Curriculum Information Models in Health Professions Education in Australia: An Innovative Approach to Efficient Curriculum Design, Development, and Maintenance

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Abstract: Over the last decade, there has been a significant increase in attention to the overall accountability of higher education in Australia, and this is expected to continue. Increased accountability has led to the need for more explicitly documented curricula. The curricula from ten health-related disciplines developed over the last five years in Australia were the basis of this study. Curriculum information modeling is an approach that allows for the dynamic nature of curricula since elements and their linkages can be moved about and reconnected into meaningful patterns. In addition, the models give disciplines and institutions the ability to effectively monitor curricula and draw comparisons in a more unified manner. Curriculum information models are an efficient innovation in the design and management of curricula in higher education and particularly in the health care disciplines. They rest on the principles of reusable elements and linkages independent of content that were first used in the design, construction, and maintenance of buildings. The translation of this approach to the higher education sector provides a higher level of interoperability of resources and a clearer pathway for content design within a curriculum.

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Higher education in Australia (particularly in the health professions) over the last decade has undergone significant development and a widening of participation. This has paralleled the significantly increased overall accountability for the higher education sector that is expected to continue to expand in the ensuing ten to fifteen years. This need for more accountability has led to the need for more explicitly documented curricula. In many cases, disciplines have done this without a universal framework, which has led to many different approaches among institutions and within institutions. Even within single disciplines, various models of curriculum design and documentation have evolved. Although this is an important part of niche marketing of different programs, it does not make for easy overall systemwide governance. The terminology used by disciplines and institutions for some of the basic elements of a curriculum (e.g., what do we call a subject) differs significantly. This variation (although argued for strongly as ensuring “localization” of curriculum design and documentation) has the potential to confuse students, government, and policymakers. This confusion is expected to grow as higher education students increasingly move between institutions as a result of an increasing number of graduate professional programs and greater mobility among the programs.

Similar issues were prevalent in the building design, construction, and ongoing management sector of the economy. Each design, construct, and operationalization were so different that buildings had to be treated as independent events with varying nomenclature to fit the specific needs of each client. However, today in the building management sector, the Building Information Model (BIM) has taken hold. This model provides the builders of new large-scale facilities (e.g., hospitals) with significant cost savings and a systematic approach that can make for greater portability of outcomes and certainly greater portability of skills. Overall, this has produced significant economies and a systematic approach to building design and construction.
construction and operation. The American Institute of Architects defines BIMs as “a model-based technology linked with a database of project information.” BIMs address the need to relate a sequence of elements in a meaningful way that can facilitate the development, documentation, and ongoing monitoring and maintenance of these elements. The field of building design and construction has now developed electronic systems that can document the design of a building, not just in terms of its shape, but in terms of its function, using approaches that are universally applicable and address the myriad of systems used to design and maintain a facility. The key to this systematic development was to step back from the data and form a metadata architecture that would then be adaptable to each new project.

Discussions of context and needs in relation to higher education curricula operations are not new, and others have voiced the need for systematic relational documentation as provided by a Curriculum Information Model (CIM) through relational database management systems. Our study aimed to develop a systematic CIM approach as a methodology for curriculum design, modification, and documentation.

Methods

Australian higher education curricula developed over the last five years at degree (or above) level were the basis of this study. These curricula came from the disciplines of medicine (n=1), dentistry (n=4), oral health (n=3), speech pathology (n=1), and veterinarian science (n=1). All were developed and articulated using an electronic database system and are from a wide variety of jurisdictions and institutions across Australia. To preserve confidentiality, the courses and institutions will remain anonymous. A total of ten completed curricula were included in the study sample. All of these have successfully attained their respective discipline-specific accreditation certification. Half were new curricula developed from scratch, whilst others were redevelopments undertaken as part of curriculum reform in the respective school.

Results

No two curricula in the sample had the same architecture. This included curricula from the same discipline that had gone through the same accreditation processes but from different institutions. The largest differences were those between disciplines, in which the blueprint of each was so different it was difficult to find any similarities. Institution-specific requirements and terminology were significant causes of the differences. For example, the simple idea of a subject differs dramatically across institutions and disciplines even within a single institution. Terms such as “units,” “modules,” “subjects,” and “learning activities” were all used to articulate the same idea (a unit of effort by a student to learn a new concept/skill or cluster of concepts/skills).

All curricula had at the core a collection of elements that were linked to form a cohesive design. These included such basic generic details as institutional identifiers, names, and descriptions of content. Importantly, all also included such elements (although all were named differently) as learning outcomes, assessment tasks, textbooks/materials/equipment, and generic skills. Linkages were between elements, and in most curricula these linkages were between learning outcomes and assessment, generic skills, professional skills, and subjects. At their core, all curricula are a collection of interacting elements and the development, documentation, and ongoing monitoring and maintenance of these elements require clear articulation of the linkages between them and their hierarchical relationships.

To develop a CIM requires the development of a metadata approach, in the same way as the BIM does. The CIM focuses on examining not the content of elements, but how elements are linked in meaningful patterns. In our study, a series of CIMs were developed to provide proof of concept. A CIM is not content; it is a framework that provides an exoskeleton into which the content of a curriculum is inserted. CIMs also provide the opportunity for efficient and meaningful data modeling of curricula that can lead to a more universal approach to curriculum management systems. In addition, the evolution of a curriculum over time (an essential part of good governance) is simplified. CIM modeling provides the opportunity to articulate the changes in the metadata before working on content, therefore providing institutions a clear pathway for efficient content modification (Figure 1).

