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In My Opinion

Rethinking Knowledge and Pedagogy in Dental Education

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Abstract: Dentistry as a profession has often been considered both art and science. Traditional dental education has attempted to address both; however, in many places only the science of dentistry is emphasized. The move toward competency-based curricula in dental education requires an expansion of what constitutes meaningful knowledge in the curriculum and what pedagogies best support that curriculum. The scientific and technical knowledge considered foundational to clinical practice is not sufficient to teach competencies associated with the art of dentistry. Habermas, a social scientist, offers a way of looking beyond technical knowledge to consider two other forms of knowledge: practical and emancipatory. Pedagogy that supports development of practical and emancipatory knowledge includes problem-based learning and case methods, heuristics, reflective practica, journals, storytelling, and performance-based assessment methods. These important teaching strategies are being integrated into various dental curricula including a new competency-based dental curriculum at Marquette University's School of Dentistry. It will be critical for dental educators to continue developing these methods to provide efficient and effective education for future practitioners in both the art and science of dentistry.

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The movement toward competency-based curriculum in dental education aims at producing graduates who are not only able to provide comprehensive patient care that is scientifically based and technologically appropriate but also able to appreciate, understand, and actively seek solutions to current intellectual, social, behavioral, and philosophical problems in dentistry. They are dentists who are committed to reflective practice and life-long learning.^{1,2} In the move toward a competency-based model, many dental schools are experimenting with different methods of curriculum organization and sequence.¹⁻⁷ However, simple alteration of instructional timing or sequence may not significantly affect the teaching practices of dental school faculty.⁷ In addition, new ways of organizing the dental cur-

riculum may not change faculty beliefs about the kind of knowledge that is essential in dental practice.

Beyond Technical Knowledge

Some dental schools have been experimenting with teaching methods like problem-based learning, reflective activities, heuristic strategies, and performance-based assessment,^{3,6,8-11} while other schools remain locked into more traditional methods. As many leaders in the curriculum revolution in nursing education have argued, if the goal of professional education is a technically knowledgeable graduate who is a life-long learner, socially astute, professionally aware, and competent, then the kinds of knowl-

edge needed to shape these particular attitudes and skills need to be meaningfully addressed in the curriculum.¹²⁻¹⁵ Dental educators not only need to become aware of forms of knowledge other than the technical, but they need to become aware and skilled in the teaching strategies that foster these other forms of knowledge. In this article, we share how we are integrating these methods into a new dental curriculum at the Marquette University School of Dentistry in the hope that more institutions will continue to develop them and expand their use.

Habermas,¹⁶⁻¹⁷ a German social theorist, offers a way of looking at knowledge beyond the technical in his description of three forms of knowledge: technical, practical, and emancipatory. Habermas's argument is based on his critical examination of the claim that science offers a neutral objective reality, which can be understood in the same way by natural and social scientists. Instead, Habermas maintains that different forms of knowledge (in both natural and social sciences) are determined by different groups of people whose needs and interests vary and whose research methodologies and ways of knowing differ, depending largely on those needs and interests. For Habermas, technical knowledge is developed by those interested in controlling and manipulating the environment; it tends to look for causal explanations. Technical knowledge includes the laws, principles, and theories derived from the empirical, analytical sciences. In dental education, technical knowledge includes most of what has been traditionally taught in both basic and clinical sciences.

Practical knowledge is developed by those interested in social interaction and communication; it tends to seek interpretations derived from the historical-hermeneutic sciences like history, literature, and the social sciences. Instead of laws and theories, its focus is on collective understandings and applications within a particular context. A curriculum that seeks development of practical knowledge emphasizes communication, collaboration, and group problem-solving rather than objective knowledge acquisition. In dental education, practical knowledge includes many of the critical thinking, problem-solving, and communication competencies promoted for comprehensive patient care. Meehl,¹⁸⁻¹⁹ a clinical psychologist, proposes that these aspects of practice knowledge (cognitive activities of the clinician) can never be replaced by technical knowledge alone but largely by the clinician's experience and skill. In a clinical context, the dentist must relate scientific prin-

ciples to a particular aspect of the patient's life history and clinical presentation. Such decision-making is often referred to as the art of dentistry.

