIS opens itself to lawsuits. Citizens and special interest groups have successfully brought suit against agencies for producing EIS documents that are difficult to understand (e.g., Oregon Environmental Council v. Kunzman 1985; Sierra Club v. Froehlke 1973). An agency's defense against such suits must be considerably more costly than producing an EIS which citizens understand in the first place.

For all these reasons, the inaccessibility of current EISs is a problem worth solving.

Two Possible Solutions

In this paper we test two possible solutions—two relatively simple techniques which have the potential to increase the accessibility of EISs; photosimulations showing the "before" and "after" of the proposed project, and simple editing. In Sullivan et al. (1996), we worked with local citizens to measure the level of understanding yielded by an unaltered EIS project description; in this paper, we worked with the same population of citizens and measured the understanding yielded by two altered versions of the same EIS.

Photosimulations

One possible technique for making EISs accessible involves supplementing EIS material with "before" and "after" photosimulations. Photosimulations offer an inexpensive, yet potentially powerful technique for depicting proposed environmental changes (Orland 1993; Zube and Simcox 1993). Recent advances in computer and over-the-counter software technology make it possible to create realistic pictures of places or objects, which in fact do not yet exist. With minimal training, a person can create photosimulations that show, for example, alternative locations and designs for a proposed bridge, alternative layout patterns for a new subdivision or various designs of a new highway interchange. Because this technology is so easily implemented, and because so many EISs involve projects that would bring visible changes to the environment, photosimulations could become a widely used part of EISs.

Will photosimulations help? On the one hand, most EISs already provide highly detailed, written descriptions of proposed projects and their alternatives; moreover, these written descriptions are often supplemented by maps and various diagrams. It seems quite possible that the thoroughness and com-

pleteness of these descriptions renders any supplement, however easy it might be to produce, unnecessary.

On the other hand, there are reasons to suspect that providing photosimulations might help lay persons understand an EIS. Cognitive and environmental psychologists Kaplan and Kaplan argue that humans are especially effective at grasping information presented in pictures, as compared to information presented in text, maps, or diagrams. (S. Kaplan and R. Kaplan 1982, 1989; R. Kaplan and S. Kaplan 1989). Moreover, architects, urban planners, and other environmental designers have used photosimulations increasingly to help non-designers understand and participate in decisions concerning the design of specific buildings and of urban areas (Clipson 1993; Marans and Stokols 1993; Zube and Simcox 1993). Both psychological theory, and the successes of environmental designers, suggest that adding photosimulations may make EISs more accessible.

Does providing photosimulations make EIS material more accessible to members of the general public, or does it merely provide redundant information? We added photosimulations to an existing EIS and then examined their impacts on the comprehension of lay persons.

Simple Editing

A second technique for making EISs accessible involves simple editing, or what might be called "rote" editing—the application of very simple, almost mindlessly straightforward editing principles.

Many authors have argued that if basic editing principles were employed more widely in EIS preparation, the documents would be easier to understand (Axline and Bonine 1990; Baird et al. 1987; Gallagher and Jacobson 1993; Leach 1993; Moen 1989; Ryan 1993; Weiss 1982). However, Gallagher and Patrick-Riley's (1989) work suggests that the reading level of EISs may be far, far beyond the average reader—if what is needed is extensive editing, how much impact could simple editing have? We suspected that a small tool kit of editing techniques might substantially increase the accessibility of EISs.

Can simple editing substantially increase the accessibility of EISs? We applied simple editing principles, in addition to providing photosimulations, and examined the impacts on lay persons' comprehension.

In sum, to assess the impact of photosimulations and simple editing, we tested three versions of an EIS project description: the original material (version 1), the original with photosimulations added (version 2), and and edited version with photosimulations (version 3). Each version was given to a group of local citizens to read; the impact of each version was assessed by asking the citizens a number of questions about the proposed project and its environmental effects.

