

Promoting the Teaching of Critical Thinking Skills Through Faculty Development

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Abstract: Practical and effective faculty development programs are vital to individual and institutional success. However, there is little evidence that program outcomes result in instructional changes. The purpose of this study was to determine if and how faculty development would enhance participants' use of critical thinking skills in instruction. Seven faculty members from the University of Florida College of Dentistry and one faculty member from another health science college participated in six weekly two-hour faculty development sessions in spring 2007 that focused on enhancing critical thinking skills in instruction. Kaufman's and Rachal's principles of andragogy (adult learning) were used to design the sessions. Participants used learning journals to respond to four instructor-assigned prompts and provided one presentation to peers. With the use of qualitative methods, eight themes emerged across the learning journals: teaching goals, critical thinking, awareness of learners, planned instructional change, teaching efficacy, self-doubt, external challenges, and changes made. Five of eight participants incorporated critical thinking skills into their presentations at a mean level of 2.4 or higher on a 5-point scale using Paul and Elder's behavioral definition of critical thinking skills. Faculty development opportunities that cause participants to reason through learning journals, peer presentations, and group discussion demonstrated the incorporation of critical thinking concepts in 63 percent of this cohort group's presentations, suggesting that if evidence-based pedagogies are followed, instructional changes can result from faculty development.

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I ncreasingly, faculty development has become an important component in professional education. Used to manage change and develop professional skills, one of the primary purposes of faculty development has been to improve instructional practice. From the novice to the veteran professor in academia, the practice of educating students in a clinical care profession requires lifelong learning.

The research question we asked in this study was this: How will faculty development focused on enhancing critical thinking skills influence participants' instructional practices? The purpose of this study was to explore whether faculty development would foster the participants' ability to infuse critical thinking skills into their instruction and to describe the evidence that showed their integration of critical thinking strategies. The development and assessment of this seminar were linked with concepts of evaluation in andragogy, "the art and science of helping adults learn."¹ In this study, evaluation was viewed as an instructional methodology that focused on the learners' knowledge base and experience, while

providing them with feedback about their own performance.²

In an era in which dental educators are experiencing numerous fundamental changes in the curriculum, new teaching and learning methods,³ and rapid clinical and technological advances, teaching has come to be recognized as a skill associated with but separate from content expertise.⁴ Therefore, the design, methodology, and implementation of practical and effective faculty development programs are vital to the success of individual and institutional teaching effectiveness. The evidence-based characteristics associated with program effectiveness in faculty development include the following:

- experiential learning, applying what has been learned and receiving feedback;
- systematic and constructive feedback to improve performance;
- peer feedback and collegial support to promote change;
- adherence to teaching and learning principles of adult (e.g., Steinart et al.⁵) and experiential learn-

- ing (e.g., Kolb⁶) as an organizing structure; and
- multiple instructional methods to accommodate learning styles and to meet diverse objectives.⁷

Critical Thinking, the Learning Process, and Andragogy

Current dental education accreditation standards call for evidence of students' critical thinking in the learning process.⁸ This position requires faculty competence in teaching students the development of critical thinking skills, yet researchers debate whether critical thinking can be learned or is a developmental process, regulated by motivations, dispositions, and personality traits. Despite differences of opinion, many researchers agree that critical thinking is "purposeful, self-regulatory judgment which results in interpretation, analysis, evaluation, and inference, as well as explanation of the evidential, conceptual, methodological, criteriological, or contextual considerations upon which judgment is based."⁹

The Commission on Dental Accreditation (CODA) recently proposed new standards for teaching predoctoral students critical thinking skills. Standard 2-9 stipulates that graduates must demonstrate competence in the use of critical thinking as it relates to comprehensive patient care. To ensure that students develop this competence, the dental education curriculum must use pedagogical methods that provide evidence of its development such as

- explicit discussion of the meaning, importance, and application of critical thinking;
- use of questions by instructors that require students to analyze problem etiology, compare and evaluate alternative approaches, provide rationale for plans of action, and predict outcomes;
- prospective simulations in which students perform decision making;
- retrospective critiques of cases in which decisions are reviewed to identify errors, reasons for errors, and exemplary performance;
- assignments that require students to analyze problems and discuss alternative theories about etiology and solutions, as well as to defend decisions made;
- asking students to analyze and discuss work products to compare how outcomes correspond to best evidence or other professional standards; and

