Using the National Engineering Education Delivery System as the Foundation for Building a Test-Bed Digital Library for Science, Mathematics, Engineering and Technology Education

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Findings

1. Developed a test-bed SMETE Digital Library

The results of the activities (described in the Activities Section) confirmed for us the need for, and value of a science, mathematics, engineering, and technology education (SMETE) digital library. Because of this we have a deep understanding of the kinds of technological and social issues that we must address in building a SMETE digital library. We are committed to developing a national digital library for SMET education that is much more than a static information repository. Through an alliance of partners we intend to create a dynamic learning community that promotes and supports SMET education in the 21st century by providing educators and learners with seamless access to partner collections and shared services to improve learning.

2. Results of Focus Groups Activities for the SMETE Digital Library User Community

The primary concern of the focus group participants was having the ability to find good learning materials to meet their immediate needs. Convenience to the user was high on the list of concerns of these faculty, they want to be able to very quickly identify if the material fits with their goals, if they can download it, if it is free, and so on. Effective indexing was also critical—especially considering the complexity of searching for similar concepts across disciplines. Participants wanted to see a wide selection of course materials, from simple exercises to full courses. They also felt it essential that the system be stable, archived, and reliable. Features they were most concerned about reflect the need for good quality control of the holdings; they preferred an expert review system akin to, but not necessarily the same as, journal reviews. In particular they felt it was important to include experts in pedagogy and cognitive science in the review process. They also wanted support or assistance in using the learning materials, such as contacting the author and having on-line and in-person training.

Differences among the participants regarding the potential use of a digital library appear to be based in their identification with their own disciplinary community. Faculty participants in our focus groups represented reform–minded faculty dedicated to improving education in their respective disciplines. It appears these communities recreate the kinds of disciplinary splits already apparent at most colleges and universities. These faculty acknowledged the value of multi-disciplinary work and appreciated the value of being able to have access to the other disciplines. However, as users, they would first look to their discipline before possibly exploring others. Their communities are strong and effective; they depend primarily upon personal

connections for learning about and implementing technology enhanced leaning. Access to new ideas and training at national conferences and meetings, as well as collaborative work on grants, provide these faculty with the network they needed to initiate and sustain change on their individual campuses. The results from the focus groups highlight some of the challenges that must be addressed to create a SMETE digital library [1].

3. Results of Evaluation of the test-bed SMETE Digital Library

We initiated an evaluation process that integrates, at this point, a triad of three types of data that are useful during this formative planning stage. The first point of this triad focuses on identifying and understanding user needs. The focus groups (described above) have been an effective means for identifying and tracking changes and differences in needs among the various sub-groups of users of the test-bed. The needs assessment is a necessary component of the prototype evaluation process in that it is an efficient way to gather data necessary to inform the design of the library.

The second type of data collected centers on tracking users' actions in order to better understand how actual users use the site. In addition to knowing the rates of use of the site it is important to learn how users tend to use the site. In order to better understand this, we have expanded on the existing tracking system to devise a more effective process to identify trends regarding, time spent at the site, types of use (e.g., searching for learning resources, reading comments, or downloading materials) or paths through the site (how deep into the site users tend to go).

The third type of data we wish to collect centers on what users tell us about using the site: what they think are its strengths and weaknesses, what features or services are valuable and so on. To better understand these areas, user surveys have been designed and piloted with NEEDS users. There are multiple tools being designed to address: user satisfaction with the library, user satisfaction with the contents of the library, impact of learning resources on the primary user (faculty and teachers) and the user's clients (students). Additionally we are designing more specific tools to gather data regarding critical design issues such as how to modify our user registration system. Such a system will provide a readily identifiable population from which we can survey. The surveys that have been piloted are standalone, meaning that the sample population was selected and invited to participate via email. In the future, the surveys will also be embedded in the site so that these data can be collected on a regular basis. Embedded site surveys will be supplemented with regularly scheduled surveys of registered users and selected samples of potential users.

An online user satisfaction survey was developed after a 'paper/pencil' version of the survey of potential users was pilot tested at the 1999 ADL meeting in Baltimore, Maryland [2], and at the ASEE meeting in Charlotte, North Carolina [3] This survey was designed to gather information regarding engineering faculty use of the Web and NEEDS to find engineering computer enhanced learning materials. For the on-line version, faculty participants in two engineering Coalitions, representing approximately 15 different colleges and universities were surveyed regarding their use of the Web.

