A Case Study on Development of an Integrated, Multidisciplinary Dental Curriculum


Abstract: Calls for fundamental reform of dental education were made twice in the twentieth century. More recently, spurred by the work of the American Dental Education Association’s Commission on Change and Innovation in Dental Education (ADEA CCI), North American dental educators have again begun advocating for major curriculum reform in order to develop in students the higher order thinking skills required for the contemporary practice of dentistry. This case study describes the process of curricular reform at one school designed to move from a traditional siloed curriculum to one that uses case-based, integrated multidisciplinary courses to improve teaching and learning. The process was broad-based and comprehensive and included a schoolwide values clarification exercise and agreement on desired characteristics of an ideal graduate. Stakeholders agreed that the reform curriculum should incorporate inter- and multidisciplinary courses, case-based and active learning strategies, and concepts from adult learning theory. The new curriculum model is comprised of five unique but related curriculum “strands,” each managed by a small group of interdisciplinary faculty content experts. Challenges in the development and implementation of the reform curriculum are discussed, and an assessment plan is presented.

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In the early twentieth century, the Carnegie Foundation for the Advancement of Teaching funded a series of reports on the status of professional education in North America. The Flexner report on medical education, the fourth in the foundation’s series, was released in 1910 at the urging of the medical community and became a landmark in the development of medical curricula.1 Surprisingly, the Flexner report was the last stimulus for significant change in medical education until the more recent move, in the last thirty years, to a problem-based learning (PBL) curriculum model.2 After the publication of the Flexner report, the foundation turned to the state of dental education in the United States and Canada. William J. Gies, a biochemist at Columbia University who had cofounded that university’s dental school, was selected to lead the investigation. As Gies wrote, “When the Carnegie Foundation issued its report on medical education, in 1910 . . . it did not seem possible to deal with the question of dental education without larger knowledge than was then available. In particular it was not then clear whether dentistry ought to become a specialty of the conventional medical practice or whether it should remain a field of practice for a separate body of practitioners” (p. xv).3 Gies completed his investigation in five years. Dental Education in the United States and Canada, published in 1926 and widely known as the Gies report, highlighted the flaws and challenges of dental education at the time. Among other issues, Gies identified loose admissions standards, the lack of a scientific foundation in the training of dentists, the apprenticeship model as the signature pedagogy, no formal accreditation standards or processes, and the housing of most dental programs in independent, for-profit institutions without university affiliation.
Although the Gies report triggered significant change in dental education at the time, including an increase in university affiliations, development of stronger scholarship in biomedical and clinical sciences, and the establishment of formal accreditation processes, change has not been sustained, and many of Gies’s recommendations have still not been adopted.4

A subsequent comprehensive review of dental education was published by the Institute of Medicine (IOM) in 1995. Dental Education at the Crossroads: Challenges and Change6 argued for modernization of courses, elimination of redundancy, and implementation of “an integrated basic and clinical science curriculum that provides clinically relevant education in the basic sciences and scientifically based education in clinical care” (p. 141). To advance a curriculum reform agenda in dental education, the American Dental Education Association (ADEA) formed the ADEA Commission on Change and Innovation in Dental Education (ADEA CCI) in 2005. The ADEA CCI was charged with the development of programs and initiatives to support the reform of dental education based in part on the recommendations in the IOM and Gies reports. From 2006 to 2009, the Journal of Dental Education (JDE) published a series of influential white papers that came out of the ADEA CCI, emphasizing the need for change and presenting a vision for its implementation. This body of work, subsequently published in the collection Beyond the Crossroads: Change and Innovation in Dental Education,8 has reinvigorated the discussion in the academic dental community around the need for major curriculum reform and instigated further development in the approach to teaching and learning. Several of these papers are among the most frequently cited JDE articles in recent history,7 suggesting the important role this work may have on decisions about dental curricula being made across the country.