- demonstration of the use of active learning methods, such as case analysis and discussion, critical appraisal of scientific evidence in combination with clinical application and patient factors, and structured sessions in which faculty and students reason aloud about patient care.⁸

Critical thinking is also regarded as intellectually engaged, skillful, and responsible thinking that facilitates good judgment because it requires the application of assumptions, knowledge, and competence and the ability to challenge one's own thinking. Unlike other forms of thinking, critical thinking requires the use of self-correction and monitoring to judge the reasonableness of thinking as well as reflexivity. When using critical thinking, individuals step back and reflect on the quality of that thinking. Simpson and Courtney pointed out that critical thinking processes require active argumentation, initiative, reasoning, envisioning, and analyzing complex alternatives and making contingency-related value judgments.¹⁰

According to Banning, critical thinking involves scrutinizing, differentiating, and appraising information, as well as reflecting on information to make judgments that will inform clinical decisions.¹¹ Brookfield asserted that identifying and challenging assumptions as well as analyzing assumptions for validity are essential to critical thinking skills. He also suggested that because critical thinkers possess curiosity and skepticism, they are more likely to be motivated to provide solutions that resolve contradictions.¹²

Critical thinkers use these skills appropriately and usually without prompting. They are generally predisposed to think critically and to evaluate the outcome of their thought processes.¹³ These attributes are important for health care practitioners. Moreover, instructors' incorporation of them into the learning process must be intentional, not assumed or random. Helping health professions educators learn to do this requires attention to the ways adult students learn.

The principles and characteristics of "andragogy" were used to design the faculty development workshop opportunities at the University of Florida College of Dentistry in this study. Andragogy, a term rejuvenated by Malcolm Knowles, is "the art and science of helping adults learn," according to Rachal,¹⁴ and is the most persistent practice-based instructional method in adult education. Knowles proposed seven guidelines for teaching adults to become self-directed and independent in their pursuit of

new knowledge.¹ At the heart of these guidelines is an approach based on collaboration between the facilitator and the learner involving a learning contract that includes learning objectives, strategies and resources, evidence of achievement, and means for evaluation. Additionally, voluntary participation is one premise of andragogy, according to Knowles. These, coupled with a nonthreatening learning environment, are key to encouraging success of the individual learner.

Additional characteristics of andragogy can be found in work by Forrest and Peterson in which they looked at the adult learner as an independent adaptable individual.¹⁵ Forrest and Peterson proposed four assumptions regarding adult learners: adult learners are self-directed, rely upon experience, are ready to learn, and have a performance-centered orientation to learning. Rachal extended Knowles's guidelines for developing in-class activities and out-of-class assignments for faculty development seminars.¹⁴ Rachal revised Knowles's concept of "pedagogy to andragogy" as a continuum and proposed seven criteria that reach towards the andragogy side of the continuum:

1. Voluntary participation.
2. Adult status: "learners who have assumed the social and culturally defined roles characteristic of adulthood and who perceive themselves to be adult."
3. Collaboratively determined objectives: the learner plays a significant, if not primary, role in determining learning objectives.
4. Performance-based assessment of achievement: low-threat, performance assessment in which performance is either successful or not and in which the reason for pursuing the learning activity is to exhibit a specific desired outcome.
5. Measuring satisfaction: the inherent pleasure or satisfaction of participating in a learning activity.
6. Appropriate adult environment: physical and psychological characteristics including creature comforts and a room arrangement that fosters a sense of collaboration. Respect for the learner as an adult, respect for the learner's experiences, minimization of anxiety, and avoidance of the "schooling experience."
7. Technical issues: use of one or two facilitators in various settings.¹⁴

Faculty development programs that incorporate these principles can create a more meaningful experience for the participants.

When writing about andragogy and assessment, Bolton suggested that rubrics are helpful to use with

adult students.¹⁶ Rubrics are used to articulate the required elements of a successful program. In our study, Paul and Elder's rubric for defining critical thinking¹⁷ was used to help participants understand the linkages between learning objectives and desired outcomes.

