Electronic Curriculum Mapping: Supporting Competency-Based Dental Education

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The publication in 1995 of the Institute of Medicine's report on the state of dental education, *Dental Education at the Crossroads*, spelled out what dental leaders already knew — that wholesale curriculum changes were needed to modernize the teaching of dentistry. One suggested solution for curriculum renewal was the adoption of competency-based education. The goal of competency-based education was to impart to students the necessary knowledge, skills, ethics and attitudes required to establish a general practice upon graduation. In the early 1990s, a set of competencies were developed in Canada for use by the Association of Canadian Faculties of Dentistry (ACFD) for curriculum development and delivery, by the Commission on Dental Accreditation of Canada for program accreditation, and by the National Dental Examining Board of Canada for dental licensure. Initially there were 46 competencies, which were validated in 2002 and revised in 2006 to 47 competencies.[1]

In addition to developing a curriculum that focuses on the core knowledge, skills, ethics and attitudes necessary to acquire competency, an institution must also demonstrate that students are competent upon graduation. Outcome evaluation, the demonstration that competency has been achieved, is an integral component of our institutional evaluation process at the University of Manitoba's faculty of dentistry. In this article we discuss how curriculum mapping enables us to demonstrate how we help students achieve competency and shows that competency-based education is a valid educational approach.

Curriculum Mapping

Curriculum mapping is a systematic process for gathering and analyzing data on what is taught within our curriculum. Data gathered include content, teaching methods, assessment methods and where specific competencies are addressed in individual courses and the program as a whole.

The purpose of curriculum mapping[2,3] is to:

- enhance the transparency and authenticity of teaching and learning
- demonstrate links between the different elements of the curriculum
- align instruction to the written standards
- develop integrated curriculum units
- provide a baseline for the curriculum review and renewal process
- identify staff development needs
- provide communication among instructors

The curriculum map provides a "big picture" view. It allows everyone to see where each course contributes to our students' attainment of the core competencies and serves as a guide that faculty should be using to set out their individual course content. The objective is to align curriculum content, teaching and assessment methods. If gaps are found in the teaching or assessment of competencies, the curriculum is changed then re-evaluated. To effectively use a curriculum map, data must be accurate and updated regularly. To assist in keeping the map current, we have developed an electronic curriculum mapping software that offers the following advantages:

- mapping is ongoing
- easy data entry and updating
- generation of tables for analysis
- promotion of ongoing review
- assistance in decision making

The program for the electronic curriculum map was developed at the University of Manitoba under the leadership of Dr. Dieter Schönwetter from the faculty of dentistry and the technical expertise of Mr. Peter Tittenberger and Mr. Mark Roy from the Teaching with Technology Centre at the University of Manitoba. The initial design was developed by Dr. David Singer in preparation for the 1990 accreditation process

Initially, all the data generated by the curriculum mapping project were reviewed by the curriculum and accreditation committees. Feedback was presented to department heads

Table 1 Examples of course content that supports the first 6 competencies of the ACFD

	C1	C2	C3	C4	C5	C6
DDSS 4130	Mentally challenged patients, dentistry provided under general anesthesia, conscious sedation, special needs dentistry	Oral health, medically compromised patients, bone marrow transplant, oral and head and neck cancer, bisphophonates, radiation therapy, bleeding disorders, orofacial pain, maxillofacial trauma, orofacial and neck space infections, immune-compromised patients		Ward rounds, clinic(al) patients, interactions with hospital-based staff, patients, their family and relatives, history taking	History taking, development of problem lists	Comprehensive history taking, patients from the hospital oral surgery clinic, chart review, assessment of medical and dental information collected, development of problem list
DENT 4020		Student is required to discuss the issue and the significance and interrelationship of general and oral health	Course covers levels of evidence, database searching using keywords, development of clinical questions, discussion of rationale for choosing specific evidence and using this evidence to rationalize treatment modalities	Student is asked to evaluate the effectiveness of his or her communication skills based on patient reporting (with help of an instrument being developed which asks the patient questions about the student's communication skills)	Student is required to discuss the chief complaint as a starting point in the synopsis of his or her portfolio case	In the synopsis of the portfolio case, discussion of the case features is expected to be completed thoroughly and to include the significance and relation to the treatment plan discussed

ACFD = Association of Canadian Faculties of Dentistry; DDS 4130 = Hospital Dentistry; DENT 4020 = Interdisciplinary Case Studies.
C1: recognize the determinants of oral health in individuals and populations and the role of dentists in health promotion, including the disadvantaged.
C2: recognize the relationship between general health and oral health.
C3: evaluate the scientific literature and justify management recommendations based on the level of evidence available.
C4: communicate effectively with patients, parents or guardians, staff, peers, other health professionals and the public.
C5: identify the patient's chief complaint/concern and obtain the associated history.
C6: obtain and interpret a medical, dental and psychosocial history, including a review of systems as necessary, and evaluate physical or psychosocial conditions that may affect dental management.

and course coordinators, and courses were reassessed and refined. Feedback from the users of the tool, both course coordinators and administration, was used to refine the online curriculum mapping tool. The software was acquired in 2006 by Digital Learning, an external vendor, and has been extensively revised to make the program more user-friendly and available not only to dentistry programs but other educational programs as well.

Once all of the initial course data have been transferred to the updated mapping software, there will be ongoing and annual input of curriculum information by course coordinators.