Method

Selecting an EIS

Three criteria were used to select a project and its EIS for this study. Obviously, to investigate the impact of using "before" and "after" photosimulations, the proposed project had to involve a physical and perceivable change in the landscape—change that could be seen. In addition, for our participants to take the EIS document seriously, the project had to be real rather than hypothetical, and it had to be fairly new or ongoing, not already complete. An EIS prepared by the state of Illinois Department of Transportation, for flood improvements on the Hickory Creek met these criteria and was selected. It included features typical of EISs, descriptions of the proposed action and its alternatives, and supporting maps and diagrams.

To assess the representativeness of this EIS, we compared it to other EISs with respect to typography and reading level (see Sullivan et al. 1996 for a fuller description). There is evidence that the authors of this EIS took steps to make the document readable. The typographic quality, as judged by Gallagher and Jacobson's (1993) criteria, is about average, and the reading level, as judged by the Flesch Reading Ease Scale (Flesch 1974), is substantially more accessible than the average reported by Gallagher and Patrick-Riley's (1989) survey of federal land management plans. Whereas the most easy-to-read plans in their survey were at third-year college level, the material tested in this study was written at the second-year high school level.

Creating "Before" and "After" Photosimulations

To supplement the original EIS project description material, photosimulations were produced showing how the creek would look "before" and "after" the proposed flood control measures.

To create images of the "before" conditions, we took 35mm slides of the Hickory Creek at places along the creek where flood improvements were proposed. The slides were then developed, scanned, and saved as computer files to be incorporated in a wordprocessing document.

To create images of the "after" conditions, we took 35mm slides of other creeks that had the three kinds of flood control features proposed for the Hickory Creek. These slides were also saved as computer files, and then Adobe Photoshop software was used to "cut" and "paste" these flood control treatments onto the pictures of the Hickory Creek. Figure 1 shows one "before" picture and three "after" photosimulations depicting how the creek would look after the proposed bank modifications were constructed.

The two modified EIS project descriptions included six pictures; three "before" and three "after" images that were presented as pairs. A short caption under the pair of pictures described the changes. One caption, for

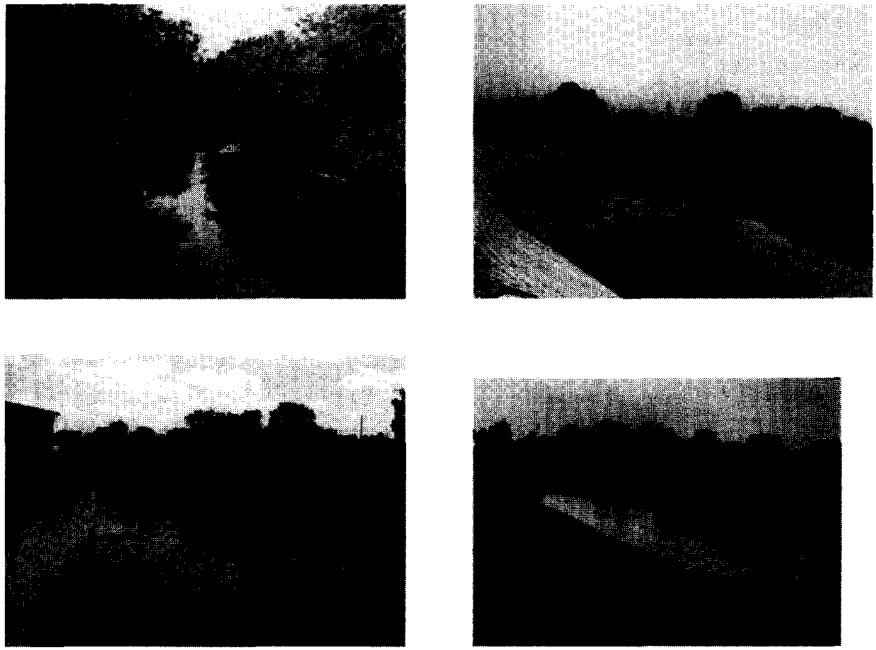

FIGURE 1. The flood control features suggested for the Hickory Creek included three different treatments of the creek banks. The banks were to be changed from their existing condition (top left) to either a fabric formed concrete embankment (top right), a vertical concrete wall (bottom left), or an earthen embankment (bottom right).

instance, read: "Hickory Creek after channel improvements with sloping concrete walls."

