

Article

The Design and Impact of Interactive Online Modules for Dental Faculty Calibration

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Abstract: The diverse backgrounds of health professions faculty often result in inconsistent teaching, clinical techniques, and feedback for students. Faculty calibration is essential for uniform, high-quality instruction. However, scheduling training sessions is challenging due to faculty availability. This study introduces a self-paced, interactive online approach to dental faculty calibration. Four self-paced online modules were developed using an interactive cloud-based platform. A variety of learning activities were interspersed throughout the module to promote active learning. A survey captured faculty's perception of the online format. ANOVA analyses examined differences in perceived effectiveness of the online format between full-time, part-time, and adjunct faculty. The platform analytics offered insights into the faculty's module performance. Anecdotal feedback from faculty provided evidence of behavioral changes. 94% of the faculty expressed high satisfaction with the online format. The majority of faculty agreed or strongly agreed that the online format was effective (89%), engaging (88%), and easy to navigate (84%). They highlighted the modules' user-friendliness, flexibility, and engaging content. ANOVA analyses revealed no significant differences in perceived effectiveness of the online format between full-time, part-time, and adjunct faculty. Anecdotal feedback demonstrated that faculty were incorporating the knowledge gained from the modules into their teaching practices. This positive online experience also motivated several faculty to integrate similar online approaches into their own courses. This online approach provides a more flexible, sustainable, and interactive approach to faculty development that could be beneficial to other institutions.

Keywords: faculty development; faculty calibration; online learning; cloud-based technology; dental education



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1. Introduction

In health professions institutions, students usually work with multiple faculty who teach and assess them on their clinical performance. In this context, the term “faculty” in this study refers to individual faculty members. However, due to varied educational and clinical experiences, there is often disparity among individual faculty in their clinical techniques, teaching, and assessment. Several studies have reported inconsistency among dental educators in areas such as periodontal disease diagnosis, radiographic interpretation, treatment planning, and assessment standards [1–7]. The inconsistent instruction and feedback from multiple faculty led to students' frustration and dissatisfaction with their education and interfered with their competency development, which could ultimately impact the quality of patient care [4,5,8]. Henzi et al. found that only 53% of students were satisfied with consistency in clinical teaching and assessment by multiple supervising faculty and that over 20% of students perceived their dental school curriculum weakness to be centered around inconsistency in faculty teaching [9].

As faculty take on the dual roles of clinician and educator, they not only need to keep themselves abreast of the latest practice guidelines of the profession but are also obligated to comply with the school's clinical protocols. However, faculty often do not consistently implement the school guidelines when making teaching and clinical decisions [7]. Many other factors impact faculty's clinical decisions, such as personal preferences, prior learning experience, and private practice experience [7,10,11]. Providing consistent instruction and feedback to students is key to improving teaching effectiveness, ensuring patient safety, and allowing students to attain competency. According to the accreditation standards for predoctoral dental education by the Commission on Dental Accreditation (CODA), *"Students must receive comparable instruction and assessment at all sites where required educational activity occurs through calibration of all appropriate faculty"* [12]. It is imperative for institutions to calibrate faculty to promote consistency in instruction and assessment. Studies showed that faculty recognized the need and value of calibration to reduce variations in teaching and improve student satisfaction [5,7,13].

Nonetheless, faculty training and calibration are demanding tasks. Scheduling is challenging for in-person training due to faculty's availability. The training needs to be repeated multiple times to accommodate faculty's different schedules, which is time consuming and labor intensive [14]. This challenge is compounded by the fact that many institutions are increasingly employing part-time faculty from private practice [13,15]. Although these faculty members offer a breadth of valuable clinical expertise, their infrequent presence on campus presents unique challenges for faculty calibration.

Institutions need to identify flexible and sustainable approaches to faculty training [13]. One promising approach is online learning. Online learning, specifically asynchronous online learning, offers enhanced flexibility by allowing learners to study at their own pace, time, and location. As technology advances, educators have access to a wide array of tools, which, when integrated strategically, could move online learning away from the often-seen, passive format towards a more active learning environment. There is a proliferation of studies on online learning with students across disciplines, with results pointing to the conclusion that the online format could be as effective as the face-to-face format [16–20].