Finally, emancipatory knowledge is developed by those interested in self-knowledge and self-reflection with a particular emphasis on gaining control over constraints on personal and social progress. Drawing from the critical social sciences, a curriculum that seeks the development of emancipatory knowledge emphasizes active investigation and inquiry, self-reflection, ethical decision-making, and individual empowerment often derived through a critique of the social and political forces that shape and hinder personal and professional activities.^{12-14,17} In dental education, emancipatory knowledge includes the skills needed for autonomous and life-long learning that are stressed in current discussions of competency.^{1-3,6,7} It also includes moral decision-making and application of ethical principles needed for care of underinsured, uninsured, and diverse populations.

Pedagogy That Supports New Views of Knowledge

It is our contention that the practical and emancipatory forms of knowledge have been underemphasized in the dental curriculum. Until they are acknowledged and fostered, visions of competency in dentistry and the joining of theory and practice will be difficult to achieve. Dental educators need to investigate teaching strategies that develop practical and emancipatory forms of knowledge. We highlight some of these strategies here in the hope that dental educators will explore them more deeply as they consider competency-based curricular change.

Problem-Based Learning and Case Methods

In recent years, problem-based learning and case methods have become an often-used approach to bridge theory and practice in medical, legal, business, and teacher education.²⁰⁻²³ Methods used in these fields vary considerably. In law school, cases are used to exemplify legal precedent; in business and teacher education schools, cases are often vivid stories of professional dilemmas that require students to collaboratively engage in a complex-problem-solving process in which they consider alternative solu-

tions and attempt to apply theory to practice. In medical and dental schools utilizing problem-based learning for clinical problem-solving,^{7,20-26} small groups of students analyze patient cases that allow them to use the technical knowledge gleaned in their basic science coursework for clinical problems.⁷ Advocates of case methods and problem-based learning argue that these instructional methods foster a variety of competencies important in professional practice. These include problem-solving and clinical reasoning skills⁷ and cognitive flexibility as students are immersed in the ill-structured domain of practice where problems are not solved by simple formula or application of textbook learning.²⁷ Case methods and problem-based learning sharpen the ability to look at problems from multiple perspectives^{28,29} and encourage collaborative inquiry. At the same time, case methods can promote the individual autonomy and reflection that have been associated with advanced stages of cognitive development and reflective judgment.³⁰

A variety of fields have employed hypermedia and videodisk technologies to simulate patient cases and problems of practice.^{7,31} By exploring and reconstructing cases through the manipulation of moving and still pictures, multiple audio tracks and text, students can practice nonlinear problem-solving techniques. The process allows students to revisit situations quickly so that they can consider multiple perspectives on one event almost simultaneously in a way that is often required in clinical situations.

At the Marquette University School of Dentistry, we have developed case-based CD-ROM educational modules involving decision tree algorithms that can be used either individually or in small groups. These cases involve patient assessment, diagnosis, and treatment planning. A comprehensive patient history is provided along with findings from a clinical examination and followup lab tests or biopsy results. The student has the opportunity to ask additional questions to acquire more relevant data. The student is then required to navigate through a diagnostic and treatment planning algorithm. Each time a proper decision is made, the student is permitted to continue. If an error is made, the student is redirected to relevant data from the clinical exam and patient history along with links to appropriate background information from basic and clinical sciences. The student then gets another chance to navigate the algorithm. After completing the exercise, the student

receives an assessment of performance and feedback regarding the appropriateness of questions asked and data obtained along with suggestions for improvement.

These self-directed modules prepare students for a "Dental Grand Rounds" curricular track where students present cases for discussion and review with clinicians and basic scientists acting as facilitators. The cases are presented in an integrated interdisciplinary fashion that emphasizes comprehensive care. Students are required to justify the patient assessment and treatment process as well as discuss the relevance of basic science foundation knowledge to the clinical procedures and outcomes.

