

Evolution and Revolution: The Curriculum Reform Process at UCSF

Mark I. Ryder, D.M.D.; Peter Sargent, Ph.D.; Dorothy Perry, Ph.D.

Abstract: The challenges, problems, and solutions for developing a more streamlined and integrated curriculum at the University of California, San Francisco, School of Dentistry (UCSF) centered on thematic streams are presented. The central feature of the approach was that the curriculum reform efforts were initiated, developed, and implemented for the 2004–05 academic year primarily as a grassroots faculty effort with support by the administration. In addition, the issues in obtaining the consensus support of the faculty, students, and administration in order to proceed to implementation are discussed. Under the direction of a newly created position of assistant dean of curricular affairs and a faculty curriculum oversight group initiated in 2002, curriculum hours were adjusted to thirty-two hours per week. Departments conformed to this schedule, resulting in reductions in all areas of the curriculum, except clinical instruction, in order to provide time for independent study and electives. A new two-week introduction to the curriculum and an online course support system were also instituted. The new courses were generally well reviewed by students and faculty. Formal course evaluations and focus groups provided specific indications of needed adjustments. National Board scores were monitored and found to be unchanged from past experience. Curriculum change at UCSF required many changes in faculty behavior, including interdepartmental collaboration and efforts to improve teaching. Although many issues were anticipated and addressed in this multiyear reform process, careful faculty and administrative oversight continues to be required to maintain this structure. Continuing challenges include better integration of course materials and incorporating more learner-centered teaching strategies into the curriculum.

Dr. Ryder is Professor and Chair of Periodontology and Director, Postgraduate Program in Periodontology, Department of Orofacial Sciences; Dr. Sargent is Professor and Interim Chair, Department of Cell and Tissue Biology; and Dr. Perry is Professor and Associate Dean for Education—all at the School of Dentistry, University of California, San Francisco. Direct correspondence and requests for reprints to Dr. Mark I. Ryder, School of Dentistry, University of California, San Francisco, Box 0650, San Francisco, CA 94143; 415-476-1699 phone; Mark.Ryder@ucsf.edu.

Key words: dental education, evaluation, information technology, curriculum, learning

Submitted for publication 2/21/08; accepted 9/15/08

**“All happy families are alike;
each unhappy family is unhappy
in its own way.”**

—Leo Tolstoy, first sentence of *Anna Karenina*

The year 2008 marks the eleven-year anniversary of the inception of a broad-based effort at curriculum reform at the University of California, San Francisco, School of Dentistry (UCSF). In looking back on the history and process of this reform, the opening line from *Anna Karenina* has special meaning for the faculty, staff, and administrators at UCSF. These words speak both to the similarities between families and dental academic institutions and to some critical differences. In the case of curriculum reform, the source of “unhappiness” within the academic “family” of faculty and students arose from a number of factors, including redundancy, overcrowding, lack of coordination of content, lack of critical thinking and active learning, and lack of time to pursue individual interests. In the late 1990s, UCSF found itself struggling to keep its curricular offerings current. Many had read the

Institute of Medicine (IOM) report calling for curriculum reform¹ and analyses like the Tedesco report on dental curricula lamenting how little has changed in a changing world²—but there was little in the way of an institutional response at UCSF.

Each dental school can approach these common issues with different approaches, depending on the particular environment and resources.³ A central feature of the curriculum reform effort that began at UCSF was that it originated from faculty and student concerns rather than as a mandate from the administration or other top-down approaches as has been reported at other dental schools⁴ or as a recommended approach.⁵ As with a recently published article describing the faculty-led curriculum reform efforts at Case School of Dental Medicine,⁶ this grassroots approach at UCSF brought its own problems of “buy-in” from the faculty and students, as well as commitment from the administration to devote the necessary resources in order to make significant changes. Reforms were achieved with curriculum content flow, integration, and oversight through consensus support from all constituents.

In this article, the strategies and actions used to develop, refine, and modify the curriculum reform plan, problems encountered during the planning and implementation process, solutions devised to bring the reform plan to reality, assessment of the revised curriculum, and issues in preserving its central goals over time are presented.

Identifying the Problem

During the early to mid-1990s, the curriculum at UCSF had undergone major changes, including the institution of a comprehensive care approach to clinical teaching, which encompassed all four years of the curriculum.⁷ While this revision addressed several major issues in the clinical predoctoral education program, there remained a litany of problems with the didactic and laboratory components of the curriculum. These issues were continuously raised in a variety of settings, including meetings of the schoolwide Educational Policy Committee, the Basic Science Coordinating Committee, Clinical Sciences Coordinating Committee, Faculty Council, Student-Faculty-Administration Liaison Committee, and general faculty meetings. Critically lacking was a feedback process for oversight and general administration of the curriculum. Specifically, there was no one individual or group of individuals in the administration with the authority to coordinate course material across disciplines and departments.

An example of one of the major curriculum issues at UCSF was that clinical courses for the comprehensive care approach, designed to place the dental students into the clinic in the first and second years, were scheduled during the few remaining free hours during the week and in the evening following a full day of classes.⁷ No sustained effort was made to evaluate other components of the curriculum to identify free time or redundancies that would allow new course offerings to be added without increasing the total number of hours of instruction. The structure of the curriculum was constrained by departmental responsibility for hours and topics and by a lack of overall administrative authority for the curriculum that would have permitted meaningful reform of the entire system.

The UCSF curriculum was made up of a collection of incremental changes, many of them created appropriately and with faculty oversight, but without consideration for the consequences to the total curriculum. As has been stated by others, such long-

range oversight is critical for far-reaching curriculum reform efforts to be achieved.⁸ The schedule at UCSF was populated with many one- or two-unit courses of one or two lectures or three to six hours of laboratory instruction per week. This cluttered schedule had a particular effect on final examinations, in which as many as fifteen finals were administered over just a few days at the end of each quarter. Students accommodated to this system by studying selectively for large-unit courses. As a result, they often undervalued and did not learn adequately the content that had been presented in the smaller courses. As reported in previous studies in other dental schools, the burden of numerous courses and examinations also created a high level of stress among the students at UCSF.⁹⁻¹³ Curriculum material was also poorly integrated: the students were expected to make connections among biological sciences, the mastery of skills, and clinical care of patients with little faculty guidance. The situation is illustrated in Table 1. The school's curriculum prior to July 1, 2004 could be summarized as follows:

- Year One—a jam-packed schedule of courses, mostly of small-unit denomination. The comprehensive care instruction placed students in the clinics one evening per week.
- Year Two—a crowded schedule with an emphasis on preclinical instruction and with two comprehensive care instruction periods in the evening (half the class participated each of the biweekly sessions), plus National Board review sessions also presented at night.
- Year Three—transition to predominantly clinical instruction with one-unit and sometimes two-unit courses taught every morning between 8:00 a.m. and 9:00 a.m. and every afternoon between 1:00 p.m. and 2:00 p.m. Because clinics started at 9:00 a.m. and 2:00 p.m., students either left class early to set up and greet their patients on time or arrived in clinic late to set up and begin patient care. This led to much dissatisfaction among the faculty, students, and patients.
- Year Four—clinical instruction with no didactic courses, and a schedule that permitted students to organize a “day off” at least once each week.