The challenges facing dental education and need for curriculum reform have spawned much additional attention from dental educators in the last decade, including Donoff’s call for a new Gies report.4,8,5 A group of dental school deans and other leaders from North America, organized and supported by ADEA, have been dedicated to the deconstruction and reconstruction of the dental curriculum.10,11 There is widespread agreement that dentistry, a primarily surgical discipline within health care, requires higher order cognitive skills than previously assumed. Students must be able to access, critically evaluate, and apply knowledge from diverse fields to real-world clinical problems: they must develop the ability to synthesize information, as described by Bloom in his seminal work.12 There is evidence to suggest that a multidisciplinary case-based approach to content delivery lends itself to the synthesis of information and evaluation of outcomes necessary in dentistry.13–15

Case-based learning is an adult learning model that involves in-depth discussion of clinical cases among a small group of students with a faculty member who acts as facilitator. In the health professions, students actively engage in data-gathering, discussion, and decision making to make the exercise more directly relevant to clinical care.13,16 Case-based learning has been used in medicine and law for some time, but dentistry has been slow to adopt the concept because of the emphasis in dental education on microsurgical procedures.13,14 This emphasis has historically limited dentistry to surgical treatment and the mastery of techniques as the primary method of treating oral disease. Gies6 argued for a reduction of technical training in dental education in favor of strengthening the biomedical component of the curriculum and the relationship between science and the clinical practice of dentistry. His call has been echoed by many leading dental academics, including DePaola and Slavkin.17 They recommended “a model for dental education that fosters critical, science-oriented thinking, a sense of social and professional responsibility, and awareness that oral health is a critical component of overall health,” a model that stresses “an evidence-based approach to clinical decision making that rests on a foundation of critical thinking and an integrative understanding of basic and applied science” (pp. 1146–7). Significant recent revisions to the predoctoral accreditation standards18 and ADEA’s Competencies for the New General Dentist also point in this direction.19

One curriculum structure that supports the implementation of case-based learning is the development of multi- and interdisciplinary courses. In a dental context, an integrated curriculum model provides an opportunity to systematically integrate clinical, biomedical, and behavioral sciences in a way that is meaningful to students and makes clear the application to clinical practice.15,20 If dentistry is to move toward a combination of the medical and surgical models of treatment as recommended by Gies in 1926, a multidisciplinary, integrated approach may hold promise in preparing graduates for the demands of evolving practice.

In a recent comprehensive review of educational methodologies and changes in dental education
in the last seventy-five years, Hendricson\(^1\) reported minimal progress at most dental schools on developing a meaningful blend of basic and clinical sciences (other than at several historically PBL programs) or the elimination of the smokestack approach to the curriculum design. “From what I have seen at more than fifty U.S. and Canadian dental schools during my career,” Hendricson reported, “most courses are internally well organized within their particular silos in the overall curriculum. However, students experience the curriculum in a different manner as they try to make sense of information communicated in multiple concurrent courses taught back to back, hour by hour, day after day (horizontally, across discipline silos)” (pp. 137-8).

The purpose of our article is to describe the process used by one U.S. dental school to design and implement an integrated, multidisciplinary, case-based curriculum model that incorporates major recommendations of the Gies and IOM reports as well as the work of the ADEA CCI. The goals of the reform effort were to align the school’s planning and curriculum development with what was occurring nationally and to further elements of the school’s mission to prepare oral health care providers for scientifically based practice, to define new standards of education, and to discover and disseminate new knowledge about teaching and learning. Future articles will discuss specifics of the implementation process for each curriculum strand and present related outcomes.

**Micro-Environmental Factors**

With a history of innovation in comprehensive patient care, humanism, and competency-based education, the faculty of the University of the Pacific Arthur A. Dugoni School of Dentistry formally embarked on curriculum reform in 2005. The first step in the process was a comprehensive, school-wide exercise to identify core values that inform the culture of the school and to solicit recommendations for future directions. All students, faculty, and staff were invited to participate in the values clarification exercise. Findings contributed to the development of a comprehensive strategic plan that, among other directives, emphasized educational innovation.\(^2\) Results of both processes were analyzed and then discussed in various public forums to create the foundation for and to foster widespread buy-in into the reform process.

The results of the values clarification and strategic planning exercises led the faculty to form a guiding vision for curricular reform: to graduate lifelong learners and critical thinkers able to integrate the science and technology of dentistry. Not surprisingly, common themes emerged from the discussions, with several recommendations specifically related to educational innovation: 1) curriculum integration, both inter- and intradisciplinary and multidisciplinary; 2) incorporation of active learning techniques to promote increased student engagement and learning; and 3) increased use of case-based teaching methodology. A review of the minutes from curriculum committee meetings and surveys of academic departments conducted at the time and analyzed in a separate study\(^3\) documents the support of the adoption of multidisciplinary and case-based learning strategies as a means to advance the curriculum. Table 1 summarizes the common aspects of case-based learning and multidisciplinary teaching ultimately implemented at the school.

