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Course Management Systems and Implications for Practice

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Abstract

The development of online tools and the use of course management systems (CMS) in education are accelerating due to the improvement of the interactive features of Web 2.0. This article outlines the different types of CMSs and explores the selection process of implementing an appropriate system. After reviewing past research on web-based instruction, the article focuses on employing a CMS in an educational setting with particular emphasis on multi-user implementation and multimedia integration. Specific examples of an online environment at a higher education institution in Asia are illustrated.

Keywords: Course management system – virtual learning environment – online learning – Web 2.0

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Course Management Systems and Implications for Practice

Transforming Online Learning

While rudimentary systems for managing content or knowledge have been in place since the beginning of recorded history, it is only recently that we have been able to digitalize, process, and share this knowledge over high-speed networks. Due to rapid developments in information technology, one would expect that teachers and learners would have become exponentially more productive in both acquiring and sharing knowledge – compared with previous times – by utilizing and implementing today's available new technologies. But to what extent are educational institutions, administrators, teachers and learners harnessing the vast power of the most current digital technologies to manage content, and to what extent are they able to fabricate a learning environment that facilitates knowledge acquisition for today's learners?

The Web as Platform

Online learning is accelerating largely due to the development of the interactive features of Web 2.0. While the terminology implies that Web 2.0 (the read/write web) follows Web 1.0 (the read-only web), some argue Web 1.0 was already in fact an interactive network connecting communities (Berners-Lee 2006). Warschauer & Grimes (2007) describe the shift between Web 1.0 and Web 2.0 as "changes in the communicative uses of the underlying web platform" (p. 2) rather than a new version of web technology. Others suggest that the differences between the two define the dynamics of the 'next generation' of web applications and software. One example, as noted by O'Reilly (2005) is the morphing of Britannica Online and similar static information resources to Wikipedia, with the latter a widely used collaborative platform that accepts contributions, additions, and corrections from users. Web 2.0 is a platform built on an architecture of participation, open source development, and an emphasis on community building and collaboration. It incorporates social software designed to allow users to actively produce content, rather than merely being an audience for it and offers interconnected services that allow the users to access their content – from wherever they happen to be – on a variety of web enabled electronic devices.

For educational institutions, Web 2.0 technologies have the potential to shape both the way instructors teach and the way students learn. Web 2.0 not only expresses the dynamics of changes in the web through social networking sites, for example, but also serves as a platform for open source productivity and online learning through the new dynamics of collaboration.

Types of Management Systems

A practical starting point to understanding how Web 2.0 can facilitate online learning would be an investigation into the types of information management systems and their applications. Course management systems (CMSs), learning management systems (LMS), and virtual learning environments (VLE) each play important roles in supporting digital learning content both inside and outside of the classroom. Whether it is text, links, graphics, sound or video, and whether the task is that of creating, storing, retrieving and viewing, or listening to digital material, database-driven management systems based on Web 2.0 technologies are the best prospects for organizing and delivering learning materials.

With different acronyms such as CMS, LMS, LCMS, and VLE trying to differentiate between various types of management systems can be a bit puzzling. While all of these are electronic,

or eLearning systems that are used to deliver learning content via the Internet, and all share many of the same functions, the environments in which they are used differ. Course management systems (CMSs), learning content management systems (LCMSs) and virtual learning environments (VLEs) are generally used to facilitate learning in an academic setting. While both the terms CMS and VLE can be used interchangeably, these terms seem to be region specific. CMS is more commonly used in North America and VLE is more prevalent in European countries (Weller 2007). These eLearning acronyms are further complicated with the more recent introduction of the PLE or personal learning environment, intended to shift greater control of learning environments to the learners by giving them greater flexibility in choosing their learning tools (Sclater 2008).

Learning management systems (LMS) typically are used to train employees in business environments. LMS uniquely offer training materials in step-by-step modules designed to allow learners to assess what they have learned, then either move to the next module or choose to review additional material based on the quality of their achievement. LMS course designers create learning modules that closely control the learning path while allowing for advancement only if sufficient mastery of the content has been achieved.

Content Management Systems are used by businesses and organizations to publish information to audiences using a 'workflow process.' Note that the acronym CMS is used for both course management systems and content management systems. In this chapter, CMS refers to course management systems only.