This constraining schedule made it difficult for faculty and students to take full advantage of the rich intellectual environment and resources at UCSF. A major concern of the faculty was the limited extent to which students were learning to think critically and developing the skills to continue to grow intellectually beyond graduation from dental school, an

Table 1. Overview of the old UCSF curriculum illustrating the relatively large numbers of courses, units, and final examinations required for undergraduate students at that time for each quarter

Term	Students	Number of Courses	Units	Final Examinations
Prefall/Fall	D1	11	24	9
Winter	D1	10	18	7
Spring	D1	9	24	8
Fall	D2	10	17.5	8
Winter	D2	12	18.5	10
Spring	D2	11	26	11
Summer	D3	13	9.5	7
Fall	D3	19	9	9
Winter	D3	17	8	7
Spring	D3	18	33	15
Summer	D4	6	4	1 + CEs
Fall	D4	5	0	0 + CEs
Winter	D4	5	0	0 + CEs
Spring	D4	5	51+	0 + CEs

CE=clinical competency examination.

†Large unit-value courses extended over more than one quarter.

issue that has been addressed in several key position papers on dental education in the past.^{2,14-19} There was also little time to identify and mentor promising students who could be encouraged to participate in research and/or to train for careers in academic dentistry. A few students managed to participate in these activities, but most were simply too burdened with the demands of the dense and uncoordinated curriculum.

In 1996, UCSF revised its strategic plan to address several curriculum problems. The recommendations that emerged were similar in intent to those of the IOM report¹ and included the following: 1) making the curriculum more intellectually challenging, scientifically current, and biomedically oriented; 2) providing students with an education in which problem-solving and critical thinking were fundamental to the instructional program; 3) better integrating clinical medicine and physical and psychological diagnosis with oral health care; and 4) promoting lifelong learning.

The path to curriculum reform clearly included eliminating redundancy to streamline the curriculum offerings and preserving some time in the curriculum for independent learning and reflection. The first step in the process was to develop a comprehensive and far-reaching strategy that was nimble enough to serve the curriculum needs for the future and, at the same time, be feasible in its planning, implementation, and assessment. Of paramount importance in this process

was an attempt to fully integrate basic and clinical material across all departments and disciplines. This task of full integration is perhaps one of the most difficult to achieve. For example, the 2004 report by Kassebaum et al. on a survey of U.S. and Canadian dental school reported that only 7 percent of schools had a curriculum organized around specific themes.²⁰ While a minimal level of resources need to be available to institute large-scale curriculum reforms,³ the UCSF School of Dentistry did not have extensive resources to coordinate a large-scale planning and implementation process. As an alternate strategy, a dedicated group of faculty members expressed to the administration and to the dean of the School of Dentistry, Dr. Charles Bertolami, a willingness to take on the ambitious task of planning an extensive evaluation of the full curriculum and proposing a comprehensive reform plan. With administrative support, this group of faculty members was formally appointed as the curriculum reform committee for the school and was charged to evaluate the entire current curriculum and to recommend a sequence of new courses for a new curriculum.

Creating the Blueprint

A challenge in developing a blueprint for broad-based curriculum change is that both issues of the content of the curriculum and the form in

which the content is delivered must be eventually addressed.¹⁴ The planning committee embarked on a task to develop a workable plan to reform the content of the curriculum so that it met academic needs. Once a plan for content reform was developed, a structure to provide time for independent activities and ways to augment teaching methods to include more active, student-centered learning strategies could be addressed.

The first task was to examine what was taught to students over the four-year curriculum. This required examining the existing curriculum course by course and lecture by lecture. The committee recognized that the individuals who knew the most about the curriculum were the students, so students provided information about each course. The process took a year and generated about 5,000 pages of lecture notes, course outlines, and old exams. It became apparent from the analysis that much of the material presented could be organized into thematic “streams” of knowledge (or themes) that could serve as a framework for reordering the content of the curriculum and allow for better vertical and horizontal integration of course material across departments and disciplines. Similar thematic approaches have been reported in the past, in particular as complementary pathways to the content approaches used in the first two years of the medical school curriculum at the same institution.²¹⁻²³ Utilizing these thematic streams, course material would be centered around concepts rather than time constraints for units, department offerings, or even academic years. This entailed elimination of smaller and more narrowly focused courses taught by one department or division and integration of material and faculty into larger interdepartmental courses. The first diagrammatic model for this structure is presented in Figure 1 and served as the framework for all further developments in planning. The basic stream elements proposed at these initial planning meetings were as follows:

- **Biomedical Sciences Stream:** Material incorporated the basic science disciplines that form the core knowledge for understanding human health and disease. This also included material of clinical relevance to dental practice.
- **Dental Sciences Stream:** Material specifically related to oral tissues and diseases was organized together to teach dental diagnoses, understand the development and progression of dental diseases, and apply scientific understanding to dental problems. Disciplines included growth and development, pulp biology, periodontology, and cariology.

- **Preventive and Restorative Dentistry Stream:** Traditional preclinical laboratory courses were reorganized into a systematic presentation of techniques moving from simple to complex procedures. Biomaterials science was included at appropriate times to relate techniques taught and materials used.
- **Patient-Centered Care Stream:** Comprehensive care continued to be the emphasis. The first year was planned to include basic skills in patient interviewing, examination, communication, diagnostic imaging, and infection control. The second year included patient examination and periodontal and restorative patient care under close supervision. During years three and four, students would develop independence and judgment and refine their skills at diagnosing, managing, and treating patients in the comprehensive care setting and in community clinics. Integrated didactic courses were planned in years three and four to bring together basic scientists, clinical scientists, and master clinicians to present core material and discuss cases.

During the identification and development of these four thematic streams, the committee realized that important elements were missing: the development of the critical thinking skills and the acquisition of skills needed for students to become lifelong learners. The committee thus proposed a fifth stream for this purpose that would also help with the integration of the other four streams.

- **Scientific Methods Stream:** The scientific literature would be explored so that students developed the reasoning tools to better analyze and solve problems related to the practice of dentistry. The goal of the stream courses was not to have every student become a scientist, but to have students become “men and women of science.”^{14,24} The courses would be planned and taught by epidemiologists, statisticians, public health dentists, and dental clinicians and would present the basics of research methodology, illustrated by examples from the dental literature.