Applying Simple Editing Principles

We consulted with a reading expert from the Center for Reading, at the University of Illinois, to generate simple editorial principles for making EIS material more accessible. Seven simple rules were generated (Table 1). Four of these are intended to help the reader see the forest *before* the trees:

1. *Provide an overview.* For each section, e.g., the Project Description, provide an introductory overview paragraph.
2. *Provide headings.* Use headings to break sections into subsections of about 3–6 paragraphs. These headings serve as mini-overviews of the subsections.

TABLE 1. Changes Made to the Hickory Creek Project Description

	Before	After
Provide overviews	none	"The purpose of this project is . . ."
Provide headings	1 heading	2 headings
State headings as questions	"Channel Improvements"	"What will channel improvements involve?"
Make headings distinct	Heading formatted like the rest of the text.	Heading formatted in capital letters.
Use local landmarks	"From station 122 + 30 to station 123 + 10, a concrete transition flume would be constructed."	"At about Washington Street (station 122 + 30 to station 123 + 10—refer to Map 2), a concete transition flume will be constructed."
Explain technical terms as you go	"Hickory Creek would be channelized from its mouth . . ."	"Hickory Creek will be channelized (straightened and deepened) from its mouth . . ."
	"the slope of the channel will be . . . between 0.0016 and 0.0020 vertical feet per linear foot"	". . . with a very gradual slope (between 0.0016 and 0.0020 vertical feet per linear foot)."
Use bullets	paragraphs that included many details about distances, slopes, slope ratios	bulleted sentences about a distance or slope.

3. *State headings as questions.* Framing headings as questions is one way to make headings effective overviews for what's ahead; the heading asks the question that the subsection answers.
4. *Make headings distinct.* Use typography to make headings readable at a glance, so that readers see the headings (the forest) before the text (the trees).

The remaining three principles are intended to help the lay reader comprehend highly technical information:

5. *Use locally recognizable landmarks.* Use landmarks that citizens will recognize to identify locations, and provide station points parenthetically.
6. *Explain technical terms as you go.* Explain technical terms in the body of the text rather than in the glossary, and provide interpretations of technical terms.
7. *Use bullets.* Use bullets, rather than text, to convey a series of technical specification.

The original project description of the Hickory Creek EIS was one page of single spaced text. After editing, and especially the addition of bullets and explanation of technical terms, the text for version 3 was almost one-half page longer than the original.

Testing Understanding

Measuring a reader's understanding of a written document can be tricky. If one asks questions that require only recall to answer, a person with a good short-term memory for verbal items may score well without truly understanding. Conversely, a person who understands the basic idea may score low on recall, if they have trouble with technical jargon included in many EIS documents. For this reason, we measured understanding in three ways. We asked questions that required (1) recall of the basic facts, (2) understanding the gist of the project, and (3) understanding the project's environmental effects.

PROJECT RECALL. Five multiple-choice questions probed students' understanding of the proposed project's basic features. For instance, one question asked about the type of embankment proposed for the creek, and another asked how much of the creek would be bordered by a vertical concrete wall. Five possible answers were provided for each, only one of which was correct. On these questions, blind guessing would produce one correct guess for every 5 questions; thus on this measure, 20% correct corresponds to performance at chance or blind guessing.

UNDERSTANDING THE GIST. The extent to which students understood the gist of the project was assessed through a picture selection exercise. Students were presented with nine pictures, three of which showed how the Hickory Creek would look after channel improvements were completed. The remaining six images showed the creek in its current condition, or showed flood control treatments (such as a dam) that were not planned for the Hickory Creek. Students were asked to identify three pictures that most closely showed how the creek would look after the improvements were constructed. None of the images that we included in version 2 or version 3 of the modified description were used.

ENVIRONMENTAL EFFECTS. While the EIS material the students read did not describe the consequences of building the flood improvements, students were asked to anticipate what those consequences might be. Twelve true–false questions examined their understanding of the possible impacts of the project. The true–false questions included items such as *constuction of this project will require digging up material from the creek channel* (true), *the natural appearance of the Creek will be lost because of the channel*

improvements (true), and *the improvements will not destroy the homes of any animals living in the water* (false).