Methods

A diverse, international group of seven faculty members from the College of Dentistry and one faculty member from an affiliated health science college participated in this study. The group consisted of five females and three males; there was one participant each born in Taiwan, Brazil, Italy, England, Israel, and India and two born in the United States. Faculty members were invited to attend the faculty development seminar through email and announcements about faculty development offerings. Participation in the seminar was strictly voluntary and was subsidized by an educational foundation grant and departmental funds. Faculty received no release time for their participation. Approval to conduct the study was obtained from the university's Institutional Review Board (IRB; UFIRB #2006-U-0791). Inquiry for this study was carried out in accordance with IRB approval. Each participant signed a letter of informed consent during the first session.

The faculty development seminar was designed using the principles of andragogy (Table 1). The seminar consisted of six two-hour sessions in spring 2007: three were instructor-led sessions on the topics of teaching efficacy, curriculum auditing, and peer observation; the other sessions focused on participant presentations, including a discipline-based teaching session and oral recitation of participants' changes in planning, delivering, and evaluating teaching. After each of the first three and the fifth sessions, the participants were asked to respond in their learning journals to instructor-assigned prompts (Table 2). During the fourth and fifth sessions, participants presented a discipline-based lesson plan to showcase the kinds of changes in teaching critical thinking skills they had articulated in their learning journals. Each participant received feedback about his or her presentation from colleagues and the course codirectors. During the last session, they read the contents of their personal statement of growth to the class.

Two types of data were collected and analyzed to answer the research questions: learning journals and a discipline-based teaching presentation. Par-

participants wrote four learning journals in response to instructor prompts. Researchers do not agree on a single definition of learning journals, but they do agree that learning journals share a common element:

students write and reflect upon course content and how it relates to their own experiences.¹⁸ Despite the lack of an agreed-upon definition, researchers agree that learning journals promote active learning.

Table 1. Application of andragogy principles to the faculty development seminar

Principle	Application of Principle
1. Create comfortable and safe learning environments where learners feel able to speak freely. ¹ 2. Establish a climate conducive to adult learning. ² 3. Provide a learning environment that is appropriate for adults. ³	Participants met in a large conference room from 11 am to 1:00 pm over six sessions. Food and beverages were provided. Handouts were provided. A check-in was conducted at the beginning of each session. The instructor took participants' questions throughout each session. The course director responded to questions at the time they were asked. Learning journals served as a medium for participants to communicate with the course director. The course director read the journals and provided written feedback on them.
4. Learners and instructors select the use of methods and content. ¹ 5. Create an organizational structure for participative learning. ²	Participants developed a brief PowerPoint presentation to showcase the kinds of changes in teaching critical thinking skills they had articulated in their learning journals.
6. Learners diagnose their own needs. ¹ 7. Diagnose learning needs. ²	Participants were asked to document in learning journals the areas of teaching in which they felt efficacious and those in which they did not, e.g., planning for instruction, delivering instruction, writing assessments, assigning grades, providing varied forms of instruction, managing students, and dealing with disruptive and/or confrontational students.
8. Learners write their own lesson objectives. ¹ 9. Learners formulate direction of learning (objectives). ² 10. Learners collaboratively determine objectives. ³	Participants presented a lesson plan (with learning objectives) within the PowerPoint presentation to showcase the kinds of changes in teaching critical thinking skills that they had articulated in their learning journals.
11. Learners locate and use resources to achieve objectives. ¹ 12. Learners develop design of activities. ²	Participants developed discipline-based lesson plans.
13. Instructors help learners achieve goals. ¹ 14. Operate the activities. ² 15. Technical issues. ³	Following each PowerPoint presentation, participants received feedback from the instructor and their peers that identified aspects of the lesson that promoted critical thinking skills as well as what else (instructionally) the presentation could have done to promote critical thinking skills in the context of this lesson.
16. Learners evaluate success of their learning. ¹ 17. Learners rediagnose (evaluate) learning needs. ² 18. Learners participate in performance-based assessment of achievement. ³	Participants were asked to critique and document in their journals the learning activities in their course syllabi and identify a) those that currently promoted/required critical thinking skills, b) those they thought approximated students' understanding and use of critical thinking skills, and c) those they wanted to promote/require critical thinking skills.