In addition to identifying five thematic “streams” of content, the committee also sought to organize the number of hours of formal instruction, both to ease overcrowding of the curriculum and offer students time for reflection and synthesis of course content and to permit students to take electives and pursue research. The committee set, as a goal, a maximum of thirty-two hours of formal teaching per five-day week and the scheduling of two half-day

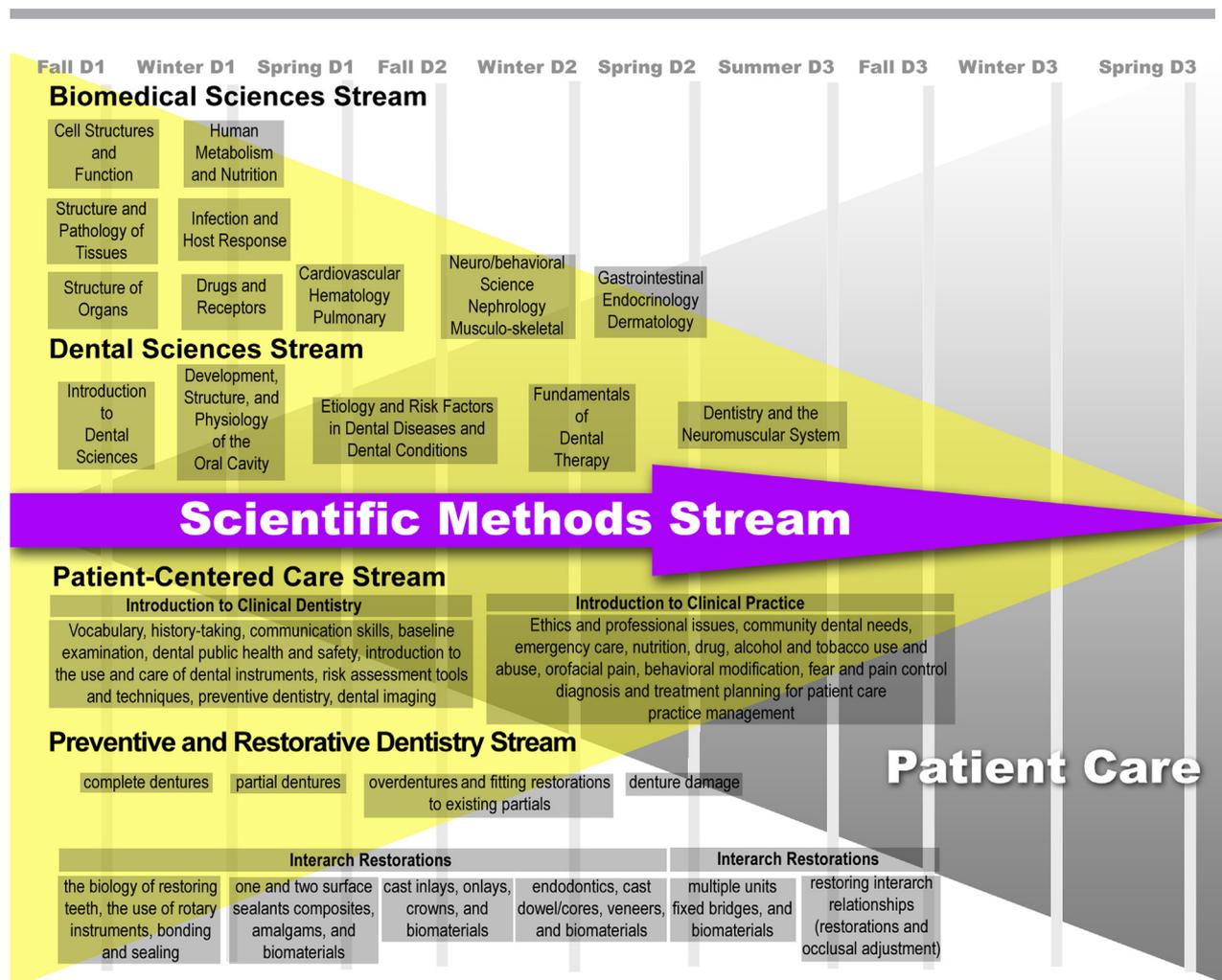


Figure 1. The first working draft developed by the planning committee for curricular reform

Note: The content of the curriculum was refined into four thematic streams, with a fifth stream called Scientific Methods running through the entire curriculum as a unifying and integrative stream. The curriculum plan shows the concentration of scientific background early in the four years gradually changing to a primary focus on patient care.

blocks of time of four hours each for independent study. These times are referred to as Independent Study Options (ISO) time. The committee also was aware that a reduction of formal teaching from thirty-eight or more hours per week to thirty-two hours per week was a reasonable step, as several other dental schools have achieved fewer formal instruction hours per week.

During the planning process, the faculty discovered what students already knew: that there was tremendous repetition in the curriculum. Although some degree of redundancy is desirable for reinforcement of concepts, the principle developed was

to minimize unplanned redundancy. An example of “planned redundancy” or reinforcement would be learning a basic medical concept in lecture during the first year of the curriculum, such as diabetes, and then reviewing the concept subsequently when the medical management of the diabetic patient was treated in the comprehensive care clinic.

Building Consensus

The daunting challenge of taking this curriculum plan to the implementation step with widespread

support required a major increase in resources, time commitment from faculty and staff, and a new administrative structure. Central to the success of the plan was the creation of the position of a full-time curriculum administrator who would oversee all the aspects of the curriculum and have administrative support sufficient for the task. This individual would function at the assistant or associate dean level to provide leadership and would support the stream leaders during the detailed planning and implementation phases. In addition, in-service training programs would be required to assist faculty in preparing for and creating educational changes. The stream leaders also needed support to free preparation time—anticipated to require one to two days per week devoted to planning, implementation, oversight, and management of the multidisciplinary courses taught within each stream. The stream leaders, together with the curriculum dean, would be responsible for reviewing and assessing defined outcomes, ensuring horizontal and vertical integration of the curriculum, and both assessing and addressing the ongoing needs of the faculty and students.

As stated in the recent position paper by Haden et al., a broad consensus among educators is essential for any successful major curriculum reform efforts.¹⁸ At UCSE, such a broad consensus and approval from the faculty prior to implementation was achieved through participation and engagement at each stage of the planning process, particularly when frameworks and drafts were proposed. Existing forums such as the school committees, general faculty meetings, faculty-student-administration liaison meetings, and town halls were used. In addition, over a three-year period, the annual schoolwide faculty retreat was almost entirely devoted to curriculum reform efforts in three phases:

1998: presentation of the state of the current curriculum, general problems, and general approaches in improving flow of content, integration, and teaching methods.

1999: presentation of a detailed curriculum plan with thematic streams and proposed integrated courses.

