Technology acceptance by professors and adherence of undergraduate dental students to virtual classes during COVID-19 pandemic

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ABSTRACT

The aim of this study was to analyse the acceptance of technology by professors and the adherence of dental students to virtual teaching during the social distancing period due to the coronavirus disease (COVID-19) pandemic. This was a retrospective observational cross-sectional study that involved the anonymous opinion of dental school professors. After each virtual class, the professors filled out the e-questionnaire about the remote activities (discipline identification, method used, number of students, satisfaction of the professor, and a technology acceptance model questionnaire) performed between 18 March and 18 May (60 days of virtualisation of theoretical classes during interruption of face-to-face classes). This study showed a good acceptability of this learning technology by professors (TAM score 81.82 ± 11.79). During the pandemic, live video conferencing classes (n = 632, 63.6%) were the most preferred method of teaching by professors, followed by previously recorded video lessons (n = 403, 40.5%). The acceptability of professors was strongly associated with the perception of the quality of interaction ($p < 0.001$). Higher student participation was significantly associated with live video conference classes ($p = 0.019$). Prior availability of articles or documents for study ($p = 0.028$) and the absence of technological complications during the virtual classes ($p = 0.003$) significantly increased acceptability. In conclusion, the virtual class technology used during the COVID-19 pandemic period was well accepted by professors at a dental school and had good adherence by students, especially in videoconferencing classes.

Descriptors: COVID-19. Education, Dental. Educational Technology. Dental Informatics.

1 INTRODUCTION

An outbreak of pneumonia caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), which has been identified as a novel coronavirus, was initially detected in Wuhan, Hubei Province, China[1]. It has spread worldwide, with an exponential increase in the number of new cases and deaths, confirmed by the World Health Organization (WHO), and is considered a major public health concern[2]. According to the Chinese Association of Preventive Medicine, transmission of the virus is believed to occur by human-to-human contact via respiratory droplets and aerosols[3]. Due to the high transmissibility of SARS-CoV-2, its continued circulation in some regions, and the emergence of new viral variants, it is unlikely that SARS-CoV-2 will be eradicated. We need to continue to focus on mitigation strategies, especially vaccination[4].

Public health measures are being taken to control the outbreak of this respiratory disease[5,6] with the primary objective to decrease the number of newly infected cases. Several measures such as strict observation of quarantine, social distancing, isolation policies, and restraint from community[7], are being implemented on a large scale by governments and agencies across the world[6]. Due to the current situation, face-to-face classes have become a potential risk of infection[8]; therefore, distance education, which is a reliable educational method [9], has become an important tool during this period[10].

Due to this pandemic situation, dental academic institutions have adopted a series of modifications in order to protect students, patients, and staff, and at the same time continue the academic progress of students[11].

E-learning has recently been proposed as a basic supplementary tool to enhance medical and dental education[12]. It appears as an alternative source of education for individuals unable to study in person and it is characterised by self-regulated learning, that consists of the student's ability to plan and formulate educational goals and find ways to achieve them, using self-assessment strategies and time and resource management[13].

Different tools and methods have been developed with effective e-learning and online learning to expand the possibilities of teaching and learning in the field of health, including dentistry[14,15].

Undergraduate dental students have considered the e-course to be a positive method of supplementing traditional learning methods, whereas the teaching staff expressed negative views on the same[16]. Successive reports on the use of information communication technology in e-learning indicated that those working in a university system preferred traditional classroom teaching methods to web-based education, while others encouraged students to access the web-based learning model[17].

The aim of this study was to analyse the acceptance of technology by professors and the adherence of students at a dental school in northeastern Brazil to the virtual teaching, during the social distancing period due to the COVID-19 pandemic.

2 METHODS

This retrospective observational cross-sectional study, which involved the anonymous opinion of professors from a private dental school in north-eastern Brazil, followed the rules of Resolution 510/16. The project was approved by the Ethics Committee of the university, in accordance with the Brazilian guidelines for research involving human beings, as established in Resolution 466/12 (Record: 30535020.5.0000.5049).

Due to the COVID-19 pandemic, public and private colleges were no longer conducting face-to-face classroom activities. Since the first day of interruption of academic activities, the dental school of this study started to prepare and conduct

virtual lessons, and train/instruct faculty members via distance learning in order to avoid disruption of the activities of its numerous undergraduate students (n = 721), distributed in two campuses, with morning and evening classes. After each virtual class, every professor filled out the *e*-questionnaire using Google® Forms to control remote activities.

We collected the responses between 18 March and 18 May (60 days of virtualisation of theoretical classes during interruption of face-to-face classes) and included all the questionnaires of that period. None of the questionnaires were excluded from the study.

The questionnaire was designed with two blocks of questions. Block 1 (figure 1) contained questions regarding the lecture topic, the material provided to the student before the virtual class (in advance), the interaction tool used during class, and the number of students present in live interaction with the professor.