Heuristic Strategies

Research and theory in the cognitive sciences suggest that, for optimal learning and the ability to apply knowledge into practice, students need to actively construct and organize what they are learning.³²⁻³³ Heuristics are supportive structures that encourage students to do so. For example, teachers can introduce graphic organizers to their students as a tool for note-taking, study, and concept acquisition as well as ongoing self-assessment of understanding. Smith³⁴ adapts the Vee diagram developed by Gowin³⁵ as a way in which nursing students can first outline specific concepts, principles, and theories related to clinical practice skills and then use that theory to answer a question about a specific clinical event. The Vee heuristic offers the student a way to create practical knowledge from theory. Concept maps and relational diagrams where students create schematic drawings of their mental understanding by organizing and linking relevant concepts are used widely both in nursing education³⁴ and K-12 education.³⁶ Similarly, a variety of templates and pedagogical structures have been developed to help students develop problem-solving skills.³⁷⁻³⁸

At Marquette, we are currently using three specific heuristic strategies in our new curriculum. The ethics area utilizes a specific model to approach ethical decision-making, which consists of a series of approaches to analysis of the particular problem. These approaches are based on philosophies of several authors and leaders in ethics and moral decision making. Students are encouraged to apply these different analytical approaches and to compare basic assumptions and value systems being utilized. This results in a stepwise analysis of the factual data sur-

rounding the problem. Students progressively eliminate undesirable decision options until they are able to arrive at a defensible decision based on the available information. Oral pathology employs customized decision trees to arrive at the proper diagnosis of oral lesions. The decision trees are organized to guide students through the diagnostic process in a stepwise fashion emphasizing integration and analysis of clinical findings, laboratory tests, and patient history. General dentistry uses a template for the medical management of cases that guides students through various treatment options based on clinical findings, patient history, and patient preferences. The template allows for multiple treatment options dependent on clinical judgment and level of practitioner experience.

The Reflective Practicum

Under the guidance of an experienced mentor, students can gradually move from external direction in learning to greater self-direction.^{13,39-40} In curricula sensitive to this transformative process, the student's own experiences are recognized as valid knowledge¹⁴ throughout the learning process. Brown, Collins, and Duguid⁴¹ describe these practica as "cognitive apprenticeships." In these apprenticeships, the clinical teacher acts as a coach, first modeling the desired skills and attitudes, then coaching the student to do the same, then gradually withdrawing needed supports until the student is able to work independently and reflect on the experience.⁴⁰⁻⁴¹ Schon has described how such practica can work in a variety of professional fields.⁴⁰

Marquette School of Dentistry has developed an extensive extramural program for all dental students that provides "externships" in private practice settings. These off-site experiences are variable in length, comprising rotations of two weeks to three months. During these externships, students are essentially participating in an apprentice relationship with practicing clinicians. They observe patient interactions and treatment, provide patient care under close supervision, and gain first-hand experience with the skills and attitudes required for successful doctor-patient relationships. In addition, within our dental school clinics, we have initiated a mentorship program in which certain clinical faculty are assigned to students on a permanent basis. These faculty supervise all patient care and provide an apprenticeship experience on site. We have also initiated pilot

programs utilizing telehealth technology (live audio and video streaming) to allow students in conference rooms or lecture halls to observe patient care at remote locations. Faculty facilitators lead discussions concerning doctor-patient interactions, doctor-staff interactions, provision of care, and patient responses.

Journals

Journal writing is used widely in teacher education to develop practical and critical reflection about clinical experiences to aid student teachers to consider alternative interpretations and solutions to problems and to push students into considering political, moral, and social issues that affect practice.⁴²⁻⁴³ Beyer,⁴² for example, describes his use of journals in a course where student teachers participate in a human service project in an agency that works with people of low socioeconomic status. The project and the reflective writing aim at helping "prospective teachers develop a theoretical framework that will draw them outward, uncovering the political, moral, and social issues with which teachers necessarily deal." Smyth's⁴³ method of journal writing is also aimed at fostering critical analysis and transformative action. After writing a narrative about a confusing or contradictory situation, the student is asked to analyze the implicit operational theories in use behind the situation and then situate those theories in a broader cultural, social, and political context with particular attention to what social constraints exist.

