

Developing and Pretesting Case Studies in Dental and Dental Hygiene Education: Using the Diffusion of Innovations Model

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Abstract: Case-based learning offers exposure to clinical situations that health professions students may not encounter in their training. The purposes of this study were to apply the Diffusion of Innovations conceptual framework to 1) identify characteristics of case studies that would increase their adoption among dental and dental hygiene faculty members and 2) develop and pretest interactive web-based case studies on sensitive oral-systemic health issues. The formative study spanned two phases using mixed methods (Phase 1: eight focus groups and four interviews; Phase 2: ten interviews and satisfaction surveys). Triangulation of quantitative and qualitative data revealed the following positive attributes of the developed case studies: relative advantage of active learning and modeling; compatibility with a variety of courses; observability of case-related knowledge and skills; independent learning; and modifiability for use with other oral-systemic health issues. These positive attributes are expected to increase the likelihood that dental and dental hygiene faculty members will adopt the developed case study once it is available for use. The themes identified in this study could be applied to the development of future case studies and may provide broader insight that might prove useful for exploring differences in case study use across dental and dental hygiene curricula.

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Several calls for change have been issued regarding the future direction of dental and dental hygiene curricula.¹⁻⁴ Consistently advocated changes include increasing students' exposure to patients' oral-systemic health issues early on and throughout their entire training^{1,5} and increasing the utilization of computer-based and web-based information technology.^{2,4} Moreover, the American Dental Education Association Position Paper on the roles and responsibilities of academic dental institutions in improving the oral health status of all Americans recommended creating more effective mechanisms to prepare dental students to provide oral health ser-

vices to diverse populations and patients with special needs.⁶ Similar recommendations have been made regarding dental hygiene education.⁵

Case-based learning may provide the opportunity for students' exposure to oral-systemic health issues they may not encounter in their clinical training, thereby increasing students' experiences in differential diagnosis, patient-provider communication, and patient-specific treatment plans. Case-based learning typically consists of relevant clinical case scenarios, accompanied by structured questions that relate directly to the case and require students to synthesize and apply knowledge.⁷ The term "case-based learning" is

sometimes used interchangeably with “problem-based learning” (PBL) even though distinctions have been made; PBL, for instance, is usually less structured than case-based learning and is not typically used to augment didactic learning experiences.⁷

Surveys of dental and dental hygiene students reveal positive overall ratings of case-based learning.^{8,9} Dental hygiene program directors have reported the following faculty perceptions of case-based learning: it is more effective than conventional learning, and it prepares students to problem-solve.¹⁰ Despite demonstrated benefits of case-based learning,^{7,8,11,12} teacher-directed instruction still predominates in many dental schools and dental hygiene programs.^{8,10,13} Additionally, a survey of North American dental schools suggested that the use of case-based learning decreased slightly from 2003 to 2009, although reasons for this trend were not explored.^{2,14} Therefore, additional research evaluating the perceptions of dental and dental hygiene faculty members may detail specific characteristics of case-based learning that can influence the adoption of this pedagogical method.

The purpose of the current study was twofold: 1) to identify characteristics of case studies that would increase adoption among dental and dental hygiene faculty members, and 2) to develop and pretest interactive web-based case studies on patient communication of sensitive oral-systemic health issues. The case study that was developed utilizes video clips to model a nonconfrontational method for identifying, communicating with, and treating patients presenting with various oral findings associated with disordered eating behaviors. Active participation is elicited via questions interspersed throughout each case. The multiple-choice questions require students to generate differential diagnoses, communication strategies, and treatment plans specific to each case.

This research is part of a larger study pertaining to the adaptation and evaluation of a web-based training program on secondary prevention of eating disorders for use in dental and dental hygiene curricula. Focus group data were obtained from the larger study that explored factors for increasing adoption of e-courses among dental and dental hygiene faculty participants.¹⁵ Thus, in the current study, qualitative data from focus groups are triangulated with data from the interviews and surveys. Furthermore, the content of the current research is distinct and focuses on case-based learning and the process of developing case studies that possess characteristics important for their adoption by faculty participants.