2000: discussion of the implementation plan and approval of the general faculty to proceed.

Throughout this process, there were also frequent meetings with the general faculty, Faculty

Council, and student representatives, as well as posting of curriculum plans and proposed new courses online for all faculty members to provide feedback. During the early stages of planning, the initial proposals were met with a general level of approval and enthusiasm; however, some faculty members expressed concern when it became apparent that they would be giving up their individual, small-unit courses and would likely need to modify their teaching content in the context of redesigned courses. At the third faculty retreat of 2000, a formal ballot measure posed two questions, asking first for general support for the curriculum revision plan and then for a more personal response about willingness to work with other faculty members to change both curriculum format and teaching strategies. Fortunately, both ballot questions receive very high approval ratings. With broad consensus established in 2000, the implementation process was begun.

Continuing the Process

A newly named assistant dean for curricular affairs was appointed late in 2001 with the responsibility of assuming the administrative tasks and assisting the faculty in developing and implementing this new curriculum. The first step in this process was to identify specific goals and core values related to the curriculum. Table 2 lists the goals and core values of the curriculum that were adopted and approved first by the faculty committee and then by the Faculty Council in early 2002.

As in the earlier stages of curriculum planning, faculty involvement was the driving force behind sustaining the curriculum reform movement. Faculty members stepped forward and volunteered to spend time and energy to further develop the thematic streams and courses. One or two faculty members headed each stream. The planning process began with lunchtime meetings on campus, but developed into quarterly off-site retreats that included a full day of discussion and planning. The retreats were resourced with notebooks of background materials detailing issues that were painstakingly reviewed and debated. Follow-up included administrative actions to facilitate communication and resolve identified issues such as conflicts in scheduling and use of facilities, changes in teaching responsibilities of certain faculty, etc. In addition, the stream leaders met on campus with faculty members who would be teaching in these new integrated courses to develop

Table 2. Curriculum goals and core values

Curriculum Goals

- The UCSF School of Dentistry provides the opportunity for dental students to become outstanding clinicians, scientists, educators, and leaders for new generations of professionals.
- The UCSF School of Dentistry trains competent dentists who understand the relationship between the craniofacial complex and the rest of the body.
- The UCSF School of Dentistry curriculum provides for the improvement of oral health through integrating basic, behavioral, and clinical sciences for individuals and communities.
- The UCSF School of Dentistry curriculum is aligned with the competencies required for new dentists as defined by the faculty, and has a system for assessing those competencies.
- The UCSF School of Dentistry faculty evaluates and adopts learning strategies that encourage lifelong learning.
- The UCSF School of Dentistry curriculum provides students with four to six courses of thematically related material per quarter that includes significant time for non-classroom learning.
- The UCSF School of Dentistry curriculum exhibits consistency in philosophy and grading across all streams.

Core Values

- The School of Dentistry fosters rigorous study in a diverse community of learners.
- The curriculum provides sufficient time for individual study and reflection.

Note: The curriculum goals and core values were developed by the faculty over several meetings. Their adoption represented significant agreement about the direction for the curriculum revision.

strategies for recreating and integrating every course in the predoctoral curriculum.

Among the first agreements of the faculty leaders were to maintain the goal of the first curriculum planning committee of limiting the curriculum hours to thirty-two per week for the ten-week quarters and to preserve the three-month summer break that occurred at the end of the first year. Limiting curriculum time would permit the school to encourage both independent study and reflection by students and provide time for students to engage in mentored research activities. As planning and implementation progressed, the agreement to limit formal instruction to thirty-two hours a week has been the most difficult to maintain; every thematic stream faced a reduction in hours of instruction, but there has been relentless pressure to increase instruction time. A major concern was that this arrangement would decrease clinic time for students in the third and fourth years. It was therefore decided that clinics would continue during final exams week. This was made possible by the integration of all the one-unit courses in the third year, so that there was one planned final examination rather than eight or more. In the final plan, clinics ran forty-four weeks per year, four more weeks than previously.

When the commitment of the planning group to keep the same number of clinical instruction hours was made, it meant that other disciplines would shrink disproportionately. Time would have to be found during the day to teach the first- and second-

year clinical courses, thus further impacting clinic assignments for others. The faculty groups particularly affected were the restorative laboratory faculty in the Preventive and Restorative Dentistry stream and the biomedical science faculty in the Biomedical Sciences stream. Both faced major issues in reducing hours in the curriculum. The resolution of this issue was managed using the following approaches:

- The biomedical sciences faculty members combined and streamlined their curriculum content and made biochemistry a prerequisite for admission to the school. A similar approach to decompressing the curriculum by making some of the basic sciences prerequisites for admission to dental school was recently proposed by Geissberger et al.²⁵
- The restorative laboratory faculty rescheduled content to move incrementally from simple to complex procedures and effected a 30 percent reduction in curriculum hours of laboratory instruction. This was facilitated by upgrading laboratory facilities to utilize contemporary simulation technologies.
- The traditional three-day administrative orientation period was lengthened to ten days and included introductory academic material from each thematic stream. It was renamed Introduction to Dentistry.
- The curriculum planning committee made a commitment to increase the role of electronic and web-based aids to instruction and initiated a computer requirement for incoming students. The decision was also made to not distribute laptop computers

as part of the student kit because there are limited resources for computer support.

When the curriculum was defined in weekly half-day blocks of time totaling thirty-two hours per week, there was concern that the four hours of time in one lecture hall or studying particular topics would be too much to ask of students. However, laboratory and clinic sessions were already three hours in length, and graduate dentists were required to take continuing education courses often modeled as full-day courses. Thus, the planners agreed to this structure in order to preserve the two one-half-day time periods for independent study (ISO time). An example for this thematic plan for the curriculum for one quarter of the first year of dental school is presented in Figure 2.

Issues Critical to the Implementation Process

The ten-day Introduction to Dentistry course was created to encompass all the thematic streams and the administrative needs of the School of Dentistry. It was designed to prepare the entering class for the transition to professional education as well as an orientation to the overall UCSF campus and the School of Dentistry and culminated in a White Coat Ceremony and celebration.

New information technology was brought into the curriculum. WebCT had been available through the UCSF library for several years but was not heavily utilized within the school. As curriculum planning progressed, a template was created for the School of Dentistry courses, and faculty training was provided to assist in the utilization of these tools. A template was instituted so that certain web tools would be available in each of the courses and the homepage of each course looked consistent.

The idea also emerged to have an electronic “commons room” for students, which was developed as an e-Commons site. This was particularly needed at UCSF because there was no physical gathering place for students such as a student union. The e-Commons contained discussion boards, access for postings for each class, rosters, schedules, National Board review materials, administrative resources, and general information. At the suggestion of the students, an anonymous suggestion box was added.

