Prosthodontics 1966–2042: Changes in Prosthodontic Education, Past and Future

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Abstract

Past changes in prosthodontic education have been influenced by educators' understanding of learning, the physical plants in which they teach and the evolution of the profession (both clinically and politically). A 1968 survey illustrates an emphasis on materials and techniques, and the literature of the day respected "expert" opinion. Although the need for prosthodontics was expected to decline with the promotion of preventive measures, it is actually increasing with the aging population.

Organizational support for defining the specialty of prosthodontics to encompass a broad spectrum of dental restorations and related care helped develop commitment to improved research and education. Instrumental in these improvements were faculty with advanced education in the discipline, better physical plants in which to work and an understanding of the theories of teaching and learning.

Faculty will continue to be innovative and adopt new approaches such as evidence-based dentistry and problem-based learning. However, the lure of research funding and institutional expectations will probably influence how faculty spend their time and energy. Prosthodontic education will continue to evolve, but it will be influenced by its institutional and professional environments.

MeSH Key Words: *education, dental/trends; prosthodontics/education; prosthodontics/trends*

Examining prosthodontic education over a period spanning 2 careers is interesting and challenging. History is known to individuals from a very personal perspective; the future is unknown to all. The period from 1966 to 2042 has already seen significant movement toward science, changes in clinical care and growth in the specialty of prosthodontics. This article presents some history, especially organizational history, that has influenced prosthodontics and prosthodontic education. It ventures into learning theories that are relevant to prosthodontic education, and it addresses the context for and influences on the future of prosthodontic education.

History

Atwood's "Practice of prosthodontics: past, present, and future"[1] was written two-thirds of the way through the last century, a time near the beginning of the period under review. His article, which focused on specialization, opened with "There is little argument today that there has been a knowledge explosion in this century." In retrospect, we now know there was much more to come. Unfortunately, a search of the literature has not revealed any longitudinal studies of prosthodontic education. No survey of current teaching was conducted for the preparation of this article. This leaves open the question, "Has there been change?"

A few responses to Levin and Sauer's survey[2] of complete denture procedures concluded in February 1968 provide something of a baseline. They reported on responses from 33 dental schools in the United States and Canada. Several questions and the most frequent responses are representative of teaching at the time. What material is used for preliminary impressions? Modelling plastic (18 responses). What is the final impression material? Zinc oxide and eugenol paste (28). What is the material used for baseplates? Shellac (10). If remount records are obtained, how are they made? Wax (21). The survey was oriented toward clinical materials and techniques; there was no mention of educational theory or teaching techniques.

The 20 years following World War II saw a rise in continuing education and specialization through graduate and postgraduate education. The need for faculty with advanced education was recognized, as was the need for modernization and building of new facilities.

In 1951, the first issue of the *Journal of Prosthetic Dentistry* was published. Important as it was for a developing specialty, the style was to respect the opinion of the "expert." Research was increasing, but the emphasis was on dental materials and prevention. The belief in prevention became so strong that many were inclined to question the wisdom of choosing prosthodontics as a career. Douglass and others[3] recently expressed a contrasting view. Their analysis of available data led them to conclude that "the number of people in the United States who need complete dentures will increase over the next 20 years despite an anticipated decline in the age-specific rates of edentulism."

Originally the specialty of prosthodontics, as recognized by the Canadian Dental Association (CDA), was limited to removable prostheses and supportive care. In the 1960s, proponents of fixed prosthodontics were fighting for recognition. Graduate and postgraduate programs focused on one or the other. CDA was interested in consolidating the specialties, and George Zarb and Doug Chaytor acted to unite all educationally qualified prosthodontists regardless of modality emphasis. They were joined in this mission by others, including Don Kepron, Jacques Fiset and Brock Love. In 1971, the Canadian Academy of Prosthodontics agreed to relinquish its specialty section status in CDA in favour of the newly formed Association of Prosthodontists of Canada (APC). APC limited its membership to licensed and educationally qualified prosthodontists. In 1973, CDA approved the broadly defined specialty of prosthodontics to include operative dentistry, fixed, removable and maxillofacial prosthodontics.[4] Sometime later, the United States followed this example, but with the exclusion of operative dentistry. Eventually all graduate programs were required to address all aspects of prosthodontics.

The American College of Prosthodontists was founded in 1970 with a similar mandate to enroll educationally qualified prosthodontists. It has become the leading prosthodontic organization in that country.[5] On the world scene, since 1982, the International College of Prosthodontists also seeks to promote the specialty of prosthodontics and its supporting education and research.[6]

Has all this effort influenced prosthodontic education? At the very least, it has led prosthodontists and prosthodontic educators to think and work in the broader sense of the discipline. Structural changes in the administrative units in educational institutions in Canada and the United States have come slowly. In some instances, so-called "mega-departments" were formed and the disciplinary units were retained within them. Since the early 1980s, osseointegrated implants have emerged as the means of addressing all forms of partial and complete edentulism.

