

Electronic curriculum mapping: what are they and why would we want one?

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1. Introduction

This report is drawn on issues raised at the workshop *Curriculum maps: what are they and why would we want one?* sponsored by Higher Education Academy Subject Centre for Medicine, Dentistry and Veterinary Medicine and held at Hull York Medical School on 18 October 2006. We are grateful to the presenters at the workshop and the participants for their invaluable input. This guide, while based on input from those discussions, reflects the opinions of the authors only and is not intended to imply an official endorsement by the Academy or any of the workshop participants.

This guide seeks to offer basic guidance on issues around the development and maintenance of an electronic curriculum map. It is aimed principally at faculty in institutions that are contemplating building such a map, or are still at the early stages of the development process. It is not intended to be about technical implementation or frameworks, nor a theoretical paper on the possibilities of curriculum mapping in its entirety, such as Harden, 2001.

Based upon HYMS' own experience, and discussions with other institutions, we suggest that a curriculum map development may be planned according to the following practical categories as a useful starting point.

2. Overall approach and pre-requisite resources

While non-web electronic curriculum maps certainly exist, most current curriculum map developments typically adopt a web-based approach, whereby core curriculum data is held in a structured format (usually a relational database and/or XML format) and rendered via a web interface. In-house technical development resource is generally used to construct them.

We are not currently aware of the existence or successful deployment of any commercial curriculum mapping software in this sector. Although some proposed future developments in commercial VLE software indicate an increased focus on management of learning outcomes in general (see for example Blackboard's "Caliper"), we are unsure at present how suited this functionality will be to the intricacies of a medical / dental / veterinary curriculum.

In-house curriculum map development typically requires significant and sustained resourcing, by a multi-skilled team. Technical web application development skills

need to be combined with an overall analysis of the logic of the curriculum structure. Additionally, management of the learning outcome data requires specialist skills in the taxonomy of medical education. Ongoing staff input if necessary to make sure outcomes remain current and relevant. Overarching project management is necessary to ensure that the development proceeds in a feasible and sustainable direction.

3. Purposes of a curriculum map

A curriculum map can serve a number of purposes. The following points and principles have emerged from the workshop and from discussions with fellow institutions in medicine, dentistry and veterinary medicine:

3.1 - At its simplest, a curriculum map is a tool which allows the framework of Learning Outcomes within the curriculum to be displayed and queried.

3.2 - Although part of the impetus for some organisations to develop a curriculum map may have come from the requests of regulatory and quality assurance bodies, there is no single prescriptive view from the GMC as to what a medical curriculum map should look like, or what data and functionality it should offer. Furthermore, a curriculum map should not be *solely* a tool to satisfy external authorities.

3.3 - A curriculum map should be a useful contextual guide to students, enabling them to place their learning within the overall curriculum framework.

3.4 - The core set of Learning Outcomes within a curriculum map should be an authoritative statement of *intent*, whereby the school informs the student what s/he is intended to achieve.

3.5 - Students should potentially be able to personalise their views of, and interactions with, the map.

3.6 - The map should serve partly as a revision aid, showing students what they should have achieved in previous years.

3.7 - Students should also be able to look *forwards* in the curriculum, to appreciate the future applicability of what they are currently studying.

3.8 - The map should therefore facilitate 'vertical integration' within the curriculum, for example by illustrating the recurrence of topics within a 'spiral curriculum'. Note that there may be a conflict here with the practices of a 'pure PBL' course, whereby students are expected to derive their own outcomes, not be given them in advance.

3.9 - In attempting to create something that is student-centred, it is important that organisations remember to involve their students in the design and testing of such a tool!

3.10 - A curriculum map should not be a substitute for 'real-life' teaching and student interaction

3.11 - A curriculum map is not simply a course timetable, though it may be considered useful to provide links from the map to timetable-like information. Any outcome could potentially be fulfilled by any number of events in a timetable and vice versa, with any event contributing to several outcomes.

3.12 - A curriculum map can be extremely valuable as a tool for curriculum overview and development. This is a particular bonus in new schools in which curriculum development is a major ongoing task. By providing an explicit logical framework within which Learning Outcomes must be placed, it helps to ensure coherence, balance and quality control.

3.13 - A curriculum map can be a useful tool for prospective students. Schools may wish to distinguish themselves from one another by means of their individual approaches to curriculum delivery and curriculum structure.

