Anticipated and Actual Implementation of Case-Based Learning by Dental Faculty Members During and After Training

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Abstract: The aims of this study were to describe the processes used to train dental faculty members in case-based learning (CBL) and to determine their beliefs about the anticipated implementation of CBL and perceptions of actual implementation following use of the CBL approach. Participants were dental faculty members at the University of Florida who received a four-day intensive training course in the use of CBL. Two focus groups were conducted. The first occurred during training to assess how the participants anticipated using CBL. The second was conducted during the faculty members' implementation of CBL. All 19 trainees participated in focus group 1 (100%). During the course of the study, two faculty members left the school; of the remaining 17, 12 participated in focus group 2 (participation rate of 71%). The findings showed that initially the faculty members were hesitant and uncertain about using CBL. Following implementation, those issues dissipated, as the participants began to consider how to optimize the effectiveness of CBL as a legitimate method for fostering student ownership of learning and active participation. Understanding what CBL means for individual educators at varying stages of change will likely allow the dental education community to better anticipate and address tensions and challenges that faculty members are likely to experience.

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Academic organizations are perceived to work harder at maintaining a legacy of histories, personal privileges, and positionality than creating innovative futures.[1] Conservative leadership and individuals resistant to change characterize academic institutions.[2] Hierarchical power and authority structures as well as tenured faculty members who tend to behave as if they are relatively independent of their environment frequently thwart change initiatives. Making change in academic dental institutions presents additional challenges. Declining state resources, the modernization of health care schools, and the imperative to ensure that clinical educational programs mirror the reality of dental practice necessitate offering curricula that foster students' integration of the biomedical foundations of oral health pathology with comprehensive patient care.

The need for making a change in our dental school at the University of Florida was brought about by observations that the school's 2 + 2 curriculum (based on didactic courses and preclinical laboratory training in the first two years followed by clinical training in the last two years) was not benefitting student learning in the ways that the faculty had hoped. Of even greater importance, faculty members reported that many students were unable to translate didactic preclinical knowledge into the clinical application environment when they began providing patient care. We started to search for ways to develop a dental school curriculum that could foster a multidisciplinary health science education experience. Our aim was to infuse better integration of biomedical preclinical information while focusing on patient care so that students could recognize that a

biomedical foundation is integral to the provision of oral health prevention, treatment, and maintenance of patients.

For many years, health professions schools including dentistry have used a traditional lecture-based curriculum. The traditional didactic lecture uses an instructor-centered classroom setting in which students are passive listeners rather than active learners.[3] The focus of the traditional lecture setting is to expose students to course materials and discipline-related concepts; however, it allows few opportunities for student interactions. Providing students with the most recent research and evidence-based findings is unattainable in schools' curricula that continue to be packed with an overwhelming number of didactic lectures. When properly structured, lectures can be an efficient method of teaching for providing up-to-date knowledge. When properly implemented, lectures can integrate the instructor's personal overview of the material with complex information from multiple sources.[4] However, traditional lectures are less effective in promoting the application of theory and the development of critical thinking skills.[5]

Persistent concerns about the unpreparedness of students to link preclinical theory and training to clinical application propelled the faculty to seek alternative teaching methods, such as active learning. Active learning is a student-centered, not instructor-centered, teaching approach that uses interactive, multimodal strategies to create a more engaging classroom setting than is possible in the traditional didactic lecture. Case-based learning (CBL) was considered to be the teaching approach that could address the students' lack of connection between preclinical experiences and clinical application.

The overarching goal of CBL is to prepare students for clinical practice by promoting critical thinking skills and evidence-based decision making. A well-developed CBL should link theory to practice through inquiry-based learning methods and the application of knowledge to cases.[6] CBL is used to further develop students' ability to think critically and treat a patient comprehensively, while taking into account the patient's medical, dental, psychosocial, economic, and cultural conditions and simultaneously using students' understanding of the basic biomedical aspects of the presenting pathologies. As a mechanism for integrating basic and clinical science, CBL is believed to increase students' retention and transfer of knowledge to the clinical setting and to promote interest by allowing them to see the relevance of basic science content to clinical prac-

tice.[7,8] From a theoretical perspective, this study was grounded by Kotter's eight-stage process of creating a major change: 1) establishing a sense of urgency; 2) creating the guiding coalition; 3) developing a vision and strategy; 4) communicating the change vision; 5) empowering broad-based change; 6) generating short-term wins; 7) consolidating gains and producing more change; and 8) anchoring new approaches in the culture.[9]