The physical plants for dental education and research did indeed expand significantly in the 1960s and 70s. In 1971, Don Gullet, in his *History of Dentistry in Canada*,[7] reported, "Within the last 15 years, the facilities for training new dentists in Canada have more than doubled…. New faculties have been opened in 5 provinces; established schools have been enlarged and modernized." He illustrated these statements with photos showing the use of closed-circuit television at the University of Toronto and the clinic in the new building that opened at Dalhousie University in 1958. Just over 7 years later, a decision was made to construct a larger building at Dalhousie. The 1958 development under the leadership of the dean, J.D. MacLean, brought the first full-time educationally qualified specialists to that faculty. These were certainly times of great change in dental education in Canada. Prosthodontics was a part of it.

Blackburn and Baldwin[8] stated, "One of the most effective ways of changing an organization is to change the people who comprise it." In their opening paragraph they had already said, "The vitality and effectiveness of a college or university is directly linked to the quality, resourcefulness and vigor of its faculty members." Dentistry's need for more faculty, and in particular the need for faculty with advanced education, prompted the creation of the Canadian Fund for Dental Education (CFDE), which has been absorbed into, and succeeded by, the Dentistry Canada Fund (DCF). Beyond supporting graduate education, CFDE and DCF have supported the improvement of teaching through the funding of educational events and programs including summer teaching and administration institutes. Prosthodontics, in particular, has benefited from the Lorne E. MacLachlan bequest and other DCF sources that have supported teaching conferences. Three conferences on implant teaching in the undergraduate curriculum have influenced the development of that component of the prosthodontic curriculum.

Learning

Given that it is the role of the teacher to translate knowledge into an understandable form and to give it a structure that will facilitate learning, it behooves teachers to know something about how students learn. Various theories of learning can be applied to dental education. Three will be identified in this paper. First, R.C. Anderson, an educational psychologist, is credited with developing the schema theory of learning.[9] The second theory, known as the information processing theory of learning, is credited to several theorists.[10] George A. Miller[11] theorized that only a limited number of "chunks" of information, probably 7 plus or minus 2, could be held in short-term memory. This concept enters other theories of learning as well. With so little storage capacity, processing is required. Processing obliges

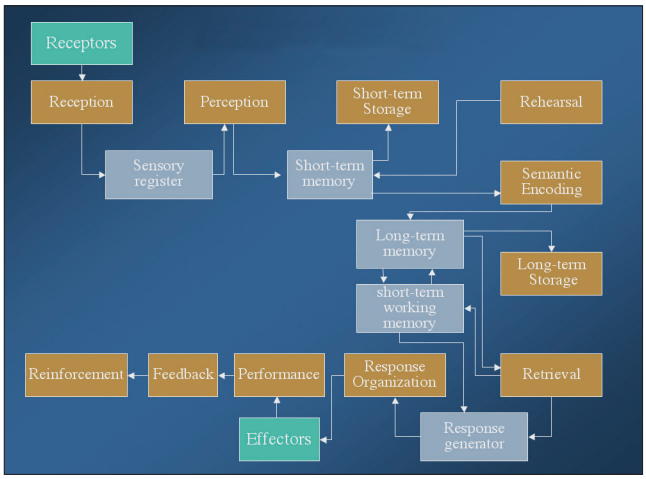

Figure 1: *The process of learning (based on Gagne[12]).*

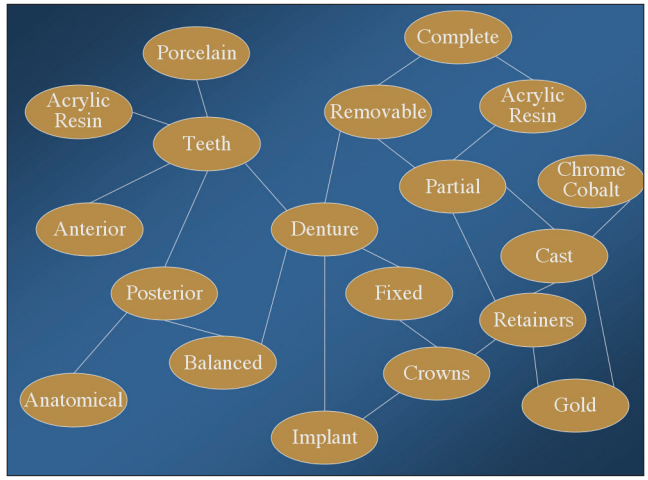

Figure 2: *Schemata, a simplified example.*

the mind to gather information, transform it, store it and respond to it. So there is encoding, retention and retrieval in sequence[12] (**Fig. 1**).

In contrast, schemata are complexly related to each other like multiple interconnected spider webs (**Fig. 2**). They represent different levels of abstraction although they are not hierarchical. They will include much related information. A person, given some of the stored information, can often recall much that is related to it. This theory suggests that learning occurs by connecting information to what is already known and, in so doing, developing multiple connections between old and new knowledge.

The third theory, situated learning,[13] perceives learning as a function of the activity, context and culture in which it occurs. Learners participate in communities of practitioners. Mastery of knowledge and skill requires movement toward full participation in the sociocultural practices of the community. Treatment in a clinical setting surrounded by aspiring students and supervising professionals illustrates this setting.