Sources:

1. Kaufman DM. ABC of learning and teaching in medicine: applying educational theory in practice. *Br Med J* 2003;326(7382):213–6.
2. Knowles MS. *The modern practice of adult education: Cambridge adult education*. Englewood Cliffs, NJ: Prentice-Hall, 1980.
3. Rachal JR. Andragogy's detectives: a critique of the present and a proposal for the future. *Adult Educ Q* 2002;52(3):210–27.

Table 2. Faculty development seminar prompts by session

Session	Prompt
1	Identify areas of teaching in which you feel efficacious and those in which you do not, e.g., planning for instruction, delivering instruction, writing assessments, assigning grades, providing varied forms of instruction, managing students, and dealing with disruptive and/or confrontational students. Using Paul and Elder's critical thinking skill guide, critique the learning activities in your course syllabus and identify a) those you currently provide that promote/require critical thinking skills, b) those you think you approximate (almost do), and c) next steps for implementing/developing others that will deepen students' understanding and use of critical thinking skills.
2	Construct a teaching philosophy based on the assigned readings and your previous teaching experiences.
3	View peer observation/evaluation scenarios. Write a one-minute paper to describe what you saw. Identify what aspects of the first/second peer observation could lead to improving instruction. Submit a one-minute paper and peer observation scenario feedback. Develop a PowerPoint presentation on a learning experience that requires students to demonstrate critical thinking skills or that approximates students' use of critical thinking skills, or teaching an activity that is new for you that you believe will deepen students' understanding and use of critical thinking skills.
4	Observe critical thinking skills presentation. Identify aspects of lesson that promote critical thinking skills. Identify what else (instructionally) could be done to promote critical thinking skills in the context of this lesson.
5	Observe critical thinking skills presentation. Identify aspects of lesson that promote critical thinking skills. Identify what else (instructionally) could be done to promote critical thinking skills in the context of this lesson. Write your personal statement of growth.
6	Present your personal statement of growth.

Learning journals provide a place in which participants can document self-reflections about their experiences, beliefs, and responses to instructor-provided prompts.¹⁹ Some researchers consider learning journals essential to professional practice,²⁰ especially when they are used to promote participant insight into “self-awareness and learning.”²¹ Nurses and educators have used learning journals “to enhance creative and critical thinking among students in the classroom.”²¹ Learning journals also give students an opportunity to step back, carefully articulate the meaning of new experiences, and consider how those experiences relate to their current experience. Kitchenham used reflective journals to help teachers self-evaluate transformative experiences as they integrated educational technology into their classrooms,²² and Brown reinforced the importance of reflection with the use of experiential learning portfolios.²³ As written documents, learning journals provide instructors with feedback concerning what students are understanding, what connections they are making, and how well they are progressing. While working with physical therapy students, for example, Williams and Wessel found that students experienced positive shifts in their attitudes about working with the elderly and

were able to see how the scope of physical therapy practice assists this population.²⁴

In our study, the learning journal provided a medium for written participant-instructor communication. The first and second authors hand-coded the dataset, and the third author analyzed the learning journals, peer observation, and feedback using NVivo, a qualitative analysis software that allows the researcher to import, sort, and analyze files and can be used to code themes embedded in transcripts. Our collective analysis produced several overlapping themes. As a result of this overlap, we developed a codebook of themes (Table 3), which consists of eight cover terms and conceptual definitions. After developing the codebook, each author independently recoded the data. The criterion for coding segments of the data was its fit within the conceptual definition of a cover term.