A set of standard demographic questions was included with the test. These questions asked the participants' age, education, and how close they lived to the creek.

Participants and Procedure

Bendix (1984) suggests that EISs be reviewed by teenagers before they are published, arguing that if the material is understood by teenagers, given their reading abilities and levels of experience, then the vast majority of the general public should be able to understand the material. We tested the three EIS versions on 373 students from the two public high schools in Joliet.

One advantage of testing EIS material on high school students is that the effects of different versions can be assessed on readers of varying skill levels. Both schools gave us access to participants' scores on the *Comprehensive Test of Basic Skills*, the standardized achievement test given to students in their first year in high school. The test scores include a measure of each student's reading ability, ranked according to national ranges for high school students.

The three versions of the EIS were distributed randomly to participants; 113 received the original (Version 1), 128 received the original + simulations (Version 2), and 132 received the edited original + simulations (Version 3). Along with an EIS version, each student also received three maps that were part of the original EIS. Students were instructed to read the description and the maps, and were told they would be taking a short quiz after they had read the materials. The participants took an average of 20 minutes to read the material. After they completed their review, each individual handed in the study material in exchange for the test. They took between 5–15 minutes to complete the test.

Results

The analyses that follow address four questions; (1) did the original EIS material yield adequate understanding of the project?; (2) did the changes to the original version increase understanding?; (3) were the changes sufficient to yield adequate understanding?; and (4) did the changes increase understanding for everyone, even the less skilled readers?

How Did the Original EIS Do?

Did the original project description (Version 1) provide lay readers with an adequate understanding of the project? No. As described in Sullivan et al. (1996), participants who received the original EIS material performed far below the academic equivalent of a "C," or 70% correct, on the test for

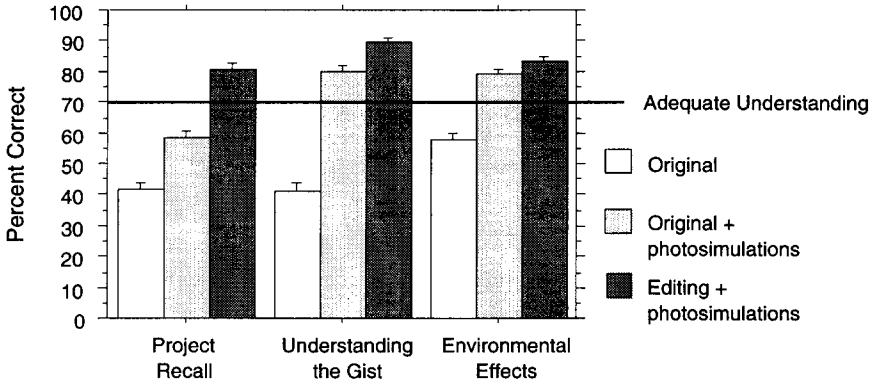

FIGURE 2. Percent correct on three measures of understanding for participants who read the original project description, the original description plus photosimulations, and the edited project description plus photosimulations.

each of the three measures of understanding. Moreover, on two measures of understanding, 70% of the participants answered correctly at a level no better than chance (blind guessing).

Did the Changes Help?

Did adding photosimulations increase readers' understanding? Yes, Version 2 (the original EIS material + photosimulations) performed significantly better than Version 1 (the original EIS material), as assessed by a multivariate analysis of variance (MANOVA) using EIS format as an independent variable, and the three measures of understanding as dependent variables, $F(3, 237) = 54.3$, $p < 0.0001$. Furthermore, ANOVAs comparing Versions 1 and 2 showed that the version with photosimulations outperformed the original EIS material on each of the three measures, at $p < 0.0001$. The addition of photosimulations yielded significantly greater understanding in lay readers.

Did simple editing, in addition to photosimulations, increase readers understanding even further? Yes, Version 3 (the edited version + photosimulations) performed significantly better than Version 2 (the original version + photosimulations), as assessed by MANOVA, $F(3, 256) = 20.1$, $p < 0.0001$. Again, individual ANOVAs confirmed that the edited version outperformed the unedited version on each of the three measures at $p < 0.0001$.