Diffusion of Innovations¹⁶ served as the conceptual framework for the current study. Diffusion of Innovations is the process by which an innovation (e.g., web-based case study) is diffused into an environment (e.g., dental and dental hygiene curricula) and is ultimately adopted by its members (e.g., dental and dental hygiene faculty members).¹⁶ According to Diffusion of Innovations, certain innovation attributes (e.g., relative advantage, compatibility, complexity) increase the likelihood that an innovation is adopted by a targeted population.¹⁶ If an innovation is too complex for the adopter to use, for example, then the likelihood of adoption is reduced. We have interpreted these attributes as they pertain to the adopter (i.e., dental and dental hygiene faculty members) and the innovation (i.e., case-based learning) (Table 1).

Methods and Results

An exploratory assessment of online case-based training among dental and dental hygiene faculty members was conducted using mixed methods. The University of South Florida’s Institutional Review Board granted approval for the study that spanned two phases: Phase 1, faculty input and case study development; and Phase 2, pretesting and refining. The methods and results are described as they relate to each phase.

Phase 1a: Faculty Input

The first step of Phase 1 entailed soliciting input from potential innovation adopters (dental and dental hygiene faculty members) regarding attributes of case studies. Eight ninety-minute focus groups (three dental and five dental hygiene) representing six universities/colleges were conducted with a convenience sample of dental and dental hygiene faculty members at collaborating schools in the Eastern, Southeastern, Midwestern, and Pacific regions of the United States. Participants were recruited via an e-mail invitation sent by the contact person at each collaborating dental school and dental hygiene program participating in the larger study. Details regarding recruitment of focus group participants can be found in a previous study.¹⁵ Four focus group participants (two dental and two dental hygiene) also agreed to participate in a one-hour, follow-up semistructured interview.

Based on innovation attributes (Table 1), a semistructured focus group moderator’s guide and semistructured interview guide were developed

Table 1. Attributes of case-based learning that may influence its likelihood of adoption by dental and dental hygiene faculty members

Attribute	Description Pertaining to Case-Based Learning
Relative advantage	The unique benefits of case-based learning (i.e., how is it better than other teaching methods?)
Compatibility	How well case-based learning fits with the overall curriculum and the norms and ideological value systems of faculty and students
Complexity	The degree of difficulty in developing or using case-based learning materials
Trialability	The degree to which case-based learning can be tried on a small scale before it is adopted
Observability	The ability to observe or evaluate outcomes of using case-based learning
Communicability	The degree to which case-based learning strategies can be transmitted to and understood by others, or how effective case studies are at transmitting knowledge to others
Time	The amount of time that must be invested to develop, implement, and maintain case-based curricula
Risk and uncertainty	The degree of risk and uncertainty when developing and utilizing case-based learning materials
Commitment	The degree of commitment and resources needed for the development, facilitation, and maintenance of case-based curricula
Modifiability	The extent to which case-based curricula can be modified or updated

by the principal investigator (author R.D.D.), with input and feedback from the research team and expert panel. Questions were developed following Gorden's guidelines, which involve the organization of questions to allow for a funneling effect.¹⁷ The questions began with a less structured approach resulting in free discussion, moving toward a more structured format with specific questions pertaining to the conceptual framework. Specific questions and probes were originally included in the focus group and interview guides (Table 2). However, as is often the case in semistructured focus groups/interviews, additional spontaneous probes were used to further explore topics that arose.¹⁷

The principal investigator and one member of the research team, both experienced with focus group and interview procedures, moderated all focus groups and interviews. Prior to each focus group and interview, each participant was asked to read and sign a consent form; the procedures and purpose were explained by the moderator; and participants were given

an opportunity to ask questions. All focus groups and interviews were audiotaped and later transcribed verbatim (with the exception of identifying information) by an experienced transcriptionist. All transcriptions were reviewed by the principal investigator to verify that the transcripts were accurate and reflective of the focus groups and interviews.

Two independent coders initially hand-coded the focus group and interview transcripts. Focus group and interview transcripts were then imported into NVivo 2.0 (QSR International, Melbourne, Australia), where axial coding was performed to identify overarching themes and subthemes. Lastly, a working conceptual framework was developed that describes attributes identified by the dental and dental hygiene faculty members for increasing adoption of case studies.

