Development of an Electronic Library of Lessons for Multi-Institutional Use

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Abstract

The learning curve for developing distance-delivered educational materials can be daunting, especially for faculty with limited time and financial resources available to support such an endeavor. Rather than developing entire courses, several faculty have developed a different model of individually creating electronic materials which are then pooled to provide a resource each can tap into for their particular overall needs. This presentation will describe an on-line library of lessons found at http://croptechnology.unl.edu that has been developed by faculty in several multi-institutional projects. Faculty appointments have been diverse, covering all areas of research, teaching and extension. In all cases though, on-line materials created supplement their current career activities, as well as putting together a portfolio for distance education activities. In this way they have been able to capitalize on their time and financial resources both individually and collectively for advancing their education and outreach activities. These peer-reviewed interactive lessons contain downloadable animations, explanations of cutting edge crop technology topics, a hyper-linked glossary and graphics. The lessons are used to support high school classes, university courses and extension programming throughout the world. They have been developed for several topic areas, including crop genetics, nutrition science and plant biochemistry. Some lessons have been translated into Spanish. The peer-review aspect has released faculty to develop quality materials, demonstrating their professional creativity and contributions. Student impact and assessment of these lessons will be discussed.

Background

In the agronomic and horticultural science areas, emerging research technologies are providing opportunities our clientele (adult learners) can utilize to advance their individual careers and businesses. This has been especially true with crop genetics and agriculture biotechnology. Often times a challenge lies in bridging the gap between the university and its applications beyond the research field or laboratory. Our learner backgrounds are diverse, some requiring introductory materials while others needing advanced curriculum. Furthermore, their educational goals vary: some earn graduate academic credit, some require continued education credits for professional certification, and others want no credit because they are participating for their own interests.

At the same time, advances have also been made in distance education technologies, which have the potential to provide an infrastructure for readily meeting these education and training needs to a larger audience. Even though university instructors and extension educators are highly qualified and motivated to meet these educational needs, they lack the time and financial resources to also become distance education experts or develop complex distance materials. The learning curve for developing distance delivered programs can be daunting, especially for already stretched faculty. If a working model for content authoring could be established and supported by an electronic environment that was truly user friendly, we believed distance delivery of educational materials could effectively bridge the information gap between cutting edge agricultural research and its uses by our clientele.

Objective

An overall goal of this project was to create both a software program infrastructure and a content authoring model for faculty to develop materials within their resource constraints to meet these educational needs efficiently. Long term sustainability of both the software and working model was a crucial requirement.

Project Description

Land grant universities have a mission to provide unbiased agricultural research, college education and public outreach of research information discovered. The model of developing entire courses which are password protected was not a satisfactory option because this would limit the potential audience, hindering our overall mission, as well as place unrealistic expectations upon a single instructor. Instead, an idea of an electronic library of lesson materials with free public access for educational use was envisioned. With this in mind, a group of faculty could individually develop a short lesson and illustrating animation movie addressing a specific content topic in their field of expertise. Collectively these lesson materials would form a resource library which public educators worldwide could go to and pull out those particular materials to support their specific resident course, distance course, extension program or workshop (Figure 1). These materials could also be subjected to a peer review process to insure the learner of accurate up-to-date information and provide the authors with a venue for scholarly development and creativity. The electronic learning environment would have to be expandable in many aspects: number of lessons per topic, number of topic areas addressed, number of content authors who were geographically dispersed, and number of world-wide students accessing the site.

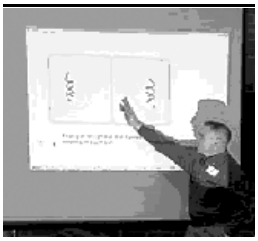

Figure 1 *Dr. Alex Martin using an animation for an extension program.*

Collaboration Between Information Technologists and Agriculture Scientists

With this vision in mind, experts at the Distributive Environments for Active Learning Lab (DEAL) at the University of Nebraska were consulted. Was there a way to develop a truly user-friendly environment to provide the necessary infrastructure? Once fully developed could it essentially stand alone with minimal technical maintenance required? What we discovered along the way was the challenge and yet importance of clear communication between experts in two very different disciplines of crop science and information technology. We found brainstorming sessions effective in which the content authors explained what their dream internet library characteristics would be, without considering if the technology was available. It was then up to the information technology experts to go back to their labs and see if they could produce such a product. It was also helpful for the content authors to look at other case examples to begin developing their own ideas. Finally, it became imperative for all involved to keep the larger picture in mind and not merely focus on the immediate needs. This was important in order to create an expandable software system and authoring model.