Implementing case-based learning was driven by a sense of urgency in our college to bring about curricular change and adhere to accreditation mandates, as well as the college's curriculum revision process and faculty observations. Funding from a major grant source, the Human Resources and Services Administration (HRSA), and insight from the grant's implementation and evaluation team provided a vision for developing a coalition of faculty around this change. Multiple presentations to the college's faculty and meetings to solicit the participation of individual faculty members in the training groups helped communicate the CBL agenda, propose methods for realizing this change, and establish buy-in to the week-long training. The change initiative was based on a prospective view that the profession has moved towards requiring dentists to successfully engage in analytic inquiry and integration and the need to adapt and apply their learning, so that they can take appropriate actions in response to complex and often unanticipated challenges throughout their careers. At the professional level, the Commission on Dental Accreditation (CODA) began mandating that dental students demonstrate critical thinking and acquisition of evidence-based information in clinical reasoning and problem-solving. The new CODA standards require students to 1) integrate medical treatment into dental treatment plans, 2) identify needs to consult with other health care providers, and 3) critically appraise, apply, and communicate scientific literature.[10]

The CBL method was seen as a vital contribution to creating a series of progressive biomedical science presentations via an organ systems (e.g., cardiovascular, digestive) approach in successive semesters, so that basic, behavioral, and oral clinical sciences would become seamlessly integrated. The aim of the prospective curricular change was to aid in the development of clinical skills for diagnostic and treatment planning while the students were enrolled in didactic courses. The ultimate purposes of active learning are to keep students engaged in the material in an environment that increases student

performance and motivation to learn. Active learning was also expected to increase classroom satisfaction and facilitate higher-level thinking skills.

Small-group CBL, one type of active learning, is similar to problem-based learning (PBL) in that it relies on the use of a case, problem, or inquiry that is used to stimulate and underpin the acquisition of knowledge, skills, and attitudes.[11] As noted by Azer, the process helps to develop students' cognitive skills.[12] CBL is an active method of teaching, in which five to ten students meet together with an assigned faculty member who serves as a case facilitator. Facilitators play a crucial role in CBL by allowing students to develop a collaborative, team-based approach to their education. Cases are generally written as problems, which provide a background of the patient history including relevant clinical situations—for example, vital signs, clinical signs and symptoms, and laboratory results.

In a systematic review of health professions CBL studies, Thistlethwaite et al. explored its effectiveness in the achievement of learning objectives.[6] Of the studies they reviewed, only 23 of the 104 (22%) met the criteria for high quality and significance. Of those studies, only one (by Richards and Inglehart[13]) focused on ways to increase the effectiveness of CBL with and without a behavioral science instructor. The findings of this study sustained the hypothesis that students with a behavioral science instructor would rate patient-centered and culturally relevant information higher when identifying a case-based problem list than students without a behavioral science instructor. In particular, Richards and Inglehart's work supports the use of CBL in the predoctoral dental curriculum. Their findings showed that the interdisciplinary teaching of CBL assists in shaping the prospective values and thinking of future dentists. According to Thistlethwaite et al., teachers enjoy CBL and find this method to be an efficient use of their time.[6]

There are various methods for implementing CBL. However, what distinguishes CBL from other teaching methods is the use of a real or simulated case that encourages students' "application of knowledge to clinical cases [to promote] their understanding of concepts, [to focus their] attention on a presented scenario [that requires] students to develop resolutions, [and develops] their thinking skills and creative abilities" (p. 1521).[6] Overall, CBL promotes student meaning-making, encourages student self-directed inquiry, and supports students' application of biomedical information to patient oral health dilemmas.

The aims of this study were to describe the processes used to train dental faculty members in CBL and to determine their beliefs about the anticipated implementation of CBL and their perceptions of actual implementation following use of the CBL approach. To our knowledge, this is the first article that reports dental faculty perceptions of CBL training and implementation.

Materials and Methods

This study was conducted after receiving approval from the University of Florida's Institutional Review Board (IRB #U-274-2013). Signed letters of informed consent were obtained from each participant prior to the focus group interviews. The participants were 19 dental faculty members from the University of Florida who received a four-day training session in CBL. Of these participants, nine were clinical faculty members and ten were basic scientists; nine were females and ten were males.

Focus group interviews were conducted on two occasions: during the CBL training week (focus group 1) and after implementation of a pilot CBL case in the curriculum (focus group 2). According to Hesse-Biber and Leavy, focus groups are recommended when the study's purpose is to qualitatively describe participants' experiences of a new initiative.[14] Focus groups are especially useful when the objective of data collection is to obtain information that would otherwise remain unknown or would not be comparable to what might be acquired through surveys or individual interviews.[14] Most qualitative researchers opt for homogeneous focus group participants. Homogeneous groups are advised by Hesse-Biber and Leavy when the researcher wants to gain an in-depth understanding of participants' experiences. Since all of the participants experienced the CBL training, the use of focus groups was a natural fit.

