2005

Development of an Online Digital Multimedia Library and Database for Medical Education

Steve Pera
University of Nebraska, spera@unmc.edu

Jim Medder
University of Nebraska, jmedder@unmc.edu

Thomas Birk
University of Nebraska, tbirk@unmc.edu

Development of an Online Digital Multimedia Library and Database for Medical Education

Steve Pera, MA
University of Nebraska Medical Center
spera@unmc.edu

Jim Medder, MD, MPH
University of Nebraska Medical Center
jmedder@unmc.edu

Thomas Birk, PhD
University of Nebraska Medical Center
tbirk@unmc.edu

ABSTRACT

At the University of Nebraska Medical Center (UNMC), the Departments of Family Medicine, Internal Medicine, and Pediatrics in the College of Medicine teamed with Information Technology Services (ITS) and Library Services to create an online retrieval and repository system for sharing digital medical multimedia objects among health care practitioners, educators and students. A pilot launch of the system was done within the above three primary care departments. This presentation will focus on how the website structure and database structure were determined, what programming techniques and software were involved and the results of the pilot of this initiative. We will also discuss the next steps involved in expanding use of the system across other departments and colleges at UNMC.

KEYWORDS

Digital multimedia library, image database, information retrieval, medical education, reusable learning objects.

INTRODUCTION

In that health science instruction is highly visible, still images, video and audio are all desirable to students and practitioners alike. The educational psychology literature has presented evidence on the value of the proper use of multimedia for achieving positive outcomes in learning and retention, principally in managing learner cognitive load (e.g. Clark and Mayer, 2003; Chandler and Sweller, 1996).[1,2] Managing large quantities of this type of content has proven difficult however.

Medical educators experience duplication of time and expense when using digital medical multimedia objects to prepare lectures or presentations. Faculty and researchers at UNMC have created tens of thousands of such multimedia objects. Over the past several years numerous faculty, including the Associate Dean for Research, have requested ITS find a way to collect these objects into a central place for easy shared access. There is a growing awareness among educators in general for a need to "examine methods and processes for storing and accessing both text and the multimedia learning objects fundamental to…e-curricula."[3] In response to these forces, we have developed eDoc, an indexed online digital retrieval and repository system for sharing digital medical multimedia objects among UNMC medical educators, students, preceptors and other health care educators. Such a system is essential to make "reusable learning objects" truly reusable.[4]

At UNMC, a development team was created in 2002 from primary educators and library and information technology personnel. Our plan was to start with representatives of a limited number of departments, create a quality product, and then expand campus-wide, thus avoiding the bog of too much input early on from too many sources. The team obtained a Predoctoral Training in Primary Care Grant from the Department of Health and Human Services to develop online clinical resources, including video, that would be readily accessible and free for use by students and primary care physicians. The team initiated a needs assessment of the types of medical procedures target audiences would find most useful in teaching and practice. ITS members created a media database, a file-storage structure for the learning objects and a web interface for both searching the database and contributing new learning objects. On each element of the project, consultation was sought from the Health Education Assets Library (HEAL), a central nation-wide medical database initiative, involving researchers from UCLA, University of Utah, University of Oklahoma, and Michigan State University.[5] As legacy content was catalogued and new content created, the primary care educators continuously reviewed this content before releasing it to the database. Library team members catalogued and indexed multimedia content after it was approved. In January, 2004, the system was dubbed "eDoc".

CREATING QUALITY CONTENT

The eDoc collection consists essentially of any web-deliverable media object.

Members of the development team have produced much of the initial media content. Involved in creating and editing the material are medical doctors, medical students, and ITS personnel. Quality cameras and, where possible, studio-quality lighting are used. Video clips use standard opening and closing frames. To start, the team developed videos of 16 medical procedures that third year medical students are required to learn. Since digitizing analog media is time consuming, when possible a digital video camera was used. Even so, much care went into scripting, editing, and narrating videos. Series of still images are often incorporated into PowerPoint Presentations or Flash modules. Faculty and staff have access to state-of-the-art media processing equipment and professional educational advice in the Faculty Development Center provided by Learning Environment and Internet Services (LEIS), part of ITS.

The Health Insurance Portability and Accountability Act of 1996 (HIPAA) requires obtaining patients' written consent to film them for educational purposes. Where possible we film in such a way as to maintain a patient's anonymity. When using patients in videos or still images, we follow UNMC Policy No. 6030: "Informed Consent for UNMC Media Production and Distribution Policy."

It has been the development team's goal to motivate faculty to produce new quality media content and to contribute existing material. Offering recognition and copyright credit is an important incentive.[6] Content in the eDoc collection will have a certain amount of prestige, since only high quality items pass the review process. Quality control so far has been provided by the development team, and criteria are being developed for an Expert Review Panel. Copyright specifications are defined with a web-based utility called Creative Commons.

