A Web-based Environment for Assembling Multimedia Learning Stories in Irish Primary Education

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Abstract

The Empowering Minds Learning Network is a web-based environment that supports discussion and reflection on classroom activities. The environment collects and organizes multimedia files and documents from participating students and teachers, allowing them to share their work with each other, with their communities, and with the world. The environment also gathers extensive data on teachers' usage of the service, providing a means for study and personal reflection on each teacher's emergent interests and pedagogical development. The application is currently being used to support Constructionist learning with new digital technologies in Irish primary schools.

1. Introduction

The ongoing Empowering Minds project introduced new digital technologies into 13 Irish primary schools, along with a framework for teacher professional development that recognized teachers' passions and interests in bringing about pedagogical change. The students worked with Lego Mindstorms materials, creating models that interacted with other models and with the world through sensors and motors. During the first two years the project was running (1999-2001), students and teachers took hundreds of photos and created dozens of documents describing their work. This body of material and the desire to share and discuss it was the impetus for the Empowering Minds Learning Network (EMLN), a database-backed web service that allows the learners to share the files and reflect on their learning. The EMLN is available at http://rasmussen.mle.ie/.

The design of the Empowering Minds Learning Network echoes the philosophy of the original project. Specifically, the learning environment recognizes the role of teachers as learners in the classroom, and it acknowledges the importance of the community in learning. The design also reflects teachers' desire to maximize communication while minimizing any increase of workload.

In this paper we review the history of the project and the need that evolved for this type of online environment. We discuss the structure and features of the online environment as it developed. The application is compared to two groupware systems that also target learning environments, and we discuss possible extensions to the system.

2. Project History

"Empowering Minds" is a collaborative project between St. Patrick's College, Media Lab Europe, the National Centre for Technology in Education, the Higher Education Authority and a growing group of Irish primary classrooms. The project began in October 1998 with an open call for participation to all Irish schools. Four schools were selected for the first phase of our project, March 1999 to June 2000. Classrooms were selected from a range of school types: large middle class suburban, inner city disadvantaged, medium-sized semi-rural, and two-teacher rural. In the second phase, August 2000 to June 2001, the sample was expanded to include more small rural schools and disadvantaged schools, as well as some single sex schools and children with special needs. At present there are 13 schools and 29 teachers (24 classrooms) participating in the project. There are over 500 students participating, ranging in age from six to thirteen. All of the teachers in the project are volunteers; their experience with technology ranges from complete beginner to experienced.

A unifying theme of "Story, Myth and Legend" was developed in order to avoid a narrow technological focus in the work. This theme provided a narrative context for the children's learning within which the design activities were brought to life. The teachers and children were encouraged to interpret this theme by building on their own interests and passions, and the unique heritage of their schools and localities [1] - [4].

Prior to August 2001, communication within the group consisted primarily of face-to-face meetings. When the project moved from the initial core group of 9 to 29 teachers, alternative methods of communication had to be developed. Geographical clustering and a buddy email system were established to facilitate communication

among project members with varying success. The teachers and children also wanted a way to share the projects they were working on in the classrooms with the other schools. It was proposed that each classroom create a regularly updated website to solicit feedback, ideas, and help from the other classrooms. A web-authoring workshop using Macromedia Dreamweaver was organized for the teachers in February 2001. Each teacher was given their own copy of the software and a manual to help them with site creation. Despite this, few websites were developed. Teacher's comments indicated this was due to a lack of technological fluency with the web authoring software, the teachers' lack of time to devote to the task of developing a site, and the lack of Internet access in most classrooms.

The problem of communication and sharing across schools was becoming critical. We decided to address two main questions:

- Could we get Internet connectivity into each of the project classrooms?
- Could an engaging web-based environment be developed to facilitate learner communication while requiring very little technical expertise?

In response to this we decided to install wireless technology into each of the schools and began to develop the Empowering Minds Learning Network.

3. Design of the Environment

When designing the Empowering Minds Learning Network, we wanted a feature set and architecture that would enable open learning across the boundaries of classrooms and communities. The technology had to respect teachers' time constraints, and not require a large amount of computer fluency, which is perceived by the teachers as a barrier. In this section, we describe the EMLN's features and software foundation.

3.1 Website Features

The end-user-visible content of the EMLN is divided into four sections: About Us, Media, Documents, and Discussions. The color scheme of each web page is determined by its section, aiding in navigation.

The About Us section contains textual information about the project and its participants. The bulk of the information in this section is updateable by the teachers through web forms. It includes facts about school size and location, a teacher directory, and information on project history and funding.

