


ORIGINAL ARTICLE

Introducing dental students to complete denture treatment in times of COVID-19: Students' responses

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Abstract

Objectives: The COVID-19 pandemic required changes in the complete denture courses to comply with lock-in and social distancing requirements. The objectives were to assess (a) dental students' interest in a required complete denture course and the prosthodontics specialty, (b) how much time students spent on studying background, lab, and clinical content, and (c) how difficult and helpful course components were. Additionally, open-ended responses concerning what the students liked and what they wanted to have changed were analyzed as well.

Methods: After this “complete denture” course, 81 of 109 students responded to a web-based survey with questions about course content and design. This hybrid course consisted of weekly asynchronous virtual lectures, in-person simulated laboratory (sim lab) exercises, and synchronous virtual workshops.

Results: Exactly 53.7% were much/very much interested in this course, with nobody considering prosthodontics as their specialty. The students studied on average of 79.61 minutes for 1 hour (of background-related lecture, 69.92 minutes for a lab-based lecture, and 77.00 minutes for a clinical-content lecture ($p < 0.001$). They evaluated clinical content as most difficult, lab content as less difficult, and background material as least difficult (3-point scale with 1 = not at all difficult: means = 1.90/1.85/1.80; $p < 0.001$). They rated background lectures as least helpful, clinical material as more helpful, and lab content as most helpful (5-point scale with 1 = most helpful: means = 2.33/2.67/2.96; $p < 0.001$). Open-ended answers showed exceptionally positive responses for content and pedagogy of sim lab and clinical content.

Conclusions: Gaining a better understanding of students' responses to hybrid “complete denture” courses is critical for optimally teaching this material in times of COVID-19.

KEYWORDS

complete, COVID-19, culture, dental, denture, education, prosthodontics, schools, teaching

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1 | INTRODUCTION

In 1970 and 1980, dental educators reported a decline in the numbers of edentulous patients in United States (US) dental school clinics, and considered this situation to be a threat to optimally train future dentists.¹ This fact might have resulted in a reduction of the number of hours for complete denture education in the pre-doctoral dental curricula in the US.² However, the Centers for Disease Control and Prevention reported that while 49 million of US adults were 65 years or older (15% of the population) in 2016, the numbers are expected to climb to 98 million by 2060 (25% of the population).³ With this increase in the older population, the number of patients with complete edentulism is likely to grow, challenging educators to assure that dental school graduates can meet this need for prosthodontic care.^{4,5}

One question is how interested dental students are in meeting this increased need for prosthodontic care. In 2012, Dhima et al showed that only 3.4% of dental students considered prosthodontics to be a desirable career, and only 1.7% pursued the specialty of prosthodontics.⁶ Shin et al found that the most important determining factor for choosing a dental specialty was the enjoyment of the specialty.⁷ Zarchy et al confirmed that this factor was also most important for students who entered a graduate program in prosthodontics.⁸ Other important factors for choosing the specialty of prosthodontics were faculty mentor influence,⁹ length of a specialty program, cost of the specialty program, and the expected future salary.^{7,8} The decrease in face-to-face interactions between students and prosthodontic faculty during the COVID-19 pandemic in the preclinical years could therefore lead to a decreased interest in the specialty of prosthodontics.

Due to the expected increased demand for the treatment of edentulous patients, it is important to assure that removable prosthodontic curricula will meet the needs of the future US population,¹⁰ even when COVID-19 requires teaching these courses as hybrid courses. The question, therefore, is how to optimally prepare dental students for this task. Rashedi et al argued that there is no consensus on how to teach “complete dentures” courses optimally.² During the first 2 years of dental school, pre-doctoral students are engaged primarily in basic science courses and pre-clinical education.¹¹ In 2013, the majority of dental schools (77%) taught their first complete dentures course in the second year of their curricula.² These courses ranged in length from 2 to 13 months (median: 5 months) and both the number of lectures and of laboratory hours ranged widely (lecture: 12–80 h; mean = 28 h/lab: 31.5–150 h; mean = 74 h). In their laboratory sections, 49% of these schools used manikin heads and 70% of them used edentulous dentofoms.²

In order to reduce the amount of time between pre-clinical complete denture education and clinical treatment of edentulous patients, some dental schools started to introduce their students to patient care in their second year within the complete denture course¹² or in a transition clinic.¹³ In 1970, Adisman et al, and then in 1980, Miller et al, suggested that early patient contact could provide a good transition to the clinical prosthodontic care of patients and increase students’ interest in complete denture prosthodontics.^{14,15}