Phase 1a: Results

A total of fifty participants were involved in the eight focus groups (twenty-seven dental faculty

Table 2. Key questions from Phase 1a focus groups and interviews

- What has been your experience with case-based learning?
- Describe what you would like to see with regard to interactive components and features in a web-based training program.
- In your opinion, how does the use of case-based learning compare to didactic teaching strategies such as lectures?
- What other comments or thoughts do you have on case-based learning that have not been covered?

members and twenty-three dental hygiene faculty members). The majority of participants self-reported as female (84 percent), non-Hispanic (92 percent), and white (78 percent). The mean age of the participants was forty-three years. Two dental faculty members and two dental hygiene faculty members from the focus groups also participated in the in-depth interviews. All four interview participants were female. Three were Caucasian, and one was Asian-American.

A number of themes emerged from the focus groups and interviews pertaining to characteristics necessary for increasing adoption of case studies in dental and dental hygiene curricula (Table 3, columns A and B). All themes emerged from both dental and dental hygiene participants with little diversity across the two groups. The description that follows presents findings that support the themes associated with innovation adoption characteristics.

Relative advantage. Notably, the participants did not report any direct advantages that case-based learning might provide them as instructors. However, three themes emerged as representing relative advantages for students in case-based instruction. Illustrative quotes from participants are included with each theme.

Develops critical thinking skills was the first theme. One dental faculty member made these comments: “As an educator, I think it [case-based teaching] is a good way to teach the student about thinking well, to look at the whole picture, be able to analyze the different contributing factors, and be able in a professional way to work with your patient’s physician, patient’s medical doctor, and help the patient achieve something for their life. I like it.” Similar, a dental hygiene faculty member said, “I think it’s good because it [case-based teaching] allows the students to use their synthesis of a thought, their ideas, their incredible thinking skills and being able to relate one aspect into another and to integrate all of their knowledge together. And to me, a case-based type scenario whether you’re testing or even learning is the best way to put it on there.”

Provides active learning was the second theme. The following comment by a dental hygiene faculty member exemplifies this theme: “I think they [case studies] are awesome because it just keeps it interactive and engaging and makes a student think without the teacher having to divulge everything. They have to sort of figure it out in order for them to be able to move along.” In the words of another dental hygiene faculty member, “It [case-based teaching] makes it much more interesting and kind of interactive for the

student other than a lecture and same-ole-same-ole. I just think I like cases and anything that has to do with the computer, Internet-based, or anything like that.”

Reflects real-world application was the third theme. “If you want to make it like the real world, I think a case study would probably be ideal,” said one dental hygiene faculty member. Similarly, a dental faculty member commented as follows: “if you had a . . . case scenario of a child sitting down and sort of evaluating and then the assessment and then bringing the parent in, having a conversation. So you’re sort of modeling this process through an actual presentation but help[ing] contextualize, so that for the dentist, they’re not just hearing about this disorder, but they’re actually seeing how it would be experienced in their environment.”

Compatibility. Two faculty members from one dental school indicated that their school would be changing to an entirely case-based format in the near future. Most of the other participants reported that case studies are currently used in at least one course in their dental or dental hygiene curriculum. Other areas of compatibility centered around three themes.

The first theme was that case-based learning *reflects the format of national board exams and trends in curricula*. One dental hygiene faculty member noted, “They [the students] have those [cases] on their board exam, and that’s what we ultimately teach to is their board exam, so they can take it and pass it. So if you put different case scenarios about eating disorders in there that they could utilize to learn for their boards, I think that would be excellent.” Another dental hygiene faculty member said, “That’s the trend in the learning is evaluating the case scenario.”

The second theme was that case-based learning is *compatible with students’ preference for online format*. “Students today want everything on the Internet,” stated a dental faculty participant. “They want lectures on the Internet and they want PowerPoint and everything so that they can utilize it themselves.”

Online case studies appear to be highly compatible with dental and dental hygiene curricula, board examinations, and student preferences. However, there were a few exceptions as noted in one additional theme: that case-based learning is *incompatible with some programs/courses*. For example, one dental hygiene faculty member commented, “I don’t personally use cases in my courses because what I teach, there is nothing case-based that I have found.” A dental faculty member noted that “it’s just our curriculum is not built for that. We still haven’t found a way to incorporate more of the case studies.”

