Advances in Computer-Supported Learning

Francisco Milton Mendes Neto
Federal Service of Data Processing, Brazil

Francisco Vilar Brasileiro
Federal University of Campina Grande, Brazil

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Chapter IV

Learning Management Systems:
An Overview and Roadmap of the Systemic Application of Computers to Education

William R. Watson,
Indiana University - Purdue University Indianapolis, USA

Sunnie Lee, Indiana University, USA

Charles M. Reigeluth, Indiana University, USA

Abstract

This chapter discusses learning management systems (LMS) as a technology necessary for supporting the educational needs of the information age. It defines LMS and argues that the move from the mechanistic, sorting-oriented paradigm of the industrial age to the customized, learning-oriented paradigm of the information age requires the application of LMSs to succeed. The history of LMS is presented and the definition further clarified by comparing and contrasting LMS with course management systems (CMS), learning content management systems (LCMS) and learning objects. Several major K-12 LMSs are presented, evaluated, and their features compared. Finally, the current trends of LMS are discussed, and goals for further development are offered. A better understanding of LMS, its role in the new paradigm, and the areas where it needs to improve and continue to grow are essential to improving the effectiveness of education in the information age.

Introduction

The potential impact of computers on learning has been recognized since well before the widespread adoption of the technology itself. With a history dating back to the 1950s, computers have been used to assist with or even directly provide instruction to learners (Reiser, 1987). Learning management system (LMS) is a relatively recently coined term that refers to computer systems that incorporate providing instruction, tracking achievement, and managing resources for individual students and an organization as a whole. This chapter defines LMS, discusses the pressing need for LMS technology in the emerging knowledge-based paradigm of education, and examines the history of LMS and how it has developed from, and differs from, past computer learning technologies. LMS is then compared to other computer learning technologies and related concepts, after which four popular K-12 LMS products are described and evaluated. The chapter concludes with a discussion of the current state of LMS, what trends exist in the further development of LMS, and what needs LMS must meet in order to satisfy the requirements of the information-age paradigm of education.

Definition of LMS

Learning management system (LMS) is a generic term often used to describe a number of different types of computerized training and instructional systems. Essentially, an LMS is an infrastructure that supports the delivery and management of instructional content, the identification and assessment of individual and organizational learning goals, and the management of the progression toward meeting those goals, while providing data for the supervision of the organization as a whole (Szabo & Flesher, 2002). To differentiate LMS from the sea of acronym-driven computer learning technologies in the literature, it is important to understand the systemic scope of LMS. An LMS, as Gilhooly (2001) states, "goes beyond basic content delivery to offer course administration, registration, tracking, reporting and skills gap analysis" (p. 52). General characteristics include the following:

- instructional objectives are specified with individual lessons;
- lessons are integrated into the standardized curriculum;
- courseware extends several grade levels in a consistent manner;
- a management system collects and records the results of student performance; and
- lessons are provided based on individual students' learning progress. (Bailey, 1993)

Need for LMS

There have been a substantial number of publications discussing the shift of society from the Industrial Age into what many call the Information Age (Reigeluth, 1994; Senge, Cambron-McCabe, Lucas, Smith, Dutton, & Kleiner, 2000; Toffler, 1984). In order for our schools to meet the needs of today's learners, the way in which the schools function must also change dramatically and systemically to focus on individual learners' needs (Reigeluth, 1994; Reigeluth & Garfinkle, 1994; Senge et al., 2000).

The current educational system was built to fit the image of the industrial-age society, in which learning is highly compartmentalized into subject areas and students are "treated as if they are all the same and are all expected to do the same things at the same time" (Reigeluth, 1994, p. 204). Furthermore, much of the onus for learning is laid at the feet of teachers rather than the students themselves, and students do not take an active role in either their own learning or the school community as a whole. The current industrial model of education places an emphasis on sorting students rather than developing their knowledge. A fixed amount of content is presented in a fixed amount of time, and students must move on, whether they have learned it or not. Students are divided into grade levels with classes in which they learn the same things at the same time. This forces "achievement to vary among students, with the consequence that the low-achieving ones gradually accumulate deficits in learning that handicap them in their future learning endeavors" (Reigeluth, 1997, p. 204), while high-achieving students are held back and lose interest. The system is not designed to promote student learning; it is designed to select students. In the industrial age, it was important to separate the laborers from the managers, and educating the common laborers was not economical and, indeed, was not desired, for they would not be content doing the repetitious and dull tasks that their jobs at the assembly lines would require (Joseph & Reigeluth, 2002).