Half a century later, the COVID-19 pandemic introduced new challenges for in-person patient exposure early on in medical and dental education.¹⁶ Since March 2020, dental schools have had to consider which educational methodology would be most suitable for teaching a complete denture course safely. Considerations of asynchronous, synchronous, or hybrid teaching had to be explored.¹⁷ Prior to the COVID-19 pandemic, research had analyzed the use of videos for replacing clinical exposure.^{18–20} In addition, in 2006, Hollis et al²¹ explored the benefits of online learning, and some discussed the value of hybrid learning, also known as “blended learning.”^{22,23} Some authors suggested that a combination of online learning and face-to-face class interactions should be considered as a best practice.^{21,24,25}

In addition, it is interesting to review research related to the factors that affect the number of hours students spend on studying outside of classroom-based settings. Kember et al²⁶ argued that students are able to spend up to 50 h a week on educational activities. This means that as the number of hours spent in the class increases, the number of hours for independent study decreases.²⁶ A second factor affecting the number of hours spent on studying is the difficulty level of the material. Metcalfe et al found that students spent most time on proximal learning study material that was not too difficult or easy,²⁷ since this material will be learned best with minimal effort.^{28,29} If more study time is available, students will then study the difficult topics.²⁸

While educational research analyzed optimal strategies for teaching and learning in general, there is a lack of understanding of how to teach complete denture material to pre-doctoral dental students optimally. The objectives therefore were to assess (a) dental students’ interest in a complete denture course and the prosthodontics specialty, (b) how long students spent on studying background material, lab, and clinical content, and (c) best practices, for example, how helpful they rated the course components, and challenges, for example, how difficult the components of this revised course in times of COVID-19 were. Open-ended responses concerning positive and negative aspects of the course were analyzed and used as the basis for revisiting the course design.

2 | METHODS

This study was determined to be exempt from Institutional Review Board (IRB) oversight by the Health Sciences and Behavioral Sciences IRB at the University of Michigan, Ann Arbor, MI (#HUM00193078) on September 8, 2020. This cross-sectional study used web-based survey methodology to collect data from dental students.

2.1 | Respondents

In the total denture course for the 2020 Fall Term, 81 of 109 second-year dentistry (D2) students participated in the survey (Response rate: 74.3%). All 109 students who took the course could volunteer to participate anonymously.

2.2 | Procedure

All 109 D2 students at a Midwestern dental school participated in the “complete denture” course. Attendance of the asynchronous lectures and the preclinical lab sessions were required. The students who did not attend the preclinical exercises failed this part of the course. After the grades were submitted, the students were informed about this evaluation survey in the first class of another course in the next term (January 2021). A consent form was handed out and all students signed this form and consented to participate in the web-based survey. The students then received a follow-up recruitment email that explained the purpose of the research again and asked them to respond to an anonymous web-based Qualtrics survey by using a link provided in this email. They also received one additional follow-up email.

2.3 | Key features of the educational intervention

In US dental schools, the complete denture course is taught usually in the second year. In the first year, students learn about restorative dentistry. In the second year, students take fixed and removable prosthodontics courses. Before March 2020, the “Clinical Foundations II – Complete Denture” course was an in-person required class in the Fall Term of the D2 year. The lectures were delivered in person in a lecture hall. There was a weekly quiz testing material from the week before, before the lecture took place and answers to the quiz were shown after the quiz was completed.

In order to comply with the lock-in and social distancing requirements due to the COVID-19 pandemic, this

in-person course was changed to a hybrid course during the Fall Term 2020. This 11-week long course consisted of weekly 1.5 to 2 h of asynchronous virtual lectures, nine 3-h long in-person simulated laboratory exercises, and two 3-h long synchronous virtual workshops with breakout groups and review of materials.

Table 1 provides an overview of the material covered and the timeline of the coverage of this material. In order to reduce personal interactions, the teaching pedagogy was revised to allow optimal learning of the didactic/background, laboratory, and clinical materials related to the fabrication of complete dentures for edentulous patients during the COVID-19 pandemic. In order to allow social distancing in the preclinic and reduce person-to-person contact, the students were randomly assigned to two groups for the simulated laboratory portion of the course. Each smaller group performed the laboratory work in the preclinic at its own time. During these nine 3-h long sessions, the students performed the technical laboratory procedures of fabricating complete dentures. In addition, a virtual small group exercise was added to assure deeper understanding of the content concerning the relationship of the maxillary and mandibular arches during the jaw relations appointment. The students took all quizzes online on Fridays within a 12-h window. The quiz answers were discussed in class the week after the quiz was taken. Students asked in-person questions about quizzes in the lab session or asked to meet virtually during office hours if they wanted to have a one-on-one discussion with the instructor.