In sum, adding photosimulations to the original project description resulted in a significant increase in understanding, and simple editing of the EIS text resulted in a further, significant increase in understanding. Figure 2 shows how dramatic these increases in understanding were for each of the three measures.

As Figure 2 shows, the increases in understanding were substantial. The mean performance of Version 2 was between 17 and 39 percentage points superior to that of Version 1, and the mean performance of Version 3 was between 5 and 22 percentage points better than Version 2's.

Did the Changes Help Enough?

So far, we have seen both that the original EIS material did not yield a level of citizen understanding adequate for meaningful public participation, and that the two techniques tested here lead to significant, dramatic gains in understanding. A third question arises—did these modifications help enough? That is, did individuals who received Versions 2 and 3 gain a level of understanding that would allow them to participate meaningfully in the EIS process?

First, we examine whether Version 2 yielded adequate understanding. Adding photosimulations was sufficiently powerful to yield what we have called adequate understanding (70% correct) on two of three measures of understanding—a mean of 80% correct on *Understanding the Gist,* and a mean of 79% correct on *Understanding the Environmental Effects.* One sample t-test showed that performance on these two tests was significantly greater than 70%, $t(127) = 4.4$, $p < 0.0001$ for the former, and $t(127) = 6.0, p < 0.0001$, for the latter. However, Version 2 did not yield an adequate understanding on *Project Recall* (mean 58% correct), significantly less than 70%, $t(127) = -5.6$, $p < 0.0001$. As the *Project Recall* measure is more dependent on participants' understanding of technical terms and concepts used in the EIS, perhaps it is unsurprising that photosimulations had less effect on this measure.

Version 3 yielded even better comprehension than did Version 2. The combination of simple editing and photosimulations was sufficient to yield better than adequate performance on each of the three measures of understanding. Mean performance was in the 80% range for each of the three measures; mean 81% correct for *Project Recall,* mean 89% correct for *Understanding the Gist,* and mean 83% for *Understanding the Environmental Effects.* One sample t-tests confirmed that these scores were significantly greater than the criterion score of 70% correct, $t(131) = 5.3$, $p < 0.0001$, $t(131) = 11.7$, $p < 0.0001$, and $t(131) = 9.5$, $p < 0.0001$, respectively.

Whereas the original EIS material lead to little or no understanding of the proposed changes to the Hickory Creek, adding photosimulations was sufficient to yield adequate understanding on two of three measures of understanding. Simple editing, in addition to the photosimulations, raised understanding to well above adequate on each of the three measures.

Did the Changes Help Everyone?

Reading skills of the general public differ widely. To the extent that EISs are intended to include all members of the citizenry, they must communicate

effectively not only to facile readers but less skilled readers as well. Thus, a technique for enhancing the accessibility of EISs cannot be considered wholly successful if it makes EISs accessible to good readers only. Did the two EIS modifications tested here lead to an adequate understanding for less skilled readers in our sample? To answer this, we used reading comprehension scores to identify those who read at or below the national 50th percentile and then examined the effects of the modifications on this subsample. The results echoed those of the population as a whole. For the less skilled readers, Version 2 yielded adequate understanding for two of three measures of understanding, and Version 3 yielded adequate or better understanding on all three measures.

Discussion

Taken together, these results offer considerable hope for citizen involvement in the EIS process. Although the original project description yielded very little understanding, the two modifications had consistently positive and substantial effects. Adding photosimulations alone was sufficient to yield adequate understanding on two of three measures and adding photosimulations to an edited project description raised understanding to well above adequate on each of the three measures. These patterns held even for less skilled readers.

Perhaps, given these results, photosimulations and simple editing techniques should be adopted by all agencies that prepare EISs. But before making such a recommendation, it seems sensible first to consider the possible limitations or negative aspects of using photosimulations and simple editing principles in EISs.

Possible Limitations or Down Sides of Photosimulations

Photosimulations have one obvious limitation. Their value is limited to EISs that describe a visible change to the landscape; e.g., flood control modifications to a river, development of a highway interchange, development of a visually sensitive landscape. It seems clear photosimulations would add little to EISs that involve imperceptible changes in, for example, water quality.