Participants' presentations were analyzed using Paul and Elder's¹⁷ criteria for critical thinking skills behaviors. To ensure that we were systematic in assessing each of these behaviors, we reviewed the participants' PowerPoint presentations together, evaluated each participant's demonstration of critical thinking skills (CTS) behaviors, and reached agree-

Table 3. Codebook for analyzing data

Theme	Definition
Awareness of learners	Emergent knowledge of students as learners and how instructional practices influence the quality of learning and outcomes
Changes made	Modifications that occurred in instructional practices as a result of the course
Critical thinking	Ways in which faculty members promote and assess students' ability to critically think
External challenges	Difficulties faculty members face during instruction and/or assessment
Planned instructional changes	Steps or plans with the intention to improve teaching
Teaching efficacy	Faculty perceptions of their relative strengths and abilities to teach
Teaching goals	Ways in which faculty members will generally enhance teaching to improve student learning
Self-doubt	Faculty perceptions of their weaknesses or perceptions that they cannot teach in ways they want

ment as to what constituted CTS. Each author evaluated the participants' PowerPoint presentations independently by responding "yes" or "no" to these criteria:

1. raises vital questions and problems, formulating them clearly and precisely;
2. gathers and assesses relevant information, using abstract ideas to interpret it effectively;
3. comes to well-reasoned conclusions and solutions, testing them against relevant criteria and standards;
4. thinks open-mindedly within alternative systems of thought, recognizing and assessing, as need be, their assumptions, implications, and practical consequences; and
5. communicates effectively with others in figuring out solutions to complex problems.²⁵

One point was awarded for a "yes" response, and zero was awarded for a "no." For each criterion, a participant could earn a range from zero to three points; thus, the overall score for each participant could range from zero to fifteen. A mean score across all of our responses was calculated for each participant.

Results

The themes that emerged from the learning journals were awareness of learners, changes made, critical thinking, external challenges, planned instructional changes, teaching efficacy, teaching goals, and self-doubt.

Themes in Participants' Learning Journals

Awareness of learners. This theme accounted for 13.4 percent (n=34) of the dataset. Chaim, one of the participants, acknowledged becoming aware of students' learning needs when he realized that he did not need to cover all the information during instruction and that he could hold students responsible for the content. Laura, another participant, reported that she observed students' reactions while teaching and modified her teaching methodology as needed. Ilka identified the powerfulness of theory to practice connections. "By presenting clinical cases and additional problem sets in both labs and lectures," she said, "I believe that students were more engaged in the subject matter." Adrianna reported that as she learned more about students, she came to an understanding that teaching did not have to be dogmatic.

Changes made. This theme accounted for 7.1 percent (n=18) of the dataset. Eric described how the use of the automated response system (ARS) was great for "providing immediate feedback and guidance." Chaim described the changes he made to slide shows by adding a slide listing the objectives. He said he also started placing more questions on slides "as [a] break to the lecture and [to] serve as reminders to the student [as an] application of the concept." Adrianna wrote that she made several changes in her instructional techniques during clinical instruction, such as asking her students to name three things they had learned that day. She explained that she encour-

aged the pediatric dentistry residents to take greater ownership of their learning by introducing varied forms of instruction in her craniofacial anomalies course. “Initially I found this concept quite daunting,” she said, “but . . . [it] gave me the opportunity to appreciate their initiative [and] a shared responsibility for learning. In addition, I introduced . . . case-based learning.” Lucy explained that she began asking students questions to make them think and talk aloud about the patient’s treatment more frequently than she had before the seminar.

Critical thinking. This theme accounted for 14.6 percent (n=37) of the dataset. Laura wrote that an excellent way to help students become critical thinkers was to have them “compare multiple points of view and understand how and why they differ.” She also stated that she wanted students to make comparisons using multiple sources. Lucy discussed two ways that she helps students to develop critical thinking skills: first, “questioning students before [start-check], during, and at the end of each clinic session, making them access what they have learned in the classroom to apply in that session,” and second, “highlighting/making them identify important points on each patient’s medical history, their anatomy, and specific traits in personality/habits that would influence treatment plan and procedures.”

Adrianna described how she used the probing technique to get students to use critical thinking. One of the questions she reported typically asking was “can you tell me which radiographs you would recommend for this patient and the reason for your recommendations?” She said she asked students to think about what they would do in their own private practice if the child’s parents, expected to pay for additional radiographs, questioned this because x-rays were taken six months ago; a typical question she asked was “can you tell me how you would justify your recommendation to a parent who is concerned about cost and x-ray exposure?”