How the Electronic Mapping Process Works

Course coordinators are responsible for entering information on what competencies are addressed, and at what level, in their course, what teaching and evaluation methods are used, the marking or grading scale applied, and what formative or summative feedback is provided. The mapping software then generates tables that permit an analysis of the curriculum indicating to what extent each of the 47 competencies is addressed over the 4-year DMD program (i.e., frequency of the competencies taught and level at which

Table 2 Strongest ACFD competencies as ranked by graduating DMD students, alumni and curriculum mapping

Graduating class	Alumni	Curriculum mapping
C4: communicate effectively with patients, parents or guardians, staff, peers, other health professionals and the public	C4	C2: recognize the relationship between general health and oral health
C9: perform a clinical examination	C5: identify the patient's chief concern/complaint and obtain the associated history	C4
C13: interpret the findings from a patient's history, clinical examination, radiographic examination and from other diagnostic tests and procedures	C9	C10: differentiate between normal and abnormal hard and soft tissues of the maxillofacial complex
C28: achieve local anesthesia for dental procedures and manage related complications	C13	C13
C34: manage dental caries, tooth defects and esthetics problems and, when restoration is warranted, use techniques that conserve tooth structure and preserve pulp vitality to restore form and function	C28: achieve local anesthesia for dental procedures and manage related complications	C17: develop a problem list and establish diagnoses

ACFD = Association of Canadian Faculties of Dentistry

Table 3 Weakest ACFD competencies as ranked by graduating DMD students, alumni and curriculum mapping

Graduating class	Alumni	Curriculum mapping
C3: evaluate the scientific literature and justify management recommendations based on the level of evidence available	C15	C15
C15: recognize signs of abuse and/or neglect and make appropriate reports	C27	C27
C27: recognize and institute procedures to minimize occupational hazards related to the practice of dentistry	C37: manage trauma to the orofacial complex	C39
C39: manage abnormalities of orofacial growth and developmental and treat minor orthodontic problems	C39	C42
C41: select and, where indicated, prescribe appropriate biomaterials for patient treatment	C42: manage partially and completely edentulous patients with prosthodontic needs including the provision of fuxed, removable and implant prostheses	C46: apply basic principles of practice administration, financial and personnel management to a dental practice

ACFD = Association of Canadian Faculties of Dentistry

they are taught — preliminary, moderate or extensive), course content supporting each competency (**Table 1**), as well as teaching methods, evaluation methods and grading schemes used.

The curriculum map is reviewed by the curriculum committee and course coordinators to identify inconsistencies, redundancies, weaknesses or gaps, and for any misalignment of content to the competencies. Any areas of concern are forwarded to the course coordinators, and as changes occur, the electronic map is revised by the course coordinator.

What Has Our Analysis of the Curriculum Map Revealed?

The curriculum mapping tool revealed that each of the 47 ACFD competencies is taught in at least 4 courses. The 5 competencies that are taught most frequently (in 30 or more courses) over the 4-year DMD program are: C2, C4, C10, C13 and C17 (see "Curriculum mapping," **Table 2**).

Equally important, the mapping tool also reveals which competencies are taught the least frequently. Currently, 6 competencies are taught in less than 11 courses: C15, C27, C39, C42, C43 and C46 (see "Curriculum mapping," **Table 3**).

Based on the findings of the curriculum mapping tool, for instance, the faculty of dentistry is incorporating clinical implant therapy (C42) into the fourth-year general practice clinic for 2008–2009, where previously it had primarily been taught as a didactic subject with an elective clinical option open to a few students.

Are the Mapping Results Valid?

To ensure that the results from the curriculum mapping project are valid and reliable, a triangulation study was developed whereby graduating students and alumni were invited to rank their learning experiences on each of the 47 ACFD competencies through a survey. These findings were compared with those found in the curriculum mapping project. Competencies identified in the mapping tool as the strongest and weakest in the curriculum paralleled those of the survey participants (**Tables 2** and **3**). Two of the top 5 ACFD competencies (C4 and C13) were rated as strong across the board (**Table 2**). Competencies C15, C27 and C39, which were identified as weak by the graduating students, alumni and the mapping tool, are also the least frequently taught competencies in the DMD program (**Table 3**).

Curriculum mapping results have also been compared to other graduating student and alumni surveys that were independent of the curriculum mapping procedure, as well as the literature. The survey of graduating students, conducted for the last 3 years, strongly parallel curriculum mapping findings. These findings, especially as they relate to the competencies that students perceive as important for clinical practice and yet did not feel competent to perform, are critical in identifying areas where we may need to provide more clinical exposure. Findings from an alumni survey on the importance of the core competencies to general practice also substantiate curriculum mapping findings. When asked to assess their learning experiences in light of their current clinical practice, alumni felt that the 47 ACFD competencies were important (all scoring well above the median of the scale), thereby substantiating our approach of focusing our curriculum on these competencies. Finally, published studies on the importance of competencies to practice reiterate the significance of ensuring that curriculum mapping parallel authentic practice. Our curriculum mapping project is in agreement with the literature validating the competencies.[1]

Future Research

The bottom line is that what we teach is perceived as important. Competencies rated as high in importance by students and alumni were heavily covered in the curriculum and emphasized across the 3 domains of learning — classroom, clinic and outreach.

Beginning in 2010, we plan a 3- and 5-year follow-up alumni survey of previously surveyed graduating students. As the dental curriculum changes in response to innovations in dentistry and the development of teaching resources, continued annual surveys of graduating students will be critical to ensure that the education of our dental students is at its highest level.

To lead the dental curriculum, rather than be led by it, a faculty needs to be constantly aware of the strengths and challenges of its program. Our curriculum map, which is complemented by input from our most important stakeholders — our students and alumni, constitutes a valuable source of information. We hope that our educational research will make a difference and enrich the educational experience for our students. ◈

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References

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Related Information

Additional information (including the 47 competencies) on the curriculum mapping project of the faculty of dentistry is available on the JCDA website at www.cda-adc.ca/jcda/vol-74/issue-10/886.html.