CMSs are widely used by colleges and universities to manage and deliver course content presented via the web. For example, MIT uses Stellar; the University of Michigan uses CHEF; and Stanford uses CourseWork. Often these systems designed for a particular institution are not publicly available. Educational institutions without adequate resources to develop a personalized CMS can employ an open source CMS such as Moodle, .LRN, or Sakai. For institutions needing additional technical support, proprietary learning systems are available from companies such as Blackboard and Desire2Learn. CMS applications typically run on a web or network server and allow educators to easily manage course and student data through a web browser. The primary functions of CMSs are to organize and distribute course content, administer learning exercises or quizzes, and track student progress. While CMS software is often used to manage distance learning courses, it is just as popular in supporting face-to-face instruction.

Selecting and Implementing a CMS

For educators and administrators, deciding which CMS product is most suitable for their institution can be an intimidating and formidable task. The suitability of a CMS is determined by the effectiveness of their content and how efficiently learners interact with that content. CMSs can help support the administration and deployment of collaborative learning activities and tasks, with their main strengths being the organization and distribution of content, not content creation.

As CMSs become more prevalent, educators need to fully comprehend the realities of balancing online learning with course management. New Web 2.0 tools such as discussion forums, blogs, wikis, and shared whiteboards, have made it simpler to implement activities that involve collaborative document creation, multimedia publication, and social networking. However, administrators and instructors must also be sure that a selected CMS possesses management aspects that centre on promoting, rather than discouraging, student learning. In addition, repetitive language practice activities, which are often easiest to develop and deploy, must be structured to be meaningful within the larger context of the course.

Deciding on a CMS requires 'test driving' the different tools and administrative interfaces of each product to determine whether all necessary tools and functions necessary for the institution's learning environment are included. Some products offer an online sand-box area for testing the application, while other CMS products can be downloaded and installed locally to determine their suitability. For a helpful comparison of CMS applications, EduTools (2009) offers a well-organized community supported site. A review of the most recent articles and research on CMS products is also required before making a final decision on which system is most suitable for both student learning preferences and instructional methods.

Research on Web-Based Instruction and CMSs

A logical starting point for familiarizing decision-makers with CMSs, LMSs or VLEs is Weller (2007) and Siemens (2006). Weller (2007) discusses a previous improvised period of eLearning in higher education in which educators bundled together an assortment of Web 2.0 tools to create learning environments, and the shift toward the centralized VLE which encompasses a range of Web 2.0 tools with a single package. The integration of tools within a centralized system offers easier access to the tools, monitoring of usage, and a single sign-on (Weller 2007). Siemens (2006) asserts that Learning Management Systems (LMS), while effective in helping institutions select appropriate tools for specific tasks, may also limit available options. The management aspects of LMS have proven useful for the tasks of sequencing and structuring content for educators, as well as measuring students' success and progress in terms of number of students enrolled and number of page views by students, but Siemens (2006) also cautions against making the assumption "that if we just expose students to the content, learning will happen" (p. 5).

Research on CMSs and learning frequently highlights the benefits that CMSs or web-based instruction have on independent learning, life-long learning, or student-centered learning. There is certainly a strong indication that CMSs are beneficial in bridging the gap between traditional face-to-face classroom instruction and independent learning. As educators begin to adapt more learner-centred instructional methods, the barriers between in-class and out-of class activities become less defined. CMSs provide the resources to encourage learners to view learning as an ongoing process that does not involuntarily start and stop as one enters and leaves the physical classroom. Research on CMSs also emphasizes the convenience, interactivity, and connectivity of learning tasks (Coryell & Chlup, 2007; Olphen 2007). Since few studies state whether a CMS is being used, we must sometimes rely on research aimed at general web-based instruction.

Two studies that examine the state of web-based instruction are Mendoza (2002), which outlines the key issues that surround the design, implementation, and assessment of web-based language courses, and Coryell and Chlup (2007), which explores how programs across the United States have successfully implemented eLearning components in their adult English language classrooms. The research emphasizes two emergent trends in eLearning: (a) individualized instruction and (b) collaborative activities and projects.