The assignments were questions pertaining to Edentulous Anatomy and Teeth Selection. The instructor (= Author 1) wanted to make sure that students understood anatomical landmarks and motions during border molding in the Edentulous Anatomy assignment. This exercise applied knowledge. The Teeth Selection assignment was also applying knowledge of the two lectures (Anterior Teeth Selection, and Complete Denture Occlusion). These exercises were reviewed in the first virtual synchronous review session. There was a second virtual synchronous review session reviewing material for the final exam. There was an additional synchronous virtual review session at the end of the term to allow the students to ask questions.

2.4 | Materials

The first recruitment email and the follow-up email were formulated according to the guidelines provided by the Health Sciences and Behavioral Sciences IRB at the University of Michigan.

The course content was listed in the syllabus for the course and the CANVAS course website modules

TABLE 1 Key features of the educational intervention

Week #	Content	Type of instruction				Resources			Assessment		
		Background	Lab	Clinic	Photo	Video	Zoom	Quiz	Sim lab	Assignment	
1	Intro to complete dentures	x			x	x		x			
	Pre-prosthetic surgery	x						x			
	Custom tray		x		x	x		x			
	Articulator		x		x			x			
2	Edentulous anatomy	x			x	x		x		x	
	Custom tray		x		x			x		x	
	Triad record bases		x		x			x		x	
3	Border molding and final impressions			x				x			
	Master casts		x		x			x			
	Triad record bases		x		x	x		x		x	
	Jaw relations			x	x	x					
4	Jaw relations exercise			x			x			x	
	Anterior teeth selection			x	x	x		x		x	
5	Complete denture occlusion		x		x	x		x		x	
	Wax try-in			x	x	x		x		x	
6	Processing of dentures/digital dentistry		x		x	x		x		x	
	Insertion of complete dentures			x	x	x		x		x	
7	Post-insertion complications			x	x	x		x		x	
	Immediate dentures			x	x	x		x		x	
8	ACP classification	x			x						
	Review	x	x	x	x				x		

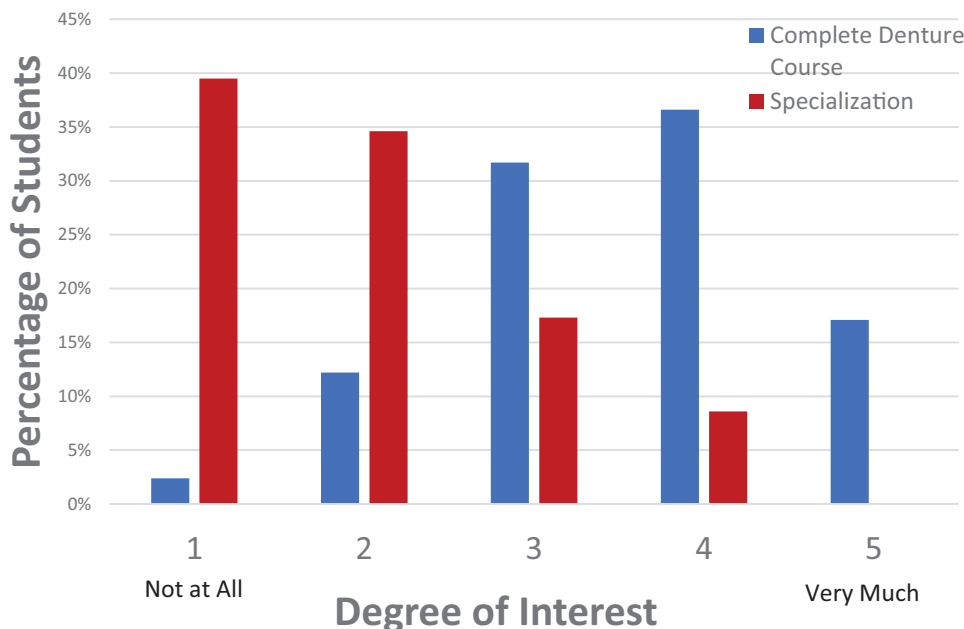


FIGURE 1 Degrees of interest in taking the Complete Denture course and in specializing in Prosthodontics.

(see Table 1 for the overview of the course materials by week). The survey questions mirrored the titles of the weekly covered topics in this course. The external validity of this content was demonstrated by analyzing the consistency of the material covered in this class, syllabus, and survey as is covered in two external sources, namely (a) the well-known *Prosthodontic Treatment for Edentulous Patients* textbook edited by George Zarb³⁰ and (b) the American College of Prosthodontics CD of the Complete Denture educational curriculum.³¹ For each topic, we inquired (a) how many minutes the students had studied, (b) how difficult the topic was, and (c) how helpful these aspects of the course had been. The responses concerning the time spent were open-ended. The responses concerning the difficulty of the material were provided on a 3-point answer scale, and the responses concerning the helpfulness on a 5-point rating scale. Two open-ended questions allowed the respondents to provide additional information about what they liked about the course and what should be changed.