Table 3. Faculty-reported themes regarding attributes of case-based learning (columns A and B) and translation of themes to case development (C)

Attribute	A) Pertaining to Faculty	B) Pertaining to Students	C) Translation to Case Development
Relative advantage		<ul style="list-style-type: none"> + Provides active learning of didactic information + Increases critical thinking skills + Interactive/interesting + Reflects real-world application 	<ul style="list-style-type: none"> • Threaded questions throughout case studies to increase active learning • Developed cases using video in order to capture interest and model realistic verbal and non-verbal communication
Compatibility	<ul style="list-style-type: none"> – Some courses are not conducive to case studies 	<ul style="list-style-type: none"> + Already used in at least some courses so students are familiar with case format + Case studies are included as part of national board exams + Students prefer online learning 	<ul style="list-style-type: none"> • Developed cases to “fit” for use in a variety of courses within the curriculum • Incorporated multiple-choice questions similar to national board exams • Developed cases for online use
Complexity	<ul style="list-style-type: none"> – Difficult to develop accurate/realistic cases 		<ul style="list-style-type: none"> • Developed four cases to provide a variety of opportunities with differential diagnoses and patient communication
Observability	<ul style="list-style-type: none"> – Challenging to gauge student learning and know if case was completed 	<ul style="list-style-type: none"> – Need to provide students with feedback 	<ul style="list-style-type: none"> • Instant feedback is provided on responses to questions • Included printable certificate of completion
Communicability	<ul style="list-style-type: none"> – Web-based can be a challenging way of effectively communicating information 	<ul style="list-style-type: none"> + Web-based is an easy way for students to access and retrieve information 	<ul style="list-style-type: none"> • Cases are self-contained within a larger online didactic program, making related materials and information easy to access
Time	<ul style="list-style-type: none"> – Time-consuming to develop – Time-consuming to complete in class 		<ul style="list-style-type: none"> • Created cases online with quiz completion certificate so that students can complete cases outside of the classroom

Note: Themes based on results from focus groups and interviews with dental and dental hygiene faculty members conducted in Phase 1 of the current study.

+ refers to positive characteristics of case-based learning
 – refers to negative characteristics of case-based learning

Complexity. A few dental and dental hygiene faculty participants mentioned the complexity of creating case studies. This theme is illustrated by the following representative quote from a dental faculty member: “So those would be real cases most of those, rather than invented cases, and so they have the actual blood work and photographs that all hold together nicely. That’s the problem: it is so hard to synthesize a case. . . . it is so hard to get all the details exactly right.”

Observability. A number of dental hygiene faculty members mentioned the importance of knowing that students had completed the case by including some type of quiz or assessment. Representative comments from dental hygiene faculty members were the following: “That’s why if we do the cases, to have the assessment as part of the case”; “I like the idea

of the quizzes. A short one for each one [case]”; and “having a quiz would make them read.”

Quizzes were also described as a way to provide students with feedback regarding learning outcomes. This was illustrated in the following quotes from dental hygiene faculty members: “I would probably put more quiz-type questions in there at smaller intervals of the learning experience just to give [students] feedback, and then prepare them for the next section”; and “What would be a nice feature is if when you chose an incorrect answer, it gave some type of an explanation or rationale for why that’s an incorrect answer.”

This theme was not as prevalent among dental faculty members. Although some felt quizzes might be useful, not all dental faculty members agreed, as indicated in the following two quotes: “I don’t know

how that works from a faculty perspective when you get the results of the quizzes if it's like coursework where you can kind of get a gauge for what people are grasping and what they're not, so that's kind of a nice feedback for faculty from a data perspective. I would imagine it's quicker to tell you that up on a computer submission"; and "But in terms of that quiz, I mean how valid is that? The students can access it and do it together."

Communicability. A few faculty members expressed concerns about the ability of online learning to effectively transmit information. This concern was illustrated in the following quote from a dental faculty member: "I do feel that if you're doing clinical teaching, it's very difficult to be able to do that online. . . . how do you teach someone to talk to a patient, to care about—you know, those are things that you can't teach someone off a computer screen."

