



## Integrating bioscience and clinical learning through technology

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Successfully integrating bioscience and clinical learning is a major challenge for designers of medical curricula. A new learning system being developed at the University of Melbourne will make it easier for medical students to locate, access and utilise bioscience and clinical learning resources to support both formal and informal learning activities. Backed by a comprehensive database of curriculum, bioscience and clinical resources, students will have immediate access to the best available bioscience and clinical resources via interactive activity and search-based interfaces. Student portfolios, based around new patient record and procedural log systems will be fully integrated within the system. Implementation will be supported by an extensive program of evaluation and research, with particular emphasis to be placed on student's selection and use of digital resources and the use of electronic health records to support clinical learning.

Keywords: learning systems, resource use, electronic health records, student portfolios

### Curriculum renewal

In 2011 the Melbourne Medical School (MMS) shifted from a six-year undergraduate (MBBS) to a four-year graduate (MD) curriculum. The shift to a graduate curriculum brings the MMS into line with the majority of Australia's twenty medical schools, although the MD is unique in being accredited as a masters level degree. The clinical components of the two curricula are broadly similar but formal campus-based biosciences instruction has been reduced from five semesters (two and a half years) in the MBBS to four terms within a single year in the MD. Whereas all students' requisite bioscience learning was embedded in the MBBS curriculum, the first year of the new MD is designed to consolidate and, where necessary, extend students' existing bioscience knowledge so they enter the clinical phase of their learning with an equivalent bioscience knowledge base.

### The challenge

Successfully integrating the comparatively pure elements of bioscience learning with the strongly applied elements of clinical learning is one of the fundamental challenges of all medical curricula. At Melbourne, as in a majority of medical schools locally and internationally, problem- and case-based learning have been adopted in an effort to ground students' bioscience learning in a strong and meaningful clinical context (Barrows, 1996). The inverse – the application and integration of bioscience learning into clinical learning activities – is often less

formally supported, the expectation being that students will adopt a self-regulated learning approach to draw and build upon their bioscience learning throughout their clinical years. However, in our teaching staff's experience, students aren't necessarily able to recall, locate or apply core key bioscience knowledge when required in clinical settings. Honing students' information management and seeking skills can help here. Today's medical students are expected to assimilate and apply, an ever increasing and complex body of medically related information. Added to this, they are time poor and must function at a consistently high level when working, and learning, in clinical settings. To work and learn effectively, they clearly need simple, rapid and effective access to both their core learning materials and an array of quality medical information sources. And, for maximum benefit, they need the necessary skills and tools to be able to combine, synthesise and assimilate and apply this information in an efficient and effective way.

### **Educational technology and the curriculum**

Educational technology plays a major role in the delivery of the medical curriculum at most Australian medical schools and Melbourne is no different, although it was perhaps an earlier and more vigorous adopter than others (Keppell et al, 2001). Learning resources have been delivered via an LMS since 1999 and a suite of rich multimedia applications were developed to support the teaching of key areas of the medical and bioscience curricula between 1999 and 2005 – most of which are still in regular use. While both bioscience and clinical learning are well supported by educational technology, to date the majority of the technical innovation and support has undoubtedly been directed towards the campus-based (bioscience) components of the curriculum. The LMS has primarily been used to deliver problem-based learning resources, to host discussion forums and to support formative and summative assessment tasks, while rich multimedia applications have been delivered to students through shared computer laboratories and, for selected applications, via the distribution of physical media. Technology-based support for clinical students has focused largely on student management – e.g. allocation of student placements, timetabling and student messaging and announcements – and much of this functionality has been provided through an in-house Clinical Administration and Tracking Service (CATS).

### **Curriculum Connect**

Educational technology will assume an even greater role in the delivery of the MD curriculum, supporting a range of new and expanded learning and teaching and administrative functions and activities. The majority of these will be delivered through a new in-house curriculum delivery and learning system – *Curriculum Connect*. The *Curriculum Connect* project has two major aims. The first is to create an engaging learning environment for MD students that is accessible, useful and relevant to them throughout their course – i.e. it is neither bioscience or clinically focused and equally supports and is integrated with all phases of the curriculum. The second is to provide a high level of integration between bioscience and clinical resources, allowing students working with bioscience resources to quickly and efficiently locate and access related clinical resources and vice-versa. *Curriculum Connect* attempts to meet these aims by (i) identifying and implementing new modes of access to existing resources, (ii) identifying and embedding access to new sources of high quality information that are aligned with both general and specific learning objectives within the new curriculum, and (iii) designing and implementing new learning activities that enhance the curriculum by leveraging these resources.