Chaim described how he believed he could promote students’ development of critical thinking skills. For example, in the first reading assignment of his course, he highlighted places where students would need to process the information and suggested a couple of questions they should ask themselves. During the second reading assignment, he highlighted the area where they should process the information but did not provide any hints about questions. During the third and subsequent assignments, he let students work on their own. If students came to him later for

confirmation, he planned to ask them what kinds of question they had asked themselves.

External challenges. This theme accounted for 11.4 percent (n=29) of the dataset. Ilka reported that being able to cover material and still have time for class discussion was something new for her. She shared that “expecting [students] to do it so you can have a meaningful conversation and motivating them to comply presented a shift in my approach.” Adrianna shared that she struggled with students’ low expectations because she believed that some seemed to prefer a “quick fix” or accelerated pathway to getting through dental school and did not seem to give much thought to “the quality of the person or practitioner on the other side of graduation.” She expressed her concern “that the current culture in our dental school appears to pander to these low expectations, and subsequently I find myself competing in an unofficial popularity contest.” Walter described how, while in the clinic, he struggled with himself when he tried to give out information rather than helping students arrive at the answers themselves. He reported that, after the seminar, he recognized what he was doing and, given this realization, had the ability to change. Moreover, he shared that “there is a voice in my head that won’t go away . . . continually asking me if I’m connecting with students in an effective way.”

Planned instructional changes. This theme accounted for 13.4 percent (n=34) of the dataset. While describing the seminar assignments, Eric stated that it was during this course he had begun to undertake his own efforts to improve his teaching and that “peer evaluation led me to see styles which I will adopt for my teaching.” Ilka shared that she planned to use a microphone to try and improve her voice projection in large rooms. Marion planned to challenge her students by asking questions at the beginning of the class because it would provide her with some information about what they know. She explained that “if we revisit the question at the end of the session . . . they may retain this information more.” Laura shared that when she writes questions in the future, she will be more careful and ask questions that cannot immediately be answered. She planned to ask the type of questions that require a series of progressive responses before reaching the final answer. She also suggested that she might ask students to write their answers because “this will give some time for everyone to think.” Lucy wrote that she was now thinking about what she wanted her students to learn during her lectures and how she

could get them thinking about the situations during her presentations.

Teaching efficacy. This theme accounted for 11.8 percent (n=30) of the dataset. Walter expressed his growing sense of mastery in grading: “I think that I am improving with grading.” Marion reported that she “felt quite efficacious in the way that [she] plan[ned] for instruction.” Laura reported feeling effective in her ability to help students think critically by “crafting questions that stimulate thinking . . . providing intellectual stimulation . . . [and] creating challenges [to] make students think about alternative explanations.”

Teaching goals. This theme accounted for 16.5 percent (n=42) of the dataset. Ilka described her aspirations for students. One of her teaching goals was to provide learning experiences in which students could explore science and discover their own interests. Some of Laura’s teaching goals were to “help students transition . . . from a passive to a reactive state . . . and from a reactive to an active state.” Lucy wrote that her teaching goals included getting the point across; presenting the topic and relating it to clinical applications so that students would understand why what they were learning was important; giving students a reason for learning particular information; and demonstrating to students how they would use or need a particular concept or idea in dental practice. She wrote that she wanted to help students apply their knowledge because she felt that this was motivating and engaged them during learning.

Chaim, who teaches dental materials, wrote that he wanted students to come up with reasons rather than to remember reasons. He explained that, for students to demonstrate reasoning, they first would need to understand the scientific principles that govern how a material behaves in certain conditions. Adrianna shared that her personal teaching goal was to be recognized as an educator inside and outside the classroom and that she wanted students to learn from their interactions in both settings. She noted that “the role of a teacher is no longer restricted to the classroom.”

Self-doubt. This theme accounted for 11.8 percent (n=30) of the dataset. Walter expressed his self-doubt about planning and organizing material. Marion expressed her doubt about using instruction, saying, “I do not feel efficacious in changing my form of instruction during the didactic course.” Along the same lines, Lucy reported that prior to the faculty development seminar, she did not recognize that there were so many ways to establish critical thinking and that she had never recognized its importance. She

reported, “I still have not got[ten] to the point I want in terms of teaching and stimulating critical thinking . . . but I will get there!” Adrianna confided that she held pessimistic views of students and feared losing control over unruly or disruptive students: “I do not yet feel equipped or confident to deal with students who are confrontational either in the clinic or class, and I fear that it has in the past interfered with my delivery of instruction in these arenas.”

