Use of Online Portal for Advanced Learning (OPAL) to enhance Medical Education

Sat Sharma, Charles Conway, Keith McConnell, Ira Ripstein, Bruce Martin, Aarti Paul, Ilana Simon, Jocelyn Advent, Carol Ann Northcott, Chuck Loewen, Dean Sandham

Abstract—Web based Curriculum Management Systems (CMS) are increasingly utilized to deliver medical education across Canadian and other Universities. CMS can facilitate the delivery of learning resources, broadens the capacity for tracking and reporting of teaching & learning across an institution, simplify and automate administrative and supervisory tasks, and serve a useful function for institutional accreditation. Some of these systems are 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 medical school accreditation visits. At University of Manitoba, we have been using Online Portal for Advanced Learning (OPAL) to generate reports to find missing sessions, learning objectives, resource uploading and instructor assignment during the pre clerkship year. In this paper, we demonstrate approaches to creation of necessary reports for curriculum governance and accreditation standards. We used OPAL for the following quality improvement projects: 1) reports of missing learning resources for the MED 1 year (Class of 2014); 2) reports of missing clinical encounters for the clerkship rotations for the Class of 2012. To determine if there was an impact on educational quality, we followed the trends of missing clinical encounters for four periods. We also used OPAL for accreditation reporting and curriculum mapping utilizing analytics dashboards to examine areas of potential gaps and overlaps. These intelligence reports can improve curriculum governance and are expected to be immensely advantageous while preparing for medical school accreditation visits.

***Keywords*—**Learning Management System, Curriculum Management System, Learning/Curriculum Management System, LMS, CMS, LCMS, eLearning

Manuscript received August 23, 2011: Revised version received September 24, 2011. This work was supported in part by the Faculty of Medicine, University of Manitoba.

Sat Sharma is Director of Medical Informatics, Faculty of Medicine, University of Manitoba, 260 Brodie Centre, 727 McDermot Avenue, Winnipeg, MB, R3E 3P5 Canada. Phone 204-237-2217; (email: ssharma@mts.net).

Charles Conway is VP, Medical Learning Systems, Online Business Systems (email: cconway@obsglobal.com).

Keith McConnell is Director of Operations, Faculty of Medicine, (e-mail: mcconnek@cc.umanitoba.ca).

Ira Ripstein is Associate Dean, Undergraduate Medical Education, Faculty of Medicine, (e-mail: ripstein@cc.umanitoba.ca).

Bruce Martin is Associate Dean, Student Affairs, Undergraduate Medical Education, (e-mail: bmartin@cc.umanitoba.ca).

Aarti Paul used to be Manager Information Technology from 2005 to 2009 (e-mail: aartipaul@exchange.ubc.ca).

Ilana Simon is Director of Communications & Marketing, Faculty of Medicine (e-mail: simoni@cc.umanitoba.ca).

Jocelyn Advent is Administrator Curriculum Management System (e-mail: jadvent@cc.umanitoba.ca).

Carol Ann Northcott is Program Manger, Undergraduate Medical Education (e-mail: northcot@cc.umanitoba.ca).

Chuck Loewen is CEO Online Business Systems, (email: cloewen@obsglobal.com).

Dean Sandham was Dean Faculty of Medicine from 2004 to 2010, University of Manitoba (e-mail: Dean_Sandham@umanitoba.ca).

I. 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]–[5]. Initial applications of eLearning were therefore designed on the basis of the old classroom model and its associated characteristics [6]–[10]. 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) [11]–[13]. Since then, the discipline has developed and evolved into a newer wave of a more sophisticated e-learning [14]. 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 [15]–[18].

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 [12]. 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 [19]. 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 [20]–[26].

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 [24]–[25]. 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) [22]–[26]. 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) [22]–[25].

In this paper we describe the approach taken at University of Manitoba to acquire a comprehensive Learning/Current Management System (CMS). We examined available electronic curriculum systems and conducted needs assessment of the students, faculty and administrative staff. A pilot evaluation of one CMS solution to assess system's strengths and weaknesses and an outcome evaluation of user satisfaction was performed. The pilot experience proved a profound need for an electronic CMS for the undergraduate medical education at Faculty of Medicine, University of Manitoba. Lessons learned from the pilot experience led to the development and implementation of Online Portal for Advanced learning (OPAL) *Fig.1* OPAL is a product of academic and business collaboration and offers Web 2.0 technology via an appealing, user friendly Liferay Portal [27]. We adopted a phased approach to the development and created governance and organizational structure to solicit feedback, provide a milieu for collaboration and communication, and mandate accountability. OPAL was successfully launched as the exclusive Learning/Curriculum Management System in August 2009 [28]. OPAL is a comprehensive CMS that offers the following suite of functionalities:

Individualized Calendars: Students and faculty see their own unique calendar. If an event changes, the user's calendar updates immediately.