One goal of reform was to promote a learning environment that pushes the student to integrate and synthesize material at a higher level than what had been expected in the past. Historically, the dental curriculum delivered content in lecture and laboratory sessions with the expectation that the student independently connect foundational knowledge to clinical practice. The reform curriculum was conceptualized to allow faculty members to help learners integrate information in a more prescribed and predictable manner. One element of reform was the complete restructuring of within-course contact hours to create large blocks of time, allowing flexibility for content placement and delivery and an emphasis on case-based learning activities. Another element was the integration of content from multiple courses to create large classes beyond the limitations of the traditional departmental structure. Hendricson\(^1\) encourages dental educators to find ways to limit the demand on students’ attention to no more than four courses at a time to create an environment better suited for deep learning compared to traditional disciplinary silos. The intent is to create a program that is more learner-centered and that matches the pace of learning with the professional development of the adult student.

Curriculum reform at our school was predicated on several key components. Desired learner outcomes were determined first, followed by frank discussions about the support systems and resources required to reach them (Figure 1). Faculty members, department chairs, the admissions and curriculum committees,
students, and administrators were involved in discussions that spanned several months. Additional benefits of the reform curriculum became apparent during these discussions:

- improved timing of what the students learn in a classroom relative to their clinical experience;
- increased flexibility in content delivery to match learning needs;
- more efficient use of instructional time;
- better utilization of visiting faculty members and increased opportunity for faculty cross-training;
- complete delivery of foundational concepts before the final program year, thus creating more case-based learning experiences during that time; and
- greater need for creativity in developing integrated assessment techniques such as cross-disciplinary comprehensive examinations and objective structured clinical examinations (OSCEs).

As the vision of curriculum reform became clear, faculty members realized the change would need to follow a series of steps both conceptually and in practice. The first step was to bring together
the “siloed” stand-alone courses in a way that allowed for the integration and sequencing of similar and related content from each course. Conceptually, separate but related courses were joined to create five major content areas known as “strands” (Figure 2): Integrated Medical Sciences (IMS), Integrated Preclinical Technique (IPT), Integrated Clinical Sciences (ICS), Clinical Practice (CP), and the Personalized Instructional Program (PIP). In the figure, Q refers to the length of the academic program in quarters.

This initial step required faculty members to work together to examine course content, learning objectives, assessment, and timing and sequencing of content within a strand. During this process, faculty members realized that students experience all courses and the themes they represent in real time and that students may not see the separation of strands and the relationships between them (Figure 3). To emphasize the relationship between content of the multidisciplinary strands, faculty members felt that “links” connecting the individual learning experiences to the larger goal of general competence were needed to support student learning. These links were created through timing of experiences, delivering content areas across strands as appropriate, and formerly department-based faculty teaching in multiple areas and courses in the curriculum. Figure 4 depicts relationships that were created when faculty members intentionally coordinated content areas within the reform curriculum utilizing a more case-based methodology.

Two elements of the school’s mission are to prepare oral health care providers for scientifically based practice and to define new standards for education. To that end, the curriculum model discussed above was created and formally named the Pacific Dental Helix Curriculum (PDHC). The model places a strong emphasis on active learning, critical thinking, and integration across multiple disciplinary areas and uses small-group, case-based learning as its signature pedagogy to promote high-level thinking and to assist learners in grasping the connections across strands and content areas. A logo was developed as a visual aid in clarifying and supporting the vision for the PDHC internally and externally (Figure 5).

**Implementation**

Curriculum design is a high-stakes operation. Faculty members are responsible for creating and managing a curriculum that provides the necessary learning opportunities for students to achieve stated programmatic goals and other desired outcomes.
Because of the weight of this responsibility, change is often put off or feared and can result in stagnation and inertia. However, given the need to incorporate rapidly growing fields of knowledge and technology, and the impact of such growth on dentistry, curricula must be increasingly flexible.