The adoption of online formats for faculty calibration is on the rise, yet its efficacy is underreported [13]. Prior studies on dental faculty training and calibration often used the face-to-face format e.g., [1,11,21–24]. A limited but growing number of studies have examined utilizing online learning for health professions faculty calibration, with initial findings pointing to benefits such as increased flexibility and positive faculty reception towards online modalities [13–15,25,26]. Given the substantial resources required to develop high-quality online training programs, it is crucial for institutions to understand faculty's experience with such training to determine whether it is a wise use of resources and to inform program development. There is consensus that the traditional online delivery format that features one-way passive information delivery often fails to engage learners [16,27]. However, it remains unclear what makes the online format most effective for faculty learners.

Like other health professions schools, our dental school is facing similar challenges as outlined previously. To tackle these issues, our dental school has initiated the development and delivery of self-paced, interactive online calibration modules via a cloud-based platform. The purposes of this study were twofold: Firstly, to outline the process of creating these online modules, with a focus on the evidence-based design strategies employed; and secondly, to assess the impact of the online approach using Kirkpatrick's four-level outcome evaluation model, focusing on faculty's satisfaction, engagement, and behavioral changes [28]. The study aimed to answer the following questions:

- What was faculty's perceived effectiveness of the self-paced online approach?
- What were faculty's level of participation and engagement with the online modules?
- How did participating in the online calibration modules impact faculty's teaching behaviors?

2. Methods

This exploratory study was conducted at a private dental school in the U.S. and was approved by the university's institutional review board (IRB #2022-197). Faculty at the school are classified into two categories: salaried (full-time and part-time) and non-salaried (volunteer/adjunct) faculty. The study employed a non-experimental, mixed-methods design by collecting both quantitative and qualitative data from multiple sources, with the goal of developing a more comprehensive understanding of the impact of the online calibration format. This included survey data featuring numeric ratings and written responses, analytics from online platforms, and anecdotal comments from faculty members. In particular, the written responses in the survey helped us better understand the specific aspects of the online format that faculty found to be helpful and their suggested improvements.

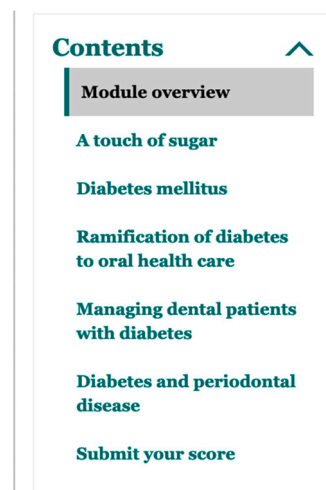
All salaried ($N = 211$) and non-salaried faculty ($N = 267$) were invited to participate in the online calibration modules. The design, delivery, and evaluation approaches of the online modules are detailed in the subsequent sections.

2.1. Interactive and Gamified Online Design

Four online calibration modules covering these topics were developed and delivered: oral pathology diagnosis and referral process; managing diabetic patients in dental clinics; antibiotics stewardship; and the new periodontics disease classification systems. Each module took between one and two hours to complete and was developed by the faculty at the dental school, who specialize in the respective content areas. For example, the antibiotics module was developed by a faculty member who has been teaching and practicing in this area for over 30 years. The module on the new periodontics disease classification systems was developed by the department chair of the periodontics department, who has taught at the school for nearly 40 years. The first author, who has a doctoral degree in education, worked with the faculty on the online module design by providing pedagogical guidance.

The modules were created with SoftChalk (<https://softchalk.com/>; accessed on 15 December 2023), a cloud-based platform. The platform is relatively easy to use and presents a minimal learning curve for faculty. It supports a variety of interactive features to promote active learning and self-assessment. It provides comprehensive analytics data, offering insights into learners' participation and performance.

The design of the online modules was guided by evidence-based principles: chunking, active learning, formative assessment, and timely feedback. For each module, the materials were divided into shorter segments, each presented on a different page focusing on a specific subtopic (Figure 1). Based on the module goals, it incorporated a variety of materials, such as text, clinical cases, and animated videos, to enhance the learning experience (Figure 2).



Contents
Module overview
A touch of sugar
Diabetes mellitus
Ramification of diabetes to oral health care
Managing dental patients with diabetes
Diabetes and periodontal disease
Submit your score

Figure 1. Chunking materials into shorter segments (*Managing Diabetic Patients in Dental Clinics* module).

