

## Reading “Reasoning Minds”

Dental educators are paying a lot of attention to how to incorporate and assess students' critical thinking skills, accelerated by implementation of an accreditation standard on critical thinking and problem-solving in 2013.<sup>1-3</sup> The difficulty we face is that both the teaching and assessment of these skills are challenging given their very nature. How does one design exercises that allow students to practice these skills and show improvement to the assessor, especially exercises that can be assessed in a standardized way?

A “reasoning brain” or “reasoning mind” involves steps that may not always be apparent to the observer since so many variables impact the way in which individuals process and apply information.<sup>4</sup> One of those variables—experience—plays a central role. Dental educators frequently design experiences in which students practice how to reason and apply. Case presentations, research projects, problem-based learning, and team-based projects require students to practice reasoning, critical thinking, hypothesis formation, and problem-solving. Assessments that allow educators to observe how students are developing these skills include objective structured clinical examinations (OSCEs), checklists, well-designed essays, case-based exams, and portfolios.

The challenges we face have to do with the amount of time it takes to design those exercises and assess these skills in a calibrated, objective way. There are validated tools for measuring critical thinking skills, but these are useful mainly for research purposes.<sup>5</sup> However, artificial intelligence and machine learning concepts may allow a future in which students and faculty can track reasoning minds in a different way.<sup>6</sup>

In the classroom, our students are constantly interacting with us using technology. They download our PowerPoints, watch lecture capture, and access resources through learning management software platforms. Using interactive technologies, students answer questions we pose during the lecture. We use software programs to deliver exams and grade them, providing students with customized reports on their performance. Students access e-books and e-journals in libraries or on their laptops. Some publishers have technologies that use machine learning to customize learning pathways for users based on information

students are accessing and how they perform on quizzes. Imagine now a system that could gather all this information across all machines and platforms to analyze the data using artificial intelligence. The output could be used to help students customize their learning, and it could help faculty and educators understand each individual student's strengths and weaknesses. In fact, IBM Watson Education and other machines are making this future happen.<sup>7</sup> IBM claims, “We are transforming the learning experience through personalization. Cognitive solutions that understand, reason, and learn help educators gain insights into the learning styles, preferences, and aptitude of every student. The results are holistic learning paths, for every learner, through the lifelong learning journey.”

Perhaps, as we seek new ways to design learning experiences for and assess critical thinking, we can all look to a future in which the reading of reasoning minds will be facilitated by machine learning and artificial intelligence.

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