A third study, by Olphen (2007), focuses on the strengths and weaknesses of web-based instructional environments and indicates that web-based tools can enhance learner experiences by providing (a) greater interactivity and connectivity between the instructor and students as well as among the students themselves, and (b) more opportunities for academic exchanges.

In the field of language learning, research on the effectiveness of CMSs is relatively new. Those studies that have been published have generally focused on the benefits of using a

CMS for language learning. Polisca (2006) investigates the effects that a VLE has on second language learners in an independent language learning course. The research suggests that the VLE has positive effects on students' motivation and their ability to learn independently as opposed to a traditional classroom-based learning approach. The research also identifies the important role a VLE plays in helping learners acquire skills that could be used later in their professional careers.

Lee (2005) investigates how web-based instruction can encourage learners to actively participate in the learning process. The research incorporates both questionnaires and oral interviews to express student experiences with collaborative web-based course. The research suggests that web-based learning allows students to take control of their own learning through active participation. Chang (2005) also emphasizes the motivational aspects of web-based instruction. Using a Motivated Strategies for Learning Questionnaire (MSLQ), Chang's research concluded that the application of self-regulatory strategies within web-based instruction can improve learners' perception of motivation – which includes students' goal orientation, perception of task value, beliefs of learning control, and expectancy for success and self-efficacy. Students in this study became more confident and more challengeable, placing a higher value on what they learned after experiencing the web-based instruction with self-regulatory strategies. In addition, the study found that students learning within this environment were more likely to feel responsible for their own learning.

In order to better understand the advantages of a CMS, it is equally important to evaluate the actual tasks that learners are engaged in when using the CMS. The organizational and administrative qualities of a CMS are almost immediately apparent, but a CMS also has the ability to administer network-based tasks such as shared whiteboards, chat sessions, and even games. In addition to managing network-based tasks, a well-designed CMS is able to embed multimedia sources within web-based activities. When developing any web-based activity, both Long's (2009) methodological principles of language teaching and Chapelle's (1998) principles for developing multimedia CALL offer valuable insight and guidance. González-Lloret's (2003) study makes use of these guidelines in developing multimedia activities for Spanish language learners. The researcher provides evidence that activities involving web-based communication and negotiation can help facilitate comprehension. Another study by Wagener (2006) focuses on the multimedia aspects of self-access language learning program and suggests that "short online video clips can provide a uniquely rich resource" (p. 286).

The newest CMS applications effectively provide an all-in-one solution for collaborative and multimedia-rich activities, giving educators a welcome technical advancement over the previous requirements for piecing together a variety of web-based tools.

Research on CMSs also investigates types of activities or behaviours in which students are actively involved when online. Most CMSs offer some type of logging function, making it possible to monitor variables such as time spent on individual activities, number of attempts at individual exercises, or number of words produced in a writing activity. One example of this type of research is Chenoweth's (2003) study, which attempts to measure how much learning takes place in an online environment. The study found that with written activities, learners studying online surpassed those in a traditional classroom setting, but at the same time, learners enrolled in the online course spent less overall time studying than students in the face-to-face classroom.

CMS Fundamentals

Open Source versus Proprietary CMSs

There are many different CMSs available for eLearning in both corporate and educational settings. A comprehensive list of CMSs can be found at the website of Centre for Learning and Performance Technologies (C4LPT).

Similar to the Windows vs. Linux rivalry, there has been an ongoing battle between 'open source' and 'proprietary' software in the eLearning sector. The two principal players among the proprietary competitors, Blackboard and WebCT, have now merged to form Blackboard Inc. which is determined to lead the eLearning market into the next generation.

The open source community has developed equally robust learning applications. Claroline, Moodle, and Manhattan Virtual Campus were some of the earliest CMSs to emerge around the year 2000. ATutor was released in December 2002, followed by the more recent developments such as Sakai (January 2004) and dotLRN (October 2004). Although the user statistics are difficult to verify, it appears that Moodle boasts a larger user base compared with other open source CMSs. Based on the web traffic of eLearning suppliers, Moodle has the second largest market share behind Blackboard, according to community website traffic data from Alexa.com.