### **Improving access and adding value to resources**

A considerable number of information resources are used to support the medical curriculum. These include lecture notes and recordings, textbook readings, journal articles, medical portals and multimedia software. Since 1999, the majority of these resources have been recorded in a curriculum database containing information about individual resources (e.g. author/s, summary, keywords) as well as the general and specific learning activities they are designed to support. This database is used by curriculum developers and teaching staff and although not directly linked to the LMS, is the primary source for content and resources supporting lectures, practicals and problem-based tutorials that are delivered through the LMS. For *Curriculum Connect*, the database is being redesigned and expanded and, in a major change to its use, students will have direct access to almost all of the resources and information it contains. Instead of accessing these resources through a series of static web pages, students will be able to interactively locate and access resources in a variety of ways. Event-based access of resources will be mediated through a personalised interactive timetable object, which lists and links to the resources associated with any scheduled event (lecture, tutorial, practical etc.). Case-based access will use a case 'browser' to present an aggregated list of resources associated with all the events associated with every virtual case. Search-based access will allow users to locate relevant curriculum resources by conducting keyword and title searches.

In the current LMS-based implementation, the focus is on delivering resources associated with the current week's activities – content is released on a week-to-week basis. While students can browse existing content by following links, there is no mechanism for aggregating or searching resources and there is no way to access resources associated with future events or phases of the curriculum. In *Curriculum Connect*, almost all resources will always be accessible. Moreover, value will be added to individual resources (and cases) by enabling students to bookmark, add notes to and comment on them. Each student's bookmarks, notes and comments will be aggregated so that they can quickly locate and access their preferred resources, while the system-wide implementation of shared comments will provide valuable context for discussions between students and staff. *Curriculum Connect* will also provide easy access to our existing suite of multimedia-based learning resources.

### **Supporting new learning activities**

While the MD curriculum adopts a case-base rather than a problem-based framework to support students' bioscience learning, the differences between the two approaches are relatively subtle and many of the learning activities associated with the MBBS have been adopted within the MD with only minor modifications. More substantial changes are being implemented within the clinical phase of the curriculum (beginning 2012), with including the introduction of a student-centred patient record or Electronic Health Record (EHR) system. Whereas there is no general requirement for students in the MBBS to record their patient interactions on a regular basis (most students record a small number of interactions on an ad-hoc basis to support formal case presentations), MD students will be expected to systematically record a representative sample of their patient interactions using a semi-structured record/interview format. In conjunction with a clinical procedures log, these records will form the basis of students' new clinical portfolios. These portfolios are designed to play a dual role – to support students' learning and to improve their reflective practice (Driessen et al, 2005), and to inform formative and summative evaluation of students' clinical performance and progress. While the use of procedural logs within the clinical phases of medical curricula is relatively widespread, the use of more comprehensive electronic health records to support learning is still in its infancy (Elliott, Judd & McColl, 2011).

The EHR system will be tightly integrated with the other elements of *Curriculum Connect*, with particular emphasis placed on resource discovery and access. Users will have direct access to key clinical resources (e.g. Australian Medicines Handbook, Therapeutic Guidelines, MD Consult) and will be able to run simple keyword searches of the curriculum database, the university library (including all its medically related subscriptions) and selected medical portals from anywhere within a record. There will be some capacity for students to share their EHRs with other students and staff, although the extent to which sharing will be allowed is currently under review.

## **Implementation**

### **Leaving the LMS**

The LMS has played a central role in the delivery of the medical curriculum at Melbourne since 1999. While it has effectively supported the delivery of the bioscience component of the MBBS curriculum, it has been less suited to the demands of administering students and delivering content across a range of clinical contexts with a diversity of operational requirements. To support these activities, our in-house clinical placement allocation, timetabling and messaging system (CATS) has been incrementally developed and progressively rolled-out across the MMS's network of clinical schools during the past few years,

Successfully implementing some of the key ideas that underpin *Curriculum Connect* clearly involves the development of new components and systems. Some of these might have been developed as LMS compliant 'add-ons' but more likely would have operated independently and simply linked to from within the LMS (as CATS currently is) or, at best, the LMS would be superficially 'wrapped' around them. In either case there would be little or no real integration between the LMS and these independent systems. Given that we would be responsible for developing, implementing and maintaining these systems (which sits in stark contrast to our ability to control and adapt the university's LMS) we had the choice of either partially integrating our new components with the LMS or developing an entirely new and independent learning system. In the case of the latter, key LMS functionality outside the scope of our system would be provided by linking to specific modules of the LMS, or embedding these within our system's interface. After weighing up our options we decided to develop *Curriculum Connect* as an independent learning system. Design and development of the new system

began in early 2010. As the MD curriculum was due to start in 2011 and we expected development of the complete system to take at between two and three years we elected to retain the LMS to deliver bioscience content for 2011 and we will continue to rely on it to support key elements of both the MBBS and MD curricula as *Curriculum Connect* is progressively developed and rolled out.

### Rolling it out

*Curriculum Connect* is being rolled out through a staged implementation. In Stage I (February 2011), all MD students were provided with a USB stick containing approximately 30 multimedia-based learning resources and a basic 'software browser' application for searching, previewing and launching them. In Stage II (September 2011) students' USB sticks were updated with a preview version of the 'full' *Curriculum Connect* application. This version included *Timetable* (event-based resources), *Cases* (case-based resources) and *Resources* (search-based resources) modules in addition to the existing *Software* (teaching software) module. A *Library* module providing students with direct access to key library subscriptions, resources and online textbooks was subsequently added via a minor update.