The first step in the development of a CIM is to formulate a clear definitional strategy. A core set of definitions to describe elements and their linkages and hierarchy is required to document the metadata of a CIM. For example, although every curriculum
Figure 1. Two curriculum information models (CIMs) from two disciplines in the same institution

Note: These two maps are from unrelated areas of study and should be seen as independent examples. Each box represents a set of data relevant to the curriculum. For example, “course outcomes” are the generic outcomes for the entire three-year course, while “domains” represent the learning domains of a particular program. The circles with “L” show where database linkages between the elements are required. For example, in the top image, there is an L on the pathway from learning outcomes to course outcomes. This means that each learning outcome is database-linked to the course outcome(s) to which it contributes. These maps are used (mainly by the web-developers) to formulate adaptations of the relational database that is then presented in a web-based format.
will have some name for an element related to subjects, this needs to be documented. Similarly, there will be some language used to describe an assessment task, and these definitions need to be agreed upon in order to develop the metadata framework in a way that is meaningful for all members of the discipline involved. Each of these definitions needs to be mapped into a completed metadata set as in BIMs. This definitional map is then used to bring the elements of the curriculum together to form a unified structure, independent of its local definitions.

Every discipline will have some fixed elements that are requirements of either the institution or its discipline-specific accreditation (or professional) requirements. These may also come with fixed linkages in the CIM. For example, many disciplines are required to show that the subjects address some generic skills. This is saying that there are elements called generic skills and the linkage is through to subjects. Alternatively, some disciplines’ professional accreditation requires specific assessment tasks. This again is a series of elements that are linked to learning activities within the CIM.

Just like a BIM, a CIM early in its development is very dynamic. Often disciplines are not completely sure of their full element set, and this can change at any time; moreover, the linkages are often changed as a clearer understanding of the CIM model is gained. This dynamic nature is paralleled in BIMs and requires computer systems that can rapidly adapt to the changing model without being content-specific. Elements must be independent objects and their linkages articulated in the software as “non-locked” or open linkages.

The core advantage of developing a CIM approach to the systematic design and documentation of a curriculum is that it then provides a rapid transportable template to operationalize the CIM into tailored software systems for curriculum management. The CIM provides the core elements and their relationships that can be translated into a relational database approach with software management tools. Similarly, this approach means that elements and linkages can be reused and shared among curricula, and structures can be developed to link CIMs together at higher governance levels to provide multidisciplinary overviews (Figure 2). The efficiency gained through such an approach has been proven in the building sector and is clearly translatable to higher education.

To implement a CIM approach for either a new curriculum or curriculum reform requires as a first step making decisions on a definitional strategy. For example, are we going to use the word “unit” or “course” to describe structural elements to the CIM? Secondly, an exercise to map the linkages among structural elements needs to be completed. This mapping exercise will result in maps similar to those shown in Figures 1 and 2. The final step is to articulate these maps as web-based relational databases built to ensure that the content of the elements and the linkages are separate and movable against the metadata framework. This allows ongoing adaptation of the map and its content as the curriculum evolves over time, without the need to rewrite structural elements.

Discussion

A CIM is an innovative approach to the articulation of a curriculum in a way that provides universality to the view. This approach allows for the dynamic nature of a curriculum since elements and their linkages can be moved about and reconnected into meaningful patterns. In addition, the models give disciplines and institutions the ability to effectively monitor curricula and draw comparisons in a more unified manner.

Importantly, the explicit construction of a CIM provides staff and students with a framework to understand learning in the context of the entire curriculum. This explicitness of linkages can be enhanced by the dynamic nature of the approach. Additional linkages and mapping can be added to review and enhance the model in order to give key stakeholders information on the curriculum’s plan to enhance student learning. CIMs like their building counterpart are not a fixed approach that ends at the completion of curriculum development, but provide an ongoing maintenance and monitoring framework for curricular improvement.

The core of an effective living CIM is the use of relational database models to document the curriculum and reflect its dynamic nature. Table-based simple database models are insufficient for ongoing dynamic data management. A more relational approach that focuses on linkages and elements more than content is required to ensure the relational database is flexible enough to remain fit-for-purpose. At the front of the relational database there is a need for a simple but explicit user interface. Students, staff, and key stakeholders need to interact with the
Figure 2. Examples of relational database software systems for the translation of Curriculum Information Models into content containing elements (top) and defined linkages (top and bottom).
relational database in a way that is intuitive and holds to some of the early paradigms that many will expect to see. For example, the user interface must retain the universally accepted concepts of subjects, hours, and learning outcomes even if innovative curricula have done away with these concepts. The user interface should be focused on non-expert uses. The experts can use the CIM and recognize the subtlety of the design while non-expert users need simplicity.

Conclusions

Curriculum information models are an efficient and effective innovation in the design and management of curricula in the higher education sector, particularly in the health professions. They rest on the principles of reusable elements and linkages independent of content that were first used in the design, construction, and maintenance of buildings. This approach to higher education curricula provides a higher level of interoperability of resources and a clearer pathway for content design within a curriculum.

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REFERENCES