Learning/Curriculum Management Systems (LCMS): Emergence of a New Wave in Medical Education

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Abstract: - For millennia, classroom teaching prevailed as the paradigm of learning. Formal learning was scarce, and resources centered on the availability of the educator, rather than the learner. The preliminary applications of eLearning were therefore paralleled with the old classroom model and its associated characteristics. The old method of learning, while comprehensible, does not achieve the true potential of the new paradigm of the Internet as a learning medium. The first wave of e-learning was focused on solutions associated with administering classroom training, i.e., the Learning Management System (LMS). However, the discipline has developed and evolved into a second wave of more sophisticated e-learning, which requires an e-Learning Curriculum Management System (LCMS) to fulfill the needs of personalized and adaptive e-learning. Web-based LCMSs are increasingly utilized across medical universities on an international scale. The LCMS can aid in the delivery of medical education, broaden the capacity for tracking and reporting of teaching and learning across an institution, simplify and automate administrative and supervisory tasks, and facilitate institutional accreditation. These systems are equipped with business intelligence tools to analyze data and create reports to promote curriculum governance and education delivery. The most sophisticated systems additionally incorporate version control, multiple authors, and project management. LCMS comprises a multi-user environment where developers may create, store, reuse, manage, and deliver digital learning content from a central object repository. LCMS solutions are ideally suited to create content-centric learning strategies, supporting multiple methods for gathering and organizing content, leveraging content for multiple purposes, and achieving educational goals and objectives. Thus, LCMS in medical education, with focus on the learner, is a significant breakthrough in eLearning. This new wave of eLearning in medicine is anticipated to alter the landscape of education in favor of learners and their dynamically changing needs.


1 Introduction
Classroom teaching prevailed as the traditional model of learning for several millennia. At the time, formal learning was scarce and resources were centered on the availability of the educator, rather than the learner [1-3]. Initial applications of eLearning were therefore designed on the basis of the old classroom model and its associated characteristics [4-6]. The classroom model, while comprehensible, does not achieve the true potential of the Internet as the new learning paradigm. The first wave of e-learning offered solutions that assisted with administration of classroom training; i.e., the Learning Management System (LMS) [7-9]. Since then, the discipline has developed and evolved into a newer wave of a more sophisticated e-learning [10]. This second wave involves an e-Learning Content Management System (LCMS), also termed Learning Curriculum Management System or Learning Course Management System, designed to facilitate self-regulated and lifelong learning [11-13].

The adoption of LCMS for web-based instruction continues to increase in higher education. LCMS is a software program or integrated platform that contains a series of web-based tools to support a number of activities and course management procedures [8]. Examples of Course Management
Systems include Blackboard, WebCT, eCollege, Moodle, Desire2Learn, Angel, and OPAL. The adoption of e-learning environments using CMS facilitates learning in areas away from the institutions for distributed learning. The e-learning environments also offer added advantages that improve the self-regulation skills of both students and educators, in particular, their metacognitive skills (‘knowing about knowing’ as reflected in applied learning theory). Despite the potential of LCMS to improve the delivery of e-learning, the features and functionalities built into these systems are often underutilized. Consequently, the learning environments created; do not adequately support improvement of self-regulation skills by learners. Therefore, to improve implementation of LCMS by learners and enhance the overall learning experience, the e-learning environments should be constructed with particular attention to the diversity of individual learning styles, prior knowledge, and self-regulation skills (14). Self-regulated learning requires personal initiative, adaptive skills, perseverance and adequate monitoring strategies, and metacognitive skills. The e-learning environments should encourage learners to plan, attend to the relevant content, and monitor and evaluate their learning. Policy makers, educators and researchers should collectively provide leadership to develop and implement LCMSs as powerful learning tools. An effective LCMS should thus incorporate features and functionalities that provide extensive mentoring and support self-regulated learning.

2 Problem Formulation
Learning, in particular, the means by which individuals learn effectively, is an extremely complex process. Historically, learning is a fragmented process with little use of technology and varies significantly among individuals. Therefore, uncertainty exists on what constitutes a comprehensive e-learning suite for medical education. An all-inclusive e-learning solution with the institution and learner at the centre is comprised of three core components:

1. Infrastructure
2. Services
3. Content
The infrastructure refers to the application-level software that allows all aspects of learning (from classroom to web) to be created, managed, delivered, and measured. Similar to all e-business technologies, the e-Learning infrastructure builds on classic networking and enterprise infrastructure services and standards, such as IP-based networks, web browsers and database repositories. At the application level, three primary sets of technologies can be integrated to provide an infrastructure framework for delivering the complete suite of e-learning services. These components include the Learning Management System (LMS), the Learning Content/Curriculum Management System (LCMS), and the Virtual Classroom (VC). A revolution in medical education that began with the advent of the Learning Management System (LMS) is at the verge of emerging into a new wave of learning, termed Learning Content/Curriculum Management System (LCMS).