The main *Curriculum Connect* rollout will occur at Stage III, which is scheduled for the beginning of the 2012 academic year. This version will include all of the Stage II components plus an *Announcements* module (announcements through the LMS will be deprecated at this point) and *Patients* (EHR system) and *Procedures* (procedural log) modules for clinically based (2<sup>nd</sup> year) students. Key elements of the existing CATS system will also be integrated at this stage. The Stage III rollout will involve around 700 MD students (there are approximately 350 students in each MD cohort), increasing to the maximum of about 1400 students in 2014. A selection of screenshots from development versions of the Stage II and III client applications are available at [http://www.mdhsonline.unimelb.edu.au/curriculum\\_connect/ASCILITE\\_2011](http://www.mdhsonline.unimelb.edu.au/curriculum_connect/ASCILITE_2011)

During Stage IV (first half of 2012), specific *Curriculum Connect* components (the *Patients* and *Timetable* modules initially) will be released as mobile applications. We will initially target iOS mobile devices (iPhone and iPad versions of the *Patients* module are currently undergoing testing), but other platforms are likely to be supported at a later stage. Stage V (second half of 2012) will mirror Stage IV but targeting web browsers. The final Stage (VI – beginning of 2013) will see the delivery of an integrated multi-platform browser-based application.

### Evaluation and research

From September 2011, *Curriculum Connect* will play a leading role in the delivery of the MD curriculum. Its success is critical and its implementation will be supported by a rigorous and ongoing program of evaluation covering both technical and learning and teaching related aspects of the system. Because we have access to its codebase we will (subject to ethical approval) be able to routinely capture targeted and detailed analytics about students' use of the system. These data (we have considerable expertise in capturing and analytics data – e.g. Judd & Kennedy, 2011a; Kennedy & Judd, 2007) will then be used to support comprehensive programs of evaluation and research related to *Curriculum Connect* and the MD curriculum more generally.

Two key research themes within this larger program will be (a) students selection and use of digital resources to support formal and informal learning activities, and (b) the use of electronic health records to support students' clinical learning. The first theme builds on work by Judd and Kennedy (e.g. Judd & Kennedy, 2010, 2011b) on the quality and context of electronic resources used by biomedical students to support self-directed learning. *Curriculum Connect* will allow us to more effectively establish direct links between students' use of individual resources and specific learning activities. In particular, data from this project will be used to (i) investigate the development of students' medical information literacy skills and to (ii) investigate the role of online information in informing students' clinical decision making.

The second theme represents an emerging field of research and is particularly relevant given the Australian government's current efforts to implement a centralised system of electronic health records. A program of research around this theme is already under way, with a mobile version of the *Patients* module of *Curriculum Connect* currently being trialed with 45 hospital based medical students. This trial, which builds on a pilot implementation in late 2010 (Elliott, Judd & McColl, 2011) is designed to (i) assess the overall utility of the health records system as a learning tool in a clinical setting, (ii) assess the importance of mobile (bedside) access to students' use of the system. More intensive investigations involving the full student cohort are planned for 2012.

## References

- Barrows H (1996). Problem-Based Learning in Medicine and Beyond: A Brief Overview. *New Directions for Teaching and Learning*, 68, 3-12. <https://doi.org/10.1002/tl.37219966804>
- Driessen E, Van Tartwijk J, Overeem K, Vermunt J & Van Der Vleuten C (2005). Conditions for successful use of portfolios for reflection. *Medical Education*, 39(12), 1230-1235.
- Elliott K, Judd T & McColl G (2011). A student-centred electronic health record system for clinical education. *Studies in health technology and informatics*, 168, 57-64.
- Judd T & Kennedy G (2011a). Measurement and evidence of computer-based multitasking by 'Net Generation' students. *Computers & Educations*, 56(3), 625-631. <https://doi.org/10.1016/j.compedu.2010.10.004>
- Judd T & Kennedy G (2010). A five-year study of on-campus Internet use by undergraduate biomedical students. *Computers & Educations*, 55(4), 1564-1571. <https://doi.org/10.1016/j.compedu.2010.06.022>
- Judd T & Kennedy G (2011b). Expediency based practice? Medical students' reliance on Google and Wikipedia for biomedical inquiries. *British Journal of Educational Technology*. 42(2), 352-360.
- Kennedy G & Judd T (2007). Expectations and reality: Evaluating patterns of learning behaviour using audit trails. *Computers and Education*, 49, 840-855. <https://doi.org/10.1016/j.compedu.2005.11.023>
- Keppell M, Kennedy G, Elliott K & Harris P (2001). Transforming Traditional Curricula: Enhancing Medical Education through Problem-Based Learning, □Multimedia and Web-based Resources. *Interactive Multimedia Electronic Journal of Computer Enhanced Learning*, 3(1), 1-6.

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