Curriculum Explorer: Users can search or browse the curriculum in an easy, intuitive interface, allowing them to review what's been taught and where.

Learning Materials: Learning materials are linked to the curriculum, but they can also be browsed or searched independently, providing easy access to their knowledge base.

Reporting & Analytics: The unique reporting and analytics modules provide the most advanced, integrated, and flexible access to your school's data.

Clinical Evaluations & Logbooks: Clinical tools are an integral part of the Opal workflow, allowing users to seamlessly move between their calendars and their tasks.

Questionmark Perception Integration: Opal is tightly integrated with Perception to allow exams and quizzes to be associated with individuals, events and objectives.

II. Improving Quality of Medical Education using OPAL

In this paper, we demonstrate approaches to creation of necessary reports for curriculum governance and accreditation standards. These reports encompass educational objectives, general design and content of curriculum, curriculum management and roles and responsibilities of faculty. We used OPAL for the following quality improvement projects:

1. We created weekly reports of missing learning resources for the MED 1 year (Class of 2014).
   - The curriculum governance committee communicated with the instructors to upload their resources in a timely manner.
   - To determine if there was an impact on educational quality, we followed the trends of missing resources for the whole year.
2. We created reports of missing clinical encounters for the clerkship rotations for the Class of 2012.
   a. The Director of Evaluation followed up on these reports with the clerkship directors.
   b. To determine if there was an impact on educational quality, we followed the trends of missing clinical encounters for four periods.
3. We used OPAL for accreditation reporting and curriculum mapping:
   - We created prototype analytics dashboards to examine areas of potential gaps and overlaps in the curriculum.

III. Results of the Quality Improvement Project

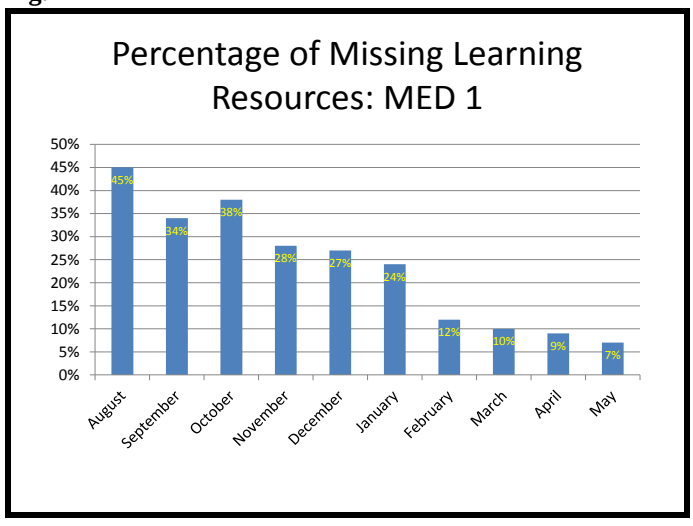
Quality Improvement Project: Learning Resources

We tracked which sessions were missing learning resources

Fig. 1 Individualized OPAL interface and log-in.

throughout the MED 1 year. The Director for Pre-clerkship used these reports to coordinate with Course Directors to post learning resources in a timely manner for students. The following data shows the tracking of missed learning resources and effect of intervention (Curriculum Governance). A marked improvement in Faculty collaboration was observed through this quality improvement initiative. *Fig. 2*

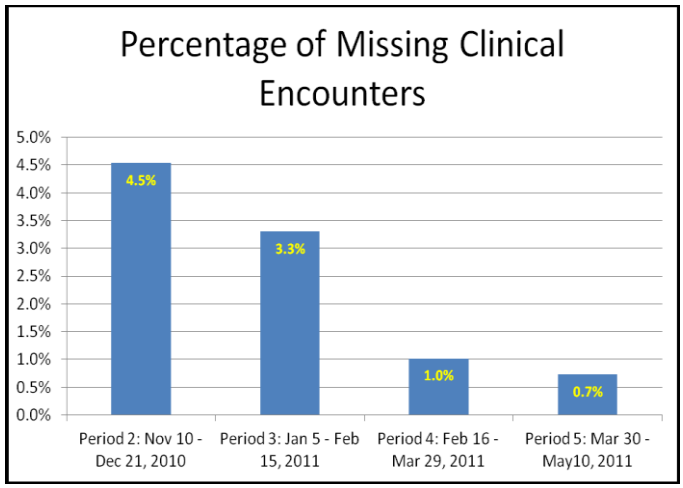
Fig. 2



Quality Improvement Project: Clinical Encounters

We tracked the number of encounters that were missing from students' Essential Clinical Procedure logs, during clerkship periods 2 to 5, relating to the LCME ED-2 standard. The Clerkship Director of each program acted on these reports with respect to their students. The Director of Evaluation also followed up on these reports with the respective clerkship directors. The following data shows the tracking of clinical encounters and effect of intervention. A marked improvement in the number of missing clinical encounters was observed through this quality improvement initiative. *Fig. 3*