2.5 | Statistical analysis

The data were downloaded from the Qualtrics website as an SPSS data file (Version 26). Descriptive statistics such as frequency distributions, means, and standard deviations were computed to provide an overview of the responses.

3 | RESULTS

Aim 1 focused on analyzing how interested the students were in taking this Complete Denture course and in specializing in Prosthodontics. Figure 1 shows that the majority of the students were much (36.6%) or very much (17.1%) interested in taking this course. Only two students were interested in this course. In contrast, nobody was “very much” interested in specializing in prosthodontics and only seven students (8.6%) were “much” interested.

When considering how much time the students spent on studying for each part of the course per week, Table 2 shows that the students spent on average most time on studying during the first 4 weeks. During week 1, they spent almost 5 h on studying (mean: 284.42 min), 4 h during week 2 (mean: 240.36 min), approximately 3.8 h (mean: 229.55 min) during week 3, and 2.8 h (mean: 166.43 min) for week 4. During weeks 5–11, the students spent on average less than 2 h per week on studying (range: week 5: 71.15 min to week 6: 95.58 min).

When the average time spent on studying for 1 hour of provided background material or lab or clinical content were compared, the data showed that most study time was dedicated to studying the background material (mean: 79.61 min), nearly as much time for studying clinical content (mean: 77.00 min), with the least time spent on studying the lab content (mean: 69.92 min; $p < 0.001$). However, in addition to considering how much time the students spent on these three types of materials per week,

TABLE 2 Average time spent on studying per topic/week

# Minutes studying for	Minutes: mean	Standard deviation	Range
Week 1: Background: Introduction to CD	71.81	52.725	0–300
Week 1: Background: Pre-prosthetic Surgery	68.72	43.778	0–180
Week 1: Lab: Custom Tray	70.77	47.043	10–180
Week 1: Lab: Articulator	70.71	49.008	0–240
Sum Week 1	284.42	175.201	60–720
Week 2: Background: Edentulous Anatomy	100.83	66.330	20–360
Week 2: Lab: Custom Tray	67.69	44.355	10–180
Week 2: Lab: Triad Record Bases – Text	71.83	55.041	10–300
Sum Week 2	240.36	148.559	60–780
Week 3: Clinical: Border Molding and Final Impression	91.03	53.479	20–300
Week 3: Lab: Master Casts	71.79	45.762	20–200
Week 3: Lab: Triad Record Bases - Text	66.73	46.723	0–180
Sum Week 3	229.55	136.399	60–660
Week 4: Clinical: Jaw Relations – Text	96.15	60.859	10–360
Week 4: Clinical: Zoom Exercise – Text	69.48	50.181	0–240
Sum Week 4	166.43	93.129	30–420
Week 5: Clinical: Anterior Teeth Selection	71.15	50.038	5–300
Week 6: Lab: Complete Denture Occlusion	95.58	73.317	20–480
Week 7a: Clinical: Wax Try-in	40.57	47.770	0–240
Week 7b: Lab: Processing / Digital Dentures - Text	40.57	47.770	0–240
Sum Week 7	81.14	47.770	0–240
Week 8: Clinical: Insertion of Complete Dentures - Text	81.22	47.175	20–240
Week 9: Clinical: Post- insertion Complications - Text	77.31	45.332	20–240
Week 10: Clinical: Immediate Dentures	85.58	53.972	0–360
Week 11: Background: ACP Classification	72.44	45.525	20–180
Sum of minutes spent for studying for	Mean	Standard deviation	Range
- for all 11 weeks	1493.87	843.566	460–4450
- on studying for four background material lectures	316.22	180.101	70–840
- on studying for eight lab-related material weeks	555.87	346.622	145–1800
- on studying for eight clinical material lectures	616.04	330.599	175–1810
Average # of minutes spent on studying for	Mean	Standard deviation	Range
- Background per lecture hour	79.61	45.050	18–210
- Lab per lecture	69.92	43.436	18–225
- Clinical activity per lecture hour	77.00	41.325	22–226
	p < 0.001		

it is also worthwhile to consider the wide range in study times (see Table 2). Over all 11 weeks, the number of minutes spent during the whole term ranged from 460 (7.7 h) to 4450 min (74.2 h).