At Marquette, the "Early Clinical Practice" course uses this approach to provide education concerning ethical decision-making. Faculty lead small group discussions on papers that describe various scenarios of ethical dilemmas. Students are required to read the materials, write journals about what they see as the moral conflict or ethical dilemma, and describe potential thought processes and approaches to resolving the situation. Thus, the small group discussion draws heavily on the written journals to stimulate and facilitate conversation. It also forces students to recognize their personal bias or their individual positions during the discussion process.

Reflective Storytelling

Mattingly⁴⁴ describes storytelling about critical incidents in clinical experiences as an effective way to develop practical knowledge for occupational therapists. Storytelling methods are based on the view

that the knowledge that guides practice is often tacit and hard to reflect on or articulate. In a project with a group of occupational therapists, Mattingly⁴⁴ asks them to watch videotapes of each other's clinical work and then take turns narrating what they see on these videotapes. This method helps the therapists recognize "the interpretive nature of their work. They become much more conscious of the immense assumptions they were making . . . about the lives of their patients, about what mattered to them and what they ought to care about." By hearing multiple interpretations of the same tape, the therapists begin to "view their own interpretations of their clinical sessions as just that—interpretations, rather than clear mirrors of how things just are."

At Marquette, our "Dental Grand Rounds" and telehealth approaches provide examples of this educational technique. Essentially, students present cases in a comprehensive format that tells a story of patient care. Other students ask questions during the presentation and are asked to analyze and evaluate what they are observing. Clinicians and/or basic scientists as facilitators lead discussions concerning what is being done and why. Students are encouraged to assess and analyze interpersonal interactions, diagnosis, treatment, and outcomes.

Performance-Based Assessment Methods

Competency-based curriculum advocates point out that judging competency as an outcome must include careful assessment methods.²¹ As disciplines move away from passive learning and simple multiple-choice tests, there has been a growing movement toward performance assessments that evaluate the application of knowledge and skills within a professional context. In medical education, although direct and indirect observations of student interactions with actual patients have been used as well as computerized simulations of patient cases, standardized patients are becoming an increasingly popular method. These live patient simulations using laypeople who have been trained to present particular patient problems have been used in medical education and more recently in dental education to assess skills in patient interviewing and examination, communication, and clinical judgment as well as technical skills.^{7,45-46}

Many performance-based assessment methods have been incorporated into the curriculum at Marquette to ensure student competency. In the clinical setting, these include faculty observation and assessment of student performance in diagnostic and restorative sciences as well as clinical competency exams on standardized simulations and live patients. These assessments are based on defined criteria that require students to demonstrate skills, attitudes, and abilities necessary for the successful practice of general dentistry. In the preclinical setting, we are developing a simulation laboratory for our new facility that will utilize standardized simulations of restorative procedures providing instantaneous feedback on student performance. Students will also be able to access standardized demonstrations of procedures by touch screen on demand, and faculty will be able to evaluate student approaches/performance from remote sites via telehealth technology.

Contributing to Successful Dental Education

In moving toward a competency-based model of dental education, dental educators must move beyond simply mastering technical knowledge and aim at the development of practical and emancipatory forms of knowledge that include the attitudes, values, interpersonal communication, ethical principles, and autonomous learning skills necessary to provide comprehensive patient care. To do this, we suggest looking more carefully at how practical and emancipatory curricula are being implemented in medical, nursing, and teacher education. We particularly encourage dental institutions that have initiated these approaches to continue to develop and expand their applications and determine how to optimally support the faculty engaged in such endeavors. Our new dental curriculum and facility are designed to incorporate such approaches based on the long tradition of the clinical art of dentistry and the apprenticeship model of training, where many of the practical and emancipatory aspects of dentistry have been learned. To be successful, dental education will need to be able to combine the nature of clinical art, epistemology, and the hermeneutic approach.

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