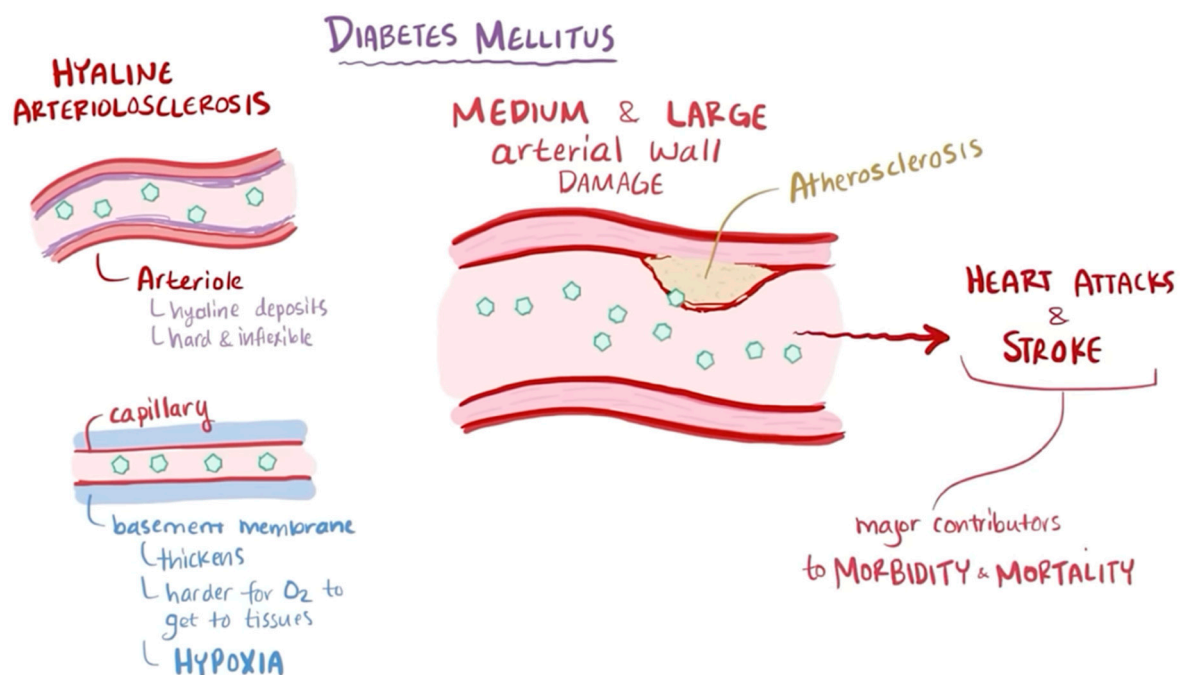


Figure 2. Whiteboard animated video (*Managing Diabetic Patients in Dental Clinics* module).

Contrary to the conventional design where an assessment is placed at the end of the module, various interactive learning activities were interspersed throughout different pages of the module to keep learners engaged and reinforce understanding of the immediately preceding material. In addition to multiple-choice questions, alternative activities such as hot spots, flashcards, labeling, and drag and drop were used in the modules when relevant (Figures 3–5). Upon completing each activity, learners received instant feedback, turning assessment into learning opportunities. If faculty missed a question/activity, they were encouraged to review the content and try again. As learners progressed through the module, their cumulative score for the activities was automatically updated and displayed on the screen.

Flash Card Activity

Instructions: Click on Flip at the bottom of the card to flip it; Use the arrows on the left/right to go to the previous/next card.