Aim 3 focused on how difficult the students evaluated the different course components to be. Table 3 shows that the students used a 3-point scale from 1 = “not at all difficult” to 3 = “very difficult” to answer for

each lecture topic how difficult the material was. The highest percentage of “very difficult” responses (61.7%) was for the week 4 lecture on “Jaw Relations” and the second highest percentage (48.1%) was for the week 3 lecture concerning “Border Molding and Final Impressions.” The highest percentage of “not at all difficult” responses was found for the week 1 lecture on background material on “Pre-Prosthetic Surgery” (49.4%), with the second

TABLE 3 Average difficulty ratings of the material per content and per week

How difficult was the material in each part of the lectures?	1 = Not at all	2	3 = Very	Mean (SD)
Week 1: Background – Introduction to CD	42%	51.9%	6.2%	1.64 (0.598)
Week 1: Background – Pre-prosthetic surgery	49.4%	48.1%	2.5%	1.53 (0.550)
Week 1: Lab - Custom Tray	29.6%	64.2%	6.2%	1.77 (0.554)
Week 1: Lab - Articulator	18.5%	54.3%	27.2%	2.09 (0.674)
Average difficulty week 1				1.76
Week 2: Background - Edentulous Anatomy	7.4%	63.0%	29.6%	2.22 (0.570)
Week 2: Lab - Custom Tray	27.2%	61.7%	11.1%	1.84 (0.601)
Week 2: Lab - Triad Record Bases	21.0%	61.7%	17.3%	1.96 (0.621)
Average difficulty week 2				2.01
Week 3: Clinic - Border Molding and Final Impression	3.7%	48.1%	48.1%	2.44 (0.570)
Week 3: Lab - Master Casts	19.8%	69.1%	11.1%	1.91 (0.552)
Week 3: Lab - Triad Record Bases	21%	67.9%	11.1%	1.90 (0.561)
Average difficulty week 3				2.08
Week 4: Clinic - Jaw Relations	2.5%	35.8%	61.7%	2.59 (0.543)
Week 4: Clinic - Zoom Exercise	24.7%	63.0%	12.3%	1.88 (0.600)
Average difficulty week 4				2.24
Week 5: Clinic - Anterior Teeth Selection	41.8%	54.4%	3.8%	1.62 (0.562)
Week 6: Lab - Complete Denture Occlusion	11.1%	46.9%	42.0%	2.31 (0.664)
Week 7a: Clinic - Wax Try-in	16.0%	63.0%	21.0%	2.05 (0.610)
Week 7b: Lab - Processing / Digital Dentures	16.0%	63.0%	21.0%	2.05 (0.610)
Average difficulty week 7				2.05
Week 8: Clinic - Insertion of Complete Dentures	11.1%	70.4%	18.5%	2.07 (0.543)
Week 9: Clinic - Post- insertion Complications	23.8%	55.0%	21.3%	1.98 (0.675)
Week 10: Clinic - Immediate Dentures	7.4%	66.7%	25.9%	2.19 (0.550)
Week 11: Background - ACP Classification	20.0%	71.3%	8.8%	1.89 (0.528)
Average indices of difficulty ratings	Mean	SD	Range	
Average difficulty of all background lectures	1.80	0.343	1.00–2.75	
Average difficulty of all lab material	1.85	0.372	0.94–2.69	
Average difficulty of all clinical lectures	1.98	0.306	1.19–2.69	
	$p < 0.001$			

highest percentage for the week 5 clinical lecture on “Anterior Teeth Selection” (41.8%). An analysis of the mean difficulty responses showed that 11 lectures were rated as being between “not at all” and “somewhat difficult,” while nine lectures received mean ratings between “somewhat difficult” and “very difficult.”

The students also rated how helpful each lecture was for completing the hands-on segment of the course. These ratings were provided on 5-point answer scales ranging from 1 = “a great deal helpful” to 5 = “not at all helpful.” Table 4 shows that a majority of the students rated six of the 19 lectures as “a great deal helpful/very helpful.” These lectures were given in week 2 (Custom tray: 56.8%), week 2 (Triad record bases: 54.4%), week 3 (Master casts: 53.1%), week 3 (Triad record bases: 59.3%), week 5 (Anterior teeth selection: 55.6%), and week 6 (Complete denture occlusion: 53.1%). More than a third of the students responded that

four of the lectures were “not at all helpful/a little helpful.” These lectures were given in week 1 (Pre-prosthetic surgery: 44.4%), in week 9 (Post-insertion complications: 37.1%), week 10 (Immediate dentures: 40.8%), and week 11 (ACP classification: 39.5%).

In addition, the mean “helpfulness ratings” showed that the laboratory material helped most with the hands-on portion of the course (mean: 2.33), the background content helped the least (mean: 2.96), and the clinical material section rating was in between these two ratings (mean: 2.67; $p < 0.001$).

