Introduction of a learning management system at the Kilimanjaro Christian Medical University College

L Killewo,[1] BA; **E Lisasi**,[1] MD, MPH; **G Kapanda**,[1] MSc; **D Tibyampansha**,[1] BS; **G Ibrahim**,[1] BA, MPH; **A Kulanga**,[1] MBA; **C Muiruri**,[2,3] MPH; **N Fadhili**,[1] MCA; **D Wiener**,[2,5] AS; **A Wood**,[5] BA; **E Kessi**,[1] MD, MMed, MSc; **K Mteta**,[1,4] MD, MMed; **M Ntabaye**,[4] DDS, PhD; **J A Bartlett**,[1-3] MD

[1] *Kilimanjaro Christian Medical University College, Moshi, Tanzania*

[2] *Duke University School of Medicine, Durham, North Carolina, USA*

[3] *Duke Global Health Institute, Durham, North Carolina, USA*

[4] *Kilimanjaro Christian Medical Centre, Moshi, Tanzania*

[5] *Learning Content Management System, Durham, North Carolina, USA*

Corresponding author: *L Killewo (amlucy2000@yahoo.com)*

Background. Medical schools in Africa face daunting challenges including faculty shortages, growing class sizes, and inadequate resources. Learning management systems (LMS) may be powerful tools for organising and presenting curricular learning materials, with the potential for monitoring and evaluation functions.

Objective. To introduce a LMS for the first-year medical student curriculum at the Kilimanjaro Christian Medical University College (KCMU Co), in Moshi, Tanzania, in partnership with the Duke University School of Medicine (Durham, North Carolina, USA).

Methods. Observations were made on the requisite information technology (IT) infrastructure and human resource needs, and participation in training exercises. LMS utilisation was recorded, and two (student and faculty) surveys were done.

Results. The KCMU Co IT infrastructure was upgraded, and an expert team trained for LMS implementation. An introductory LMS workshop for faculty had 7 out of 25 invitees, but attendance improved to more than 50% in subsequent workshops. Student attendance at workshops was mandatory. Use of the LMS by students rapidly expanded, and growing faculty utilisation followed later. By the end of the second semester, online examinations were offered, resulting in greater student and faculty satisfaction owing to rapid availability of results. A year after LMS introduction, 90% of students were accessing the LMS at least 4 days/week. A student survey identified high levels of satisfaction with the LMS software, quality of content, and learning enhancement.

Conclusion. LMS can be a useful and efficient tool for curriculum organisation, administration of online examinations, and continuous monitoring. The lessons learned from KCMU Co may be useful for similar academic settings.

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Sub-Saharan Africa faces an extraordinary burden of human disease, with a dire shortage of healthcare providers to address this burden.[1] The training of medical doctors is essential, but current training capacity falls far short of meeting anticipated needs. About 167 000 new doctors will be needed in sub-Saharan Africa by the year 2015, but only 30 000 are expected to graduate in this period.[1] Ministries of Health and Education, and the private sector, have responded by opening many new medical schools across the continent, and mandating that each school rapidly expand its class size.[1] Despite these efforts, the delivery of medical education in sub-Saharan Africa faces great challenges, including poor infrastructure, inadequate number of medical schools, insufficient number of faculty members, poor compensation for faculty and graduates, and a continued increase in student enrolment without a commensurate increase in faculty numbers and infrastructure to accommodate the changes.[1] Creative interventions to overcome these challenges are sorely needed, including the use of modern technologies and teaching methods that optimise medical student learning, despite limited resources.

One approach to enhance efficiency and organisation is the use of a learning management system (LMS). LMS has been defined as 'a software application or web-based technology that is used to plan, deliver or access a particular learning process'.[2] In upper- and middle-income countries, LMSs are extensively used in universities and businesses for organising and sharing learning materials, communications, and evaluating students/learners. In a survey of 25 African countries, 4 major impediments to successful utilisation of LMSs were identified:[2] (*i*) knowledge of LMS was limited, with only 49% responding that they had used a LMS for teaching and 52% for learning in the previous 12 months. Furthermore, they had limited knowledge of the broad capabilities of a LMS, with only approximately 50% of respondents demonstrating knowledge of 18 specific LMS features; (*ii*) infrastructure shortcomings in internet bandwidth and steady electricity supply were major impediments to usage. This was supported by a study of computers, the internet and medical education in Africa which revealed that internet speeds were rated as 'slow' or 'very slow' by 25% of respondents, with the percentage rising to 58% in East Africa.[3] In addition, the ratio of computers to students was 1:0.123;[3] (*iii*) training in the use of LMS was limited, and 25% of respondents indicated a history of less than 2 hours of training in LMS use; and (*iv*) a lack of shared content and open educational resources within Africa. A recent survey of medical schools in resource-constrained low- and middle-income countries revealed that a limited number in sub-Saharan Africa were employing a LMS for the management of their curriculum and students, and none had systematically examined their impact.[4]