When deciding between open source and proprietary systems, one must evaluate the needs of the learners, instructors and administers as well as the technical resources available within the institution. If technical support is available onsite with sufficient Linux and SQL database experience or if an institution lacks sufficient funding and wishes to experiment with a CMS before adopting it, an open source solution may be a better choice. An open source solution such as Moodle requires a modest amount of technical experience to install and configure, and hosts a vibrant community of users to assist with questions. Proprietary CMSs, on the other hand, are primarily marketed to institutions that require an all-in-one solution and those with limited in-house technical support. A proprietary package such as Blackboard may include telephone support, email support, or your own technical support manager.

CMSs: Under the Hood

At the heart of Web 2.0 and CMSs are the backend servers. As users are accessing, submitting, and updating data via their web browser, user data is organized and stored in a database running on a centralized server. In addition to the database server, a web server running either on the same or a separate server, transfers the data between the database, web server and the web browser.

This integral relationship between the browser, web server, and database server has transformed the web into the powerful tool it is today and has made possible a collaborative Web 2.0 experience.

CMSs are platform independent, meaning they are designed to be accessed through conventional web browsers such as Internet Explorer, Firefox or Safari. While the front-end or user interfaces of the various CMSs possess similarities, the back-end mechanisms differ considerably. The back-end of a CMS runs on a centralized server and is written using a programming language such as PHP or JSP, particularly when designing Open Source systems. PHP is a relatively new web-based scripting language that is often used in conjunction with Apache web server and MySQL database server. This combination is often referred to as LAMP (a stack of open-source applications consisting of Linux, Apache,

MySQL and PHP). Unlike PHP, JSP (JavaServer Pages) is a complied technology, making it more problematic to deploy. Moodle, one of the most popular open-source CMSs, is written in PHP; both Sakai and Blackboard make use of JSP.

There are numerous resources on the web focusing on the advantages of each (Ahmed 2005; White 2006). The main arguments focus on development costs, running costs and scalability. Although the evidence is inconclusive, PHP is viewed as a less expensive alternative for both server resources and programming expenses. Traditionally, programming in Java is more time consuming and Java applications tend to be resource intensive, therefore increasing costs. It is important to keep in mind that Java and PHP are continually improving and it is still too early to indicate which will be most successful in the long term.

On the issue of scalability, there is also no clear evidence that one platform outperforms the other. One reason is that there are not enough institutions with 30,000+ students accessing their CMSs. While some argue that Java is more scalable than PHP, other point out that sites like Yahoo! have been very successful in scaling PHP to millions of users. Since user data in a CMS is stored in a database, it is important to note that scalability may have more to do with the database server than the programming language with which the applications are built. Because many universities do not require a system that supports tens of thousands of users, and because they are often concerned with running costs, development costs and ease of implementation, open source LAMP systems (Linux, Apache, MySQL and PHP) used to run many open source CMS applications appear to be gaining popularity.

CMS Considerations

Once a system has been decided upon and deployed, the most crucial issue involves the content that educators create and upload, and with which learners interact. Quite often, much time and energy is spent deploying a CMS while too little effort goes into content development. A number of issues need to be considered. Since most students are accessing the content via a browser, it is important to create content that does not rely on proprietary plugins or browsers. While creating content in Microsoft Word may be more difficult, and using PowerPoint may be easier, but the software to which most of the intended users have access must be considered. And although creating content with conventional HTML is the most accessible format, it can be a challenge to enhance the content with integrated animations, video or sound.

Access speeds and file sizes also are important considerations when designing content. Text and images with a simple layout are most efficiently served in HTML. Adobe PDF files can be used for documents that have more elaborate layout, but the Adobe Reader is rather CPU intensive for the user and content download is more sluggish than if using traditional HTML. Flash or MPEG-4 are excellent options for animations and video, whereas sound is most commonly served in MP3 format. When deploying multimedia intensive content, plugins are often required. Popular plugins include Adobe Acrobat Reader, Adobe Flash Player, Java, Apple QuickTime, RealPlayer, Shockwave, and Windows Media Player. Employing third-party applications allows a more media-rich user experience, but content creators must also take into consideration the ease of obtaining, installing, and running the applications by the end user. A quick survey of learners' computing environment will help educators decide which file formats will be most effective in delivering content.