The first cohort group of faculty members (n=10) was trained in spring 2012, and the second group (n=9) was trained in fall 2013. Two contracted faculty members from a different institution (a professor and physiologist with specialization in ethics and a microbiologist), both with nearly a decade of experience in teaching dental faculty how to use CBL methods, provided the training. The training sessions were augmented by print material that consisted of the *Small-Group Facilitator Training Workshop: Handbook for Small-Group Learning and Critical Thinking* and videotaped sessions conducted at

Indiana University School of Dentistry that showed students working together in a small group and analyzing a case with the presence of a facilitator.[15] Table 1 shows the questions asked of the trainees in focus group 1 as they anticipated implementation of the CBL method.

The small number of participants in the study was connected to the overall study design and purposes. While some methodologists would assert that the small sample was a limitation to generalizability, we argue that there are particular advantages inherent in in-depth studies that illuminate the complexities of information provided by individuals.[16]

CBL Faculty Training Sessions

The training sessions (total of 35 hours), which included didactic and practical components, were conducted by two experienced CBL facilitators who had experience teaching faculty about this method. As part of the didactic component, the faculty members received information on the CBL method and its background and related teaching and modeling facilitation skills. The participants watched videos of real CBL scenarios, discussed what facilitators should and should not do, and learned the basic steps on how to write CBL cases. As part of the practical component of the training, trainees played the role of facilitators in two days of CBL exercises with students.

One day prior to the CBL exercise, the trainers reviewed the CBL approach and the goals of the exercise with the faculty trainees and with students separately. During the actual CBL activity, as students performed (read and analyzed) the case, trainee faculty members rotated through the room one-by-one while other trainees were watching their facilitation session via a camera installed in the CBL room.

Trainee faculty members received immediate feedback from the trainers after their role-play as facilitators, and a debriefing session also took place at the end of each CBL exercise session. Together, the grant leadership team received assistance from another faculty member with extensive knowledge of the college curriculum and CBL implementation to select basic science and clinic faculty members to participate in the CBL training sessions. Based on the expertise of those involved, a basic science faculty member was matched with a clinical faculty member to develop a case. The paired faculty members were asked to develop a list of objectives during the first phase of case development. The objectives were revised by another basic science faculty member who had been trained in CBL and had experience with CBL implementation to ensure that all objectives were met or to have the trainee faculty members consider some limitations on the number of objectives. This basic science faculty member provided a case writing guide and examples of cases being used and worked closely with each pair of faculty members during the design and implementation of cases in a step-by-step process. Many CBL cases have now been developed and implemented, and several cases are included as part of the closest related curriculum course. In many instances, the course director is a member of the CBL writers' team. Each course has one specific CBL case throughout the semester; the case takes the place of one to three hours of lecture time.

During this CBL training exercise or any CBL case, students read aloud a portion of a patient case-based scenario that provides a context for searching and learning curricular content and thinking about how the information can be applied to clinical reasoning. Students read the case aloud and stop after

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Table 1. Questions used in focus group 1 during case-based learning (CBL) training

1. Imagine that you are sitting down over coffee with a long-standing friend, and she asks you to describe how your views of teaching have changed after having your first day of training in CBL. What will you tell her?

2. Tell me about the teaching skills you currently possess that you think will help you in making the changes needed to (a) become an effective CBL facilitator and (b) write a case that is a good teaching tool.

3. Following this session, how comfortable do you feel becoming a facilitator of small-group learning?

4. Following this session, how comfortable do you feel in managing conflict in small groups?

5. What will be your biggest challenges related to facilitating:
   a. student knowledge acquisition
   b. teaching skills
   c. group processing skills
   d. ensuring that students evaluate their reasoning and proposed diagnosis

6. What will you recommend to students when one or more group members does not complete assigned group tasks?

each paragraph to identify what they know, identify the chief complaint(s), write down the facts as they become known, explore all existing knowledge thoroughly, identify what they need to know (also referred to as knowledge gaps), and hypothesize a provisional diagnosis. The identification of knowledge gaps is crucial for the success of CBL since students can use these gaps as opportunities to search related biomedical and clinical literature. To prepare for subsequent sessions, students search the literature to acquire information to fill their knowledge gaps, identify the sources they use, and evaluate the credibility of those sources. Students are expected to critically appraise the evidence they find and describe how the information gained contributes to their understanding of diagnosis and treatment planning. Engaging in critical appraisal of the literature requires their familiarity with research design and study methods, so that they are well positioned to evaluate the findings.

Implementation of CBL Cases

After receiving training in CBL, a basic science faculty member and a clinical faculty member were grouped in pairs to begin writing cases, which were to incorporate aspects of their own disciplines, therefore fostering a multidisciplinary collaboration and teaching approach. Two of the CBL cases written by the faculty trainees were tested as part of actual ongoing courses for later inclusion in the school's curriculum. These cases comprised three sessions (three hours total, scheduled two to three weeks apart) that were introduced in place of three hours of traditional lecture time in the specified courses. The cases provided the chief patient's complaint, laboratory and radiographic tests, and intraoral pictures as appropriate. Unlike in a previous study,[17] live patients were not used.