Similar to other medical schools in sub-Saharan Africa, the Kilimanjaro Christian Medical University College (KCMU Co) in Moshi, Tanzania, has experienced rapid growth in medical student class size, increasing from 15 when it opened in 1997 to 154 in 2011. In 2010, KCMU Co received funding from the United States Government through the Medical Education Partnership Initiative (MEPI),[5] a programme designed to assist sub-Saharan Africa by increasing the number and quality of physicians, to increase their retention in underserved areas, and to improve research capacity. With this support, KCMU Co introduced an LMS in October 2011 to manage the first-year curriculum and the incoming first-year students.

Methods

Setting

KCMU Co is located in Moshi, Tanzania, and is one of 6 Tanzanian medical schools. It is overseen by the Good Samaritan Foundation, and has 3 faculties offering 16 different health-related degrees. Its principal clinical training site is the Kilimanjaro Christian Medical Centre (KCMC), one of 4 referral hospitals in Tanzania serving an estimated population of 16 million. Similarly to many other sub-Saharan medical schools, KCMU Co has rapidly expanded its class sizes in the past 10 years. Fig. 1 shows the dramatic increase in the numbers of admitted students from 1997 - 2011.

Unfortunately, the increase in the number of admitted students has not been accompanied by increases in faculty size or other key infrastructure components. As a result, faculty are overwhelmed and teaching obligations decrease in priority. In an informal survey conducted at KCMU Co in 2010, faculty delivered less than 40% of their scheduled lectures to students. As a result, students were forced to pursue self-directed and group learning, frequently without faculty guidance or teaching.

The MEPI Leadership Team visited the Duke University School of Medicine (Durham, North Carolina, USA) to evaluate different options for an LMS intervention, including proprietary and open-source software. Important considerations were a proven record of successful hosting of medical school curricula, ease of use by students and faculty, availability of programming support, ability to deliver online examinations, monitoring and evaluation functions, and ability to easily track system activities and usage. The LMS chosen for intervention was developed by the Duke University School of Medicine, a key KCMU Co partner. It was developed specifically for medical education at Duke, and is known as the Learning and Curriculum Management System+ (LCMS+). LCMS+ is now manufactured, marketed and maintained by LCMS+ Inc., Durham, North Carolina, USA.

LMS team development

Empowered by the KCMU Co and KCMC leadership, a team was developed to support the LMS intervention, led by an LMS specialist with a background in information technology (IT) and some experience in managing educational applications. She travelled to Duke for training, and had weekly conference calls with the LCMS+ developers. In addition, the LCMS+ developer travelled to KCMU Co to assist with on-site training. She was supported by three IT specialists who oversaw the development of a fibre optic cable network on campus and internet and intranet