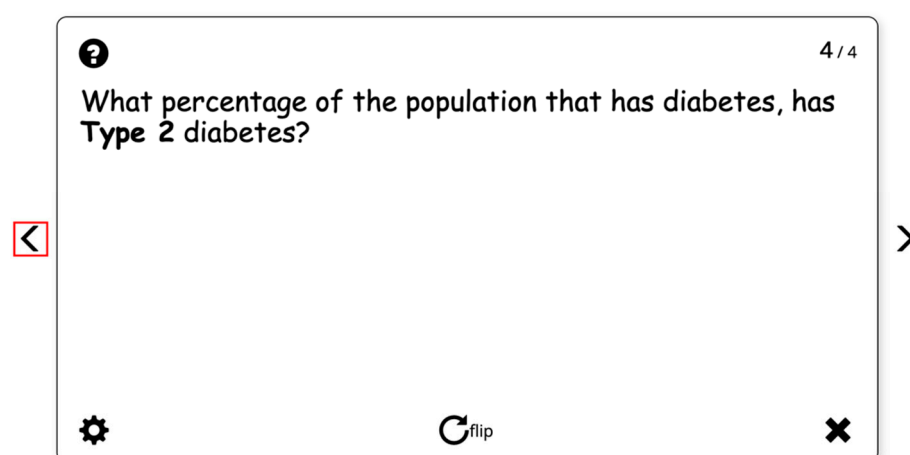


Figure 3. A flashcard activity (*Managing Diabetic Patients in Dental Clinics* module).

Value: 1

This 35 year old, male patient presents with enlargement of the gingiva. Greater than 10% of the sites are bleeding upon gentle probing. He is taking no medications and reports his mother has had similar problems with her gums. There is no evidence of bone or attachment loss.



- ☒ a. Gingival health on an intact periodontium
- ☐ b. Gingival health on a reduced periodontium
- ☐ c. Dental biofilm induced gingivitis on an intact periodontium
- ☐ d. Non-dental biofilm induced gingival disease

Check Answer

✗ Sorry, incorrect answer.

A is incorrect because the gingiva is enlarged and there is greater than 10% of sites bleeding on probing

Figure 4. A case-based question (Periodontal Disease Classification System module). After selecting an answer, participants can click Check Answer to see instant feedback.

Core Elements of antibiotic stewardship	
Education and Expertise ✓	Tracking and Reporting ✓
Commitment ✓	Action for Policy and Practice ✓
Patient Education	Staff Education
4/4 	

Figure 5. A selection activity (antibiotics stewardship module). Faculty select core elements of the Center for Disease Control's (CDC) antibiotic stewardship. Correct elements are indicated by a green checkmark. They can retry using the restart button at the lower right corner.

These interactive and gamified design elements offered learners opportunities to actively interact with the content, fostering deeper comprehension and engagement [16,20,27,29]. Each online module begins with a page that outlines the learning objectives and requirements. For example, to receive full credit, participants must complete all embedded learning activities. The page also details the minimum score required to pass the module and the number of attempts allowed for each module.

2.2. Online Module Delivery

Before releasing the modules to all faculty at the school, we invited a few faculty members to take the modules as “test learners”, with the goal of seeking their feedback on the clarity of the material. Additionally, we conducted thorough tests on the module links and content (e.g., embedded multimedia) to ensure their functionality.

For salaried faculty accustomed to utilizing the university’s learning management system (Canvas), the online modules were integrated into Canvas. When they clicked the “Finish” button on the last page of the module, their scores were automatically sent to the Canvas gradebook. For non-salaried (adjunct) faculty, who primarily taught in the clinic and did not regularly use Canvas, the modules were made accessible through a direct link sent via email. Clicking this link prompted them to enter their name, enabling the tracking of their participation on the SoftChalk cloud website.

Faculty were required to achieve a minimum score to pass each module. While this threshold varied, generally, faculty needed to achieve 80–90% of the total maximum points for each module to pass. They had three attempts for each module, with the highest score from these attempts being recorded. A tutorial on how to navigate the online platform was provided when the first module was distributed. They were given four to six weeks to complete each module.

2.3. Online Module Evaluation

The impact of the modules was evaluated using three data sources: surveys, platform analytics, and supplementary insights shared by faculty in our daily interaction with them.

2.3.1. Online Survey

For each module, faculty members who passed were invited to take an online survey conducted by the school’s continuing education department. The survey was designed by the American Dental Association (ADA). The survey report provided to the researchers is anonymous. Taking the survey was mandatory for those seeking continuing education credits. The survey collected demographic information and faculty’s overall learning experience with questions such as “Overall, I am very satisfied with the course”. We customized the survey by adding additional questions to answer our research questions. For example, we asked faculty to report their computer skills on a scale from poor (1) to excellent (4), and their perceived effectiveness of the online format on a scale from strongly disagree (1) to strongly agree (4). Sample questions included: “The online format is effective for my learning of the topic”, “The online modules are easy to navigate”, and “The online format is engaging”. Two open-ended questions at the end of the survey allowed faculty to provide additional comments on the effectiveness of the modules and suggestions for improvement.