UCSF is a small campus with tightly scheduled lecture halls, seminar rooms, laboratories, and clinics for the dental school shared with the schools of medicine, nursing, and pharmacy and the graduate

division. It quickly became apparent that a staggered start to the revised curriculum would present tremendous scheduling problems and would, in some instances, require faculty members to teach material twice in a single year, which would further limit classroom space and scheduling. So the faculty and administration decided to begin the entire curriculum on July 1, 2004. This presented many challenges for matriculated students and required modifying existing courses in the year before the changeover, so that each class of students was provided all of the curriculum material. Existing courses in 2003–04 were modified to present material in a manner that would be compatible with the flow of curriculum material the following year in the new courses. In a few instances, faculty members presented courses that were taught only once as the curriculum implementation unfolded. Student kit materials also had to be adjusted for the laboratory courses in 2003–04, as exercises were to be reorganized.

Independent of the redesign of the curriculum by the stream leaders, the Faculty Council (the elected faculty representatives of the school) initiated an analysis of grading policies. After extensive research and deliberation, the faculty decided to move the school to a pass/no pass grading system. This required that the faculty adopt criterion-referenced grading and the marginal pass (D) grade was eliminated. The new grading system included the awarding of honors grades based on criteria specified by each course director in the third and fourth years, and incorporated the use of letters of commendation by faculty in the first two years of the curriculum to acknowledge outstanding students. This change eliminated the ranking of students in classes. These proposals were presented to the faculty in the same collegial manner as the initial curriculum plans, and most faculty members endorsed the pass/no pass system. It also received wide support from the students, as they perceived that the academic environment would change to reduce competition and increase collaborative learning. With this consensus approval from faculty and students, the regulations ending letter grades were approved in time for the inauguration of the revised curriculum in July 2004.

Maximizing Communication and Pride of Ownership

To achieve the goal of an updated and revised curriculum, communication with all individuals in the school was of paramount importance. The

	Monday	Tuesday	Wednesday	Thursday	Friday	
FALL	am	Biomed 116 Structure of Cells, Tissues, & Organs	Biomed 116 Structure of Cells, Tissues, & Organs	PRDS 116 Morphology/Biomaterials	PRDS 116 Operative/Biomaterials	Biomed 116 Structure of Cells, Tissues, & Organs
	pm	PCC 117.01 Intro to Comp Care	Biomed 116 Structure of Cells, Tissues, & Organs ScMeth 117 Found. Sci. Inquiry	ISO	Biomed 116 Structure of Cells, Tissues, & Organs	ISO
WINTER	am	Biomed 117 Infection & Host Response/Cell Physiology	DentSc 116 Oral Structure & Development/Dental Health ScMeth 118 App. Sci. Inquiry	PRDS 117 Crown & Bridge/Biomaterials	PRDS 117 Operative/Biomaterials	Biomed 117 Infection & Host Response/Cell Physiology
	pm	PCC 117.02 Intro to Comp Care	Biomed 117 Infection & Host Response/Cell Physiology	PRDS 117 Morphology/Biomaterials	ISO	ISO
SPRING	am	Biomed 118 Organ Systems & Human Pathophysiology	Biomed 118 Organ Systems & Human Pathophysiology	PRDS 118 Crown & Bridge/Biomaterials	PRDS 118 Operative/Biomaterials	Biomed 118 Organ Systems & Human Pathophysiology
	pm	PCC 117.03 Intro to Comp Care	DentSc 117 Etiologies & Risk Factors in Dental Diseases ScMeth 118 App. Sci Inquiry	ISO	Biomed 118 Organ Systems & Human Pathophysiology	ISO

	Scientific Methods and Clinical Dentistry Stream Courses
	Biomedical Sciences Stream Courses
	Dental Sciences Stream Courses
	Independent Study Options (ISO)
	Preventive and Restorative Dentistry Stream Courses
	Patient-Centered Care Stream Courses

Figure 2. The first-year dental curriculum schedule by quarter, including ISO time

Note: The first-year dental student schedule was arranged in four-hour blocks, with two blocks of time reserved for independent study options (ISO). Each year of the curriculum was designed in four-hour blocks and preserved ISO time.

assistant dean and members of the stream leaders group kept faculty and students apprised of the progress of curriculum reform through the following mechanisms:

- attendance at meetings of committees to provide updates, clarify issues, and answer questions,
- presentations at departmental and division meetings,
- regularly scheduled town hall meetings for faculty, staff, and students,
- working with students to attend their class leadership meetings, and
- distributing written materials that described the changes, including frequently asked questions.

These efforts were augmented by the creation of communication materials put in a brief booklet called the “Owner’s Manual.” The booklet provided the context for curriculum reform, outlined the goals of this reform, organization of streams, curriculum changes, and the new schedule, and included a statement of support from the dean. It also highlighted the phrase developed by Dean Bertolami to identify and describe the curriculum: “Educating Men and Women of Science.” It was found that the “Owner’s Manual” was the communications tool that most effectively explained the full scope of the curriculum reform to our community. Figure 3 shows the cover of this booklet.

The planning process took about eighteen months from December 2001 to September 2003. The

implementation process to change existing courses in preparation for full implementation occurred during 2003–04, and all new courses successfully began either July 1, 2004 for the third- and fourth-year dental students (including the cohort of sixteen international students, who are fully integrated into the last two years of the curriculum) or October 1, 2004 for the first- and second-year dental students. The inaugural Introduction to Dentistry course occurred during the last two weeks of September 2004.

Assessment

Creating a D.D.S. curriculum that preserved two half-day blocks of time for independent study permitted students to take advantage of research opportunities, work with mentors, and become engaged in concurrent educational programs, namely, the master’s degree in oral and craniofacial sciences offered at UCSF. It also permitted time in scheduling for the development of a D.D.S./M.B.A. program in conjunction with the University of San Francisco. Faculty members worked together to fit material into the large, integrated courses. The recent institution of a comprehensive undergraduate implant program was testimony to the success of the integrated approach. Oral and maxillofacial surgeons, prosthodontists, periodontists, and administrators worked together to incorporate specific didactic and clinical instruction