The “helpfulness ratings” can be considered as giving input into best practices and the “difficulty” ratings as input into potential challenges of the course. Open-ended responses concerning what the students liked about the course and what should be changed complemented these closed-ended evaluations. Table 5 shows that the

TABLE 4 Evaluations of the degree of helpfulness of the material

How much did this lecture help with understanding the lab work?	1 ^a	2	3	4	5	Mean
Week 1: Introduction to CD	9.9%	23.5%	34.6%	29.6%	2.5%	2.91
Week 1: Pre-prosthetic Surgery	8.6%	18.5%	28.4%	35.8%	8.6%	3.17
Week 1: Custom Tray	14.8%	33.3%	39.5%	12.3%	0%	2.49
Week 1: Articulator	9.9%	22.2%	45.7%	21.0%	1.2%	2.81
Total Week 1						2.85
Week 2: Edentulous Anatomy	16.0%	27.2%	43.2%	11.1%	2.5%	2.57
Week 2: Custom Tray	18.5%	38.3%	35.8%	7.4%	0%	2.32
Week 2: Triad Record Bases	19.8%	34.6%	37.0%	8.6%	0%	2.35
Total Week 2						2.41
Week 3: Border Molding and Final Impression	18.5%	28.4%	33.3%	16.0%	3.7%	2.58
Week 3: Master Casts	14.8%	38.3%	35.8%	9.9%	1.2%	2.44
Week 3: Triad Record Bases	17.3%	42.0%	30.9%	9.9%	0%	2.33
Total Week 3						2.45
Week 4: Jaw Relations	21.0%	22.2%	33.3%	19.8%	3.7%	2.63
Week 4: Zoom Exercise	7.4%	21.0%	42.0%	21.0%	8.6%	3.02
Total Week 4						2.83
Week 5: Anterior Teeth Selection	17.3%	38.3%	30.9%	11.1%	2.5%	2.43
Week 6: Complete Denture Occlusion	22.2%	30.9%	33.3%	12.3%	1.2%	2.40
Week 7: Wax Try-in / Processing / Digital Dentures	12.3%	22.2%	32.1%	25.9%	7.4%	2.94
Week 8: Insertion of Complete Dentures	8.6%	25.9%	34.6%	22.2%	8.6%	2.96
Week 9: Post- insertion Complications	9.9%	19.8%	33.3%	27.2%	9.9%	3.07
Week 10: Immediate Dentures	7.4%	17.3%	34.6%	27.2%	13.6%	3.22
Week 11: ACP Classification	6.2%	17.3%	37.0%	29.6%	9.9%	3.20
Average helpfulness of	Mean		SD		Range	
- the background lectures for the hands-on portion of the course	2.96		0.825		1–4.50	
- the lab lectures for the hands-on portion of the course	2.33		0.723		1–3.75	
- the clinical lectures for the hands-on portion of the course	2.67 <i>p</i> < 0.001		0.778		1–4.56	

^aAnswers ranged from 1 = a great deal, 2 = a lot, 3 = a moderate amount, 4 = a little to 5 = not at all helpful.

presentations/pedagogy were clear and easy to understand in all three content categories. Almost half of the students liked the use of good visuals such as videos, clinical photos, and handouts. One-third of the students found the material to be thorough and comprehensive in all three sections. Concerning the content, one-third of the students considered the background and laboratory material and two-thirds the clinical material to be informative and relevant to patient care. Half of the students mentioned that the content in the background material was a good introduction with a big picture overview.

Concerning the perceived challenges, the responses provided opposing points of view: While some students wanted a broader and more concise amount of content,

other students asked for more detail or explanation in the background, lab, and clinical content areas. Over 60% of comments regarding change recommended more explanation in the laboratory and clinical section, while less than 10% recommended reducing the specifics and details in these areas. Concerning the background content, 16% wanted more concise or broader content and less than 10% recommended more explanations. Some students preferred to have more examples in terms of photos, videos, demonstration, or animation. Some students asked for more assessment materials or activities (background: 7.4%; lab: 7.4%; clinic: 17.3%) and commented that the content could be better organized/made be more cohesive (background: 14.8%; lab: 9.9%; clinic: 17.3%).

TABLE 5 Frequencies/percentages of open-ended responses concerning which content and presentation features students liked by type of educational content