Designing Systems for Multi-User Educational Settings

In much the same way that traditional classrooms require learner management, CMSs need a method to separate and store individual user data. At the basic level, a CMS has a user table within the database where username, real names, passwords and other user specific data and logs are stored. One of the most challenging tasks of setting up a CMS, besides creating pedagogically sound content, involves user management.

Since most institutions experience a constant flow of incoming and outgoing users, a primary concern is creating, editing and deleting users from the system. Many of the leading CMSs offer LDAP support. LDAP (Lightweight Directory Access Protocol) is not as complex as the name may suggest. Actually, most schools are already running some type of LDAP system for general student record keeping. The LDAP server is a centralized user database that can be integrated by various applications accessed with a unique username and password. The advantages are many. First, if a school administration office keeps a centralized database of updated students, along with information such as usernames and passwords, users do not have to be entered into the CMS. The CMS can simply connect to the school's LDAP server and authenticate a user logging on to the CMS. In addition, students only need to remember a single username and password, and if a password is changed, the updated password is recognized by any system connected to the LDAP server.

Using a centralized LDAP server, it is very easy to integrate separate applications using a single login. For example, it is possible to integrate multiple administrative or learning systems. Imagine an institution that already has a web-based administrative system in place for students to register for courses and another web-based campus mail system. The institution now wants to initiate a CMS and several instructors are interested in adopting an ePortfolio system to assess student learning outcomes. Each system has its own built in user authentication system. Creating separate sets of user accounts for each system can be circumvented by setting up a LDAP server and users will be able to access all of the systems using a single sign on.

Learning Content: Multimedia and CMSs

One of the compelling elements of a CMS is its ability to store, organize, and distribute multimedia content. Media editing, however, is not one of the strong points of CMSs' abilities. In addition, media editing is time intensive and demands large amounts of computer resources. As user intervention is often a necessity while editing media and because CMS servers are typically not designed to run resource intensive editing applications, digital media editing often needs to be completed before uploading to the CMS. There is some basic automated editing that servers can process. Many of CMSs will automatically resize images when they are being uploaded, for example. The resizing of images is usually performed using an open source graphics library called GD. Moodle is an example of an open source management system that uses GD as a graphics generation tool to resize images that are uploaded by users.

Like many schools around the world, the Graduate School of Engineering at Kochi University of Technology (KUT) in Japan, opted for using Moodle, an open-source CMS. Although it is possible to outsource a CMS through the use of a hosting service and eliminate the need for backups and server maintenance, the decision was made to install a CMS on site. With an onsite server, access speeds are far greater than those obtained using a hosted service. This is particularly important for course content having bandwidth-heavy multimedia content such as video files, or interactive modules such as a shared whiteboard that is accessed

simultaneously by multiple users. Another advantage of onsite servers is less network downtime. If a school's outside Internet connection is unavailable, the local campus network can still operate productively.

Another advantage of running a CMS locally is the flexibility to modify server settings and perform upgrades at times suitable for the school's network administrators. KUT's own LAPD server also allows the department to integrate stand-alone applications, including a single sign-on for the PC clients, webmail, Moodle, and a portfolio system. In addition, modifications made to Moodle and the portfolio applications allow students to upload and access content from mobile devices. Among the customized Moodle modules developed specifically for language learning activities at KUT's School of Engineering, a widely used module called FreeMail allows students to upload text, images, and video to a users profile page, the blog page or the portfolio system via email using either a mobile device or a PC.

KUT's engineering department also developed a number of modules to harness the power of Adobe Flash. Using Flash Media Server technology, the school was able to embed a web-based voice recorder into the Moodle blog interface. In addition to text, images, and video, students and teachers now can also add voice posts to their Moodle Blogs. Flash Media Server was also used to develop a shared virtual WhiteBoard for Moodle and instructors have been experimenting with using the shared WhiteBoard for creating concept maps. Adobe Flash—with its small install footprint—is bandwidth friendly and processes media quite quickly, making it an attractive choice for delivering multimedia-rich courseware. Flash also is able to pass data to and from a PHP script, so it can be embedded within a CMS in order to expand system functionality. Another example is the presentation module, which allows teachers and students to upload PowerPoint presentations to Moodle along with multiple choice questions. The PowerPoint is automatically converted to Flash, much like the application employed at SlideShare.net. For this particular application, KUT instructors used a piece of proprietary software called FlashSpring. But it also is possible to integrate a CMS with open-source applications such as Open Office and Java Open Document Converter, which convert files on the fly to a number of different formats. Files Converter (Block) is one such application that has this function. More information on these open-source modules, as well as the downloadable files, can be found at http://blog.netcourse.org