Much of the environment's richness comes from student and teacher uploaded Media. In our usage, a

Media file is any sound, picture, or video. It is widely observed that students are reluctant to disassemble the Lego creations they have committed much time to inventing. Creating and sharing one's handiwork through Media often helps to alleviate the distress of losing a favorite model. Figure 1 shows one of the pages in the Media section.
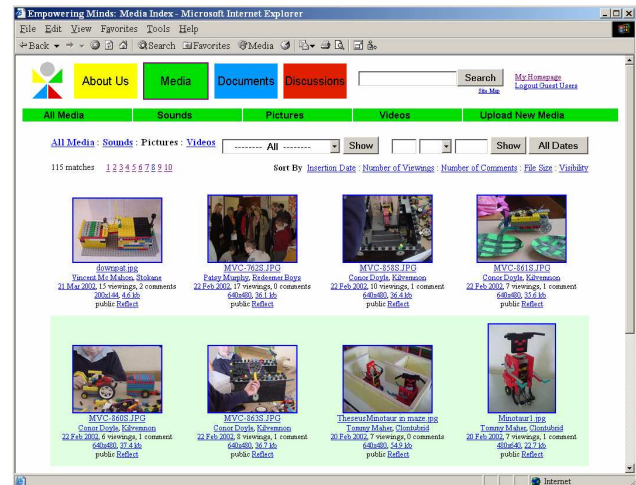

Figure 1. A Media page from the EMLN

Any computer file can be a Document. Currently contributed Documents from project members include group-meeting notes, tutorials on classroom video techniques and computer networking, and programming projects created with MicroWorlds Logo. Media and Document files are added to the environment via HTML form-based file upload.

In the Discussions section, users can combine multiple Media files with text to create a Reflection. The Media is added through a point-and-click interface, and the sequence of Media files can be supplemented with either plain text or HTML. The Discussions section also includes other features to foster discussion about the site content, including an archived mailing list and bulletin boards for both public and private message postings.

Media, Document, and Reflection objects all share several common features. The objects can be filtered by school or by classroom, and can be sorted by attributes such as creation date. The text accompanying each object is immediately incorporated into a site-wide search. Every object can be commented on. Detailed viewing information is recorded for every object, including when the document was viewed, and if viewed by a teacher, the identity of that teacher.

Because raw viewing data is stored in database tables, it can be rearranged and mined for meaningful trends. Viewing statistics for each of the main objects can be combined with other information such as posted

comments and terms used when searching the site. By analyzing this data we can answer questions such as:

- Which teachers are using the site during school hours?
- Do the teachers prefer to look at content from others or add new content themselves?
- Are any teachers looking for information on digital video editing?
- Will teachers with slower Internet connections use video in their classrooms?

This information will be useful for designing future professional development programs and as a means of assessing if this environment is an effective communication and learning platform. Each teacher is presented with this information about their usage habits, allowing that teacher to reflect on how his or her interests and classroom behavior are changing.

Privacy is an important concern, especially for students in this age range. We strongly caution teachers not to upload any objects or information that could identify a specific student. Every Media, Document, and Reflection object in the database has an associated permission, which by default limits its visibility to teachers in the project. Teachers can make these objects publicly accessible, but only by proactively changing the objects' privacy settings.

3.2 Website Architecture

Though the EMLN environment was designed specifically for use in the Empowering Minds project, we designed the system architecture to maximize its potential reusability in other classrooms. The system cost, ease of installation, and ease of maintenance were paramount. We decided to build the system on top of open-source software. Figure 2 shows a simplified version of the website architecture; each layer interfaces to the layer(s) directly beneath it.

The bulk of the EMLN software was implemented as interconnected modules for the Open Architecture Community System (OpenACS). The OpenACS is a toolkit for rapid development of community-oriented web services. In our application, it handles user authentication and permissions, user account management, and page templating. It also provides several pre-built modules to promote community interaction, such as web bulletin boards with integrated email alerts.
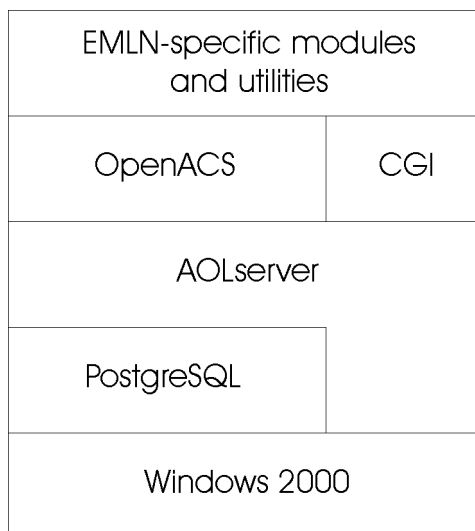

Figure 2. Simplified structure of website

The OpenACS itself largely consists of TCL scripts run by AOLserver, an aggressively multithreaded web server. Although this strong connection makes use of another web server difficult, AOLserver's stability, scalability, and excellent database connectivity make it apt for large scale, dynamic web services such as ours. AOLserver also supports CGI scripts, which we use for server administration and general log analysis.

Behind the scenes, user content is being stored in PostgreSQL, a powerful object-relational database management system. One tradeoff we made was in storing content directly in the database, rather than in the filesystem. This was done for simplicity of design and ease of development, but this arrangement consumes more disk space and results in slightly slower page loads.