	N = 81	%
Like – Background: Content		
Broad; basic information; good overview; preview; big picture; good intro	44	54.3%
Practicality; of relevance; patient care; informative	26	32.1%
Oral muscle anatomy; anatomic relevance; oral anatomy	22	27.2%
Indications for surgery; contraindications; complications	14	17.3%
Other	17	21.0%
Subtotal	123	151.9%
Like – Background: Presentation/Pedagogy		
Clear; easy to understand; made sense; straight to point; concise; simple; good explanations	46	56.8%
Good visuals; video; clinical photos; handouts	30	37.0%
Thorough/comprehensive/ /summarized slides/tie concepts together	19	23.5%
Other	19	23.5%
Subtotal	110	135.8%
Like – Lab: Content		
Applicable to lab; use of different materials; articulators; facebow; instrumentation; evaluation of lab work	149	184.0%
Practicality of relevance; patient care	27	33.3%
Occlusion; adjustment; how teeth articulate; curve of Spee; curve of Wilson	12	14.8%
Other	27	33.3%
Subtotal	215	265.4%
Like – Lab: Presentation/Pedagogy		
Clear / easy to understand / made sense / straight to point / concise/simple / good explanations	77	95.1%
Good visuals / video / clinical photos / handouts	38	46.9%
Thorough / comprehensive / summarized slides / tie concepts together	23	28.4%
Other	23	28.4%
Subtotal	161	198.8%
Like – Clinic: Content		
Practicality of relevance / patient care / informative	49	60.5%
Post insertion complications; trouble shooting problems	25	30.9%
Choose teeth; measurement/ teeth arrangement; esthetics	24	29.6%
Border moldings; muscle movements; oral muscle anatomy	17	21.0%
Applicable to lab; custom tray	15	18.5%
Clinical steps; complete denture; step by step	12	14.8%
Immediate dentures	11	13.6%
Other	29	35.8%
Subtotal	182	224.7%
Like – Clinic: Presentation/Pedagogy		
Clear; easy to understand; made sense; straight to point; concise; simple; good explanations	53	65.4%
Good visuals; video; clinical photo; handouts	37	45.1%
Thorough; comprehensive; summarized slides; tie concepts together	31	37.7%
Small groups; working with classmates; interactive; Zoom; able to ask questions; get feedback	30	37.0%
Other	36	44.4%
Subtotal	187	230.9%

4 | DISCUSSION

COVID-19 caused a lockdown of all in-person dental school activities at the home dental school in March 2020. Classroom-based education shifted to synchronous and asynchronous virtual sessions and preclinical and clinical activities were cancelled till June 2020. Clinical activities resumed gradually over the summer. Planning the Fall Term, it became obvious that the “Complete Denture” course required changes. First, the preclinical space was restricted to the use of every second chair to reduce the density to 50%. The previously classroom-based in-person didactic lecture portion of the course had to be taught virtually. It was unclear how much time the students would spend on watching virtual lectures, which aspects they would consider a best practice and helpful, and which challenges they encountered. Requiring the students to respond to surveys during the term was problematic because they were struggling to adapt to the new “normal.” However, after the students had received their course grades, they had an opportunity to provide feedback to increase instructors’ understanding of how much time was needed for asynchronous virtual education, and which best practices and challenges students perceived after experiencing this method of teaching.

Being interested in taking a course undoubtedly provides a positive motivational setting. Fortunately, a substantial percentage of the respondents was much/very much interested in taking this course. This interest might reflect the realization that even if students would practice as general dentists, they would have to provide complete denture treatment to their patients. This perspective is supported by research showing that general dentists spent 25% of their time treating prosthodontic patients with 8% in removable prosthodontics in 2007.³²

This interpretation is also rather likely because no student indicated wanting to become a prosthodontist. This finding is surprising given the research that shows that pre-doctoral dental students were interested early on in their dental school careers in specializing in Oral Maxillofacial Surgery³³ or in Orthodontics.³⁴ It is interesting to explore in future research whether the lack of face-to-face mentoring by prosthodontic faculty members during the beginning of the COVID-19 pandemic in the Spring, Summer, and Fall of 2020 might have been related to this finding. Prior research showed that working side-by-side with faculty motivated students to pursue a specialty.⁷ Having fewer opportunities for such experiences with prosthodontic faculty members due to COVID-19 might explain the lack of interest in becoming a prosthodontist.

With the introduction of the online curriculum, students spent on average a tremendous amount of time in the first 4 weeks of the course. This could have been partly due to

the need to familiarize themselves with the new pedagogy used. However, one interesting finding was the wide range of time spent on studying in each single week of the term. According to Kember et al,²⁶ students spent up to 50 h a week on studying independently and in classroom settings. The decreased face-to-face time in classes allowed more independent study time.

Also, it is possible that the other courses during this Fall term did not start with a large workload, allowing students to dedicate up to 12 h of studying the Complete Denture course. In the beginning, students had to understand basic background information, basic principles, and instrumentation to build a good foundation for the clinical and laboratory lectures. At the end of the semester, the other courses may have been more demanding and the amount of time for this Complete Denture course might therefore have decreased. In any case, it is important to realize that there was at least one student who only spent 7.7 h on studying during the complete term, while other students spent up to 74.7 h.

This wide range in the number of hours spent on studying can also be a result of living through the COVID-19 pandemic. Research with dental students showed the high degree of stress, depression, and anxiety they experienced during this time.^{35–38} In contrast to the extensive hours that some students put into the course, others may have been faced with economic hardship. For example, several students reported food insecurity in a poll taken in another class at that time or took on paid jobs, such as starting dog and cat sitting business, to help their families during the pandemic.