Fig. 3



Accreditation Reporting/Curriculum Mapping

As part of the OPAL curriculum management system, we prototyped a business intelligence / analytics dashboard, to

map the curriculum against the MeSH (Medical Subject Headings) controlled vocabulary, and to identify gaps and overlaps in the curriculum, relating to the LCME ED-33 standard. The prototype included a random allocation of MeSH descriptors to educational objectives, to demonstrate the analysis workflow. The "MeSH Summary Dashboard" shown below highlights the MeSH descriptors with two views:

1. The first view shows a browsable hierarchy of MeSH descriptors, with the number of sessions covering each topic.
2. The second view lists each MeSH descriptor and the number of sessions that reference that descriptor, sorted by the frequency that it appears in the curriculum. In this example, "Heart Diseases" is the most frequently occurring descriptor.

This dashboard allows the curriculum governance committee to view how often topics are taught, and to identify which MeSH descriptors are not covered in the curriculum. The curriculum governance committee can also use the MeSH Summary Dashboard to highlight topics of interest, for further analysis in the "Session Report Dashboard".

The Session Report Dashboard, shown on nest page, provides an interactive breakdown of which sessions contain, in this case, the "Heart Diseases" descriptor. *Figs. 7, 8* This dashboard was designed to allow the committee to search, identify, and filter on who teaches each topic, when each topic is taught, where each topic is taught (block, course, and unit). This dashboard allows the committee to review how each topic is taught, by providing a mechanism to view the source data (including educational objectives and learning resources) behind this report. This dashboard also allows the committee to identify sessions that are incorrectly tagged with this descriptor.

Conclusion of Quality Improvement Projects

Web based Curriculum Management Systems (CMS) are increasingly utilized to deliver medical education across North American Universities. CMS can facilitate the delivery and broaden the capacity for tracking and reporting of teaching & learning across an institution, simplify and automate administrative and supervisory tasks, and serve a useful function for institutional accreditation. Some CMS are 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 medical school accreditation visits. At University of Manitoba, we have been using Online Portal for Advanced Learning (OPAL) to generate reports to find missing sessions, learning objectives, and resource uploading and instructor assignment during the preclerkship year. OPAL is powered to generate reports on accreditation standards and curriculum mapping as required by Liaison Committee on Medical Education (LCME) and Committee on the Accreditation of Canadian Medical Schools (CACMS).

IV. Student and Faculty Surveys

Independent and anonymous surveys of the faculty and students were conducted at 1 month and after each block. These surveys demonstrated that student evaluation was overwhelmingly positive and adoption was universal. The survey results from the students and faculty are as follows: *Figs. 4, 5, 6, 9, 10*