2.1 The education technology revolution
Since the late 1990s, the utilization of CMS for web-based instruction has steadily increased in higher education including medicine. The implementation of CMS in universities followed the revolution of educational technology and new learning methods that promised better quality, learner-centred education and distribution of electronic learning materials to distant learners [12]. In the US, more than 96% of the courses are offered online at the largest colleges and universities (institutions with a total enrolment of 15,000 or more students) [13]. Records show that during the fall of 2005, about 3.2 million students were enrolled in at least one online course in the US. Clearly, the educational technology revolution has resulted in increasing use of CMS. As a consequence of this growing integration of CMS in higher education, faculties have begun to get involved and initiate training in their effective use.

2.1.1 Learning Management System
A learning management system (LMS) is a software application for the administration, documentation, tracking, and reporting of training programs, classroom and online events, e-learning programs, and training content. A robust LMS should include the following:

1. Centralized and automated administration
2. Use of self-service and self-guided services
3. Assembly and delivery of learning content consolidated training on a scalable web-based platform
4. Support of portability and education standards
5. Personalized content and promoted knowledge reuse
The functionality of LMS ranges from the systems utilized for management of training and educational proceedings to software for the distribution of courses over the Internet, with availability of tools for online collaboration [7-9]. Most LMSs in medical education provide a means to upload course content for the timely delivery of learning resources. Several other systems also provide student self-service (self-registration), training workflow (user notification, manager approval, waiting list management), provision of online learning (Computer-Based Training, i.e., read & understand), online assessment, and collaborative learning (e.g., application sharing, discussion threads), and training resource management (instructors, facilities, equipment). These features of LMS facilitate access to learning content and administration, and are used by the educational institutions to enhance and support classroom teaching and offer courses to a larger population of learners. A number of LMS providers include modern techniques that employ competency-based learning to discover learning gaps and guide the selection of training materials. However, these first-generation eLearning applications fulfill their role of delivery of medical education without realizing the true potential of eLearning or serving the needs of the learner in the present or future.

2.1.2 New Innovations

Based on the advances in medical education in the 21st century, expansion of the trends seen in the last century is predicted [14,15]. Massive amounts of information have been generated, but there is little time to effectively absorb it. Thus, medical students and physicians must continuously update their knowledge and skills. Learning is no longer confined to a specific period, such as schooling, but has grown to be a lifetime commitment. In fact, learning has become integrated into our daily lives, and is thus recognized as a process and not an event. In this novel environment, accountability and business intelligence are extremely critical. With the development of new technology, the delivery infrastructure of the Internet substantially complements the classroom model to compensate for its inherent drawbacks. This new approach will shift the emphasis from wisdom of the educator to knowledge inherent in the learning material, irrespective of the delivery medium.

The characteristics of this approach outlined below will correct the limitations of the previous classroom paradigm and facilitate the learning needs of the future of medicine:

1. Newer environments will adopt a learner-centric approach in terms of both content and delivery format. In preference to the top-down approach of the traditional classroom model, this bottom-up approach begins with the needs of the individual learner.

2. Dynamic delivery will be achieved, based on needs assessment. As learning needs may be difficult to predict, the novel approach should enable just-in-time and just-for-me learning.

3. Smaller units of learning and opportunities for understanding will deliver customized content appropriate for the assessed needs of the learner.

The first proponent of this new way of thinking is the emerging category of Learning Content/Curriculum Management Systems.

3 Learning Content/Curriculum Management System (LCMS)

LCMS is a technology related to the learning management system that is focused on the development, management and publishing of content typically delivered via an LMS [16,17]. An LCMS is a multi-user environment where developers may create, store, reuse, manage, and deliver digital learning content from a central object repository. The LMS cannot create and manipulate courses or reuse the content of one course to build another. However, the LCMS not only facilitates creation, management and delivery of training modules but also management and editing of all the individual sections that constitute the whole training package. LCMS applications allow users to create, import, manage, search for and reuse small units or "chunks" of digital learning content and assets, commonly referred to as learning objects. These items may include media files developed in other authoring tools, assessment items, simulations, text, graphics or other objects that make up the course content. LCMS manages the processes of creating, editing, storing and delivering e-learning content, information and learning technology materials, and other training support deliverables for either synchronous or asynchronous online training [18,19].

Comparison between LMS or CMS and LCMS

Despite clear distinction between LMS and LCMS, the term 'LMS' is often used to refer to both
systems, although ‘LCMS’ is a further development of the initial e-learning system. Due to this conformity issue, the acronym CLCIMS (Computer Learning Content Information Management System) has been proposed and is increasingly used to signify any system software based on advanced learning technology. In essence, LMS constitutes software for planning, delivering, and managing learning events within an organization, including online, virtual classroom, and instructor-led courses. The focus of the LMS is to manage students and keep track of their progress and performance across all types of training activities. LMS performs administrative tasks, such as reporting to instructors, but is not used to create course content.