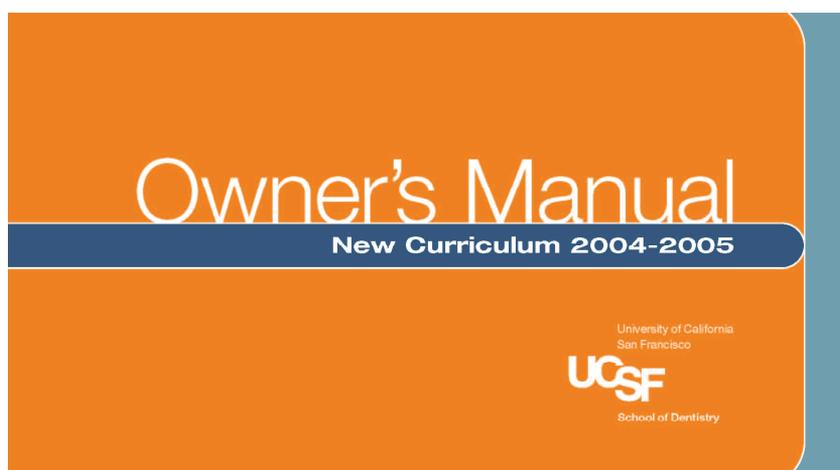


Figure 3. Cover of the “Owner’s Manual”

Note: The “Owner’s Manual” was a brief and eye-catching communication piece to assist faculty, staff, and students in understanding the development of the curriculum during the months before the new courses began.

in fixed tooth replacement into existing courses in the curriculum, so that all students would graduate at a beginning level of competence with these skills. In order to implement this comprehensive implant program, other material was constricted or removed. This would not have been possible to accomplish in the department-separated, discipline-specific educational system that existed before 2004. The School of Dentistry also has seen significant improvements in web-supported instruction. Faculty members continue to increase their skills in online course management, and the institution provides faculty development to assist them.

Approaches to Assessment and Findings

A number of evaluation strategies were developed to assess the changes in the curriculum. These included the following:

Quarterly

- Electronic course evaluations completed by students from each class.
- Mid-quarter meetings of stream leaders with stream faculty and student representatives to discuss progress of courses and possible mid-quarter adjustments.
- Educational Policy Committee meetings, the committee of the Faculty Council that is responsible for curriculum, including student representatives, to review findings and provide a forum for faculty analysis of the curriculum.
- Analysis and evaluation by faculty members within the streams.

Continuous communication

- An open door policy in the dean's office to receive and address student and faculty concerns in person or by telephone or email.
- Student Liaison Committee meetings that provided a monthly open forum for student officers from all classes, deans, associate deans, assistant deans, and department chairs to meet.
- Student suggestions and concerns received through a variety of strategies including anonymous online communications.

Annual outcomes assessment

- Monitoring of National Board examination scores.
- Sharing and discussing course evaluation data at stream leader retreats.
- Student focus groups held by the assistant dean during the first year.

Follow-up

- Biannual stream leader retreats.
- Continued meetings of stream faculty.
- Reports to the Educational Policy Committee and Faculty Council.

Student Responses to the Curricular Changes

Student focus groups held during and after the first year of the initiation of the revised curriculum provided insight into the changes. Students were mostly quite positive, as others who had completed courses the previous years under the old curriculum structure told them they were lucky to be experiencing the changes. Students also noted that the transition year was tough, some didactic material seemed out of sequence, and there was a sense of uncertainty. One major concern for students was the transition from paper to electronic course materials including syllabi. Many courses previously used extensive written syllabi to provide teaching material. At the request of the students, the faculty provided materials online at least twenty-four hours before class. The use of hard-copy handouts has greatly diminished as students preferred PDF versions that can be annotated and better used for study. As an aside, it should be noted that the faculty continue to hear complaints about insufficient chair time in the clinic, a situation unchanged over the decades.

Students revealed that some faculty members were not scanning slides and using digital presentations and were not providing enough time for student-centered learning, despite administration-sponsored efforts for faculty development in these more active learning approaches. Students urged faculty members to change their teaching techniques and offered to help. As a result, students participated in developing teaching aids in science and laboratory courses, participated more in student-led teaching, and scanned slides to assist faculty in the transition from the older instructional media to web-based electronic media. Many students had excellent computer skills and were eager to assist in improving the curriculum. As a corollary to this, communications with students became entirely digital, using campus email and email within the online courses. Telephone contact and voicemail were reserved for patient contacts, and paper mail was no longer used.

Students also clearly stated that they preferred to not have a didactic course in the fourth year, as had been the case for the previous ten years. How-

ever, the faculty felt that it was critical to continue presenting appropriate advanced didactic material in the fourth year.

Students evaluations of the Introduction to Dentistry course indicated that it was a good transition from undergraduate education to professional education. They consistently provided ratings between 4 and 5 on a scale of 1 (strongly disagree) to 5 (strongly agree) for feeling welcome (4.8), preparation for studies at UCSF (4.3), and preparation for the profession (4.2). The only criticism of the intensive program was that the days were long. Evaluation scores have remained consistent in the past four years, averaging 4.2 or higher, and the single criticism of long days has not changed.

Students were initially unclear as to what the specific performance requirements were for each course in the new pass/no pass system. Faculty set consistent pass criteria and required remediation and demonstrations of mastery of material, so that students soon recognized that the revised curriculum was just as rigorous, if not more rigorous, than the previous courses. Faculty reported that they now spent more time in remediation of students who are performing marginally than before, since the pass/no pass system required that the students sustain an acceptable level of performance in all aspects of all courses. This was in contrast to awarding “D” grades that could be averaged away in GPA calculations of acceptable overall performance.

An interesting aside to all the faculty and student changes was that staffing support for the new curriculum with extensive use of WebCT and digitally enhanced teaching needed to change. Over time, new staff members with much more sophisticated computer skills have been hired. One individual was identified specifically to interact with faculty and the library staff in support of the online courses. These changes coincided with reductions in the traditional administrative assistant support staff levels through attrition.

Student Evaluations of the New Courses

Electronic course evaluations were made available for each class at the end of each term. Students were encouraged to respond; however, the rate was rarely more than 50 percent. Students related that some feared that the system was not anonymous and others felt that faculty would not change no matter what was said. In all, response rates varied from

class to class, from a high of 78 percent of first-year students responding to an average of 50 percent for the second-, third-, and fourth-year classes.

Figure 4 represents the overall evaluations for the courses in the new curriculum on a scale of 1 (poor) to 5 (excellent) for spring quarter 2005, the first year of the revised curriculum, and spring quarter of 2008, a recent evaluation of the same courses. The goal was for every course to be rated three or higher. Courses that scored lower in the streams were addressed by the stream leader and assistant dean to make plans for improvement. Student evaluation scores for courses have been consistent over time.

Students were also asked to comment on each course and make suggestions and recommendations for improvement. During that first year, 2004–05, it was interesting to see that many comments were quite positive, complimenting the quality of the professors and the perceived importance of the materials. In general, the online course material was perceived to be helpful. The first- and second-year students asked to have things more integrated and to utilize more small-group work in the courses. Third- and fourth-year students wanted more clinic time and better calibration among the faculty.