Fig. 4

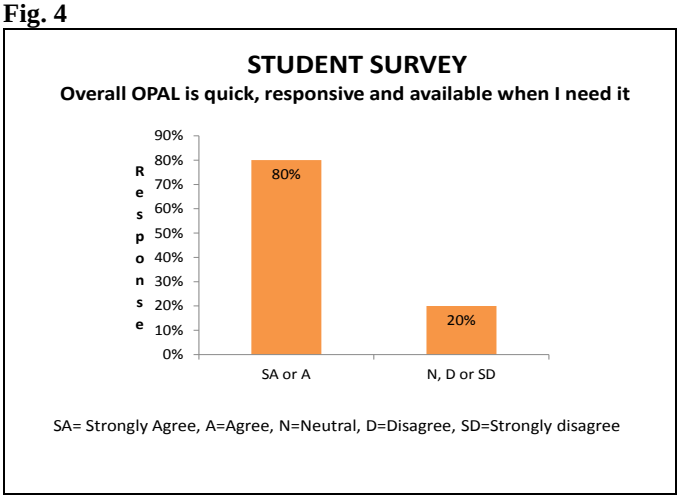


Fig. 5

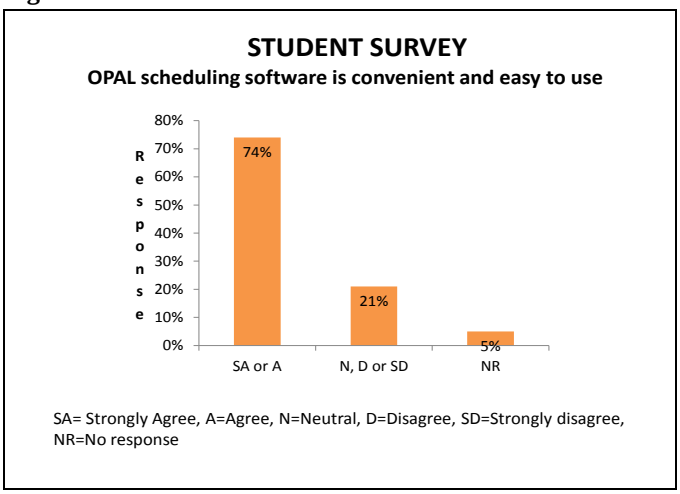


Fig. 6

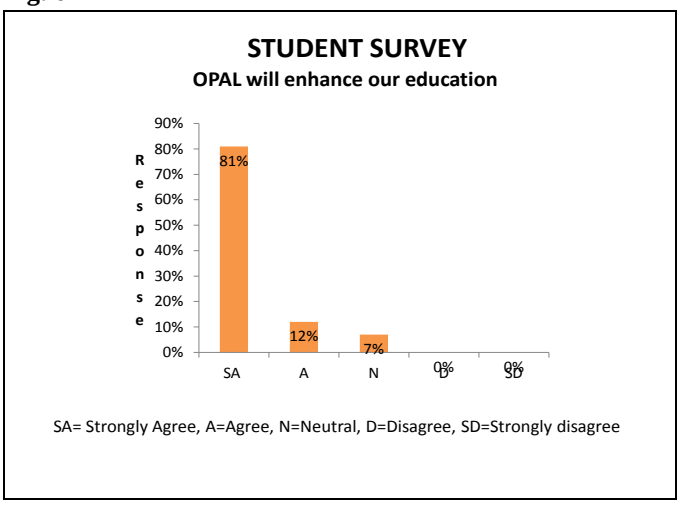


Fig. 7

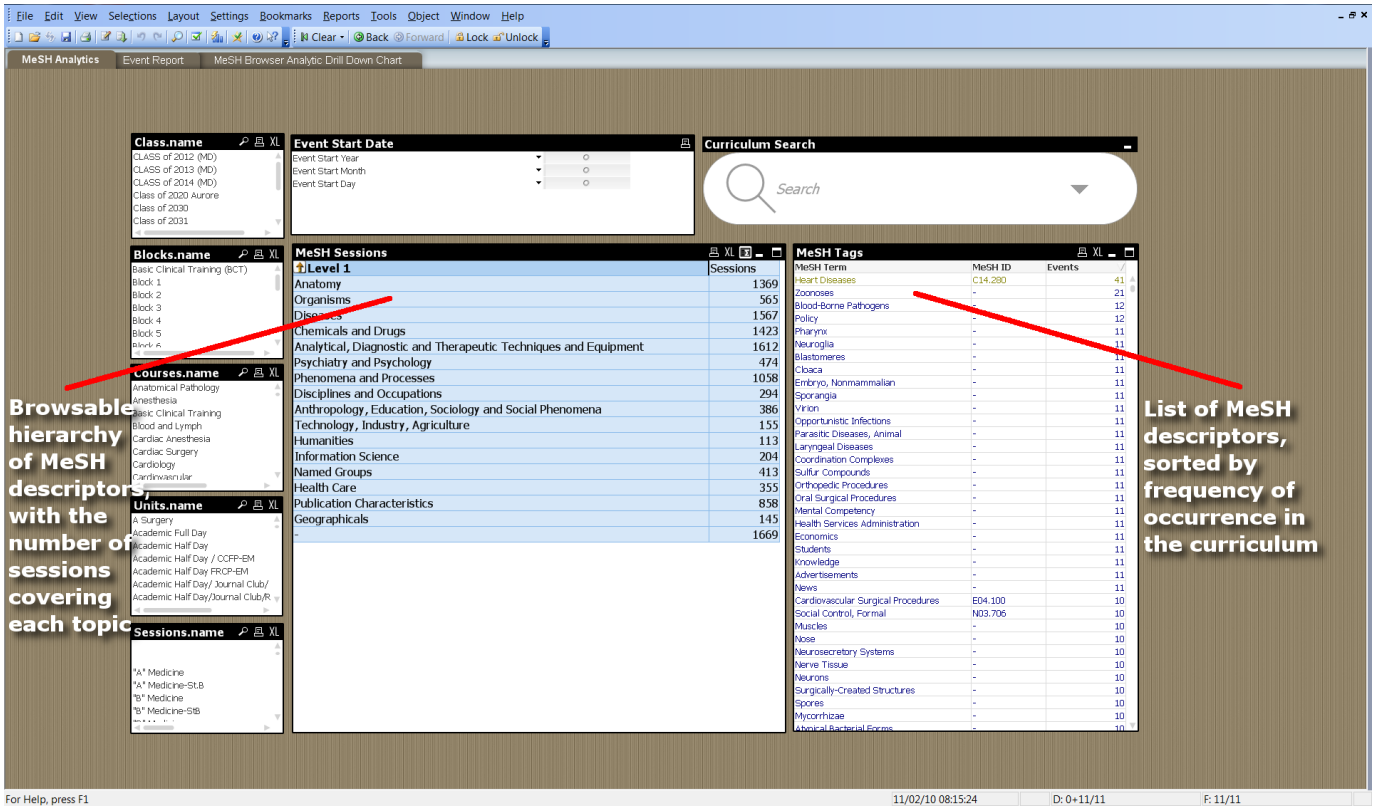

Browsable hierarchy of MeSH descriptors with the number of sessions covering each topic
List of MeSH descriptors, sorted by frequency of occurrence in the curriculum