These eight themes appeared in this rank order from most to least frequent: teaching goals, critical thinking, awareness of learners, and planned instructional changes, followed by self-doubt, teaching efficacy, external challenges, and changes made (Table 4).

Ratings of Participants’ PowerPoint Presentations

We also rated the degree to which the seminar participants infused CTS into their presentations using Paul and Elder’s criteria as shown in Table 5. Their scores ranged from zero to 4.66; the average was 2.41. Of the eight presentations, five participants showed means of 2.4 or higher across four or five of the five criteria, indicating that they had integrated critical thinking skills across multiple criteria. Two of the participants showed a lower integration of critical thinking skills with scores of 1.00 and .66 within two or three of the rubric categories. The remaining participant did not demonstrate the use of critical thinking skills in her presentation and had a score of zero.

Discussion

Overall, the majority of the faculty participants’ journal citations were in the categories of teaching goals (16.5 percent), critical thinking (14.6 percent), awareness of learners, and planned instructional changes (both at 13.4 percent). Given that the focus of this seminar was on the teaching of critical thinking, it is not surprising that the participants discussed teaching goals and critical thinking most frequently. Of interest is that, within and across each theme, the participants discussed new insights in exploring scientific concepts, seeking alternative explanations, and questioning students as opposed to solely delivering content. Some faculty members openly described their self-doubts, while others reflected on how external challenges influenced the changes they had made and were planning to make in their teaching styles.

Five of the eight participants utilized critical thinking skills with a score of 2.4 or higher across multiple criteria during their PowerPoint presentations. This finding indicates that they were able to raise vital questions clearly, assess relevant information, come to well-reasoned conclusions while testing them against criteria and standards, and communicate effectively in figuring out solutions to complex problems. A majority (63 percent) of the participants demonstrated incorporation of critical thinking skills. This finding also demonstrates the powerfulness of effective faculty development when it integrates experiential learning and a diversity of teaching methods within one course.⁵ However, all of the participants experienced this teaching seminar as a developmental process. They reported feelings of self-efficacy and self-doubt throughout the course. These findings are consistent with the challenges inherent in making changes during a faculty development process in general and during learning in particular.

In this study, the participants engaged actively in the learning process by sharing how they were responding to what they were learning and by describing how they might utilize that information in their teaching. Active integration of the material to varying degrees of growth was evidenced by the content of

participants' learning journals and through teaching presentations to their peers. The participants' willingness to try to assimilate new ways of thinking about teaching, to take a chance, and to make themselves vulnerable in front of their peers was also seen as risk-taking behavior. As corroborated by the skill levels shown in their PowerPoint presentations, cognitive change does not always result in immediate behavioral change. It is important to point out that epistemic demand alone may not be enough to change educators' views of critical thinking: while they may write about it in journals, that does not mean they are able to synthesize related concepts and apply them readily to their teaching.²⁶ Furthermore, thinking and writing about critical thinking are not enough. Educators must be able to connect related concepts to methods of teaching, while bearing in mind that

Table 4. Themes by frequency (n=254) and sources (# of participants)

Themes	Frequency	Sources
Teaching goals	16.5% (n=42)	6
Critical thinking	14.6% (n=37)	8
Awareness of learners	13.4% (n=34)	8
Planned instructional changes	13.4% (n=34)	7
Self-doubt	11.8% (n=30)	6
Teaching efficacy	11.8% (n=30)	8
External challenges	11.4% (n=29)	6
Changes made	7.1% (n=18)	6

Table 5. Ratings of participants' critical thinking skills during their PowerPoint presentations using Paul and Elder's criteria

Participants	Raises vital questions and problems, formulating them clearly and precisely	Gathers and assesses relevant information, using abstract ideas to interpret it effectively	Comes to well-reasoned conclusions and solutions, testing them against relevant criteria and standards	Thinks open-mindedly within alternative systems of thought, recognizing and assessing, as need be, their assumptions, implications, and practical consequences	Communicates effectively with others in figuring out solutions to complex problems	Mean score across criteria
Adrianna	0	0	0	0	0	0
Chaim	3	3	3	3	2	4.66
Eric	3	2	2	1	0	2.66
Ilka	2	2	2	2	2	3.33
Laura	3	3	3	1	2	4.00
Lucy	1	1	1	0	0	1.00
Marion	0	1	1	0	0	.66
Walter	3	2	3	0	1	3.00