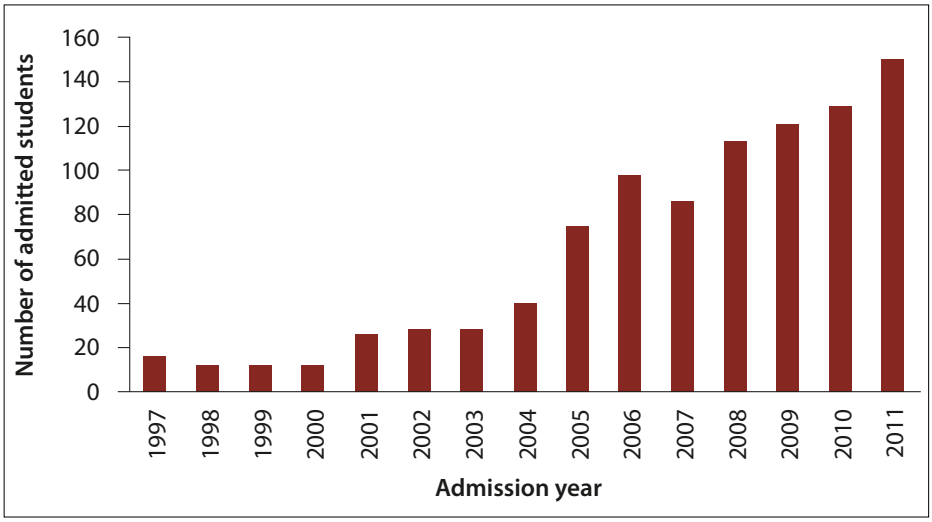

Fig. 1. Growth in KCMU College medical school admissions from 1997 to 2011.

July 2011	**Acquisition of LCMS+** ■ System set-up, configuration and testing (Duke system development and KCMU Co staff co-ordinating activities closely) ■ System content familiarisation and customisation ■ System work plan and usage
Sept 2011	**Introduction of LCMS+** ■ Communicated with potential users ■ Call for course materials submission ■ Development of security and user privileges ■ Uploading course materials ■ First training to faculty members
Nov 2011	**Official launching** ■ System introduction and training for students ■ Continuous system support, training and usage monitoring
Jan 2012	**Preparation for online examinations** ■ Training for faculty, staff and students ■ Receiving and uploading examinations to the system
Feb 2012	**Online examination administration** ■ Preparing computers, computer rooms and invigilators ■ Examination administration ■ Feedback from faculty and student surveys

Fig. 2. LCMS+ implementation timeline.

services. The timeline for the development of the LCMS+ team and initial implementation is shown in Fig. 2.

Training of KCMU Co faculty, students and staff

Once the LCMS+ was installed and ready for use, the KCMU Co Dean informed faculty about its planned introduction. A carefully organised introductory training workshop was held in September - November 2011 for KCMU Co faculty, students and staff, followed by an online examination workshop in January 2012. On-demand training and ongoing support services continued to be offered at individual to departmental levels. It was decided to initiate LCMS+ implementation with the first-year medical students entering in October 2011, and in subsequent years the LCMS+ would be extended by one class each year.

Survey assessments

Surveys were developed to assess faculty and student feedback on the LCMS+. All surveys were conducted anonymously online. Faculty and students were surveyed in February - March 2012 to solicit feedback following the introduction of online examinations. Students completed a survey on LCMS+ in December 2012, following completion of the first semester in their second year. Our LCMS+ survey adapted DeLone and McLean's[6] updated information systems success model as a way to explicitly measure and assess success. We chose this model because of its success metrics, which are specifically designed for the e-learning context. The LCMS+ student survey consisted of 15 questions using a 5-point Likert scale for responses (1 = strongly disagree to 5 = strongly agree), and focused on the quality of the software, quality of content, learning enhancement, complaints, and preferences for future content. Mean scores were calculated for student responses, and strength of consensus measure (sCns) was applied to test for response consistency.

Ethical clearance

All research related to the MEPI was reviewed by the KCMC Research Ethics Committee, and was exempted from a full review because of its focus on education. Participation in the study assessments by faculty, staff and students was preceded by verbal consent. All survey results were anonymous.

Results

Workshop participation

At the first workshop to introduce faculty and staff to LCMS+, only 7 out of 25 invited members attended. An informal survey of faculty revealed the expectations summarised in Table 1.

A second workshop was offered in late January 2012, near the start of the second semester, and 42/60 invited faculty and staff attended. Workshops for students were held in October 2011 and January 2012, and participation was mandatory; 154 students attended each workshop.

LCMS+ utilisation

Utilisation rapidly increased during the first months of LCMS+ availability. By January 2012, after 3 months of LCMS+ activity, 220 students (including medical and master's students) and 34 faculty had accessed the system. In December 2012, a year after implementing LCMS+, a survey of 2nd-year medical students revealed that 90% of them were accessing the LCMS+ at least 4 days/week, and 57% were accessing it 6 - 7 days/week.

Online examinations

Eight faculty and 116 students responded to the online examinations survey. Six faculty members (75%) reported that they were able to prepare online examinations in a week or less; the remaining 2 needed 2 weeks. Six faculty members reported that previously they had needed more than 2 weeks to grade 'paper' exams, whilst online examinations were graded instantaneously. All faculty members answered that they had a positive experience with online examinations, and 100% indicated that they planned to continue to use them in future.