Fig. 8

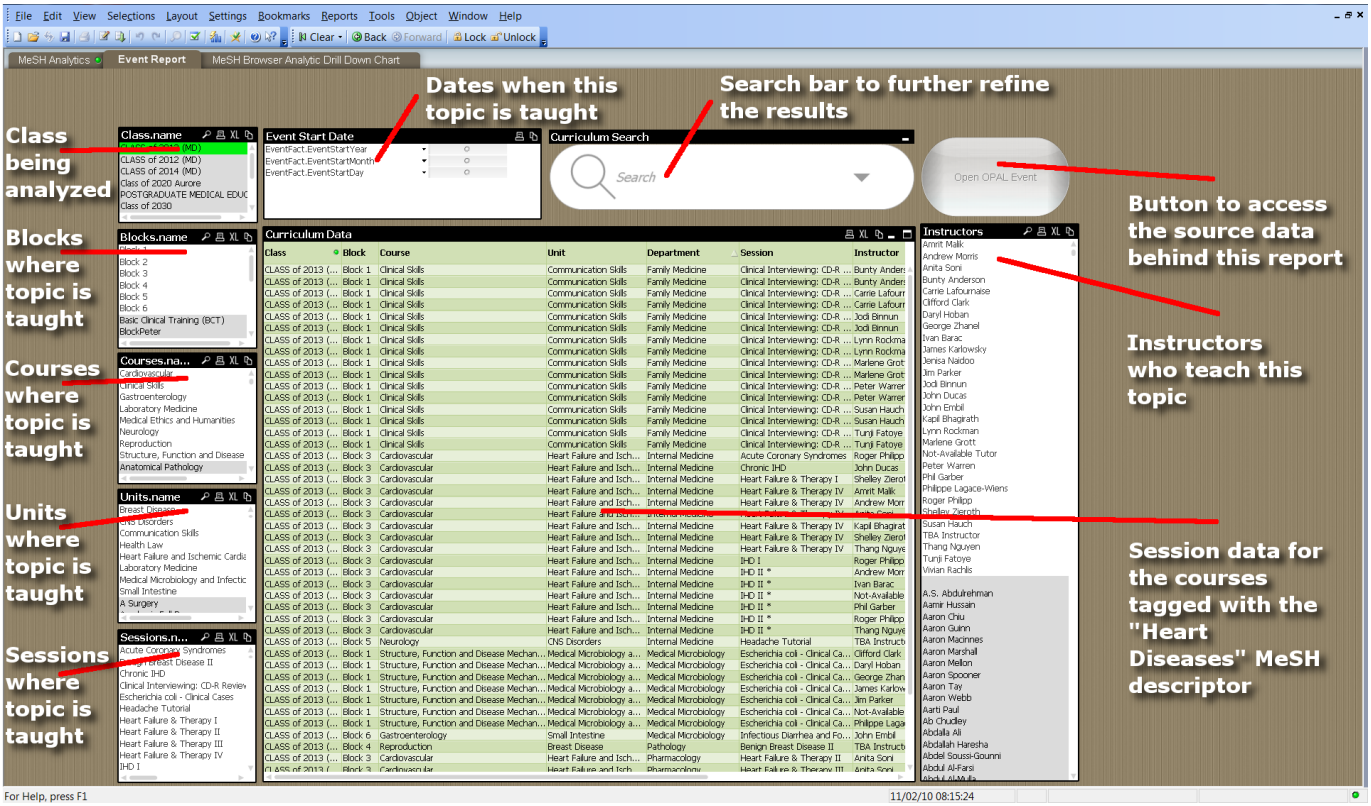

Dates when this topic is taught
Search bar to further refine the results
Class being analyzed
Blocks where topic is taught
Courses where topic is taught
Units where topic is taught
Sessions where topic is taught
Button to access the source data behind this report
Instructors who teach this topic
Session data for the courses tagged with the "Heart Diseases" MeSH descriptor