However, today the mechanistic, unthinking jobs of the assembly line have largely disappeared, and employers are now looking more and more for problem-

solving employees with initiative and a variety of skills to work effectively as a part of a team. These requirements reflect a need, in the information age, for expanded mental capabilities, which greatly increases the importance of student learning. The focus of education must shift from student sorting to student learning, and therefore, certain changes are required to truly help students learn. Since it is known that children learn at different rates and have different learning needs, even from the first day of class, it does not make sense to hold time constant and thereby force achievement to vary. Apart from not meeting the needs of society at large, it is an inhumane treatment of the children to not focus on helping all children to reach their potential. The alternative to holding time constant is to hold achievement constant at a mastery level, and allow children to take as much time as needed to reach that level. This requires the educational system to move from a process of standardization that results in high failure rates to a completely new paradigm that supports customization in order to meet all learners' needs.

This new paradigm for information-age-appropriate education will require significant changes in the use of time, talent, and technology (Schlechty, 1991). The changes in use of time entail not only allowing each student as much time as needed to achieve mastery, but also allowing each student to move on as soon as he or she reaches a mastery level. This means that the pace of instruction will be customized to help meet each student's needs.

Schlechty (1991) also argues that the use of talent will need to be altered. Talent refers to the roles that both students and teachers play. The role of teachers will change substantially as instruction moves to a more learner-centered approach (McCombs & Whisler, 1997). Teachers will become facilitators of knowledge acquisition by acting as guides, coaches, and motivators for students. No longer will the teacher be the primary source of knowledge, a talking head, but instead the teacher will help each student to find appropriate materials for acquiring the desired knowledge. This shift in roles will also place new demands on the student. Students will be required to be active learners, assuming the responsibility to take initiative and be more self-directed as they gain knowledge.

The third shift that Schechty (1991) argues will be necessary in the new paradigm of education involves the use of technology. First, with learner-centered, custom-paced instruction, technology is needed to track what each learner has mastered. This will allow teachers to easily keep records of each student's progress and thereby provide appropriate guidance to each student. Second, decisions about what to learn next (i.e., the sequencing of instruction) for each student will also be important, and technology will need to play a central role in helping student and teacher decide what should be learned next. Third, as teachers move from being the sole source of instruction to being guides or coaches, technology will be needed to help instruct the students by providing

content, often in more interactive ways than have traditionally been used. Simulations and instructional games can provide interactive content, give immediate feedback, diagnose student needs, and provide effective remediation. Fourth, technology will also be needed to help in the assessment of student knowledge to certify student mastery and store examples of student work that represent their attainments (e.g., portfolios). Finally, technology will need to provide a systemic integration of all of these features.

In essence, an information-age, learner-centered paradigm of education cannot be effectively implemented without technology, and by the same token, technology cannot approach its potential contribution to education and learning without a learner-centered paradigm of education.

Fortunately, computing is becoming more ubiquitous every day, and a major part of the information-age classroom will be the use of advanced technology to meet the five needs just listed. Instructional technology has shown promising results in evaluation studies conducted during the 1960s to 1980s, and technology is widely used in schools these days. In envisioning the information-age school, "technology will play central roles in teaching, assessment, and keeping track of learner progress..." (Reigeluth & Garfinkle, 1994). LMSs promise an integrated tool for serving the five major functions that are needed for technology in information-age schools.

History of LMS

LMS has evolved through a history of various applications of computer technology to instruction. These applications have been described with various terms, many of them generic. Computer-based instruction (CBI), computer-assisted instruction (CAI), and computer-assisted learning (CAL) are all generic terms that have been used to describe different applications of computers to instruction. While there are not specific definitions for these terms, Parr and Fung report that generally, CAI is typically used to describe drill-and-practice programs, CAL includes more sophisticated tutorial instruction, and CBI places more emphasis on individualized instruction (Parr & Fung, 2001). More differentiated from these other terms are integrated learning system (ILS) and computer-mediated instruction (CMI) which include such additional functionality as a management and tracking system on top of the instructional content, integration across the system, and greater focus on personalized instruction (Bailey, 1993; Becker, 1993; Brush, Armstrong, Barbrow, & Ulintz, 1999; Szabo & Flesher, 2002).

In the early 1980s, many classroom teachers and administrators turned away from ILSs because they appeared to be the same old products in new packaging. Most of these educators were primarily skeptical about how individualized instruction and computer-assisted instruction came and went with other educational trends of the 1960s and 1970s. But as more sophisticated ILS software began to address problems associated with individualizing instruction, it began to show greater potential to improve learning and teaching, and it evolved into a more holistic learning and data management system. Now, LMS takes these additional components even further in helping to "manage the entire instructional program and learning process" of an organization (Szabo & Flesher, 2002). Further, LMS is systemic in nature, covering both learning and e-learning programs and processes. It is this systemic nature that differentiates LMS from much of the other educational software available, in that it is neither simply a collection of instructional software nor only a student assessment tracking platform, but is instead truly systemic in addressing all aspects of the instructional process.