Other Assessments

The faculty were extremely concerned that moving to a pass/no pass curriculum, integrating courses, and making biochemistry a prerequisite would disadvantage students on the National Board Dental Examination, particularly Part I. In addition, not all biomedical science material was taught in the first year, and students wanted to take advantage of the summer between the first and second years to both prepare for the examination and take it. This was a change from the past when students sat for Part I of the exam during the July administration of the paper-and-pencil test after the end of the second year of dental school. Early examinations were permitted on a case-by-case basis in 2005, and four students took the computerized examination before the beginning of the second year of dental school. Two of them did very well, and two did poorly, which they all related to study and preparation rather than a lack of material from the courses. Subsequently, students have been permitted to take Part I after the first year, and approximately one-third of the class does so, with the rest taking it by the beginning of the third year. The assistant dean and faculty have monitored the

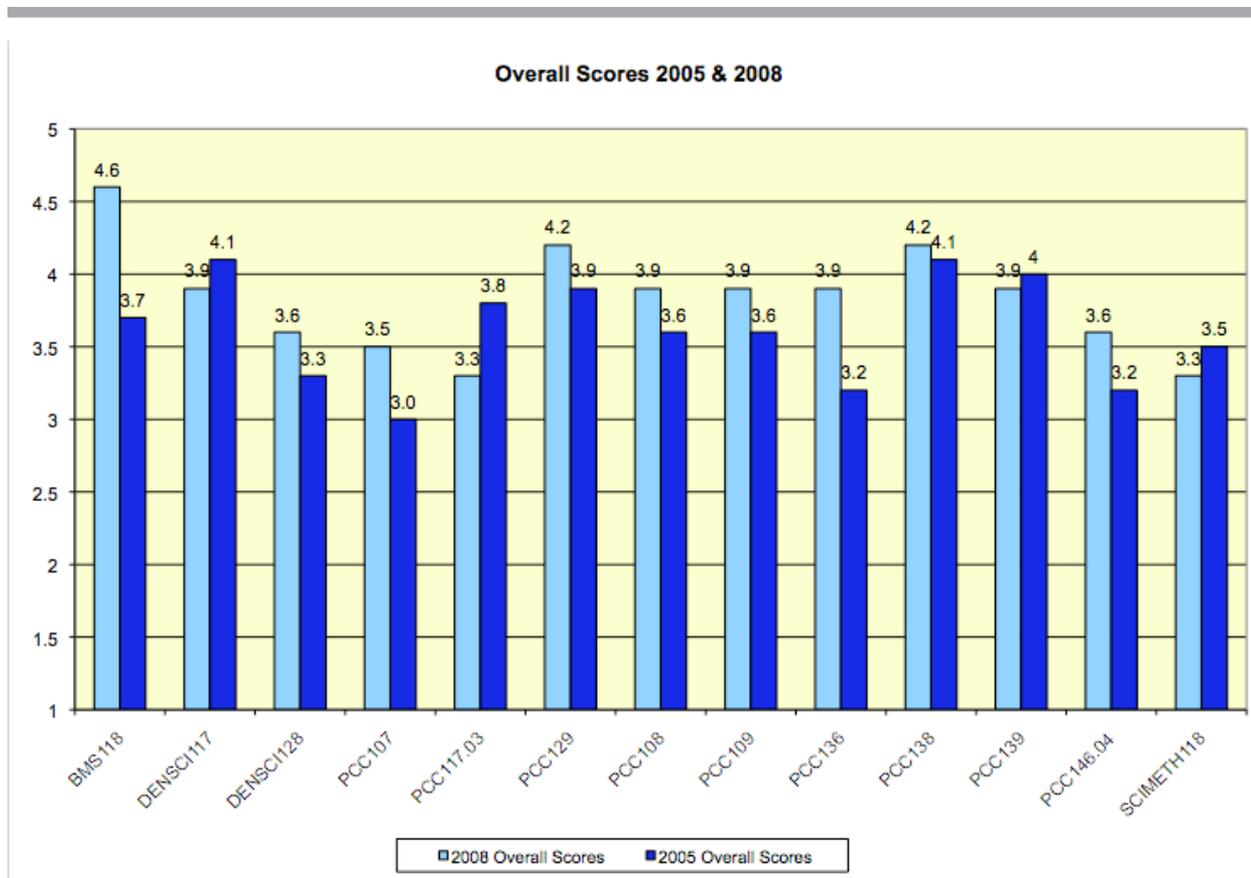


Figure 4. Comparison of student responses to the web evaluation question for individual courses rated both in 2005 and 2008 to the question “Overall (on a scale of 1 to 5 with 5 being the highest) I would rate this course as . . .”

passing rates carefully and are now comfortable with both curricular preparations for the examination and permitting students to sit for the examination at the end of the first year. Part II of the National Board is typically taken during fall or winter quarter of the fourth year. Students prepare on their own, and scores have not changed over the years. There is a very low failure rate, and mean scores are consistent over the years, with no change noted since the curriculum revision was implemented. Table 3 shows the National Board Part I comparison data for the last several years, from three years before the curriculum change to two years afterwards.

State licensure examination results have also been consistent. Almost all California graduates now take the Western Regional Examining Board (WREB) exam, although they are also able to take the California Dental Board licensure examination. All

UCSF graduates have selected the WREB examination for the last two years. First-time pass rates are at the 95 percent level.

New and Continuing Challenges

There are two major continuing challenges for the faculty as the school moves forward with this new curriculum model. Integration of topics is the key to making the courses successful and continues to require faculty time and effort. Although there have been many positive changes, there are still a number of courses that students tell us are really three courses in one. Integration efforts are ongoing, and it is important that the school succeed in this process.

Table 3. National Board Part I comparison, annual reports 2001–02 through 2005–06

Year	National Mean	UCSF Mean	National Fail Rate	UCSF Fail Rate
2001–02	85.0	86.9	10.1	5.0
2002–03	85.0	87.8	11.8	3.7
2003–04	85.0	87.0	11.6	1.6*
2004–05	84.8	88.6	14.2	0**
2005–06	85.2	87.6	10.7	2.4**

*Second-year dental students with four first-year students

**First-year and second-year dental students

Note: National Board scores were monitored closely for evidence of disciplines inadequately presented in the curriculum. Scores and fail rates remained consistent with previous years.

The second major challenge for the faculty is to change traditional teaching modes to incorporate more learner-centered activities. Thus far, small-group discussions, panel discussions, student presentations, and digital presentations that can be reviewed at any time have been used to augment the traditional lecture-style presentations. Much remains to be done, but the structure of the new curriculum has provided interdisciplinary and interdepartmental opportunities for faculty members to work together, which was difficult to achieve with the previous curriculum structure.