For each CBL case, students were organized into ten groups. All student members of the group were expected to review their knowledge gaps, use peer-reviewed sources to find information in the literature, and return to the second session to present what they had learned. The second session began with a review of the articles or other resources that students had found and brought with them. Students were expected to develop a provisional diagnosis based on information presented in the case and their own reviews of articles and other resources, to develop a treatment plan, and to answer the patient's questions. By the third session, students were expected to use role-play to show how they would share the treatment plan and provisional diagnosis with the patient, to practice communication, and to anticipate additional questions a patient might have relative to the treatment, prognosis, cost, insurance, and the patient's role in follow-up care and subsequent appointments.

During focus group 2, participants responded to questions concerning the tested cases in which the trainees were able to work as facilitators. Table 2 shows the questions asked of the participants in focus group 2. The purpose of the second focus group was to ascertain the faculty members' experiences using a case with students and to discover their perceptions of how the CBL approach could be implemented into the curriculum.

Data Analysis

A PhD student in education transcribed focus group interviews 1 and 2 verbatim. To ensure accuracy, the first author reviewed the interview transcripts while listening to the audiotapes. We used grounded theory methods, a process of successive levels of data analysis and conceptual development that leads to the explanation of a process and creation of middle range theories to analyze the data and report the findings.[18] Participants' reported experiences were the unit of analysis. The theory that arises from the research is grounded in the views of the study participants.

Data analysis began after reviewing the transcription of each focus group interview. Line-by-line

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Table 2. Questions used in focus group 2 following implementation of case-based learning

1. How comfortable were you while facilitating small-group learning?

2. What did you experience while trying to ensure that students were:
    a. able to identify their learning issues?
    b. using problem-solving skills?
    c. using appropriate communication skills?
    d. evaluating their reasoning and proposed diagnosis?

3. Did anything occur during the case implementation that caught your attention?

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coding was conducted to perform open coding. In this level of analysis, the researchers list small chunks of critical information gathered (codes) and categorize groups of codes into themes. The open coding method of "in vivo coding" preserves the participants' actual language in the coding in order to prioritize and honor the participants' voices.[19] Each theme of the respective categories that arose from open coding was labeled using gerunds (action words) as Charmaz recommends.[18] The development of themes from the codes requires frequent and comparable reflection on participant meanings, continuing analysis of the primary questions, and purpose of the research and literature review simultaneously.[16] The constant comparative method of data analysis was used to help ensure that the results are representative of the study participants' meanings. Data for focus groups 1 and 2 were analyzed using NVivo version 10.

Results

All 19 faculty members who were part of the training participated in focus group 1 (100%). During the course of the study, two faculty members left the school and could not complete the study. Of the remaining 17, 12 participated in focus group 2 (participation rate of 71%).

Emergent Themes During CBL Training

The six themes that emerged during focus group 1 conducted during the training are shown in Table 3. Not surprisingly, participants expressed considerable hesitancy about the prospect of implementing the small-group CBL approach. This feeling was expressed in a variety of ways ranging from the need for more training time on how to properly facilitate cases to reporting concerns about how much

students might learn or miss out learning with the new approach.

Sufficiency of practice opportunities. One of the comments we heard repeatedly during the focus group sessions was concern whether the training received would be enough to effectively implement CBL in the curriculum. One participant noted, "I don't believe that after four days of getting this information we really became good facilitators." Another frequent comment regarded the need for more practice: for example, "I don't think this is something . . . after a week of training that we can jump to immediately." Another participant suggested that having some repeated experiences with the same group of students over several sessions might help faculty members see in real time if their efforts in implementing CBL would be worthwhile.

Assessing facilitators' performance. During the training sessions, participants practiced learning how to facilitate student groups. This practice helped some acquire a better grasp of how to use facilitation skills and helped others define the scope of their comfort in that role. As one commented, "The whole idea of knowing the content makes me feel more comfortable with whatever course I'm in; [but] the farther I am away from my content expertise, the more uncomfortable I get." Responding to the potential of feeling uncomfortable, another participant noted, "I'm gonna stand there as a faculty member and students are going to be talking about some topic that I need to know something about." Another recognized that engaging in CBL might require learning or re-learning. Acknowledging the burden he felt, he stated that he needed to "re-familiarize myself with things and not be in the position where I don't know something; that's my own hang-up I guess and all of us have that to a certain degree." Another participant suggested that one of the primary differences of serving as a facilitator rather than a teacher was "running the group versus mastering the material. And I've

Table 3. Themes that emerged in focus group conducted during case-based learning training

Theme	Definition
Sufficiency of practice opportunities	Expressing the need for more training time
Assessing facilitators' performance	Describing effectiveness of participants as facilitators
Orienting students	Getting students acclimated to the new approach to teaching
Changing views of teaching	Expressing ideas of what teaching is and could be
Administrative support	Expressing concern about whether the school's administration would provide resources of time, space, and personnel
Assessing student outcomes	Describing student engagement with case-based learning

come to understand that they are two different things. You don't have to master the material."