Photosimulations also may have a downside. Sheppard (1989) pointed out that simulations can be deceptive—photosimulations are no exception. As with written material in an EIS, photosimulations should portray an honest, accurate image of the proposal. High standards of integrity and honesty should guide all communication in EISs, including the use of photosimulations.

What about the costs of adding photosimulations to EISs—is this technique affordable? The costs are actually quite small, both with respect to the actual expenses and the value added to the EIS process. The photosimulations used in this study were prepared by a graduate student in our

laboratory. Our costs—the student's hourly pay, two days of travel, 35mm film, and film processing—came to less than US $1,000. Because many agencies cannot prepare photosimulations in-house, we checked our expenses against two estimates for producing photosimulations. The first estimate was $4,000–$6,000 to prepare all three photosimulations. The second estimate was $3,000–$9,000. While our costs were considerably less than these estimates, even the higher estimate of $9,000 is a fraction of the approximately $1 million[1] the State of Illinois spent on the preparation of the Hickory Creek EIS. Thus, it seems likely that in general, adding photosimulation will increase the cost of producing an EIS by a tiny fraction.

Possible Limitations of Editing

In this study, we examined the benefits of simple editing in conjunction with photosimulations. Are the benefits of editing limited to EISs that contain photosimulations? That is, can we expect an increase in understanding from editing alone? Although our study did not address this question, there is no reason to think the benefits of editing depend on the concurrent use of photosimulations. In fact, a number of scholars have argued the kind of editing changes used in this study should lead to increased understanding (e.g., Axline and Bonine 1990; Baird 1987; Gallagher and Jacobson 1993; Moen 1989; Ryan 1993). Still, to our knowledge no study has examined how much simple editing changes alone affect citizen's understanding of EISs. Because editing changes are relatively easy to make, and their effect on understanding is potentially large, the question of how much editing changes alone affect understanding deserves further research.

Another area for further research is the effect of simple editing on more difficult to read EIS material. The Hickory Creek EIS was considerably easier to read than what Gallagher and Patrick-Riley (1989) suggest may be the norm. Whereas simple editing was sufficient to yield adequate understanding for this EIS, it is not clear whether it would suffice to make more typical EISs accessible to lay persons. Again, because simple editing offers so much promise at such a small cost, the effects of simple editing on EISs that require college level reading skills deserves further investigation.

What about the cost of simple editing? The editing cost considerably less than producing the photosimulations. The editor charged a total of $75 for two meetings to discuss the work, learn several terms and to edit the Hickory Creek project description.

How Can These Changes Be Made?

How can an agency obtain photosimulations for use in an EIS? There are at least three methods. The first involves preparing simulations in-house.

[1] The cost of preparation of the Hickory Creek EIS is an estimate from the Illinois Department of Natural Resources and is adjusted for inflation to 1996 dollars.

In-house production of photosimulations requires an employee who has experience with a computer program such as Adobe Photoshop, a desktop computer, a slide scanner, time and money to photograph the project site and other sites, and time to produce the simulations (perhaps two days of computer time per simulation). The second method involves hiring a consultant to prepare the simulations. Landscape architecture firms, urban planning firms, and students and faculty at large research universities can be hired to prepare photosimulations. The third method involves obtaining photosimulations that were prepared by designers as part of the initial design of the proposed project and its alternatives. As photosimulations become more and more a part of the design process (Orland 1993; Zube and Simcox 1993), agencies may find photosimulations that have already been created can be used in the EIS process.

As with photosimulations, editing changes can be made in-house or hired out to a contracting editor.

Conclusion

Despite the considerable time, effort, and money spent in preparing EISs, it appears that the majority of EISs may be so poorly understood by citizens that they have essentially no value as a public participation tool. In this paper, we have shown the power of two very simple, easy-to-implement techniques for making EISs accessible. While it is too early to recommend these techniques be adopted wholesale, it is also true that the status quo of inaccessible EISs is harmful to projects, the public, and agencies themselves. We hope the promise in these findings, in combination with the low cost of the techniques, will encourage agencies to give photosimulations and simple editing a try. We believe it is through agencies' widespread experimentation and refinement of techniques that the best methods for making EISs accessible will emerge.

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