Despite a few concerns regarding the effectiveness of this teaching method, many faculty members acknowledged that the Internet provides an easy and convenient method for transmitting information. The participants also reported that online content may improve learning because the content can be reviewed repeatedly and at the student's own pace. One dental hygiene faculty member commented, "I think from that perspective it [a web-based format] is good, and I think we can give them access maybe to a lot more material quicker." Likewise, a dental faculty member noted that "one good thing for the students: [a web-based format] allows them to repeat things and so they get more than one opportunity to listen to things that they might've not gotten on the first time."

Time. Two themes emerged reflecting time as a barrier to using case studies. The first theme was the recognition that it is *time-intensive to develop case studies*. "I actually tried to develop a couple case studies on my own for an exam and it was very time-consuming," said one dental hygiene faculty member. A dental faculty member noted, "You see how long it takes to get a case together: it is way more difficult. I mean for faculty it is way more time-consuming. Just like with online courses." The second theme was the related recognition that it is time-intensive to complete case studies. One dental hygiene faculty member identified the "biggest challenge" as "when you are going over a case study, they are time-consuming, and unfortunately a lot of our lectures are only an hour long." A dental faculty member commented, "I think it would have to be kind of a general change in the curriculum because

the way that our curriculum is designed, there's no time to have those cases."

Phase 1b: Translation to Case Development

We developed the case studies after triangulating those themes that represented positive and negative attributes of case-based learning. The steps involved were these:

1. A dentist and a dental hygienist collaborated in writing the case study script.
2. The script was reviewed and edited by the research team.
3. The script was evaluated by two dental and two dental hygiene faculty members who previously took part in the focus group. Feedback was elicited with regard to accuracy, realism, and the types of questions they would like included.
4. Modifications to the script were made by the primary researchers based on feedback obtained in step 3.
5. Questions were generated by the primary researchers with substantial input from two dental and two dental hygiene faculty members. The questions assessed basic knowledge regarding physical signs of disordered eating behaviors as well as procedural knowledge pertaining to the following: appropriate ways to approach the patient about this sensitive topic; how to determine patient readiness to address this sensitive issue; and how to develop and implement an appropriate treatment plan that is tailored to the patient's stage of readiness.
6. Questions were interspersed at appropriate points throughout the case to make the case study more interactive.
7. Pictures were taken and the script was audiorecorded to make the online case study prototype more interesting.
8. The prototype was pretested as described in detail below.
9. After the initial round of pretesting was complete, the case was filmed to create a live-action video to better model patient communication. (See Figure 1 for a screenshot of the video with a segment of the dialog—in the conversation bubble—and a sample question.)

Throughout the development and revision process, findings from Phase 1 were translated into features of the case study to ensure that identified adoption characteristics were incorporated (Table 3, column C). To address the aspect of complexity



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Case Studies

Case Study 1

Case Study 2

Case Study 3

Case Study 4

Diane, I understand that it is important for you to get your teeth fixed. However, it is not a good idea to fix them without knowing what's causing the erosion because the dental treatment I perform may fail if we don't address the underlying cause.



Question 9

As part of assessing Diane's readiness to address the cause of the underlying systemic health issue(s), Dr. Brown should determine which **two** of the following? (**select two**)

- A) Diane's perception of how important it is to identify the underlying cause of her oral health problems
- B) How much Diane knows about the effects that the underlying systemic illness can have on her oral health
- C) The extent to which Diane's teeth are bothering her
- D) Diane's confidence in her ability to take steps that will help address the underlying systemic health issue(s)
- E) How ready Diane's mother is to determine the underlying systemic health issue(s)

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Figure 1. Screenshot from developed case study

and time involved with the creation of case studies by faculty members, a total of four interactive case studies were developed by the researchers and expert panel. Although the initial case study remains the primary focus here, all of the case studies capitalize on advantages identified in Phase 1 of this study. For example, videos were used to model communication by dentists or dental hygienists with diverse patients (male, female, adult, and pediatric) who present with a variety of clinical findings, are at varying

stages of readiness to address their underlying issues, and therefore require various treatment plans. In addition, questions were interspersed throughout the cases to engage active learning. These strategies allow students to observe real-life patient-provider communication and to apply critical thinking skills.

To increase cultural compatibility with dental and dental hygiene programs, the research team structured case study questions in a fashion that is similar to cases presented in national board exams.