Fig. 9

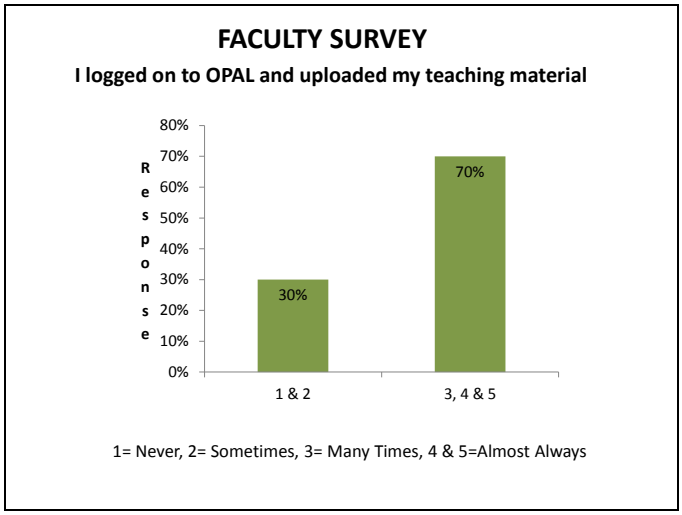
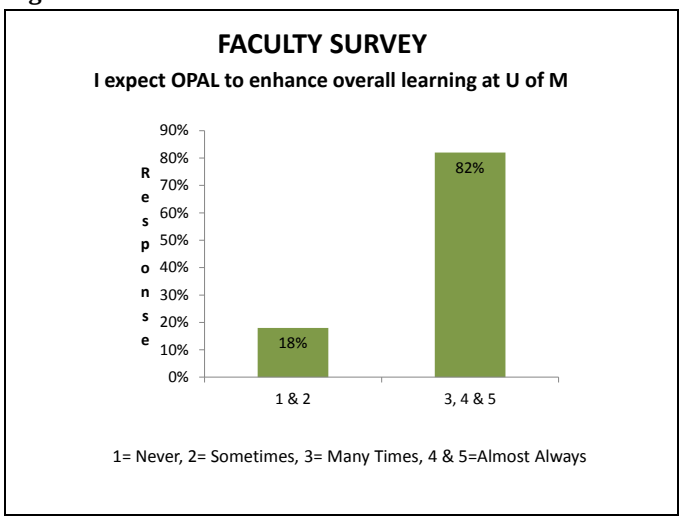


Fig. 10



V. Discussion of LCMS/CMS

Myriad of CMS solutions available for medical education do have the benefit of reasonably large install bases, and they potentially allow the medical school to use the same solution as the rest of the university. However, the generic solutions have the disadvantage of not catering to the specific needs of medical education programs. Their target markets tend to be general higher-level education, as well as K-12, corporate education, sales and product education, and supplier and customer education. These domains all share common requirements to manage learning programs, but lack the sophisticated oversight and evidence requirements of today's medical schools. This means that the schools which implement these solutions are faced with either implementing custom tools or manual processes to address the gaps.

MEDICAL CURRICULUM MANAGEMENT SYSTEMS

Through the years, Curriculum Management Systems targeted specifically at medical education programs began to emerge. These systems, including E*Value™ and one45 Software, provide functionality to support medical education accreditation requirements, such as understanding what topics are taught where and tracking educational objectives. The features in these solutions go much further than generic LMS's in addressing the needs of medical education programs. Interestingly, only 14% of medical schools in North America use medical education CMS's as their primary curriculum management system. According to the schools surveyed, two of the reasons for this – integration and customization – speak directly to the need for a solution beyond the typical CMS. Schools want to be able to integrate both the workflow and the reporting of their curriculum and quality management systems into their other in-house technologies and systems. And when they want to improve their processes, they need the products customizable to support the new processes. Neither of these capabilities exists in current CMS offerings, which has led most schools to look for solutions elsewhere.

OPAL - A NEW PHILOSOPHY IN CURRICULUM MANAGEMENT

Prior to the development of OPAL, we streamlined the entire user experience for students and faculty, taking what used to be several disparate systems and seamlessly integrating them into a highly efficient workflow. This has created a system that provides, in the current and upcoming releases, the most functionality for undergraduate medical education and the programs. All organizational reporting requirements requested by the deans and their staff led to the design of a comprehensive and integrated analytics and custom reporting system that is unmatched by any other solution on the market today.

QUALITY MANAGEMENT

The real challenge that medical schools face is managing and improving the quality of their institution. To accomplish this, they need complete and accurate information. This comes when students, faculty, and staff see their curriculum management system as useful and easy to use, leading them to use it more frequently and consistently. The result is dramatically improved data that is used to measure performance, compliance, and outcomes.