4. Scope of a curriculum map

Scope is one of the most problematic issues in the construction of a curriculum map: should it contain solely the framework of learning outcomes, or should it also be the authoritative source of links from those outcomes to:

- timetable information
- learning resources
- assessment questions
- anything else contributing to the delivery of the programme

4.1 Relationship of the curriculum map to the Virtual Learning Environment

Organisations that have already invested significantly in a Virtual Learning Environment (VLE) systems will naturally seek to integrate curriculum map development into the heart of their electronic learning environment.

Practical questions raised by this approach, however, include:

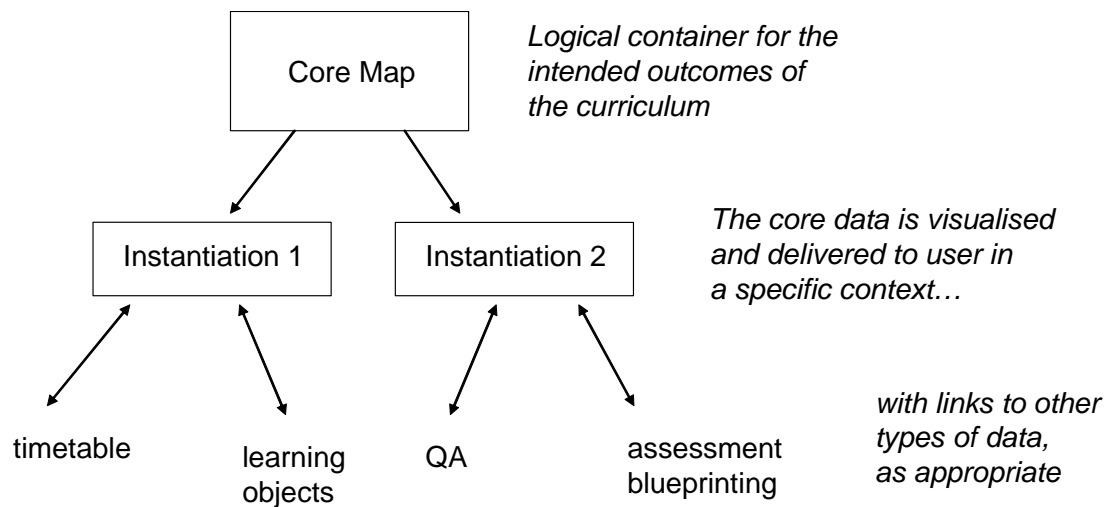
- where does the curriculum map end and the VLE begin?
(Are these terms helpful, or are we making a false distinction?)
- how do you support curriculum map access for external viewers who may not be allowed authenticated access to the VLE?
- what level of resourcing is necessary to build, support and maintain such an all-encompassing system, at the levels of technical construction and maintenance of the data it contains? Is this a feasible option for schools with limited resources?
- if a school has already invested in third party commercial VLE systems (or elected to use those of a parent university), what scope is there to integrate bespoke curriculum map developments with that commercial third party system? What level of integration is desirable in the first place?

Pragmatism may dictate that some schools attempt smaller 'stand-alone' mapping developments, at least in the first instance, but it is important to keep in mind future functionality, if the ultimate goal is integration with other systems such as VLEs or timetabling.

4.2 A proposed model to delimit the scope of a curriculum map

The following proposed model may prove useful in defining the core scope of a curriculum map, and how such a map might then link across to other types of course information*:

* Our thanks to Rachel Ellaway from University of Edinburgh for putting forward this model at the 18 Oct workshop.



Fundamentally, a "core" curriculum map may be seen as a container for the course learning outcomes - stored according to the logic by which the curriculum is organised (i.e. partitioned into modules, body systems, competencies...).

Drawing upon this core set of data, any number of "instantiations" (applications or renderings) of the map may be generated. For example, the view of the map that is applicable to a year-1 student may differ from that of a year-5 student, or an academic who is wishing to use the map for assessment blueprinting.

Interlinking with other related timetable/assessment/VLE data may then be appropriate and desirable depending on the context of the instantiation, but these additional functions are one step removed from the definitive outcome data of the core map.

4.3 Historical data

Another scoping issue is the fact that the curriculum outcomes may change from one year to the next. There are some decisions that the school should consider before embarking on the building of the map, so that these design factors can be taken into consideration.