From an administrative point of view, some faculty members still think in terms of adding new material by adding hours to the thirty-two-hour week and therefore reducing time for independent study. Three or four requests emerge every few months, with very good rationales, for increasing class, lab, or clinic time and decreasing independent study time. These are presented to the stream leaders at their retreats and to faculty committees, and are discussed at great length. Interestingly, having many faculty members discuss changes has led to increased cooperation and problem-solving, so that independent study time has been preserved.

Discussion and Conclusions

There is no question that traditional dental curricula need to change. Whether this change is achieved in a revolutionary way, in a more evolutionary way, or with a combination of strategies will be unique to the needs of the particular dental institution. There is no question that the traditional dental curriculum that emphasized technical excel-

lence and deemphasized scientific advancement^{14,24} no longer serves this generation of dentists or the coming ones. As described by Iacopino, “During the twentieth century, the practice of dentistry remained relatively static. New products and technologies were introduced at a rate that allowed dentists to provide effective and efficient patient care using the procedures acquired in dental school, and they were able to complete their practice careers incorporating few if any new products, materials, techniques, and/or office equipment.”²³ The former educational paradigm at UCSF was based on this twentieth-century notion, and it was perpetuated by faculty trained under this philosophy. Now, for the twenty-first century, new techniques, scientific understanding of disease processes and prevention, the coming of molecular medicine,²⁶ and the dizzying pace of technological advance must be integrated into the traditional dental curriculum.

UCSF has begun to address the problems in the curriculum described by Bertolami: the problem of content, in which the core question is how best to incorporate advances in biomedical science and technology; and the problem of form, which includes inadequate learning and dissatisfied students.¹⁴ The major restructuring of the curriculum at UCSF School of Dentistry has established a framework that permits faculty to redress the ills of irrelevant, redundant, and unrelated presentations of material in dated traditional lecture, lab, and clinic formats that do not appeal to this generation of students. The notion that students need time for reflection, creativity, and scientific inquiry and that they benefit from it has been embraced. Faculty members have sensed the need, if not the urgency, for change and have directed their considerable skills and attention toward creating that reality.

Acknowledgments

The curriculum reform efforts at UCSF required (and continue to require) the dedication of many faculty, staff, administrators, and students. While space prohibits listing everyone who has contributed to this effort, we would like to acknowledge the contributions of William Bird, Linda Centore, Mark Dellenges, Gordon Douglass, Gwen Essex, and Hillary Pritchard. We would also like to thank David Hand for his assistance in the preparation of this article.

REFERENCES

1. Field MJ, Jeffcoat MK. Dental education at the crossroads: a report by the Institute of Medicine. *J Am Dent Assoc* 1995;126(2):191–5.
2. Tedesco LA. Issues in dental curriculum development and change. *J Dent Educ* 1995;59(1):97–147.
3. DePaola DP, Slavkin HC. Reforming dental health professions education: a white paper. *J Dent Educ* 2004;68(11):1139–50.
4. Crawford JM, Adami G, Johnson BR, Knight GW, Knopperschild K, Obrez A, et al. Curriculum restructuring at a North American dental school: rationale for change. *J Dent Educ* 2007;71(4):524–31.
5. Hendricson WD, Cohen PA. Oral health care in the 21st century: implications for dental and medical education. *Acad Med* 2001;76(12):1181–206.
6. Pyle MA, Goldberg JS. Engineering curriculum change at a private midwest school of dental medicine: a faculty innovation. *J Dent Educ* 2008;72(3):288–98.
7. Greene JC, McCauley KR, Pritchard HK. Initiating change under the Pew National Dental Education Program at the University of California, San Francisco. *J Dent Educ* 1990;54(2):104–8.
8. Burg FD, McMichael H, Stemmler EJ. Managing medical education at the University of Pennsylvania. *J Med Educ* 1986;61(9 Pt 1):714–20.
9. Cardall WR, Rowan RC, Bay C. Dental education from the students' perspective: curriculum and climate. *J Dent Educ* 2008;72(5):600–9.
10. Grandy TG, Westerman GH, Mitchell RE, Lupo JV. Stress among first-year dental students. *J Dent Educ* 1984;48(10):560–2.
11. Henzi D, Davis E, Jasinevicius R, Hendricson W. In the students' own words: what are the strengths and weaknesses of the dental school curriculum? *J Dent Educ* 2007;71(5):632–45.
12. Lloyd C, Musser LA. Stress in dental students. *J Am Coll Dent* 1985;52(2):11–9.
13. Westerman GH, Grandy TG, Ocanto RA, Erskine CG. Perceived sources of stress in the dental school environment. *J Dent Educ* 1993;57(3):225–31.
14. Bertolami CN. Rationalizing the dental curriculum in light of current disease prevalence and patient demand for treatment: form vs. content. *J Dent Educ* 2001;65(8):725–35; discussion 36–43.
15. Greene JC. Science and the shifting paradigm in dental education. *J Dent Educ* 1997;61(5):407–11.
16. Alfano MC. The need to reform dental education: balancing curriculum to stay ahead of changing times. *Compend Contin Educ Dent* 2004;25(12 Suppl):10–1.
17. DePaola DP. The revitalization of U.S. dental education. *J Dent Educ* 2008;72(2 Suppl):28–42.
18. Haden NK, Andrieu SC, Chadwick DG, Chmar JE, Cole JR, George MC, et al. The dental education environment. *J Dent Educ* 2006;70(12):1265–70.
19. Pyle M, Andrieu SC, Chadwick DG, Chmar JE, Cole JR, George MC, et al. The case for change in dental education. *J Dent Educ* 2006;70(9):921–4.
20. Kassebaum DK, Hendricson WD, Taft T, Haden NK. The dental curriculum at North American dental institutions in 2002–03: a survey of current structure, recent innovations, and planned changes. *J Dent Educ* 2004;68(9):914–31.
21. Howell TH, Matlin K. Damn the torpedoes—innovations for the future: the new curriculum at the Harvard School of Dental Medicine. *J Dent Educ* 1995;59(9):893–8.
22. Kerosuo E, Ruotoistenmaki J, Murtomaa H. Report on the development of a new dental curriculum at Helsinki. *Eur J Dent Educ* 2001;5(1):23–30.
23. Iacopino AM. The influence of “new science” on dental education: current concepts, trends, and models for the future. *J Dent Educ* 2007;71(4):450–62.
24. Bertolami CN. The role and importance of research and scholarship in dental education and practice. *J Dent Educ* 2002;66(8):918–24; discussion 25–6.
25. Geissberger MJ, Jain P, Kluemper GT, Paquette DW, Roeder LB, Scarfe WC, Potter BJ. Realigning biomedical science instruction in predoctoral curricula: a proposal for change. *J Dent Educ* 2008;72(2):135–41.
26. Oral health in America: a report of the surgeon general. Rockville, MD: U.S. Department of Health and Human Services, National Institute of Dental and Craniofacial Research, National Institutes of Health, 2000.