ANALYTICS AND CUSTOM REPORTING

OPAL, as a learning/curriculum management system collects a wealth of information for demonstrating compliance with LCME and CACMS accreditation standards and for improving the quality of the education. But the only way to get this information is to have a robust analytics and custom reporting system, helping with identification on opportunities for improvement in education. OPAL's unique Reporting and Analytics modules can create the needed reports, add a business intelligence analytics interface, and provide educators the power to create their own custom reports. Whether a complete picture of the students' performance is required to determine if they are meeting clinical requirements, or to see if outcomes vary by site, OPAL provides the information. OPAL's reporting module collects information from school and national exams, clinical evaluations and logbooks, and even from students' usage of the system, to provide with an integrated view of your curriculum, your students, and your school.

Fig. 11

EDUCATIONAL OBJECTIVES, CURRICULUM MAPPING, AND ACCREDITATION

Demonstrating compliance with LCME and CACMS accreditation standards is a critical component of quality management strategy for Canadian and American medical schools. OPAL is designed with a focus on helping to create, implement, and demonstrate the processes for accreditation. The goal is to make the accreditation process as smooth as possible by putting all the information that is needed at the fingertips, enabling the schools to easily demonstrate that they have quality programs and meeting accreditation standards. OPAL supports the accreditation activities in numerous ways:

- Complete the curriculum mapping loop: Map from objectives, through courses, events, and finally to outcomes.
- Identify gaps and redundancies in your curriculum.
- Easily access educational objectives from the calendar and the course descriptions.
- Track where each objective is taught.
- For any session, list the objectives that were taught previously.
- Search objectives for topics of interest.
- Oversee students' clinical encounters to ensure educational objectives are met.
- Demonstrate exposure to required curriculum topics and

VI. Conclusion

In summary, 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. *Fig. 11* 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).

Acknowledgment

The authors of this paper were the OPAL Core Committee that oversaw the development and implementation of OPAL as the faculty Curriculum Management System at Faculty of Medicine, University of Manitoba. The OPAL Core Team and the authors express their gratitude and heartfelt appreciation of the cooperation, perseverance and hard work of the students, faculty and administrative staff; OPAL is alive and well today because of their unwavering passion and support. The authors also express their thanks and gratitude to the University of Manitoba administration for their enthusiastic support and generous financial support for OPAL development. Last but not the least, authors thank staff and developers at Online Business Systems who made this dream come true.

References

[1] Bergstedt S, Wiegreffe S, Wittmann J, Moller D. Content management systems and e-learning systems - a symbiosis? Advanced Learning Technologies, Proceedings. The 3rd IEEE International Conference on In Advanced Learning Technologies, 2003.

[2] Coates H, James R, Baldwin G. A critical examination of the effects of learning management systems on university teaching and learning. Tertiary Education and Management 2005; Vol. 11, No. 1: 19-36.