Descriptive data such as the mean score and frequency counts of responses were calculated for each Likert-scale question. Regression analyses were conducted to explore the relationship between faculty’s self-reported computer skills and their perceived effectiveness of the online format. Meanwhile, ANOVA analyses assessed if there were any significant differences in faculty’s perceived effectiveness of the online format according to their academic appointment types, which included salaried full-time faculty, salaried part-time faculty, and non-salaried adjunct faculty.

2.3.2. Platform Analytics

For salaried (full-time and part-time) faculty, analytics data regarding their participation and performance in the modules was extracted from the Canvas gradebook. For non-salaried faculty, this information was downloaded from the SoftChalk cloud website. The number of faculty who completed and successfully passed each module was reported for each module.

2.3.3. Supplementary Insights

Anecdotal comments from faculty and insights obtained from the first author's daily interactions with them offered additional information on faculty's behavioral changes as a result of their participation in the online modules.

3. Results

3.1. Faculty's Participation in the Online Modules

A total of 284 faculty members finished at least one module, and 89 finished all four modules. Table 1 presents the number of faculty who finished and passed each module. Combining both salaried and non-salaried faculty, the numbers were: module 1 (finished = 201; passed = 187); module 2 (finished = 177, passed = 165); module 3 (finished = 161, passed = 153); and module 4 (finished 160, passed = 155).

Table 1. The number of faculty who finished and passed each module.

	Salaried Faculty (Full and Part-Time; <i>n</i> = 211)		Non-Salaried Faculty (Adjunct; <i>n</i> = 267)		Total (<i>N</i> = 478)	
	Finished	Passed	Finished	Passed	Finished	Passed
Module 1 Oral pathology consultations and diagnosis of oral lesions (Pass: 29 out of 31 points)	120 (56.87%)	117 (55.45%)	81 (30.33%)	70 (26.21%)	201 (42.05%)	187 (39.12%)
Module 2 Diabetic patients in dental clinic (Pass: 21 out of 24 points)	104 (49.28%)	97 (45.97%)	73 (27.34%)	68 (25.47%)	177 (37.03%)	165 (34.52%)
Module 3 Antibiotic stewardship in dentistry (Pass: 19 out of 23 points)	93 (44.08%)	88 (41.70%)	68 (25.47%)	65 (24.34%)	161 (33.68%)	153 (32.01%)
Module 4 Periodontal disease classification system (Pass: 9 out of 10 points)	83 (39.34%)	83 (39.34%)	77 (28.84%)	72 (26.97%)	160 (33.47%)	155 (32.43%)

3.2. Faculty's Perceived Effectiveness of the Online Approach

The total number of faculty members who completed the survey was as follows: 99 (52.94%) for the first module, 97 (58.79%) for the second, 101 (66.01%) for the third, and 90 (58.06%) for the fourth. Over 70% of faculty members rated their computer skills as either "good" or "excellent", while the remaining participants rated their skills as "poor" or "fair" (Table 2). Due to missing data, such as unanswered questions, the number of respondents varied slightly for each survey question. Note that while this study does not examine the impact of demographic features such as age and gender, it is known that participating faculty members' ages range from 30+ to 60+, with approximately equal numbers of male and female participants. They hold a variety of academic positions, including assistant professor, associate professor, and full professor.

Table 3 presents the faculty's responses to the Likert-scale questions regarding their perceived effectiveness of each online module. When the data from all four modules were combined, the average percentage of respondents who chose "Agree" and "Strongly Agree" for each survey question ranged from 84% to 94%. This indicated faculty's favorable attitude towards the online format.

Table 2. Number of survey respondents and self-reported computer skills.