Many laboratory exercises, especially those on manikins, have been eliminated in favour of direct patient care in a regular clinic. Alternatively, increasingly elaborate approaches to simulating patients and clinical settings have been developed. An authentic context addresses the first principle of situated learning.

What do faculty and students do in these settings? They problem solve, i.e. they treat patient problems. Changes have occurred — not only in treating patient problems, but in how students are taught to do that. The authoritarian faculty is gone. Faculty and students now interact in a more sociably comfortable manner and collaborate in the delivery of care. This happens to be a critical component of situated learning, i.e., "Learning requires social interaction and collaboration."[14]

Consideration should also be given to cognitive styles. Witkin and colleagues[15] used the term cognitive style because they found that they "were dealing with a broad dimension of individual differences that extends across both perceptual and intellectual activities" and that an individual's approach was characteristic of that individual. In other words, a person's cognitive style is stable over time. The theory suggests that people vary in their ability to distinguish objects from their backgrounds, in effect the ability to distinguish important information from unimportant information. A simplified test for this ability (field dependence–independence) is the Group Embedded Figures Test or GEFT. Like most cognitive styles, field dependence–independence is bipolar, but tests are scored from high to low as a measure of field independence. Positive but diverse characteristics are exhibited by people scoring high and low. For example, those scoring on the low side tend to exhibit favourable social skills and are willing to be diverse in their thinking. High scorers tend to want structure in their learning environment. The field-independent student is likely to say, "Tell me the steps and I will do them." Or, if not present, they will bring organization to presented information. Not surprising to a dental teacher, the mean GEFT scores of the dentistry classes tested were all higher than published scores for any other group.[16] Men scored higher than women. This raises some questions for dental educators. Do women in dentistry have a greater tendency to learn like men or should teaching move to accommodate more field-dependent students?

Have faculty changed their teaching styles? Did they knowingly change to address some particular learning theory? Have they been influenced by the social scientists who have joined the faculties? Is it significant that social scientists tend to be field dependent? There was a period when the sources of educational advice given to faculty did not appear to have cognitive styles matched to dental students. Perhaps there are now fewer of that type of student. Are some students still seeking the cookbook, but others happily exploring the literature? One change has

been the introduction of problem-based learning. This approach is clearly designed to prepare students for life-long learning focused on their identified needs.

Despite the pride of prosthodontists in the biological foundation of the specialty, in the late 19th and early 20th century prosthodontics was referred to as mechanical dentistry.[17] Is that all that prosthodontists do really well or have they changed to embrace the biological, the psychological and the sociological well-being of their patients? The change question again. Have faculty changed their teaching content? Certainly textbook content has been changed.[18–20] Perhaps the most obvious change is the increasing emphasis on implant-supported prostheses.

The Future

So what of the future? Evolution rather than revolution will best serve prosthodontic education. The future evolves in a context and is influenced by people. The context of change in prosthodontic education will include the various bodies that seek to set standards and guidelines. Some of them clearly have an educational reference base, others a practice reference base. Perhaps balancing the 2 provides the guidance needed for a profession. Institutions will continue to provide the physical context. Universities have been drifting into a commercial model reminiscent of the situation rejected a hundred years ago, but now research has become the dominant part of the university mission. Faculty are not going to advance in today's universities without demonstrated success in research. Universities and their faculty members are attracted by research funding. Who will do the teaching? Even casual observation reveals that dental faculties are back to dependence on part-time teachers drawn from practice. Their careers are primarily focused on practice and they are essential in bringing a real world practice culture to professional education. This supports the situational learning approach. However, is it reasonable to expect them to have strong second careers, prepared educationally to teach, to translate research results and to place these results in practical applications for students?

Aside from modifying learning opportunities in light of better understanding of how people learn, programs will incorporate important movements such as evidence-based dentistry. Students will be expected to take a more cerebral and challenging approach to the material they must learn. They must learn to ask, "Why?" This is important for the development of a professional, the mark of whom is access to first principles, and consequently the responsibility for decision-making in the best interests of patients. Unfortunately, students may not have the required technical support. Rather than improving, dental technology programs are closing. Some enterprising companies are recognizing this and developing computer-assisted design/computer-assisted manufacturing (CAD–CAM) approaches to dental technology.

Technology has revolutionized how students gain access to information. Paper textbooks and journals are no longer their first choice for information. This trend will certainly continue.

Dentistry is not a spectator sport. Given dentistry's practical component, the profession and the institutions to which it has delegated the responsibility for education must develop practice competencies. Practice will change. Education will change to match the practice changes. The brief references to history and introductory references to learning theories and cognitive styles have been provided here to show that there has been an environmental change surrounding prosthodontic education. Indeed there have been significant changes in prosthodontic education. They have occurred within a context of institutional and organizational influences. Many changes have been made in response to changing clinical practices and to faculty acquiring a greater understanding of how learning occurs. ✦

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