Of 116 students responding to the survey, 88% preferred online to paper examinations. Most (72%) students stated that they preferred online examinations because of the short turnaround time to receive feedback on their examination grades. Most (85%) felt that the multiple choice questions were clearly written, although only 20% of students felt that enough time had been allocated to answer each question.

Table 1. Informal survey of faculty attitudes – first workshop

Percentage of faculty (*n*=7)	Attitude
50	Fear of change and adapting to the new system
40	Did not believe that the system could work in an African setting, particularly at KCMU Co
10	Eager to learn and see how the system was going to change and improve the culture of teaching and learning

Table 2. LCMS+ student survey mean scores and consensus measures

Category	Mean scores	Consensus measure, %
Quality of software	**3.93**	77
User friendly	4.3	85
Stability	3.7	73
Security	4.0	80
Interactivity	3.7	73
Quality of content	**4.19**	84
Well organised	4.2	84
Effectively presented	4.0	81
Appropriate length	4.0	81
Clearly written	4.3	85
Use for learning	4.5	91
Up-to-date	4.2	84
Clear course objectives	4.1	83
Appropriate terminology	4.2	85
Used effectively	4.2	85
Learning enhancement	**4.2**	83
Stronger analytical skills	4.3	87
Faster learning	4.3	85
Better individual learning	4.3	87
Less dependent on library	4.1	81
Flexible study schedule	4.3	86
Better communication	3.9	77

Student surveys

A total of 154 2nd-year medical students participated in the student surveys on LCMS+, representing the entire class that had utilised LCMS+ since entering medical school in October 2011. The mean scores by category and consensus measures are in Table 2. Overall, the mean scores ranged from 3.7 - 4.5, with a consensus measure of 73 - 91%. In the category of quality of software, the mean scores were 3.7 - 4.3 with consensus measures of 73 - 85%. In the category of quality of content, the mean scores ranged from 4.0 - 4.5, with consensus measures of 81 - 91%. In the category of learning enhancement, the mean scores ranged from 3.9 - 4.3, with consensus measures of 77 - 87%. Complaints about LCMS+ were also solicited; the most common were late posting of materials (25%), difficulty in submitting assignments (21%), student misuse of bulletin boards (16%), downloading and printing of documents (14%), and difficulty contacting lecturers (11%). Preferences for future content and services expressed by at least 50% of students included access to online libraries (86%), access to previous tests and answers (79%), e-mail notification of announcements (67%), access to previous study materials (60%), and discussion groups/wikis (52%).

Discussion

The introduction of LCMS+ at KCMU Co has proven successful, with rapid utilisation by students and faculty, online testing with strong preferences in favour of this method from students and faculty, and highly favourable student surveys supporting the use of LCMS+, with a high degree of consensus. Compared with paper examinations, online examinations have reduced paper usage, and printing and labour costs. In addition, faculty time spent on script marking and producing examination report was greatly reduced, and students appreciated the rapid turnaround of examination grade feedback.

The original intent in introducing LCMS+ at KCMU Co was to focus on implementation exclusively with medical students, progressing from the first-year class in 2011 and adding one new medical student class per year. However, the demand for LCMS+ access spread rapidly within the college, and LCMS+ is now used to support the curricula of 3 medical school classes and 3 master's in medicine programmes. Two new staff specialists have been hired to address the increased demand for LCMS+ services. Taken together, these observations suggest outstanding value for LCMS+ in organising, presenting and testing curricular content. Three of the top 5 complaints about LCMS+ relate to late postings, student misuse of bulletin boards, and difficulty contacting lecturers – issues that relate to users and not to the system itself. The LCMS+ has the capacity to evolve with time, and will in the future respond to KCMU Co student requests for the addition of materials such as online libraries, previous study materials and tests, and discussion groups.