The on-line survey was designed to elicit faculty perceptions of specific services offered by the World Wide Web and NEEDS, with a focus on search functions. Also included in the survey

were questions regarding how these faculty use the Web. Forty-four engineering faculty responded to this pilot survey, with over 90% of the respondents reporting that they use the Web to locate information associated with their profession, and 78% reporting that they use the Web as a way to communicate with their professional colleagues. When asked about using the Web to locate learning materials, 68% of these same respondents reported using the Web quite regularly, with 36% of the total group checking the Web as frequently as once a week. Approximately 45% of the respondents also reported using the Web to learn more about teaching. The results of the pilot test suggest that while these faculty do go to the Web to learn about course materials, they do not use NEEDS with the same frequency. Not one web site, commercial or non-commercial, was preferred by these respondents. These preliminary data also indicate that faculty do use the Web to communicate with one another and find information, and they do so with regularity.

One of the primary purposes of this pilot test was to identify an effective and efficient way to implement on-line surveys of users and potential users. As with other methods of surveying, especially those that are mailed, this on-line survey fell short of a desirable return rate. Messages were sent to over 500 individuals and of these, only 44 faculty responded. We had hoped for a higher response rate and had in fact offered two gift certificates to Amazon.com to the first two respondents returning their survey as an inducement. However, this method of surveying did serve as an effective way to advertise the NEEDS site. Many of the respondents indicated they had not visited the sight until they received the email inviting them to participate in the survey. This pilot test also pointed out the need to select sample populations carefully, and to match the purpose of the survey to the population. Additionally, it brought to light the potential effectivness of 'pop-up' style surveys to get at specific design questions rather than relying on embedded surveying techniques.

4. Evaluation of Discussion Needs and Tools

Emerging from the analysis of the focus group transcripts were several themes common to all the groups regarding community and communication. These included the notion that faculty highly value learning from communities of like minded faculty such as those initiated in workshops, meetings, and conferences. Another dominant theme centered on the belief that the web is an effective means for individuals to connect with a community, and that it encourages communication and dialogue about shared concerns. Faculty described community and personal contacts as being a driving force in learning about and supporting innovation. Digital libraries, for these faculty, had to be more than just content, or as one member said:

> *"a useful digital library has to not only have the content, but also build a sense of community of users…give you a sense that you're talking to other practitioners who have similar interests and problems and you can learn to trust and rely on the information…."*[1].

Faculty, however, also identified a number of problems in their ability to integrate and use computer-mediated learning and the Internet in their teaching. Specific concerns include: their lack of time to learn about the materials, inability to easily find usable materials, and lack of opportunity to be trained in using those materials.

These results confirmed the major component of NEEDS' focus on learning, that of creating multiple means for faculty users to communicate with one another. Threaded discussions — sometimes referred to as on-line forums —were explored as one way to build community among faculty users of NEEDS. Threaded discussions were chosen as they are better suited for contextualized conversations which require a structure for questioning, answering, and commenting on complex topics. They allow in-depth interactions along multiple, parallel, or interrelated topics or "threads", and control over the frequency and time of the interactions [4]. As they allow time for reflection and development, these threaded statements tend to be more focused than general newsgroup discussions [5]. The types of discussions described by our focus group participants would not be well suited to real-time chat where responses are typically short, basic in meaning, and are frequent.

Threaded discussions also provide a user with a permanent record of the entire conversation for later reference. In the threaded discussion model, responses can be associated with any message, thus a discussion can branch out infinitely [6] and provides users with a convenient means to track the history of a conversation from its inception. E-mail and other forms of linear discussion lack this feature, because they allow multiple and simultaneous conversations to become intertwined. We also found that threaded discussion provide a user more control over frequency and focus of the interaction. Mailing lists, another popular option can easily overwhelm a subscriber if the size of the list population expands while traditional newsgroups have the benefit of providing context to the messages but require the user to constantly check with the group for updates. The mailing list model fails because the user can only subscribe to the list as a whole, and not an individual topic within it. E-mail messages arrive in no particular order and lack the context that makes true communication and conversation meaningful [7].

As a result of this review of available communication tools against the backdrop of user needs, we developed a prototype that combined several features of traditional threaded discussion, newsgroups, E-mail, and mailing lists in order to create a form of threaded discussion that can branch, be tracked, and inform users when responses have been posted to their query or comment. These additional features are also attractive because they reduce the costs borne to the user in participating in a discussion.

5. References

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