System Description

The following discussion sections will introduce the features of the developed system in terms of interaction of learners with the system and interaction of authors/instructors with the system. We then discuss the architecture of the developed system where we briefly describe the tools and technologies that were selected; why they were selected and how the developed system allows authors to share resources such as images, glossary etc. The content itself remains copyright protected through UNL and the individual author's institution.

Learner Interactions

The audiences who wish to view the information maintained in this system access the web address http://croptechnology.unl.edu (Figure 2). The html page at http://croptechnology.unl.edu has a *menu bar* on the left side of the browser window. This menu bar contains hyperlinks/buttons that allow a user to make selections and browse through the system. For the learners the information appears to be organized according to individual lessons. A user can select the appropriate lesson from either a *subject area menu* or a *list of lessons* from the left menu bar. Once a lesson is selected the user views the first topic of the selected lesson. This topic is in form of a HTML page and has a *next* button at the bottom of the page to go to the next topic in this lesson; depending on the topic, a page may also have a *previous* button at the bottom of it. Together, the two buttons allow a user to go forward or backward while reading the lesson content.

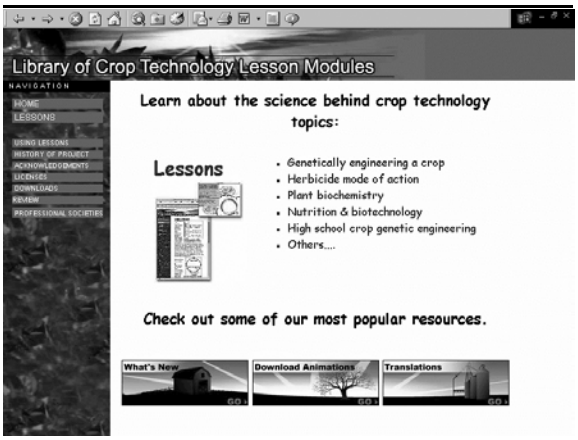

Figure 2 *Screen capture of home page for the crop technology lesson library.*

Apart from containing text and graphics, the topic pages have hyperlinked glossary elements. These elements can be clicked with the mouse and the glossary word is then displayed to the user in a small pop up window. A lesson may also have one or more associated animations, movie clips and/or PowerPoint presentations associated with it. The users can access these by clicking on a button on the left menu bar or when prompted within the lesson's text. Besides these features, the users who are registered and approved can also take a quiz at the end of each lesson. The system maintains the records of each user with information on each of the quizzes taken by her/him. A user who prefers to read a printed lesson can click on the *Get Printer Friendly Version* button. This presents the contents of the complete lesson in a printer- friendly format.

Author/Instructor Interactions

According to selected design strategy, the content objects of the system were decided and these included topics, glossary, lessons, images, animations etc. with a unique ID identifying each object. These objects are stored and managed in a database; when requested by a user these objects are written out in an html page format with the help of display managers.

In order to insert or maintain their content objects, the authors login into their account on the maintenance portion of the system. The application program performs the functions of authentication and then provides access to the author's objects. Once logged in, the authors have the capability to add, delete or modify their previously maintained objects. The maintenance interface has easy-to-use forms that an author uses to insert/edit different types of content objects. The forms interact with their server-side components that in turn update the appropriate database tables. Because all the information, including the images and animations, are maintained in a relational database and these objects are identifiable by their ID, all these resources (including resources from other authors) can be searched and then reused by an author by referencing to them through their respective display managers using the object ID.

System architecture.

The complete system operates using Open Source Technologies, namely Apache Web Server, MySQL database and application program written in Perl programming language hosted on Linux environment. The design and implementation of the developed software is done in a modular way in order to provide high flexibility and ease of maintenance.

A multi-stage approach was taken to analyze and design the infrastructure of the system. The development process involved determining the information requirements of the learners and authors. System needs were analyzed and structured decisions were made. These decisions included the conditions, alternatives, actions, and rules under which the tools will be selected and the software will be developed. Based on the evaluated requirements and decisions made, the complete system was emulated with process and data flow diagrams. These preliminary models were developed to help make the development process modular and manageable. These models formed the skeleton for the system development and implementation cycle. Although the models were changed as the system evolved, they provided an indispensable aid throughout the development process.