The implementation of the Pacific Dental Helix Curriculum has not been without challenges. Changes required to develop and implement interdisciplinary instruction and case-based learning have required significant time and energy. In the planning and development stages, early adopters needed to be identified and convinced of the soundness of the proposed direction. The school enjoys a strong reputation for producing outstanding clinical dentists, and some faculty leaders questioned the wisdom of tinkering with a proven model. Already busy faculty members and department chairs were asked to participate in more and longer meetings, many of which took place in the evening when faculty members in all departments were available. Disagreements among individuals or departments over perceived “ownership” of content or sequencing of instruction had to be addressed. With implementation came the realization that faculty development programs emphasizing active learning, small-group facilitation, alternative assessment methods, and modern pedagogy, including the judicious use of educational technology to support content delivery, were urgently needed. Most of the development programs lasted several hours and spanned weeks or months, so they were an additional demand on faculty time; the cost implications of such development programs could not be ignored. The new curriculum also demanded changes in student behavior. The move from an entirely passive learning style to one that engages students and causes them to assume an active role in their learning is ongoing. Lastly, the physical plant was stretched to capacity to accommodate the need for more and smaller seminar rooms for case-based discussions, and room scheduling became a challenge.

Despite significant challenges, the implementation of the Helix curriculum continues with general support of faculty, students, and administrators. Several factors have likely contributed to this. First, the culture of the school, developed over many years, is one that embraces humanistic values. Conversations among administrators, faculty, staff, and students are respectful and civil and reflect a desire to understand one another’s perspective. The humanistic culture has created an environment that encourages exploration of change, honest expressions of opinion, and willingness to act for the common good. Second, keeping all constituencies apprised of developments and asking for input and feedback are crucial. Feedback from students in structured focus groups and on student ratings of instruction has been very positive and signals support for faculty engaged in the reform.

Third, faculty members are evaluated, first and foremost, on their teaching, and the school’s investment in developing faculty as teachers has increased dramatically. Quarterly faculty development days regularly include up to a half-day of training on relevant topics in education such as course design, assessment, and reflective teaching. Courses offered by the Academy for Academic Leadership are held at the school, and internal and external experts have met with the faculty to discuss basic pedagogical concepts. Recently, a full-time doctoral level instructional designer was hired to assist the faculty. The dental school shares with the university the belief that teaching and learning are primary.

Fourth, the school is geographically autonomous from the main university, is not part of a large health science center, and, with an FTE student enrollment of approximately 500, is comparatively nimble. Structures can be created, adapted, or adopted with relative ease compared to larger, more complex institutions. The faculty members who are engaged in the reform process create an “interdisciplinary milieu” that is limited to dental education. This singularity of purpose likely reduces the complexity of change. Finally, strong administrative support is required and resulted in the development of a database that enables the faculty to track students’ progress to ensure that changes have not had a negative impact on critical outcomes such as national board scores.
Based on the experience described in this case study, we would make the following recommendations for dental schools considering major curriculum change:

1. Frequently and publicly inform and engage stakeholders in the process (senior administration, department chairs and other faculty leaders, individual faculty members, key staff, students, and alumni). Devote enough time to present and discuss the reasons and benefits of reform.

2. Define and agree to a clear vision of reform that aligns with school and university goals. Identify appropriate outcome measures, and set benchmarks to gauge success. Charge an individual or office to gather data and report to stakeholder groups.

3. Ensure that the faculty FTE count is appropriate for the planned changes in content delivery and that faculty members have the appropriate development opportunities.

4. Identify and train content coordinators to analyze, manage, and track critical content areas across courses and across the curriculum.

5. Link improvements in the physical plant with the planned changes.

6. Analyze whether existing admissions standards and recruitment procedures capture characteristics needed of students to succeed in the new curriculum.

7. Ensure the appropriate administrative structure to support the new curriculum (membership and chair of the curriculum committee, staffing levels in key departments, academic department structure, etc.).

8. Secure a sufficient budget to support the reform effort, including new hires and faculty development costs.

### Assessment

Until the work of the ADEA CCI, major curricular change in dental education was rare, except for the introduction of PBL in the 1990s. Little published research existed on the impact of major reform beyond the findings related to PBL. More recently, details of the work being undertaken in North America by dental faculty and administrators have been reported. Haden et al. notes that 49 percent of respondents from fifty U.S. and five Canadian dental schools defined their curriculum as primarily organized by disciplinary boundaries with few courses taught by interdisciplinary teams of faculty members. Responses also showed that 47 percent of basic science curricula and 53 percent of clinical sciences curricula were primarily or exclusively discipline-based. Twenty-one percent of responding schools had completed an interdisciplinary curriculum around themes, with another 19 percent claiming that such changes were in progress. On a more positive note, 51 percent of respondents reported that they used case-reinforced learning (CRL) or case-based learning (CBL) to deliver content.