Source for criteria: Paul R, Elder L. A miniature guide to critical thinking: concepts and tools. 4th ed. Dillion Beach, CA: Foundation for Critical Thinking Press, 2006:4.

changes in practice must also be reflected on within the larger picture of institutional commitment to teaching critical thinking and how this practice may affect student outcomes.

Possible limitations of the study were the small sample size, the absence of a pre-session presentation, and a lack of transferability of the findings beyond the context in which the study took place.

Conclusions

The need for teaching higher-order or critical thinking continues to grow as national testing has repeatedly demonstrated deficiencies in reading that requires reasoning and inference.²⁷ These skills are essential to the demonstration of critical thinking. Dental educators recognize that the status quo in how to teach is being challenged because educating

competent health care providers in a dynamically changing health care field places new requirements on the educational process. Research has shown that relying solely on the use of lecturing is a relatively ineffective technique. Learning by doing not only results in better retention and understanding of material; it increases self-confidence, communication skills, and the ability to engage in partnerships. In addition, if the revised CODA standards are approved, a substantial change in the way that dental schools teach and assess critical thinking skills will be required.⁸ In the seminar described in our study, the participants' activities were aligned with examples of CTS in the CODA standards (see Table 6).

Educators' lack of formal training in teaching has significant consequences for students who look to their instructors as respected leaders whose behaviors in thinking, speaking, and writing are those

Table 6. Alignment of participant learning experiences and CODA standards' examples of critical thinking skill (CTS) activities

Participants' Learning Experiences	CODA Standards Examples of Critical Thinking Skill Activities
Presentation and discussion in the seminar included explicit discussion of what CTS is, what CTS is not, and what it looks like during teaching.	Explicit discussion of the meaning, importance, and application of critical thinking.
Participants critiqued the learning activities in their course syllabus and identified those a) where they currently promote/require critical thinking skills, b) where they approximate (almost do) the use of CTS, and c) where they would like to try and implement the use of CTS.	Use of questions by instructors that require students to analyze problem etiology, compare and evaluate alternative approaches, provide rationale for plans of action, and predict outcomes.
Feedback regarding teaching methods provided participants with information about those areas where they wanted to or could have an opportunity to enhance their teaching of critical thinking skills and this required active learning and decision making.	Prospective simulations in which students perform decision making.
Participants identified in writing what aspects of the first/second peer observation could lead to improving instruction.	Retrospective critiques of cases in which decisions are reviewed to identify errors, reasons for errors, and exemplary performance.
Participants viewed peer observation/evaluation scenarios and wrote one-minute papers to describe what they saw. Additionally, participants identified in writing what aspects of the first/second peer observation could lead to improving instruction.	Writing assignments that require students to analyze problems and discuss alternative theories about etiology and solutions, as well as to defend decisions made.
Participants provided written feedback to colleagues. They commented upon how well the presentations demonstrated CTS and what other ways CTS could be improved.	Asking students to analyze and discuss work products to compare how outcomes correspond to best evidence or other professional standards.
Presentations represented an active learning method that required participants' synthesis of understanding of CTS and utilization of it in a presentation of an existing lesson in which they previously had not used CTS.	Demonstration of the use of active learning methods, such as case analysis and discussion, critical appraisal of scientific evidence in combination with clinical application and patient factors, and structured sessions in which faculty and students reason aloud about patient care.

that they can model.²⁸ Without a place to learn and model these skills, educators unwittingly contribute to the pre-existing problem: lack of development of students' critical thinking skills. However, when faculty development is grounded in a theory (andragogy in this case¹) that involves making meaning through experience and reflection^{29,30} and occurs during participation in communities of practice,^{31,32} it can result in instructional practice changes beyond the seminar. Further research should explore the sustainability of these practices in the classroom and clinical learning environments and other implications for faculty development.⁵

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