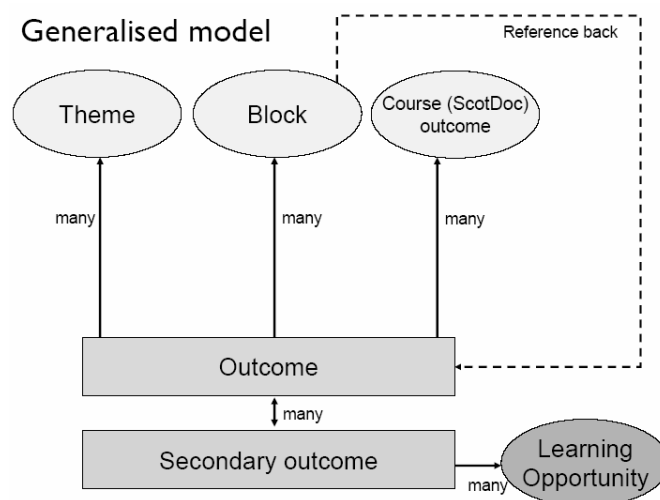
Should there always be only one 'current' copy of a curriculum map?
 Alternatively, should there be provision within the system for a 'memory' of the structure of the curriculum as it was in previous years, so that a student in later years of study can refer back to their own earlier experience of the curriculum?

Some of the more advanced curriculum map developments currently in existence have attempted the latter approach, retaining several years'-worth of curriculum data - although this increases the complexity of development of such a system.

5. Systematic analysis and modelling of the logic by which course learning outcomes are organised

A formalised understanding of the organisation of course outcome structure is essential before that logic can be translated into an electronic application. Developers need to understand the relationships by which outcomes are organised and related to one another, and to other key structural aspects of the course.

As an example, the following logical structure of the HYMS Phase I & Phase II curriculum was achieved after considerable time and discussion:



This diagram indicated that each outcome belongs within a Theme (e.g. Clinical Skills, Person-Centred Care), a Block (e.g. Respiratory, Psychological Health), and, in HYMS case, a high-level Scottish Doctors outcome. This last could be mapped to Tomorrow's Doctors or other frameworks. Different institutions will require different structures.

The discussions required to formalise this *structural logic* are valuable in themselves, and the process may reveal inconsistencies in thinking even among experienced and senior teaching staff within the same institution!

In addition, careful consideration needs to be given to the nature of the data that will be captured. In addition to the text of the learning outcomes themselves, it is advisable to consider what other data should be captured *about* them (i.e. metadata). For example, fields may potentially be needed for the owner of that outcome, or the date on which it was last modified.

The outcomes may also need additional keywords added to metadata to facilitate searching for a particular content. These outcomes may be made more readily searchable by tagging them with structured taxonomic terms - such as those present in the MeSH framework (Medical Subject Headings), <http://www.nlm.nih.gov/mesh/>

Using such a content mapping framework will allow a systematic retrieval of outcomes, such that an outcome on "hepatic function", for instance, may potentially be found, even if a student happens to be searching for "liver". However, it requires some skills both in technical development and information management to use such a framework effectively. Most medical librarians will be well-versed in the use of MeSH for indexing content and should be involved in curriculum mapping developments.

There is a need for additional collaborative work between schools, to establish a common taxonomy for describing the processes and outcomes of medical / dental / veterinary education since MeSH and other health taxonomies generally do not cover topics to do specifically with education and educational taxonomies such as BEI (British Education Index) do not cover health education adequately.

One pilot project, the Medical (METRO), constructed an Assessment branch of a medical education taxonomy which can be viewed at <http://metro2.blogspot.com/> It is hoped that this project can continue and ultimately will be included in MeSH.

6. Technical construction of database

We will not go into technical details of implementation of curriculum maps as this is beyond the scope of the workshop and this report. However, we do feel that it is important to note that the nature of the data in a curriculum map is often highly *relational* (interlinked according to various rules and to multiple other entities). The use of a relational database can prove invaluable in safeguarding the logical consistency of the data and for allowing dynamic display of the map for different end users.

Obviously this process requires technical database design skills, ideally in a robust database management system such as SQL Server, MySQL or Oracle. We would caution against trying to achieve this level of sophistication in desktop applications such as MS Excel.