An important byproduct of the development of the Pacific Dental Helix Curriculum was the realization that rigorous evaluation methods are needed to assess the impact of reform. It also became clear that new and varied assessment tools, such as those suggested by Albino et al., may be more appropriate than traditional multiple-choice examinations for measuring the desired higher order thinking skills envisioned by the reform process. In 2010, the Office of Academic Affairs instituted an annual survey of course directors and department chairs that contains questions about content delivery method, primary and secondary assessment types, and efforts toward integration. Results of systematic and comprehensive evaluation can be used to make adjustments to the curriculum and to document that the school is fulfilling its mission, meeting the goals of its strategic plan, and is in compliance with conditions set by external shareholders.

As a result of the launch of the Helix curriculum, a database was created to assist in outcomes tracking and program evaluation. Quantitative data including preadmission variables (Dental Admission Test score, undergraduate grade point average), academic performance in dental school (academic standing, grade point average, and rank by year), clinic productivity (number of procedures completed by discipline), and national and licensure board performance (score, number of attempts) have been collected and evaluated. These data existed previously but were incomplete or housed in different departments and in a variety of formats, making meaningful outcome assessment difficult. The new tool has served as a useful instrument for decision making in areas such as curriculum development, admissions, and student promotion.

Preliminary data for pre- and post-change groups on traditional outcome measures such as National Board Dental Examination (NBDE) Part I and II scores and Year 1, 2, and 3 cumulative grade point average for the first fully implemented strand (Integrated Clinical Sciences) reveal a slight but statistically significant decrease in average NBDE
Conclusion

Strong and direct calls have been issued for major reform in dental education.\textsuperscript{5,15,24,34} This reform can equip future practitioners with the advanced thinking and reasoning skills required for the modern practice of dentistry now and well into the future and can position students to be a major force in local, national, and global health promotion. The purpose of this case study was to describe the process undertaken at one U.S. dental school to design and implement an integrated, multidisciplinary, case-based curriculum model that includes recommendations of the Gies and IOM reports and the work of the ADEA CCI. This article discussed challenges faced by the school and presented a checklist of activities and behaviors that may have contributed to overcoming the challenges. We engaged in and witnessed healthy intra- and interdepartmental collaboration and communication among faculty members around elements of the curricular reform described here and sought in this article to offer our experience as a guide for schools considering a major curriculum change.

The development and implementation of the Pacific Dental Helix Curriculum is ahead of timing expectations overall (Table 2). The ICS and IMS strands have been successfully implemented, and preliminary outcomes measurement has begun; detailed outcomes on each strand will be shared in future articles. Elements of the CP strand were implemented in summer 2012, a voluntary PIP strand is currently under way, and the IPT strand is planned for launch in 2013.

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<tr>
<th>Year</th>
<th>Action</th>
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<tbody>
<tr>
<td>2004</td>
<td>Values clarification exercise</td>
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<td>2005-06</td>
<td>Curriculum committee commitment to reform and initial schedule adjustments to support integration planning for an Integrated Clinical Sciences course (ICS II)</td>
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<tr>
<td>2006-07</td>
<td>Strategic planning process</td>
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<td>2007-08</td>
<td>Selection and training of content coordinators</td>
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<tr>
<td>2007-10</td>
<td>Further planning and full implementation of the Integrated Clinical Sciences strand (ICS I, II, and III)</td>
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<td>2009</td>
<td>Facilities study (Classroom of the Future)</td>
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<tr>
<td>2009-10</td>
<td>Planning for Integrated Medical Sciences (IMS) courses and Personalized Instructional Program (PIP) strand</td>
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<tr>
<td>2011</td>
<td>Implementation of IMS course</td>
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<tr>
<td>2012</td>
<td>Implementation of portions of Clinical Practice strand and pilot launch of the PIP strand</td>
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<tr>
<td>2011-13</td>
<td>Planning for the Integrated Preclinical Technique (IPT) strand</td>
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<tr>
<td>2013</td>
<td>Implementation of the IPT strand</td>
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<tr>
<td>2014</td>
<td>Move to new dental school facility in support of Helix curriculum goals</td>
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This is an exciting and challenging time for dental education. We are in a period of rapid change as practitioners and educators come together to develop best practices in the organization and management of a dental curriculum. This case study is intended to contribute to the advancement of the many exciting changes that are occurring in the global dental education arena and to encourage others to dig deeper into their programs and begin to assess whether desired outcomes are being met.

REFERENCES