Additionally, although the cases were specifically for identifying and treating patients with signs of disordered eating behaviors, they can be applied in a variety of courses, and the skills that are gained can be used for communicating about a variety of sensitive oral-systemic topics. Lastly, cases were also developed to be used online by students. In addition to being compatible with student preferences, online cases give the instructor flexibility to use the case in class or assign the case as homework. Thus, online cases can address the concern that case studies require too much time in class.

We utilized two strategies to address aspects of observability. The first was to include instant feedback regarding the accuracy of students' responses to questions. Second, the inclusion of a personalized certificate of completion provides feedback to both the instructor and the student to enable the cases to be completed outside of the classroom.

Phase 2a: Pretesting

Pretesting is a data-driven, iterative process in which materials (e.g., web-based case studies) are tested and revised over a series of rounds until they communicate effectively with the intended audience (e.g., dental and dental hygiene faculty members).¹⁸ For the current study, participants were provided with a link to the case study prototype for review prior to the interview. A semistructured interview guide,

based on characteristics of innovation adoption, was developed by members of the research team following Gorden's guidelines, which involve the organization of questions to allow for a funneling effect.¹⁷ The interview guide included questions designed to elicit feedback on the case study specifically regarding the characteristics of adoption (Table 4). Data collection and analysis followed the same procedures described for Phase 1.

Phase 2a: Results

Participants for the pretesting were dental (n=6) and dental hygiene (n=4) faculty members from three accredited dental schools and dental hygiene programs in the Eastern, Midwestern, and Pacific regions of the United States. The age of the participants ranged from twenty-eight to sixty-seven years. The majority identified themselves as female (90 percent) and Caucasian (70 percent). Teaching experience ranged from three to forty years, but only four reported routinely using case studies as an instructional method.

The participants identified themes pertaining to both faculty and students (Table 5). The same themes were identified by both dental and dental hygiene faculty members. The vast majority of the participants expressed positive feedback regarding attributes of the case study as exemplified by the following representative quotes. Two dental faculty

Table 4. Key questions from Phase 2a pretesting

- What is your overall impression of the case?
 - What do you think students would think about the case?
 - (Time) How long did it take you to complete the case study?
 - (Complexity) Did you have any difficulties while reviewing the case?
 - (Communicability) How well did you understand the case study?
 - Subquestion: Were the objectives clear? Did you feel they were met?
 - Subquestion: Were the layout and navigation straightforward?
 - Subquestion: Was the content too difficult or too easy for students?
 - Subquestion: How about the scenario? Did it make sense?
 - (Relative advantage) What do you see as the benefits of a case study like this?
 - Subquestion: Does it provide any benefits for students?
 - Subquestion: Any benefits for you as the course instructor?
 - Subquestion: Does it provide advantages over other teaching methods?
 - (Compatibility) How could this type of case study fit into your curriculum?
 - (Observability) How well did you feel this case study evaluates student learning?
 - Can you describe any changes, edits, or suggestions that you may have for improving the case?
 - Is there anything else that you think is important for us to know regarding this case study?
-

Table 5. Emergent themes from faculty members regarding attributes of the developed case studies that are expected to increase or decrease the likelihood of adoption

Attribute	Characteristics Pertaining to Faculty Use	Characteristics Pertaining to Student Use
Relative advantage	<ul style="list-style-type: none"> + Provides information and resources not available elsewhere + Enhances current didactic lectures + Comprehensive and standardized 	<ul style="list-style-type: none"> + Active learning + Increases critical thinking skills + Realistic modeling of patient communication regarding sensitive topics + Self-paced
Compatibility	<ul style="list-style-type: none"> + Would fit in a variety of courses within curricula + Consistent with practice protocol regarding sensitive oral-systemic health issues 	<ul style="list-style-type: none"> + Similar to practice materials for national board exams + Online format is what many students desire
Complexity	<ul style="list-style-type: none"> + Easy to access and use - Need to improve usability in a couple of areas 	<ul style="list-style-type: none"> + Easy to access and navigate
Observability	<ul style="list-style-type: none"> + Students can submit "Certificate of Completion" - Can't be certain student took time to read everything - May want to also give in-class quiz 	<ul style="list-style-type: none"> + Questions provide immediate feedback regarding correct/incorrect response - Some may prefer more feedback about why answer is incorrect
Communicability	<ul style="list-style-type: none"> + Clear way to demonstrate treatment protocols 	
Time	<ul style="list-style-type: none"> + Save class time by assigning case as homework 	<ul style="list-style-type: none"> + Average time for completion was ½ hour (most faculty said length was appropriate for students)
Modifiability	<ul style="list-style-type: none"> + Multiple ways of incorporating cases in and out of class + Use cases to introduce other sensitive oral-systemic health issues - Limitations to modifiability 	