	Number of Respondents		Computer-Skill	
Module 1: Oral pathology consultations and diagnosis of oral lesions	Full-time	29	Poor	3 (3.06%)
	Part-time	44	Fair	24 (24.49%)
	Adjunct	26	Good	45 (45.92%)
			Excellent	26 (26.53%)
Module 2: Diabetic patients in dental clinic	Full-time	28	Poor	4 (4.21%)
	Part-time	40	Fair	22 (23.16%)
	Adjunct	28	Good	44 (46.32%)
			Excellent	25 (26.32%)
Module 3: Antibiotic stewardship in dentistry	Full-time	21	Poor	2 (1.98%)
	Part-time	47	Fair	26 (25.74%)
	Adjunct	33	Good	54 (53.47%)
			Excellent	19 (18.81%)
Module 4: Periodontal disease classification system	Full-time	20	Poor	3 (3.33%)
	Part-time	37	Fair	26 (28.89%)
	Adjunct	33	Good	40 (44.44%)
			Excellent	21 (23.33%)

Table 3. Number of faculty who chose “Agree” and “Strongly Agree” for each survey question.

	I Am Very Satisfied with the Overall Course.	The Online Approach Is Effective for My Learning of the Topic.	The Online Module Was Easy to Navigate.	The Online Approach Is Engaging.	The Online Format Made Faculty Calibration More Flexible and Personalized.	I Would Like to Participate in More Calibration Modules in This Online Format.
Module 1: Oral pathology consultations and diagnosis of oral lesions	97 (97.98%)	82 (82.83%)	75 (75.76%)	86 (86.87%)	80 (82.47%)	84 (84.85%)
Module 2: Diabetic patients in dental clinic	82 (88.17%)	84 (91.30%)	79 (85.87%)	84 (91.30%)	83 (90.22%)	83 (90.22%)
Module 3: Antibiotic stewardship in dentistry	97 (98.99%)	83 (84.89%)	78 (80.41%)	80 (81.63%)	81 (82.65%)	82 (83.67%)
Module 4: Periodontal disease classification system	84 (95.45%)	85 (96.59%)	83 (94.32%)	81 (92.05%)	82 (93.18%)	80 (90.91%)
Average across all 4 modules	94.15%	88.93%	84.09%	87.96%	87.13%	87.41%

Regression analyses did not reveal any statistically significant correlation between faculty’s self-reported computer skills and their responses to any of the survey questions. Additionally, ANOVA analyses failed to find any statistically significant difference in the responses to the survey questions among full-time, part-time, and adjunct faculty.

The quantitative data were corroborated by faculty’s written responses to the open-ended questions in the survey. One faculty commented that the online calibration format was an “*excellent way to teach faculty*”. The most frequently highlighted benefits of this online format were its ease of navigation, flexible scheduling, enhanced efficiency, and engaging material. Below are some representative comments reflecting faculty’s positive online experience.

"The SoftChalk format was easy to navigate, and it was different from all other CE courses we have at the dental school—it was much more engaging."

"Online calibration courses are an easy option for scheduling purposes. They are more fun and more efficient."

"All of these faculty calibration courses have been excellent. Exceptionally good quality and content for entirely online courses!"

"This is very good way to engage all faculty in learning and staying abreast with new important information from other than his/her own specialties."

Faculty also highlighted the limitations of the online format. As illustrated in the comments below, one faculty felt that the self-paced online format may not be as effective for all topics, especially clinical ones. Another faculty pointed out that the asynchronous online format lacked opportunities for peer discussions.

"While online learning may be adequate for some topics, many topics in clinical dentistry are taught with deeper understanding and retention of information when there is an opportunity for peer interaction and discussion."

"The program does not provide an opportunity for discussion. It would be nice to see what questions other faculty may have or would like to discuss further. Maybe have a space where all faculty can post questions."

3.3. Impact on Faculty's Teaching Behaviors

Faculty's anecdotal comments provided evidence of the application of knowledge gained from the online modules. The school's oral pathologist shared that most students followed the oral pathology referral process outlined in the *"Oral Pathology Diagnosis and Referral Process"* module. However, there were still inconsistencies in correctly filling out the referral forms. After completing the *"Antibiotics Stewardship"* module, a faculty reported that she incorporated the updated antibiotics prescription guidelines into her clinical teaching. Additionally, one faculty commented in the survey that he/she shared the newly acquired knowledge on antibiotics with staff at his/her private dental practice.

It is also worth noting that the positive online learning experience inspired several faculty to integrate the SoftChalk learning platform into their own teaching. Several of them developed online lessons using this platform to supplement their students' learning in didactic and clinical courses. Additionally, some faculty leveraged this online platform to deliver training modules to faculty within specific specialty areas.