For additional recognition, contributors can earmark their content for submission to HEAL, whose content is now peer reviewed. Such content may be able to count toward promotion and tenure. This is another area UNMC will continue to pursue. As with many tertiary institutions, this has been a traditionally difficult process[7], but with the emergence of HEAL and its recognition of peer review as a potentially strong component to its process, there is renewed optimism.

DATABASE AND SERVER STRUCTURE

Contributions consist of the media object itself as well as information about the object (metadata). In deciding what metadata to collect, we looked to the HEAL model, which is based on the Instructional Management Systems (IMS) metadata specification.[8] We discovered that a large number of metadata fields frustrated contributors and have cut back on the number of fields.

Our database is in PostgreSQL and is relational in third normal form with a few exceptions for ease of querying and reporting. A table-specific prefix convention eliminates field-name ambiguity (e.g., "user_id" in tbl_users becomes "c_user_id" in tbl_contributors).

Media objects are stored on a high-capacity, high-speed server. The server has dual 1 GHz processors, 2 GB of RAM, a 400 GB hard drive and a 100 MB Ethernet connection that provides bandwith of about 50 MB. Folder and file management is dynamic. No individual contributor storage limits are currently planned. Streaming video is stored on a dedicated streaming video server.

WEBSITE STRUCTURE

Overview

The web site consists of modules for contributing media, for searching the collection, and for administering the collection. We wrote the site in ColdFusion and made extensive use of JavaScript and Cascading Style Sheets. To access the site, UNMC-related persons may use their e-mail logon which is validated against Lotus Notes via LDAP. Other users create a custom username and password. Logon sessions are cookie-based and do not time out. The development team evaluated the web interface every step of the way for usability.

Contributing Media Objects

Since the collection is intended as a central repository of UNMC-produced work, only UNMC personnel can submit contributions. Contributors have asked to upload a wide variety of media types and file combinations. Similar projects, such as HEAL, HealthLibrary.ca, Campus Alberta Repository of Educational Objects (CAREO)[9], and Stanford's MediaServer Project[10] (contributor module still in production) have limited upload capabilities. Nor does Blackboard have flexible upload

options (or flexible file-sharing or off-server file-storage capability). Besides processing images and videos, the upload algorithms can process zipped PowerPoint Presentations (with or without subfolder), pdf's, ppt's, and doc's. Multiple files may be uploaded in zipped format or by using a multi-file upload utility (dcFileManager version 2). Plans exist to include a Java-based client-side PC-style file selector as well. Multiple files may count either as a series of single contributions or as one contribution of a series of objects. Additionally, legacy content already stored elsewhere on the media server may be contributed without having to upload the file(s) again.

Upload Protocols

Small files use FTP (cffpt). Larger files use an html upload (cfupload) to the media server via a mapped drive on the web server. FTP is faster for small files, because there is no need to "wake up" the mapped drive, but ftp requires files first to be uploaded to the web server before being ftp'd to the media server, greatly increasing upload time. While unnoticeable for small files it is an inconvenience for larger files.

Copyright

Parameters for Creative Commons are imbedded in the submission form and consist of 3 questions: Require users to give contributor(s) credit; Allow commercial uses of your work; and Allow modifications of your work.

Review Process

Submissions go through a review panel before being accepted. Once the review panel accepts a submission, it is marked "permanent" and is available as specified. Parameters for the review process are being developed.

Indexing

When reviewers accept a submission, eDoc sends UNMC's McGoogan library an e-mail containing pertinent metadata and a link to the object. A librarian then catalogs the object in the on-line catalog (Helix) and adds Medical Subject Headings (MeSH) to the metadata. Neither MeSH terms nor their tree-structure identifiers are static. Annually, a new text file of terms must be downloaded from the National Library of Medicine web site along with conversion rules to revise terms and tree numbers in existing records, which is done with ColdFusion.

Thumbnails

An image-manipulation utility (ImageCR from Efflare) dynamically creates thumbnails: a very small one for search results lists (avg 645 bytes), and a larger one for previews (avg 3.37 KB).

Basic Search

Users search on words or phrases, using any combination of quotes and conjunctions. Only whole word matches are returned ("ear" finds "ear" but not "research"). Clicking on an item in the results list brings up a preview page that includes all metadata for that object. Single objects are embedded in the preview page, and image collections are viewable as slide shows.

Advanced Search

Users may search on independent terms for up to four different selectable fields from the metadata and may also specify certain technical file descriptors. We intend to incorporate HEAL's browse on MeSH terms as well. As the system expands, more complex information retrieval will be added via indexed tables and a thesaurus.[11,12]

Download Options

There is no charge to use objects in eDoc. Users may right-click on items and save them, or they may create a collection of objects that eDoc zips for them to download. The zipped file includes a text file containing metadata and copyright information.