Note: Listed characteristics are based on results from interviews and surveys of dental and dental hygiene faculty members conducted in Phase 2 of the current study.

+ refers to positive attributes of the case studies that are expected to increase the likelihood of adoption
 - refers to negative attributes of the case studies that are expected to decrease the likelihood of adoption

members made these comments: "I think it's well presented. I think the subject matter is very important and it really tunes them in to looking at the patient beyond just teeth, so I like that"; and "[the case] includes everything so I don't have to worry about forgetting some details or not being able to go back and see what I gave them." A dental hygiene faculty member noted, "I think the case study, the modeling, really helps the students see a realistic type of way of managing it."

The participants did express minor concerns or recommendations for improving the case study with regard to decreasing complexity, increasing observability, and limitations to modifiability. Regarding the recommendation to *decrease complexity*, the comments of some participants demonstrated that making certain the case study is easy to use and decreasing the likelihood of technical problems were critical to adoption. One dental faculty member stated, "I think the most important thing is that I would want to know that it's easy for students to navigate because I think that I wouldn't want them to give up on something." A dental hygiene faculty member made a similar

point regarding faculty use of the case study: "If I'm going to have a lot of problems with it . . . I mean if I can easily click and click, and it doesn't do anything, that's a thing that would stop me and frustrate me and make me say, 'Oh my God. I'm not doing this. This is too hard or too challenging.'"

Regarding the recommendation to *increase observability*, the case study provides for students and instructors to be able to observe and for faculty members to evaluate whether students completed the case study. However, as illustrated in the following quotes, some faculty members expressed the desire for additional feedback or evaluative measures. "I thought maybe it would be nice to get some comments," said one dental hygiene faculty member. "When I did it first, then it was all correct and I thought, well, what if I get it incorrect. So when I did it the second time, I did it incorrectly, and then I wanted maybe something more." A dental faculty member asked, "Is there a way that if you take the test how it could be scored or not? I mean how that could be documented?" Another dental faculty member commented, "In all honesty I think it would work,

but if I was the clinical instructor and I was basing it on whether or not students were turning their certificates in, I don't know if that would be the best way to indicate to me that they truly did read through it and they truly did get something out of it."

Some participants also expressed concerns about *limitations on modifiability*. Despite the inability for instructors to modify the case study, these faculty members reported a few different ways in which the case study could be used. "I mean, you could try to give them something open-ended to write a paragraph about what you thought were the biggest challenges in a case like this or something like that, you know, if you really wanted to get into how much they absorbed it," suggested one dental faculty member. A dental hygiene faculty member noted, "But even with these more sensitive topics, role playing would be good to implement, . . . you know, divide them into teams and each team has to present their own role-playing scenario." Another possibility was raised by a dental faculty member: "I think it's a good overview, and it would sort of lend itself to giving a good lecture based on this information."

Phase 2b: Case Refinement

Based on information gathered in the pretesting phase, the research team with input from the expert panel made revisions to the cases to ensure they supported attributes that the participants had mentioned would increase the likelihood of adoption. For example, to decrease complexity, we revised the instructions for questions that required multiple correct responses because it was confusing for the participants. Additionally, several case study questions were revised to improve clarity and accuracy.

To increase observability, two revisions were made in the case study. First, if the student gets a question incorrect, a link appears that will take him or her to the section of the training program that describes the related content. This enables the student to review the material again to increase understanding of the information. Second, the certificate of completion was revised to include the percent of questions answered correctly on the first try.