4. Discussions

4.1. Faculty's Perceived Effectiveness of the Online Format

This study introduced and assessed a self-paced, interactive online approach for dental faculty training and calibration. Faculty, irrespective of their computer skills, reacted positively to this online method, as indicated by the favorable survey feedback. This finding aligns with the study conducted by Woo, who also reported dental faculty's appreciation for the flexibility of an asynchronous online calibration module delivered through the university's learning management system [14]. However, our result contrasts with an earlier study by Carter, in which only 28% of the dental hygiene faculty expressed a preference for the self-paced online calibration format [15].

In particular, the written responses in the survey showed that our faculty valued the user-friendliness, flexibility, and interactive nature of the online modules. According to David's technology acceptance model (TAM), users' perceived ease of use is an important factor impacting their acceptance of new technology [30]. Our study reaffirmed the importance of selecting user-friendly tools. The results of our study also underscored the importance of active online learning design, such as the various learning and self-assessment activities integrated into the online modules, to promote deeper comprehension and maintain learner engagement [16,27]. Additionally, in creating these online modules,

we aimed to model best practices in online learning design, such as chunking content into smaller segments to reduce cognitive overload, active learning, and formative feedback. Following the completion of the online modules, several faculty members adopted this online platform for their teaching, demonstrating the critical role of modeling in faculty development [31]. Finally, in addition to faculty's high satisfaction with the online format, their anecdotal comments provided preliminary evidence indicating their application of the newly acquired knowledge from the online modules.

4.2. Enhanced Flexibility and Inclusiveness

One of the most evident benefits of this self-paced online approach is the enhanced flexibility illustrated by the large number of faculty who completed each online module. The data showed that between 160 and 200 faculty finished each online module. This contrasts significantly with our traditional in-person calibration sessions, which typically had an average attendance of 15 to 20 participants.

Especially noteworthy is the significant increase in participation from adjunct faculty. The majority of our adjunct faculty are employed in private practice, located a considerable distance away from the dental school. Additionally, some of them teach at the school's affiliated extramural sites instead of the on-campus clinic. Attending in-person training has been historically difficult for them. This self-paced online format provides a more flexible and inclusive approach that other schools facing similar challenges can adapt.

4.3. Challenges and Lessons Learned

One challenge we faced was that most non-salaried adjunct faculty did not use the university's learning management system (Canvas). Therefore, we had to distribute the modules to them via email, while salaried faculty accessed the modules on Canvas. This required us to monitor usage data across two platforms. Another challenge is faculty motivation. Even though we communicated the mandatory nature of the online modules to the faculty, a significant number did not engage with the modules. To address this, it is crucial to establish clear institutional guidelines to improve compliance. Schools may also consider providing incentives to encourage faculty participation. In our case, we offered continuing education credits to faculty who passed each module. Allocating specific times during the workday for faculty to dedicate to the modules could also improve completion rates.

4.4. Limitations and Future Directions

There are some limitations to be addressed in future studies. First, the results were based on faculty at a single dental school. Conducting comparative studies across different institutions could enable a stronger conclusion regarding the effectiveness of this online methodology. Secondly, results from dental faculty might not be generalized to faculty in other health profession disciplines. As a result, another future direction is to conduct cross-disciplinary comparisons. Thirdly, our data regarding faculty's application of their newly acquired knowledge from the online module relied on anecdotal comments. Future research could benefit from adopting a pre- and post-design to collect data on the impact of the training on teaching behaviors. Future studies could also examine how faculty calibration impacts students' learning. Lastly, not all faculty took the survey. The survey responses might not represent all faculty who participated in the online modules.

5. Conclusions

The self-paced, online approach greatly enhanced the flexibility and efficiency of dental faculty training and calibration. The online modules were well received by faculty, who found them engaging and easy to navigate. The study confirmed several research-based principles for designing online learning, such as incorporating different types of materials, providing chances for active participation, and offering prompt feedback. Given the importance and challenges that dental schools face with faculty calibration, our study

presents a flexible and interactive method that could be adopted by other institutions to improve their faculty training efforts.

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Informed Consent Statement: Participant consent was waived, as the survey was conducted by the continuing education department of the authors.

Data Availability Statement: The data presented in this study are available on request from the corresponding author.

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Conflicts of Interest: The authors declare no conflicts of interest.

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