Administering

Objects needing review are queued in a review submodule until approved or rejected. Only administrators are allowed to edit metadata or remove objects from the collection. A contributor who wants to make a change would need to contact the review panel to request a change. We use NetTracker to do web-usage analysis.

IMPLEMENTING THE SYSTEM

During the 2004 June Term, Blackboard was used to proffer the standard medical procedures to third year medical students prior to their first rotation. Over one dozen new high-quality video presentations were involved. The videos were put into a single course, and students were required to complete a survey regarding the efficacy of the videos. Results of the survey indicated a high level of satisfaction by the students. Although some students reported that they experienced technical problems with some of the content, 84.2 percent of the respondents to a post-June Team survey of the procedural videos found them to be either “Very Useful” or “Useful.”

Expanding use of system will follow several avenues. One will be getting more departments and faculty involved in the creation and submission of high-quality, reviewed digital medical teaching objects, using the eDoc interface. This will be done by announcements in the campus-wide e-newsletter (UNMC Today), by demonstrations and training workshops with administrators and faculty, by posters, and by word of mouth.

Another avenue will be to tap into the system with modified interfaces for other uses, e.g., to share the campus publicity photograph collection. Expansion of the system will involve tagging objects with a collection name, with alternative metadata fields, with metadata and object editing rights, and with access privileges.

CONCLUSION

The creation of a central online retrieval and repository system will facilitate the creation and sharing of digital medical multimedia objects among health care practitioners at UNMC. It will prevent continual "re-creation of the wheel" and will provide contributors a reliable method to store and retrieve learning objects they create. It will also facilitate storing a single copy of an object on a high-speed media server. Objects in the eDoc collection will be accessible via the library's on-line card catalog as well as through the eDoc interface. Knowledge gained from the process of creating quality learning objects will contribute to the development of additional high-quality media learning objects.

REFERENCES

1. Clark, R.C., Mayer, R.E. (2003) E-learning and the science of instruction, Jossey-Bass, San Francisco.
2. Chandler, P., Sweller, J. (1996) Cognitive load while learning to use a computer program, *Applied Cognitive Psychology*, 10, 151-170.
3. Fleiszer, D.M., Posel, N.H., Steacy, S.P. (2004) New Directions in Medical e-Curricula and the Use of Digital Repositories, *Acad Med*, 79, 3, 229-235.
4. Polsani, P.R. (2003) Use and Abuse of Reusable Learning Objects, *Journal of Digital Information*, 3, 4.
5. Candler, C. S., Uijtdehaage, S. H. J. and Dennis, S. E. (2003) Introducing HEAL: The Health Education Assets Library, *Acad Med*, 78, 3, 249-253.
6. Uijtdehaage, S. H. J., Contini, J., Candler, C. S. and Dennis, S. E. (2003) Sharing digital teaching resources: breaking down barriers by addressing the concerns of faculty members, *Acad Med*, 78, 3, 286-94.
7. Lee, M. Y., Albright , S. A., Alkasab, T. and Damassa, D. A. (2003) Tufts Health Sciences Database: Lessons, Issues, and Opportunities, *Acad Med*, 78, 3, 254-264.
8. Dennis, S. E., Candler, C. S., Uijtdehaage, S., McIntyre, S., and Dippie, S. (2004) An Indexing Standard for Sharing Health Education Multimedia Resources: The Health Education Assets Library (HEAL) Metadata Schema. Paper given at the 37th Hawaii International Conference on System Sciences (HICSS-37), Big Island, Hawaii, January 5-8.
9. Fleiszer, D.M., et al. (p. 233)
10. Durack, J.C., Chao C.C., Stevenson D., Andriole K.P., Dev P. (2002) The Stanford MediaServer Project: strategies for building a flexible digital media platform to support biomedical education and research, in Isaac S. Kohane (ed.) *Proceedings of the 2002 AMIA Annual Symposium*, November 9-13, 2002, San Antonio, TX, USA, Hanley & Belfus, 225-229.
11. Müller, H-M, Kenny, E. E. and Sternberg, P. W. (2004) Textpresso: An Ontology-Information Retrieval and for Biological Literature, *PLoS Biology*, 2, 11, e309, 1984-1998.
12. Lowe, H. J., Antipov, I., Hersh, W., Smith, C. A. (1998) Towards knowledge-based retrieval of medical images. The role of semantic indexing, image content representation and knowledge-based retrieval, in Nancy M. Lorenzi (ed.) *Proceedings of the 1998 AMIA Annual Symposium*, November 7-11, Orlanda, Florida, USA, Hanley & Belfus, 882-6.