The published experience of other sub-Saharan African schools of medicine is limited, and does not include similar assessments of user satisfaction.[4] The University of KwaZulu-Natal described 6 academic programmes using Moodle as an LMS, largely within their School of Nursing.[7] They identified computer access as an obstacle to implementation, with difficult access during working hours and a lack of personal computer access outside working hours. The University of Colombo in Sri Lanka described their experience with using Moodle as an LMS beginning in 2007, and performed a random survey of 100 medical students[7] of whom 99% responded that the LMS material was useful, and faculty enthusiasm was described as 'high'.[8]

The use of LCMS+ by KCMU Co offered important advantages for implementation. It was specifically designed to host medical school curricula, and most of the programming development was complete prior to its adoption at KCMU Co. Technical support has been provided gratis by the Duke University School of Medicine and LCMS+, Inc., in recognition of the long-standing 17-year partnership between KCMU Co and Duke. Other sub-Saharan African schools of medicine may find the cost of this proprietary software to be an obstacle, and may wish to utilise open-source software such as Moodle. They should be aware of the programming support needs if they elect to pursue the option of Moodle or other open-source software.

The use of electronic aids in medical education may have significant impact, especially in low- and middle-income countries where faculty shortages are common. However, when they are introduced, careful planning and preparation is essential. Frehywot *et al*.[4] identified 4 critical strategies for ensuring the success of e-learning interventions: institutional support, technical expertise in IT, adequate infrastructure and support systems, and faculty and student engagement. The experience of KCMU Co in LCMS+ implementation underscores the importance of these factors.

There are a number of limitations to these observations. Firstly, we have described implementation, rapid uptake and utilisation, and highly favourable subjective responses to the introduction of LCMS+. However, we do not have objective evidence of improved medical student performance. Secondly, we had the unique opportunity to invest in educational infrastructure with MEPI support, and to access LCMS+ from Duke University at no cost. Thirdly, we do not have any comparative data on the use of other LMSs in medical education within resource-limited settings. Lastly, the survey instruments used were internally developed and had not undergone validation.

There were some challenges caused by system users: late posting of materials, student misuse of bulletin boards, and difficulty contacting lecturers. We have found that users were lacking knowledge on how to efficiently and effectively use the system. These issues have been addressed. Provision of education to users can help to solve these problems.

Conclusion

The introduction of LCMS+ at KCMU Co has assisted with curricular organisation, presentation and testing. It has been rapidly adopted by the students and faculty with very favourable responses. Other schools of medicine in sub-Saharan Africa may wish to implement similar efforts.

Conflict of interest. This study was supported by the Medical Education Partnership Initiative and Health Resources and Services Administration award T84HA21123. DW and AW are employees of LCMS+, Inc.; JAB and CM are employees of Duke University, which has a financial interest in LCMS+, Inc. The authors of this article have no conflict of interest to report.

References

1. Mullan F, Frehywot S, Omaswa F, et al. Medical schools in sub-Saharan Africa. Lancet 2011;377(9771):1113-1121. [http://dx.doi.org/10.1016/S0140-6736(10)61961-7]
2. Unwin T, Kleessen B, Hollow D, et al. Digital learning management systems in Africa: Myths and realities. Open Learning 2010;25(1):5-23. [http://dx.doi.org/10.1080/02680510903482033]
3. Williams CD, Pitchforth EL, O'Callaghan C. Computers, the internet and medical education in Africa. Med Educ 2010;44(5):485-488. [http://dx.doi.org/10.1111/j.1365-2923.2009.03602.x]
4. Frehywot S, Vovides Y, Talib Z, et al. E-learning in medical education in resource constrained low- and middle-income countries. Hum Resour Health 2013;11:4. [http://dx.doi.org/10.1186/1478-4491-11-4]
5. Medical Education Partnership Initiative. Fostering African Medical Education Community of Excellence, 2011. http://mepinetwork.org/about-mepi/coordinating-center.html (accessed 28 February 2013).
6. Holsapple CW, Lee-Post A. Defining, assessing and promoting e-Learning success: An information systems perspective. Decision Sciences Journal of Innovative Education 2006;4(1):67-85. [http://dx.doi.org/10.1111/j.1540-4609.2006.00102.x]
7. Mars M. Building the capacity to build capacity in e-health in sub-Saharan Africa: The KwaZulu-Natal Experience. Telemed J E Health 2012;18(1):32-37. [http://dx.doi.org/10.1089/tmj.2011.0146]
8. Rajapakse S, Fernando D, Rubasinghe N, Gurusinghe S. e-Learning in medical education: Guide supplement 32.6 – Practical application. Med Teach 2009;31(5):452-453. [http://dx.doi.org/10.1080/01421590902833036]