It is sensible to ask whether there are already existing programs with which to construct a curriculum map. There are related types of software such as concept-mapping software (e.g. CMap) or topic mapping (e.g. Ontopia). However, these tools are intended for different purposes and while they might offer an initial means for prototyping, it is unlikely that either would offer an ultimate solution for an individual school. It could be an interesting project if a school were to investigate these options further.

The American Association of Medical Colleges offer use of CurrMIT, a curriculum management tool, <http://www.aamc.org/meded/curric/start.htm> that also allows comparison across American and Canadian schools. However, in talking to those schools using it, it seems that the tool is difficult to use and the curriculum must be twisted to fit into the logic of CurrMIT rather than vice versa. Also, this tool is not available for the UK schools at this time.

7. Development of interface(s) to present and manage data

Once a map exists, there is the additional need to create a 'user-friendly' front end for displaying and managing the data. This process is closely linked with the database construction. In effect, one is building the *instantiations* of the map referred to in 4.2 above. In many cases, a web interface will be considered most appropriate for presenting map data to the end user.

Web forms may also be appropriate for input and editing of data within the system. (However, one might wish to investigate the idea of more familiar Word-based forms for capturing data from less technically adept users.)

As a broad guideline, technical development of both database and "web front end" to HYMS' current curriculum map (which is relatively limited in scope) accounted for approximately 6 person-months of in-house development time. A version of this map can be seen at:

<http://www.hyms.ac.uk/map>

Other more complex developments, in which the map is more closely interlinked with other curriculum / VLE-like data, could easily account for person-years of technical development time.

In a more complex development, one might consider whether some form of authentication is required, to enable differential access to various functionalities and data within the map, and whether each individual student might be allowed to annotate or save their own personalised "view" of the map.

8. Population of system with accurate curriculum outcome data; ongoing maintenance, quality assurance and ownership of data

One should budget just as much resource for initial population of such a system with data, as was required for its technical construction. This is not a technical job, in reality, but one that requires significant commitment and ongoing input from academic staff in order to keep the curriculum map up-to-date.

It must be emphasised that a curriculum map is not simply a one-off end product - it is a commitment to an *ongoing process* of data management. Ownership of outcomes and other data is a key consideration and ideally the aspiration will be that the curriculum data within the map should become the definitive statement of that data. The electronic map should not lag behind some other printed source.

During the course of populating the system, numerous quality assurance issues will inevitably come to the fore. Poorly written outcomes which do not stand as self-contained entities will need to be addressed. Areas of imbalance in the curriculum may be revealed, where too many duplicative outcomes are present for one topic, and too few for another. It is essential to gain close and continued academic input into the QA aspects of the process, in order to resolve such issues and anomalies. The academic lead needs to be given sufficient authority to amend the curriculum, delete or re-word unclear outcomes, and remove duplicative ones. In general, it should be appropriate for such work to be addressed by academic Module Organisers with a Curriculum Lead overseeing the process.

9 Conclusion

We hope that this guide has presented some of the initial issues and decisions that need to be made when embarking on an electronic curriculum mapping project. We have not gone into any implementation details as these are technical issues that would require an extensive document itself. We hope that schools will continue to meet and share experiences and resources and believe that there is an urgent need to develop shared expertise in this area.

We want to thank again the presenters at the workshop who were willing to demonstrate and critique their own attempts at curriculum mapping. The presentations from the day are available at:
<http://www.medev.ac.uk/resources/meetings/workshops>

References and Resources

Harden R M (2001). AMEE Guide No 21: Curriculum Mapping: a tool for transparent and authentic teaching and learning, *Medical Teacher*, **23(2)**, pp 123-137.

Haig A, Ellaway R, Dozier M, Liu D, McKendree J (2004) METRO—the creation of a taxonomy for medical education, *Health Information and Libraries Journal*, **21**, pp211–219

MeSH (Medical Subject Headings): <http://www.nlm.nih.gov/mesh/>

METRO (Medical Education Taxonomy Research Organisation):
<http://metro2.blogspot.com/>

Presentations from the Curriculum Mapping workshop are available on the Subject Centre for Medicine, Dentistry and Veterinary Medicine website at:
www.medev.ac.uk

Example Curriculum Map

Hull York Medical School

<http://www.hyms.ac.uk/map/public/>