The decision for opting for the open source technologies was based on the previous experience of the development group with the open source tools. The tools that were selected for this system are highly flexible, stable, have a wide developer community around the world and are freely distributed. The selection decisions were supported by our assessment of the belief such as the Apache being the most popular web server; Perl being the most popular web programming language with its excellent capability of text manipulation and rapid development cycle; MySQL being one of the most popular Open Source Databases; and the reliability of Linux. Selection of such an operating environment gave us the capability to develop a system that is easy to distribute to communities across the world. This could have been difficult if proprietary software were used because of the licensing and royalty issues. As a result, the content developed for distribution is also free of restrictive licensing.

Figure 3 illustrates the components of our system that reside on two different servers. The implementation is essentially a "fat" server and "thin" client (web browser in our case), where most of the processing is performed at the server. The first server is the application server, which holds and executes the application code. The second server is the MySQL database server that provides the database management services for the information. All the user interaction takes place with the application server which then makes connections to the database server for the data management/retrieval services.

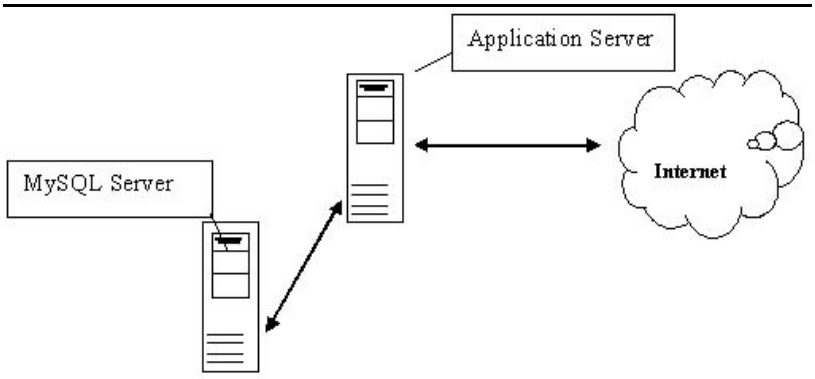

Figure 3 *System design illustration.*

The Content Authoring Model

This electronic lesson library was coupled with a content authoring model established at the faculty departmental level. In this model, both faculty with teaching appointments and those with extension appointments are able to develop distance delivered course modules without being in an overload assignment. The idea is that in both cases (teaching and extension), faculty create electronic materials in stepwise increments to enhance their current resident teaching or extension programming assignments. Not only does this improve the quality of their current activities, but it provides an environment for testing and refining the materials, which over time then can be packaged for distance students, as well.

Further maximizing our resources, we have created what we call dual-purpose modules. These are compact, intense, one-credit courses which can be taken for graduate academic credit or professional continuing education credit (CEU's). This shorter length is preferred by the full-time working learners, as

well as the faculty. In a single offering there will be non-credit learners attending just to gain new knowledge, some for CEU credit and some for academic credit. What differs among them is the particular assignments and depth of knowledge application required for each group of learners. Currently, this library of on-line lessons provides a significant portion of activities students undergo for three of these dual-purpose modules.

Impacts

What began with one instructor, one graduate student and six crop genetic engineering lesson texts in October 1999 has grown to 20 instructors from six universities, three graduate students, two high school teachers, seven graphic artists, one programmer, two educational experts, one Spanish translator, one professional society and three industry partners to produce a library of 40 lessons covering topics in agronomy, weed science, crop genetics, animal science and nutrition and dietetics. More lessons are under development, some in new topic areas, some being modified for a high school audience and others being translated for Spanish-speaking learners.

This library has been utilized in four UNL courses (three distance/grad level; one resident/undergrad) and three NMSU (two resident/undergrad; one resident/grad), where in all cases instructors linked to the site within other University courseware programs. Animations have been used in several programs at CSU. There are many other uses of the library materials, but these mentioned are part of a research study underway. More globally, between August 2001 and May 2002 the library has received 260 download requests for 5479 flash animation files worldwide to teach a minimum of 5400 learners. Between July 2001 to March 2002, the site received 809,427 hits from 85 different countries.

A mirrored site is currently being piloted with the Western Society of Weed Science. This second site will host traffic from weed science educators and learners, while periodically being updated with the latest content developed at the parent server in Nebraska.

The advantages of this project we have identified include flexibility of design and layout, ease of sharability among authors with varying needs and resources and downloadability of materials for public educators worldwide.

Acknowledgments

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