Future Developments

One of the chief developments in the near future will be in the modification of CMSs to accommodate mobile devices and mobile content. More and more course material involving text, audio and video and will be tailored for handheld devices. Mobile devices will soon be even more significant to learning technology than the home personal computer. More than one billion mobile phones were sold worldwide in 2007 (Reardon 2008), considerably more than the combined sales of PCs, portable media players, and computer game consoles. We are also just beginning to see a merging of cellular and wireless technologies. The introduction of Apple's iPhone is a good indication that other handset manufactures will follow suit. While Apple's iPhone may not seem like much of a technical advancement, it has enormous potential for mobile learning. Currently, the two biggest obstacles for mobile learning are low cellular network speeds and inhibitive data packet costs. Think about the possibilities of students having the freedom to upload and download text, images, audio, and video from a CMS at no cost via a campus hotspot.

CMSs will also transform as new theories of learning emerge. Language professionals have already seen a shift from behaviourist to cognitive and constructivist approaches to language teaching. In the near future, learning theories, approaches, models and pedagogical views

that draw upon the digital age will gain wide acceptance. Notions such as 'connectivism' and 'convergent learning' have the potential to influence both second language acquisition and CALL research in the future.

Virtual learning campuses that present new computing environments enhanced by 3D and multimedia technologies for a more real-life sensation will emerge in the near future. Adding and editing content within courses at a virtual campus is possible by merging CMSs with settings such as Second Life, a 3D world in which users can explore, build, socialize and participate. The trend to centre learning on students' interests is supported by this merging of content management and virtual environments, and is widely seen as contributing to immersive learning. Many eLearning design, development, and management professionals anticipate a tremendous growth in Immersive Learning Simulations (ILS), including games in the future (Wexler, Aldrich, Johannigman, Oehlert, Quinn & van Barneveld 2007).

The PLE may also play an important role in academic computing environments as both learners and educators appeal for more ownership and choice in their learning and teaching experiences. Although interoperability standards may hinder the rapid growth of PLEs, the integration between CMSs or VLEs and latest web tools, such as social networking sites will improve. The choice between employing a CMS with its core functions or using more flexible social software tools may not be as difficult if future web applications are designed to synchronize with institutional learning systems. The recent trend seems to be going in the direction of the integration of CMSs, e-portfolio systems, search facilities and collaboration innovations (Sclater 2008).

Another developing trend is an inevitable intersection of eLearning with games as well as more informal learning multimedia environments. One project that researches games that promote learning through authentic and engaging play was initiated by MIT's Comparative Media Studies. Cisco, Nintendo, and BTS business simulations are among the other entities that are developing educational gaming products.

BTS, the leader in business simulation game development, offers games that allow teams of learners to compete against one another. Cisco's learning games are being developed to test users' networking knowledge, gaming acumen, and awareness of Cisco solutions. Finally, Nintendo has launched several learning games such as 'Big Brain Academy' and 'English Training' for their mobile DS game platform.

The exponential growth of new and ever more sophisticated multi-platform systems – including PCs, PDAs, mobile phones, and other devices – add to the challenges of designing and delivering content for distant learning. Mobile blogging, mobile mail quizzes, lecture feedback systems, and the Moodle for Mobiles project are examples of email, standalone and web-based applications already incorporated in eLearning in educational settings.

Some technical challenges for institutions and student users – such as access speeds, access points, access costs – have yet to be overcome. But with the merging of cellular and IP devices such as Apple iPhone/Windows Smartphone, and new developments in enhancing CMSs with interactive games and multimedia-rich virtual learning environments to stimulate student immersion, the future of web-based learning will continue to play an important part in the delivery of teaching and learning.

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