Experiencing the role as facilitators was essential to helping the participants see the potential success of implementing CBL. They were relieved to discover that learning in groups could also be self-correcting after a dental student who had led one of the groups and provided her peers with wrong information came back to the group the next day and admitted, "Guys, you know we misspoke the other day, [and I] led you to believe the opposite actually."

Orienting students. Other participants pointed out the uncertain potential of CBL while expressing worry about its effectiveness, as in this comment: "I see a lot of opportunity like a lot of potential [though] I'm not sure exactly how it is going to be implemented and I think a part of the problem is that I don't see the end points or how [CBL] is evidence-based." Concurring, another participant said that the bottom line was "would students be better prepared to understand the problem patients have?" One participant expressed his concern about how to steer students' discussions to ensure they achieved the desired case-based objectives: "They get so engaged in these conversations with one another that sometimes we don't know how to say, 'Hey stop there, don't go any further' because they are so engaged . . . [and] you don't want to necessarily stop their brainstorming but at the same time you want to point out the objectives."

One participant stated that one of the biggest challenges "was making sure that nothing was skipped. It's really easy for the students to read past something significant that they don't understand"; for the facilitator, this dilemma resulted in not knowing exactly what to do, "either to stop [students'] reading [of the case] or draw attention to it and ask the group 'what about this?'" In other words, the faculty members wanted to ensure that the students did not "go too fast." One participant asked, "When do we have to be more directive about the learning issue?" Support for use of CBL was expressed in several insightful comments. One participant said CBL is "not an application but also the integration of diverse topics," more akin to the work of private practitioners because the "techniques [are more like] I had to do on my own in private practice to solve problems." After all, she continued, "Sitting in a lecture isn't the way a private practitioner answers daily questions."

Changing views of teaching. CBL represented both change and challenge to teaching for these faculty members. Some participants expressed that they were used to maintaining control of their teaching, rather than conceding to a process that was novel and somewhat unknown. For example, one said, "It is very difficult for somebody used to the frontal teaching; suddenly you have to let it go and now the responsibility is on the students to come up with the active learning process." Another participant remarked more hopefully, "For me it's an opportunity to kind of risk letting off the control and putting more responsibility on the students." Another remarked that the success of CBL was more student-dependent than faculty-dependent, noting: "I think students are willing to study and learn. If they're happy and they feel that they've fulfilled their mission in this study process, [it] is probably a good sign."

Despite their objections, engaging the participants in the training sessions seemed to promote thinking about their teaching. One participant pointed out that engaging in CBL "changes your view of teaching," and he recognized the differences between the role of facilitator and teacher: "You're guiding them and you're facilitating, but you're not teaching them anything." Another remarked that he was "open to listen to new evidence or new philosophies that might be more beneficial to students. So I think being open-minded to change, I think that's important." One other participant pointed out that "our primary job as teachers is to teach them to think. And this process is more authentic," thus suggesting one of the benefits of adopting CBL. Acknowledging that there are different ways to teach, another participant stated, "Students can take responsibility for their own learning and feel their way through." Still another pointed out that to be a good facilitator required being a good observer and having knowledge about different personalities as well as a keen understanding of interactions.

Administrative support. Potentially problematic administrative and procedural issues were also pointed out. One participant commented, "The first one in my opinion is the most problematic because if the student doesn't realize what are the gaps or the issues they have to fill in, they are not going to meet the objectives and then the whole case is sort of thrown out." Another participant reported a mismatch between the objectives of CBL and the current evaluation processes: "I'm not sure if the current system is really set up for evaluation of both students and lecturers. So you know if you look at how we evaluate peers and how students evaluate peers." Another impediment pointed out by a participant was that "faculty time is going to be a big issue. Not only

putting the cases together but facilitating it seems to be a big time commitment."

Participants repeatedly reported their concerns about the administrative support. One noted that "it has to be planned by the administration" and also pointed out the need for someone who will oversee and coordinate the process: "we need someone to really facilitate that, to just make sure the pieces are there." Perhaps the most compelling rationalization not to introduce CBL came from one participant who stated, "Why bother implementing CBL? I'm not entirely sure why we can't just expand the clinical-based learning where [students] are actually in the clinic seeing patients and expanding the discussions that go along with cases." Given the pace of treating patients in three-hour clinics and the demand to complete procedures before clinic closing, this suggestion was not a viable solution for instilling a more robust integration between biomedical conceptualizations and patient care. Overall, participants also expressed their sense of responsibility for student learning, implicit fear, and hesitancy about losing control of the curriculum because successful implementation was to some degree dependent on student contributions.