LCMS provides tools for authoring and repurposing content MLO (mutated learning objects) as well as virtual spaces for student interactions (such as discussion forums, live chat rooms and live web conferences). LCMS constitutes software for managing learning content across the various education programs of the institution. The system provides developers, faculty, administrators and subject matter experts the means to create and reuse e-learning content while reducing duplicate development efforts. An elaborate LCMS will host the content in a central repository and allow multiple LMS access. LCMS is distinct from LMS in that it provides the following additional functionalities:

1. Centralized management of an organization's learning content for efficient searching and retrieval
2. Productivity gains around rapid and condensed development timelines
3. Productivity gains around assembly, maintenance and publishing/branding/delivery of learning content

LCMS provides the ability for single course offerings to be modified and republished for various audiences, thus maintaining different versions and history, rather than developing entire courses and adapting these to multiple audiences. The resources stored in the centralized repository can be made available to course developers and content experts throughout an organization for potential reuse and repurpose. This eliminates duplicate development efforts and allows the rapid assembly of customized content.

LMS is learner-centric; it focuses on e-learning process management and content delivery. In essence, LMS constitutes software for planning, delivering and managing learning events within an organization, including online, virtual classroom, and instructor-led courses. The focus of an LMS is to manage students, keeping track of their progress and performance across all types of training activities.

In contrast, the LCMS is content-centric, the focus in this case is on authoring and management of e-learning reusable content [19,20]. LCMS solutions are ideally suited for creating content-centric learning strategies, supporting multiple methods for gathering and organizing content, leveraging content for multiple purposes, and mission critical learning opportunities. LCMS technology can either be used in tandem with LMS or as a stand-alone application for learning initiatives that require rapid development and distribution of learning content. This facilitates the rapid assembly of customized content. Brandon Hall states that “when LCMS technology is appropriately applied and matched to an orchestrated e-learning strategy with a complete instructional design plan for designing and using learning objects, great efficiencies can and will be achieved” [8]. These include:

1. The ability to make instantaneous, company-wide changes to critical learning content
2. Rapid and productive content development efforts
3. Seamless collaboration among subject matter experts and course designers
4. The ability to create multiple derivative versions of content applicable to different audiences from senior management to line-level workers.
5. Access to find and reuse learning content, ‘just-in-time’ and ‘just enough’
6. Ultimate reusability of content by making it available through a wide array of output types, such as structured e-learning courses, CD-ROM courses, learning material available from a Personal digital assistant (PDA) or Pocket PC, print-based learning for use in classroom settings.

**eLearning Impact**

What is the impact of these systems on eLearning programs and medical education? How does an LCMS system complement the existing learning and curriculum? The different approaches and new opportunities afforded through this technology would allow educators to reassess the fundamental priorities in education. One future approach may be to outsource the generic level learning while client specific learning is developed in-house. There are
strategic reasons, particularly economical ones, for this approach. The content must be served as knowledge objects in response to the assessed specific needs of learners. In this model, organizations remain the true source for their own client-specific content, and thus become producers of eLearning for this particular content. They only need to acquire the tools to capture and disseminate the content efficiently and effectively for delivery across the enterprise and beyond.

**OPAL (Online Portal for Advanced Learning)**

We at the Faculty of Medicine, University of Manitoba developed and implemented an electronic Curriculum Management System named ‘Online Portal for Advanced Learning (OPAL)’ [21,22]. All aspects of preclerkship medical education were impacted by the OPAL, these included, curriculum delivery, scheduling, sharing of information, collaboration and evaluation. OPAL is a locally developed, dynamic, scalable, integrated and functional system, was implemented in August of 2009 and was expected to significantly change the way medical education is delivered at the faculty. In addition, OPAL brings a quality management approach to curriculum oversight and overall quality management of the medical education programs. OPAL is well positioned to facilitate the curriculum delivery, broaden the capacity for tracking and reporting of teaching and learning across an institution, simplify and automate administrative and supervisory tasks. OPAL is equipped with business intelligence tools to analyze data and create reports to facilitate curriculum governance and education delivery. These intelligence reports can improve curriculum governance and are expected to be immensely advantageous while preparing for the medical school accreditation visits. We have been using OPAL to generate reports to find missing sessions, learning objectives, resources uploading and instructor assignment during the preclerkship years. OPAL is powered to generate reports on accreditation standards and curriculum mapping as required by the Liaison Committee on Medical Education (LCME) and Committee on the Accreditation of Canadian Medical Schools (CACMS).

### 4 Conclusion

The LCMS, with focus on the learner, is a significant breakthrough in medical education [20-24]. This concept promises to deliver specific content at the times and in the formats required. This new wave of eLearning will change the landscape of learning in favour of the students and their dynamically changing needs. The rapidly evolving world and its demands for more personalized learning beyond the old classroom model are not in the control of any particular individual or institution [23,24]. However, we can either choose to ignore this development, which would be to our considerable disadvantage, or leverage this innovation to our benefit and treat it as an opportunity to effectively harness this new wave of learning in the future.

**References:**


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