We automatically generate thumbnails of uploaded images with ImageMagick, which is also used to calculate image geometry and other information. Detailed software version information for the major website components is available on the EMLN in the "About Us" section.

Our application was developed on Microsoft Windows 2000, and currently runs on that operating system. All of the base components support multiple operating systems, making future development on Linux or other platforms practical.

4. Related Work

The Empowering Minds Learning Network has features in common with many industrial content management and distance learning systems. Because of space considerations in this paper, we will limit our discussion to two groupware systems that are targeted at education. The first system discussed, ACES, is nearly identical to the EMLN in architecture but differs in

intended audience and philosophy. The second system, Crossroads, is similar to the EMLN in purpose and philosophy but has a significantly different architecture.

4.1 ACES / dotLRN

The ArsDigita Community Education Solution (ACES) is a distance education toolkit whose architecture is nearly identical to that of the Empowering Minds Learning Network. The ACES was developed for use in university-level education and corporate training.

Like the EMLN, the ACES provides document management and discussion forums. It has additional modules for online surveys, quizzes, and homework submission. Administration features allow course instructors to assign students to project teams, record attendance and grades, and post lecture notes and assignments. The toolkit also includes online chat rooms for synchronous discussion of course content [5].

ACES and the EMLN share the goal of increasing communication between distributed learners. However, the features of the ACES target a heavily structured learning environment involving mandatory online interaction. Another difference is the presence of individually identifiable communication, which is extensively used in ACES to track students' work and progress. In the EMLN this tracking exists to an even greater extent, but only for teachers; content added by students is identified only by the sponsoring teacher.

The ACES was developed in conjunction with the Massachusetts Institute of Technology's Sloan School of Management. Though the toolkit is open-source, it requires the Oracle database, which is beyond the financial reach of most primary schools. Development on the next generation of the environment is underway under the name "dotLRN" [6]. The dotLRN environment is based on the OpenACS and will support both Oracle and PostgreSQL databases.

4.2 Crossroads

Crossroads is a collection of authoring tools for Constructionist learning activities developed in the Epistemology and Learning Group at the MIT Media Laboratory. The Crossroads utilities create and manage multimedia documents of text, audio, images, and video. The utilities support collaborative authoring and versioning of documents [7].

Crossroads was implemented as client and server Java applications. Effective use of the tools requires a local area network but not an Internet connection. These design choices for Crossroads have both positive and negative consequences. As Java applications, the Crossroads tools support drag and drop and WYSIWYG

editing of documents, features we were not able to implement in the EMLN. By limiting users (in the common case) to a local network, students can use the software without consuming potentially costly Internet time. Finally, restricting users to a standard viewing and editing client simplifies development and testing of the software.

In contrast, the EMLN's design as an online environment allows asynchronous contributions to the website from almost any networked computer. The work is available to families, communities, and other interested parties. Though testing with multiple clients (multiple version of multiple web browsers) added complexity to the development process, building on top of common, publicly available components decreases the probability of future administrative woes.

5. Future Work

Most of the participating schools did not have Internet access in their classrooms. Though we encourage use of the Empowering Minds Learning Network outside of school hours, our primary interest was the content that originates inside the classroom. To this end, we are creating 802.11b wireless networks within each of the participating schools. We anticipate a significant increase in the use of the EMLN once this hardware is installed.

Future development of the EMLN will initially be focused on automating administrative tasks such as database optimization and backup. We are also encouraging use of instant messaging programs between classrooms and intend to add additional archiving and searching features to the EMLN in support of that use.

Finally, we would like to study teacher and student usage of the application in greater depth. In particular, we are interested in how this type of environment can modify teachers' behavior and encourage new types of learning across the boundaries that separate schools.

6. Conclusions

Although the EMLN has not been available long enough to meaningfully quantify use, initial observations are promising. There was a dramatic increase in site activity after the first wave of classrooms was brought online. Several hundred Media and Document objects have been uploaded to the site; many have been made publicly visible. The teachers have also used the site for their first group problem solving session, which was ironically focused on configuration problems with the new wireless networking hardware.

We believe the Empowering Minds Learning Network and similar education-oriented groupware will benefit at

least four user groups. Education researchers will gain valuable information and insights on teachers' interests and usage of digital technologies. Teachers will reflect more formally on their student's endeavors and their own place as learners in the classroom. The school's community will have a greater knowledge and appreciation of school happenings. And students will have an enduring record of their accomplishments to proudly share with friends and family.

Corporations and higher education have been the traditional users of collaborative online environments, largely because of pervasive Internet access. Other corporate technologies such as handheld computers, electronic whiteboards, and video conferencing systems are successfully making the transition to primary and secondary school classrooms. If collaborative environments like the EMLN are to share in this success, simple and fast network connectivity must not be relegated to dedicated computer labs, but accessible from within the classroom.

7. References

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