LMS' Relation to Course and Content Management Systems and to Learning Objects

While we have addressed the definition of LMS and further detailed this definition by looking at the history of LMS and its relation to past computer learning technologies, it is important to also discuss the role of LMS amongst other related advancements in computer learning technologies. These include course management system (CMS), learning content management system (LCMS), and learning object (LO). While LMS is often used synonymously with CMS and LCMS and is conceptually seen as having equivalent goals as LO, LMS is again differentiated by its scope, and this section explores how LMS is related and impacted by these technologies due to its systemic incorporation of them.

Course Management System

One technology that is often confused with LMS is CMS. The systemic nature of LMS previously discussed differentiates LMS from CMS. A CMS is a tool that focuses on the management of one or more courses, typically by an instructor,

and is usually used for distance education or hybrid (both face-to-face and distance) courses. As defined by the EduTools[1] Web site, a CMS excludes:

Single function software like stand-alone assessment tools, synchronous tools or authoring packages that do not also have many other features or act as part of a larger suite that delivers online education courses, and course content materials and course content bundled with its own online delivery system. (Leslie, 2003[2])

A CMS is a tool that just helps an instructor to manage individual courses, rather than also providing a system-wide tool. Its function is defined as: "it provides an instructor with a set of tools and a framework that allows the relatively easy creation of online course content and the subsequent teaching and management of that course including various interactions with students taking the course" (EDUCAUSE Evolving Technologies Committee, 2003, p. 1). Examples of a CMS include Blackboard, WebCT, Angel, and Oncourse.

Learning Content Management System

LCMS is often used either synonymously with LMS or touted as a newer version of LMS. However, the focus on content is the key to understanding the difference between these two technologies and seeing how they relate. Oakes (2002) reports that the IDC defines LCMS as a system that is "used to create, store, assemble and deliver personalized e-learning content in the form of learning objects" (p. 73). So, the focus with LCMS is on content: "it tackles the challenges of creating, reusing, managing, and delivering content" (Oakes, 2002, p. 74). While LCMS focuses on content, an LMS is "learner and organization focused: It's concerned with the logistics of managing learners, learning activities, and the competency mapping of an organization" (Oakes, 2002, p. 74). Connolly (2001) echoes this, stating that while LMS and LCMS complement each other, the "LMS provides the rules and the LCMS provides the content" (p. 58).

Learning Object

Learning object has become a highly visible buzz-word in education recently and is taking its place as the favored technology for the future, based on its promise for reusability (ability for instruction to be reused in multiple contexts), generativity (the ability to generate instruction), adaptability (ability to be adapted to individual learners), and scalability (ability to be extended to both larger and smaller

audiences without a substantial increase in cost) (Gibbons, Nelson, & Richards, 2002; Hodgins, 2002; Wiley, 2002).

While learning object is fairly consistent in its promise of instructional design that reduces costs and produces instruction that is adaptable to individual learners and contexts, the actual definition of learning object remains unclear. Learning object has been used to describe everything from a textbook to a computer image to an instructional simulation or video game. Furthermore, terms other than learning object are sometimes used to describe what appear to be learning objects, such as MERLOT's use of "online learning materials," or Merrill's use of "knowledge objects" (MERLOT, 2005; Merrill, 2002). Parrish (2004) notes that the Institute of Electrical and Electronics Engineers (IEEE) provided the vague definition of a learning object as "any entity, digital or nondigital, that may be used for learning, education, or training" (p. 52). Wiley (2002) notes how this definition does not exclude anything related to instruction of any type. He therefore proposes his own definition of a learning object as "any digital resource that can be reused to support learning" (2002, p. 3).

This definition seems to be more on par with the general definition of a learning object as a reusable digital artifact that can be used in learning. However, Parrish (2004) argues that this definition does not eliminate software tools a student might use, such as a calculator or word-processing program. He instead argues for defining learning object in terms of its use or function: "instructional content becomes a learning object when it is used as a learning object" (p. 52).

While Parrish's arguments have some merit, and it is certainly unclear whether Wiley intends to include instructional tools in his definition as well as instructional content, it seems that Parrish's approach might result in more confusion in the long run among those unfamiliar with object-oriented concepts. However, Wiley's use of the term "resource" to describe the object itself could cause some confusion. The key elements of learning objects that lie behind much of the discussion would seem to be the ideas of learning and reusable artifacts. These artifacts would not typically include tools; therefore, Wiley's definition would be more precise if it referred to digital "media" rather than digital "resource." This clarification seems to capture the key concepts and the general understanding of learning objects and their benefits without requiring a more expert understanding of the object-oriented design process that Parrish's definition calls for. Furthermore, Parrish (2004) admits that, while the concept of breaking instructional systems intro smaller reusable objects and methods is related to learning object creation, he points out that learning is different than computer programming, and the concepts of object-oriented programming are not a perfect fit to the instructional design of learning objects.

It should be clear that learning object, while related to LMS, certainly exists at a much narrower scope than LMS. While the key component of LMS is its