Assessing student outcomes. In one case study, after studying the material better, one student realized a mistake and confessed her erroneous thinking to her classmates. Reassured by the student's self-correction, one participant reported that "the students were able to come up with the answer and that whatever mistake they made the day before, they can correct it. That was reassuring." This event also may have prompted other students to maintain a healthy sense of skepticism and to become responsible for knowing the information on their own because as one participant commented, "Leadership skills don't necessarily mean that leaders are going to lead in the right way." Another participant reported feeling relieved when she "saw how successful [the CBL process] was or at least how well the students did." Observing student engagement, another com-mented, "Most of the time they weren't even looking at the facilitator because they were speaking to each other; they were responding to each other's questions and building on each other's comments and hypoth-esis, and so that was pretty cool." However, others were left with more questions about their role and wondered how much to sit back and let the students take the lead or when to call students' attention to an observable gap in their knowledge.

Emergent Themes After Implementation of CBL Cases

Five themes emerged after implementing a case in the curriculum or during pilot-testing a case prior to its introduction; these are shown in Table 4. "Facilitator reactions," for example, are indicated by how comfortable participants felt teaching in this new role, while "reacting to the role of CBL facilitator" refers to descriptions of the instructional challenges they faced.

Assessing student contributions. Participants who wrote the case and later served as a facilitator tended to expect more from the students. One participant stated, "My expectations are a lot more from students. I mean I want them to go more into depth, and they talk kind of superficial with the case. They already had the knowledge; they were basically re-calling whatever knowledge they had." This faculty member surmised that because this was not the first time student were learning concepts as they were in the majority of case-based implementations, "they were just rushing into these things and not going too much into the depth."

Several participants noticed students' tenden-cies to place a greater focus on the treatment portion of the case than the biological principles of the un-derlying disease. Other participants were delighted by the level of student engagement and collaboration. One commented, "They were talking it through, they were talking to think . . . that was evident [among]

Table 4. Themes that emerged in focus group conducted during case-based learning implementation

Theme	Definition
Assessing student contributions	Evaluating students' insight and sharing during participation
Student dynamics	Describing student interactions during group work
Student knowledge gap	Explaining how students responded to what they did not know or understand
Facilitator reactions	Reporting levels of comfort/discomfort with role
Reacting to the role of case-based learning facilitator	Explaining difficulties with facilitating and assessing student work simultaneously

the students who were participating." In this circumstance, students received the case while they were in a course in which some of this material had already been presented to them. Based on this occurrence, it was recommended that cases be implemented prior to students' learning about the material so that they could not rely on the superficial knowledge they had gained in the course. One participant commented on student contributions, pointing out "a number of students in my group actually printed out and brought papers with them that they had retrieved." Some students developed charts and visual displays of their reasoning, which one participant found to be "pretty comprehensive." She felt that the students showcased proficiency in what they knew and what they needed to look for.

Several participants struggled with the grading of student contributions and how to evaluate what one called "other students who were less participatory." Another participant found that students could not always support their thinking. When they said something authoritative, this participant reported saying, "And can you back that up? What do you have that is evidence that supports that?" This participant reported that students would usually come out and say, "Oh, I looked it up, [but] I don't remember what it was."

Student dynamics. Participants described the dynamics of the student groups and the nature of student communication styles observed across groups. They described the ways that students assumed roles and how at times they appeared to cover for classmates who did not seem to be prepared or at other times held each other responsible for learning. They noticed a tendency for student groups to come into the session with predetermined roles. One participant noted "the way that the group carried a couple of the other students in the group. OK, it . . . seemed like these students were weaker students and that the group [had decided that they] would just carry them along."

Another participant stated that he thought his group was "pretty tough on each other. They were open and in critique of each other's evaluation. And I thought that was useful, because it led to back and forth." One participant observed the differences in students' rates of interaction, noting that "some of them as, in any other case, are more willing to speak and some of them don't speak as much as the other ones," though she surmised that was something that would improve with time. To remedy an unequal level of student contributions, participants suggested adding a student self-assessment component to the

case to highlight the importance that they remain fully engaged.

Dynamics of group interactions also potentially influenced student participation and group acquisition of learning objectives. This point was evidenced by students who said too much and led the group off track or those who contributed too little to the resolution of knowledge gaps or hypothesizing about the patient's condition. In one instance in which the student was not contributing to discussion of the case, the professor put the student on the spot and asked him what information he found about the patient and what information was still needed. Based on these observations, it was suggested that facilitators keep track of what specific information each student brings to the session and how many students brought primary sources.