Once revisions were made, a second round of pretesting was implemented with four faculty members (three dental and one dental hygiene) who had participated in the first round of pretesting. One additional dental hygiene faculty member who consented to the second round of pretesting was unable to complete it due to unforeseen circumstances. These

participants were asked to review the revised case study and then complete an eight-item Likert-type web survey to assess final characteristics of intervention adoption. The percentages of participants who "strongly agreed/agreed" with specific intervention adoption characteristics were as follows:

- provides a more practical experience on how to address sensitive topics with patients than is currently available for use in dental education (75 percent);
- is tailored specifically for dental and dental hygiene students (75 percent);
- is easy to navigate (100 percent);
- is understandable (100 percent);
- is realistic (100 percent);
- would fit well in my school's curriculum (75 percent);
- questions are appropriate for dental and dental hygiene students (75 percent);
- accurately represents patient-provider interactions regarding sensitive issues (100 percent);
- provides a better teaching method to learn about recognizing and approaching patients who present with sensitive issues than other educational methods currently used (75 percent);
- would be useful for dental/dental hygiene students to learn patient-provider communication (100 percent); and
- if available, I would recommend using the cases in my school's curriculum (75 percent).

Discussion

The two primary purposes of this study were to 1) engage dental and dental hygiene faculty members in identifying key aspects of web-based case studies that would increase the likelihood of adoption in dental and dental hygiene curricula and 2) apply that information to the development of web-based case studies as part of a larger intervention study. Public health articles have suggested that adoption of new evidence-based interventions by target populations rarely exceeds 1 percent.¹⁹⁻²¹ Real-world conditions include many factors that can interact with or moderate the reach, adoption, delivery, impact, or sustainability of an intervention.²² Barriers to successful dissemination and adoption of interventions include failure to consider the necessary steps to secure dental and dental hygiene faculty participation in intervention development and other factors needed to sustain the intervention over time (e.g., is it ap-

plicable, compatible, understandable, “fit” for many settings, feasible, and affordable?).^{19,23-25}

Attributes of case studies that would likely decrease the likelihood of adoption include being too “topic-specific” so they could not be used in a variety of courses and adding additional information into already packed courses.¹³ In developing cases, we paid attention to these concerns and made sure that the cases were examples of patients presenting with oral findings related to eating disorders, but broad enough that the cases could be used in a variety of courses. In addition, the web-based nature of the cases, with built-in evaluation feedback, enables the cases to be completed by students outside of the classroom with minimal effort required on the part of the instructor.

The results of this study provided additional key input that shaped the development of case studies so dental and dental hygiene faculty members would be more likely to incorporate them into their current courses once they become available. Negative attributes that were identified by faculty members in Phase 1 (e.g., time and complexity in creating, completing, and evaluating case studies) were eliminated in Phase 2 by the development of comprehensive case studies. More specifically, negative attributes were addressed by including questions and a certificate of completion to provide a simple mechanism by which faculty members can track which students completed the case and evaluate student performance. These self-contained characteristics allow instructors to utilize the case study in their courses with little time needed for planning and evaluation.

The limitations of this study stem primarily from the use of a relatively small convenience sample, thus affecting the ability of generalizing these results to other faculty members. However, we were able to reach saturation,²⁶ meaning that additional focus groups and/or interviews would be unlikely to reveal substantially different themes or other major recommendations for altering the case study. Nevertheless, the sample may have been biased due to self-selection of participants and overrepresentation among female dental faculty members.

Conclusions

The use of Diffusion of Innovations as a guiding framework helped elicit perceived characteristics of web-based case studies by dental and dental hy-

giene faculty members. The results from this study provided valuable and practical information that was used to inform the development of case studies for an ongoing research project aimed at increasing dental and dental hygiene students’ capacity to identify, communicate, and treat patients with signs of disordered eating behaviors. Using the Diffusion of Innovations model as the theoretical framework allowed us to capitalize on positive characteristics of case studies that may increase the likelihood that instructors would incorporate them into existing dental and dental hygiene courses. Although the purpose of this study was to provide input on innovation adoption for the development of case studies, the actual adoption of case studies is part of a future evaluation study. Nonetheless, the adoption themes identified in this study can be applied to the development of case studies regarding a variety of topics, and our results suggest that Diffusion of Innovations may prove to be a useful framework for exploring differences in case study use across dental and dental hygiene curricula.

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