The difficulty level of the material might also affect the number of hours spent on studying. Research found that students spent most time on proximal learning which refers to “skills that the learner is close to mastering.”^{28,29,39} These research findings are consistent with the results in this study, which showed that the most time on average was spent on the least difficult content area—the background material.

Overall, the students found the clinical portion of the lectures to be the most difficult and the background didactic content of the lectures to be least difficult, with the difficulty of the laboratory lecture in between the two. Research showed that students found clinical concepts difficult to grasp since the teaching was more theoretical, and faculty found it difficult to correlate ideal situations to what actually happened in clinic.¹⁹ Research also showed that demonstrations and videos⁴⁰ as well as interactive sessions were critical in understanding the clinical material. However, even when video demonstrations were provided, students reported that videos should not replace clinical demonstrations.^{18,40–42} In addition, faculty respondents felt that they were “giving half the knowledge as students

are not exposed to patients” and felt that “lack of clinical exposure” was an obstacle when training students.¹⁸ These sentiments were also reflected in the open-ended comments of the student respondents in this study who wanted to have more hands-on activities, assessment materials and activities, and clinic procedural activities.

Concerning which lectures were most helpful for the hands-on portion of the course, the lectures directly related to the laboratory work were rated as most helpful. The least helpful sections of the course were the background and the clinical content of the course. A future best practice would be to incorporate the effect of the hands-on laboratory complete denture product on clinical outcomes to allow students to realize how helpful the clinical lectures are for understanding the hands-on portion of the course.

One positive finding concerning the open-ended responses was that there were many more responses to the questions what the students liked than to the question what needs to be changed. These positive responses refer to the best practices that should be maintained and even strengthened in future courses.

The interesting overall finding concerning the responses to the question what should be changed was the contradiction between what different students wanted. For example, while some students wanted a broader amount of content, others wanted more detail or explanation in all three content areas. This situation could potentially be addressed with providing additional resource materials that students can access as needed. Clear directions during the asynchronous lecture to where additional material can be found via links embedded into the lectures could be a quite helpful response in this situation. Active learning activities were evaluated as the best resources,^{43,44} and future courses could increase these types of activities. Overall, it is important to consider that the future education about complete denture fabrication should incorporate computer-aided design/computer-aided manufacturing (CAD/CAM) into the clinical curriculum.^{45–48}

In summary, at this time, we recommend making more resources available to allow students to individualize their study approach, including links to additional videos and literature applicable to patient care and offering additional didactic information for students who need more explanation or detail to understand certain topics better. In addition, we suggest to include more assessment materials or activities for some clinical topics such as “Border Molding and Final Impressions,” “Jaw Relations,” and “Complete Denture Occlusion.” One way to allow more assessment activities is to include a simulation using a manikin typodont to practice the clinical portion from the beginning of preliminary impressions to trial wax denture try-ins.³⁵ To further limit face-to-face contacts, incorpora-

tion of digital denture teeth setup planning can be used to replace setting teeth in the Simlab.

One final consideration is the fact that the survey had external validity because the questions mirrored the titles of the weekly covered topics in this course. It is important to note that the material covered in this class, syllabus, and survey was consistent with two well-known external sources, namely (a) the *Prosthodontic Treatment for Edentulous Patients* textbook edited by George Zarb³⁰ and (b) the American College of Prosthodontics CD of the Complete Denture educational curriculum.³¹

One major limitation of this research is the fact that these data were collected from students in one particular class during one particular time during the pandemic. However, even with this limitation, some findings are quite informative such as the wide range of time spent on studying, the contradictory suggestions for changes, and the overall interest in patient-relevant instructions with good use of visuals such as photographs, videos, and handouts, and the availability of self-assessment materials and activities. A second limitation was the fact that these data were not collected during the term, but after the grades had been submitted. The reasoning behind this timing was (a) to avoid information overload during the term and (b) to receive honest responses and not socially desirable responses or responses based on impression management considerations. However, collecting data at several points during the term could have provided additional insights.

5 | CONCLUSIONS

Based on these findings, it can be concluded that the majority of dental students were much/very much interested in taking a Complete Denture course. However, not one student considered prosthodontics as their future specialty and career.


Students spent most of their study time on the least difficult content, on studying the didactic background information. They spent less time on the most difficult topic, which was the clinical content information. Students considered the laboratory content to be most helpful for the hands-on portion of the course. Open-ended positive comments focused on the instructions being clear, easy to understand, having good visuals, and being thorough, comprehensive and relevant to patient care. Suggestions for changes include adding more assessment materials and explanations, reducing specifics and adding clinical procedural steps.

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