Student knowledge gaps. Participants reported their observations of knowledge gaps, expressed as students' ability to identify what they did not know or understand. One of the participants exclaimed with surprise that her student group "felt they didn't have any knowledge gaps. So I had to be pushing, 'Do you think that would be a knowledge gap?' and the student would respond, 'Oh no, no, we know that.'" Another participant suggested that perhaps students were still acclimating to this new way of learning, unlike lectures in which they sit passively and are relatively inactive. He suggested that "they have to have some training or some type of feedback, prior to getting to the case," implying that perhaps students did not understand the notion of a knowledge gap. Also, some of the research information that students brought in was not credible, and in other circumstances, the depth and quantity of research evidence they offered were insufficient. For example, one participant pointed out that "students do not know the difference between primary, secondary, tertiary" or the characteristics of a reliable source.

Participants expressed the concern that not all students had covered all objectives and that some students were observed ignoring knowledge gaps. Another participant said, "I'm listening to students, and I'm identifying that there is a learning issue, and I let them go on for a little bit, and then I say, 'Well, the discussion has been going on for a while about this, so would you classify this as a learning issue?' They say, 'No.' So I said, 'Well, if I were in your group, I would list it as a learning issue.' But they still said 'No.' So I thought, well, let them go." Another participant said he could easily determine when students lacked knowledge because rather than directly answer questions about the material they

would, as he described, "start telling stories"—an avoidance tactic of trying to hide the obvious.

One participant suggested an organizing framework for how students could identify knowledge gaps. As one described it, the most obvious method occurred "when they're discussing something among each other and end up with a question that neither of them or no one in the group can answer, and they say, 'Aha! That's a learning issue.'" Another participant suggested that another way is for the facilitator to lead students to this recognition when "they're talking about something and they realize they don't understand, and the facilitator states, 'Well, isn't that a learning issue?'" Using a more direct approach could occur when the facilitator "blurts out that this is something that you are going to have to be responsible for going into more depth," as one participant described it. While he did not think the CBL was set up with that intention, in the case he facilitated he said the student struggled with biomedical components of the patient's pulpitis, and "The pain story got to that point where I had to butt in, because I couldn't get them to go any further than the nerve fiber."

Participants reported that, at times, students did not explain how the research they reviewed contributed to their understanding of knowledge gaps. Not having enough time to review materials and consider student contributions was also observed. Faculty members suggested that students would be better served by using role-play to depict how the student dentist would deliver information to patient. While role-play was used in CBL groups, most participants reported that students did not take it seriously and that they acted poorly or without intentionality.

Facilitator reactions. The facilitators reported varying levels of comfort, which seemed dependent upon the material used for each session and the facilitator's knowledge or lack of familiarity with the case topic. Some facilitators reported being less comfortable with the treatment planning aspect, while others experienced discomfort due to the disease presented in the case itself. Participants spoke about their reactions to serving in the role of a facilitator and their feelings of fitting into that role. One noted, "I wasn't uncomfortable either, but it was hard for me, because I was so involved" with writing the case, so "It was hard to get in the comfort zone for me for facilitating and not say something." For all of the participants, this was the first time they had served as a facilitator. Not surprisingly it was more difficult the first time for those who had not done it before. However, as one noted, "As it went on, I was more comfortable with the group, with trying to shepherd them towards different concepts." Having some experience bolstered participant confidence. One said, "If I do it again, I'd be better at it, from the beginning" although having experience as a facilitator was not the only factor that influenced participant comfort. Some participants' insecurity stemmed from not being a dentist and an inability to read radiographs. Others were comfortable but had what one participant called "uncertainty about actually what I should be doing as far as giving them information or not [or] where to lead them," while others were uncomfortable with the case concepts in which they lacked knowledge.

Reacting to the role of CBL facilitator. The participants also discussed their reactions to being a facilitator and their difficulties with facilitating and having to assess student work simultaneously. "It was hard to be just watching," one stated, "so I think for most of time, especially in the first session, I think I said more than I should." Ceding control to the students and observing their learning caused another participant some distress: "When they were going astray, I felt that they needed to learn about oral cancer. They are going to have boards. They need to know how to analyze the problem and do the differential diagnosis." Another participant who was concerned about the summative learning occurring stated, "I was afraid that I wasn't covering all the objectives as thoroughly" as needed in spite of the fact that it was the students who needed to learn the material not the instructors. Participants described struggling with having to multitask during the small-group process. As one commented, "There's the facilitation without telling them things, to get them to get to their own conclusions. There's the social interaction, there's the grading rubric," plus how to assess students who did not actively participate.