[3] Bransford J, Brown AL, Cocking RR (Eds.). How people learn: Brain, mind, experience, and school. Committee on Developments in the Science of Learning, Commission on Behavioural and Social Sciences and Education. National Research Council.
[4] Sharma S, Paul A, Raghavan M, Advent J, Northcott C, Martin B, Nesbitt S, Ripstein I, Simon I, McConnell K. Comparing Medical Students' Learning via Paper-based versus Electronic Curriculum. Recent Advances in Applied & Biomedical Informatics and Computational Engineering in Systems Application 2011. Eds. Lazard M, Buikis A, Yurly S. et al. ISBN 978-1-61804-028-2. Pages 387-392.
[5] Sharma S, Paul A, Conway C, Gillies D, Nesbitt S, Ripstein I, Simon I, McConnell K. Learning/Curriculum Management Systems (LCMS): Emergence of a New Wave in Medical Education. Recent Advances in Applied & Biomedical Informatics and Computational Engineering in Systems Application 2011. Eds. Lazard M, Buikis A, Yurly S. et al. ISBN 978-1-61804-028-2. Pages 393-397.
[6] Heckman JM, Glantz EJ. Information Processing & Management 2003; Vol. 39, No. 4: 667-668.
[7] Leidner DE, Jarvenpaa SL. The Use of Information Technology to Enhance Management School Education: A Theoretical View. MIS Quarterly 1995; Vol. 19, No. 3: 265-291.
[8] Sandham D, Paul A, Sharma S. Integration of eCurriculum into medical education. Gravitas 2008; 41: 4-5.
[9] El-Bakry HM, Mastorakis N. E-Learning and Management Information Systems For E-Universities. Technical University of Sofia, Proceedings of the 13th WSEAS International Conference on COMPUTERS, pp 555-565.
[10] Mastoras T, Fotaris P, Politis A, Manitsaris A. Establishing effective Learning Management Systems through simplicity. Proceedings of the 5th WSEAS Int. Conf. on DISTANCE LEARNING AND WEB ENGINEERING, Corfu, Greece, August 23-25, 2005, pp111-115.
[11] Koolen R. A Knowledge Mechanics White Paper. Learning Content Management Systems - The Second Wave of eLearning. Knowledge Mechanics, July 2001 Grand Rapids, Michigan, USA.
[12] Vovides Y, Sanchez-Alonso S, Mitropoulou V, Nickmans G. The use of e-learning course management systems to support learning strategies and to improve self-regulated learning. Educational Research Review 2007; 2:64–74.
[13] Wiley D. Learning Objects, Content Management, and E-Learning. In Content Management for E-Learning 2011: 43-54.
[14] Morten T, Vendel Ã. Improvisation and Learning in Organizations: An Opportunity for Future Empirical Research. Management Learning 2009; Vol. 40, No. 4: 449-456.
[15] Swenson P, Curtis L. Course management systems to learning enhancement systems a necessary evolutionary step in online education. In Proceedings of society for information technology and teacher education international conference 2004: 717–721.
[16] Swinney LA. Why faculty use a course management system (blackboard) to supplement their teaching of traditional undergraduate courses. Thesis submitted to the University of North Dakota for the degree of Doctor of Philosophy (2004).
[17] Nakano R. Web content management: a collaborative approach. (2002). Web Content Management: A collaborative Approach, First Edition, Boston: Addison Wesley Professional [ISBN: 0-201-65782-1, 222 Pages, Paperback].
[18] Campanella S, Dimauro G, Ferrante A, Impedovo D, Impedovo S, Lucchese MG, Modugno R, Pirlo G, Sarcinella P, Stasolla E, Trullo CA. E-learning platforms in the Italian Universities: the technological solutions at the University of Bari. WSEAS TRANSACTIONS on ADVANCES in ENGINEERING EDUCATION. Issue 1, Volume 5, January 2008, pp 12-19.
[19] Zimmerman B J. Becoming a self-regulated learner: An overview. Theory into Practice 2002; 41(2): 64–70.
[20] Brusilovsky P. Knowledge tree: A distributed architecture for adaptive e-learning. In Proceedings from the World Wide Web conference 2004: 104–113.
[21] Zhang D, Zhao J, Zhou L, Numamaker J. Can e-learning replace classroom learning? Communication of the ACM 2004; 47(5): 75–78.
[22] Dabbagh N. Pushing the envelope: Designing authentic learning activities using course management systems. In Proceedings of world conference on e-learning in corporate, government, healthcare, and higher education 2004: 1155–1159.
[23] Darbhamulla R, Lawhead P. Paving the way towards an efficient learning management system. In Proceedings of the association for computing machinery south east conference 2004: 428–433.
[24] Mitrovic A, Suraweera P, Martin B, Weerasinghe A. DB-suite: Experiences with three intelligent, web-based database tutors. Journal of Interactive Learning Research 2004; 15(4): 409–432.
[25] Morgan G. Faculty use of course management systems. 2003. Retrieved July 20, 2011. http://www.educause.edu/ir/library/pdf/ers0302/rs/ers0302w.pdf.
[26] Curriculum Management System Project History at Faculty of Medicine, University of Manitoba. Accessed June 23, 2011. http://umanitoba.ca/faculties/medicine/dean/history.html
[27] OPAL–Online Portal for Advanced learning. Accessed June 23, 2011. http://umanitoba.ca/faculties/medicine/opal/index.html
[28] Paul A, Yaworski D, McConnell K, Martin B, Sandham D, Sharma S. Implementation of a Curriculum Management System at a Faculty of Medicine – Lessons Learned. Innovations in Computing Sciences and Software Engineering. Sobh, Tarek; Elleithy Khaled (Editors) 1st Edition, 2010, 86-94. Hardcover, Springer. ISBN: 978-90-481-9111-6

Professor Sat Sharma, MD, FRCPC, FCCP, FACP, FAASM is a Professor and Head of Respirology for the Department of Internal Medicine at the University of Manitoba in Winnipeg, Canada. He also works within the Critical Care Section and Sleep Disorders Centre, served as program director of post graduate education in respirology at the University of Manitoba, and is the site director of respiratory medicine at St. Boniface General Hospital and Health Sciences Centre. Dr. Sharma's research interests include epidemiology of respiratory diseases, perioperative respiratory care, exercise induced hypoxemia, medical education, and medical informatics. Dr. Sharma is presently Director of Medical Informatics at Faculty of Medicine, University of Manitoba. In this position he was instrumental in creating a Learning Content Management System for the medical faculty. He is a longstanding board member of the Canadian Thoracic Society, chair of the Specialty Committee of Respirology for the Royal College of Physicians and Surgeons of Canada, governor of the Manitoba chapter of the American College of Chest Physicians, and a member of the Health and Science Policy Committee for the ACCP. Dr. Sharma maintains an active agenda of philanthropic undertakings and supports UNICEF, the Red Cross, and numerous other voluntary organizations. In his spare time, he enjoys competitive running, bicycling, travel, fiction writing, and community work.