Discussion

This study clearly showed the remarkable transition for the participants as they moved from feelings of hesitancy and uncertainty about CBL to a more comfortable level of facilitating CBL cases and introducing this new teaching approach into the curriculum after the actual implementation procedure. During implementation, their concerns shifted to emphasis on the logistics of when to introduce a case, how to ensure that all students recognized and acknowledged knowledge gaps, encouraging all

students to take ownership for learning and to participate actively in their groups, and getting students to perceive role-play as a serious learning technique. When one considers that the participants had written their own cases and participated as facilitators for their own and others' cases, it is not difficult to recognize the remarkable commitment that these faculty members have made to this process.

Since the introduction of CBL over the past two years, and with the insight offered by this qualitative inquiry, the dental faculty members are likely to find themselves better positioned to emphasize their expectations to student groups during CBL sessions. It is important to keep in mind that although efforts were made to get the same faculty facilitator with a student group throughout the case, this was not always feasible given the complexity of scheduling basic scientists and clinicians—many of whom taught classes in addition to the latter group being assigned to clinics. In fact, faculty availability to facilitate cases has been a consistent and critical issue when moving forward with implementation of the CBL approach. To date, the core curriculum has not been modified enough to allow faculty members to be released from their teaching assignments to facilitate cases. The findings in this study do not support Thistlethwaite et al. who found that instructors enjoyed using CBL and found it to be a more efficient use of their time.[6] However, in the future, should faculty members be given the necessary release time to embrace CBL and adapt course material, this could change.

The findings point out how small changes in facilitation might render moot some of the concerns that arose during implementation. For example, how facilitators ask students questions is important. Rather than asking a yes/no question, such as "Would you classify this as a knowledge gap?," the facilitator should encourage further reflection by stating, "This appears to be a learning issue, something that you need to discover more information about. How do you want to phrase this learning issue?" And, instead of asking students, "Well, isn't that a learning issue?," a more direct facilitation approach is to state, "So this is a learning issue." In this manner, the facilitator redirects student attention to inquiry and reflection and does not allow there to be any ambiguity in deciding whether or not to identify something as a knowledge gap. If students cannot answer their own questions, a knowledge gap is present. The role of the facilitator is to ensure that students can explain their thinking at all stages of the case, that they learn how to identify what they do not know or understand, and that they are able to direct their inquiries towards deepening their own knowledge base and applying clinical reasoning skills.

CBL emphasizes a patient's presenting pathology and the associated biomedical mechanisms and places them at the center of the student's learning experience. This approach to learning places the onus for learning on students and expects them to provide the best available evidence from systematic research to supports their decisions. The use of CBL requires students to work cooperatively to develop treatment plans while remaining attentive to the aspects of cultural diversity and working collaboratively. Another benefit is the active engagement of students to reduce the predominant use of passive learning and teacher-directed lectures. Promoting collaborative interactions also recognizes that group practice and interprofessional collaborations are likely to become the future of health care delivery. Because the case-based approach is learner-centered and promotes interaction among participants, it may be more effective in fostering deep understanding and knowledge retention among students. Researchers have suggested that future studies comparing knowledge retention between students educated with CBL and those with the lecture approach are warranted. The Ilguy et al. study suggests that CBL results in greater knowledge retention.[17] However, as those authors observed, without the aid of a pretest of students' knowledge, it is difficult to discern whether or not the findings were influenced by the variation in student groups such as initial knowledge level.

The CBL teaching approach is designed to make the basic sciences relevant to student practice of clinical dentistry. For example, material can be framed within appropriate clinical topics through the use of cases in the course content. Another value of this approach is to promote interactions among faculty members across departments and divisions and to reduce and consistently self-check for redundancies in the curriculum that often go unnoticed because individual units are unaware of what is presented in other courses. CBL holds promise for helping students recognize the centrality of the biomedical foundations and its application to oral health diagnosis, treatment, and patient care.

For curriculum change such as the CBL approach to be embraced and adopted by the communities in which they are practiced, it is advisable that administrators and faculty leaders take time to better understand participants' experiences in CBL, that is,

what they were undergoing or anticipating in making such a change. Understanding what CBL means for individual basic scientists and clinicians at varying stages of change will likely allow the dental school community to better anticipate and address tensions and challenges that faculty are likely to experience.[20]

For administrators, the implementation of CBL highlights the type of resources that the college needs to sustain its implementation and to ensure enough faculty members are available for facilitating sessions. Anchoring this new approach into the college culture will depend on the availability of sufficient human resources to permit faculty members to participate in facilitating case-based learning sessions. Future studies should seek to assess the impact of the CBL on student outcomes and to develop a better understanding of how their learning experiences within the CBL framework compare to those they have in didactic courses. Findings from this study can also assist faculty members in understanding their responses to this approach and in facilitating their transition to this type of curriculum integration.

Acknowledgments

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