Block 2 (figure 2) contained the Technology Acceptance Model (TAM) [18] questionnaire and a Likert-5-points scale of the professor's satisfaction with the virtual interaction. We assessed the adaptation of TAM during virtualisation of classes with the following four points: "I think it is a useful approach for conducting virtual classes", "I believe that the method of distance learning is an effective alternative amid situations of face-to-face classes restriction", "The use of technologies for conducting virtual classes helped me to better understand the concepts related to the content taught", "I would use technologies to conduct virtual classes on day-to-day basis". The sum of scores was then multiplied by 5 to adjust the TAM scale to 0-100 (TAM score).

Data from the completed surveys were exported to a spreadsheet and subsequently encoded and analysed using the software Statistical Package for the Social Sciences (SPSS – Armonk, NY, USA) version 20.0 considering $p < 0.05$.

The scores of the TAM were converted to a linear scale from 0 to 100. The mean and standard deviation was calculated, along with the overall Cronbach's alpha and Cronbach's alpha values excluding each item, and the correlation of each domain was analysed with the TAM-score (Spearman's rank correlation tests). The Friedman test was used for intra-analysis between the four items of TAM, and subsequently, the TAM scores of each student were classified as high and low by the median.

The two categories of TAM (low and high acceptance), the participation of the students in virtual classes, and the period in which the virtual classes occurred were associated with all items of the questionnaire using the Pearson's chi-squared test or Fisher's exact test and a multinomial logistic regression model (multivariate analysis).

3 RESULTS

During 60 days of interruption of social interaction, 34 days of activities were evaluated with a total of 994 virtual classes. Average classes per day were 29.24 ± 3.38 (95% Confidence interval [CI]: 28.05-30.42), ranging from 24 to 36 classes. Over time, there was no increase in the number of classes, and this number remained high during the evaluated period ($p = 0.803$, $r = 0.044$). Of the 994 virtual classes carried out over two months, 268 (27.0%) were conducted in the first 15 days, 258 (26.0%) between and 15-30 days, 220 (22.1%) between 30 and 45 days, and 248 (24.9%) between 45 and 60 days.

There was an average of 21.35 ± 9.29 students interacting per session (95% CI: 20.74-21.95) ranging from 0 to 54 students, with a median of 20 students. There was a significant correlation between the number of students interacting and the number of days of virtual activities ($p < 0.001$, $r = 0.216$). A total of 462 (50.5%) classes had up to 20

students, and 453 (49.5%) had more than 20 students participating.

Questionnaire

Block 1

Lecture date:

1. Period (Semester)

( ) 1 ( ) 2 ( ) 3 ( ) 4 ( ) 5 ( ) 6 ( ) 7 ( ) 8 ( ) 9 ( ) 10

2. Course: _____

3. Campus: **Shift:** ( ) Night ( ) Morning

4. Schedule

( ) A ( ) B ( ) C ( ) D

5. Course Director:

6. Lecture Topic: _____

7. Material provided to the student before virtual class (in advance)

( ) PDF / PowerPoint file of the slides (commented)

( ) Video lesson (recorded) (link)

( ) Sending link to "Live" class

( ) Scientific Article / Document with the lesson

8. Interaction tool used during the class:

( ) Live class (YouTube, Zoom, Hangouts, etc.)

( ) Moodle platform chat

9. Number of students present in the interaction with the professor in the class time:

(Number of present students with the professors in chats, meetings or lives to clarify doubts) _____

10. **Professor responsible for the lecture:** _____

Figure 1. Questionnaire (Block 1): questions regarding the lecture topic, the material provided to the student before the virtual class (in advance), the interaction tool used during class, and the number of students present in live interaction with the professor

Block 2

The next questions must be answered by the lecturer

Do you consider, taking into account the resources used and the interaction with students, that the lecture was:

( )Very good ( )Good ( )Regular ( )Bad ( )Too bad

Specify, if applicable, difficulties and complications:

_____

_____

It seems to me a useful approach for teaching distance classes:

( )Totally Disagree ( )I disagree ( )Indifferent ( )I agree ( )I totally agree

I believe that the distance education method is an effective alternative in situations of face-to-face restrictions.

( )Totally Disagree ( )I disagree ( )Indifferent ( )I agree ( )I totally agree

The use of technologies for conducting distance classes helped me to better understand the concepts related to the lesson.

( )Totally Disagree ( )I disagree ( )Indifferent ( )I agree ( )I totally agree

Would you use technologies to conduct distance classes in your routine?

( )Totally Disagree ( )I disagree ( )Indifferent ( )I agree ( )I totally agree

Figure 2. Questionnaire (Block 2): Professor's satisfaction with the virtual interaction

The questionnaire results demonstrated good acceptability of technology by professors, with an average TAM score of 81.82 ± 11.79 (95% CI: 81.05-82.58) ranging from 30 to 100, with a median of 80. The internal validity showed adequate values with a Cronbach's α of 0.809. When items were removed from the questionnaire, it did not significantly reduce its internal validity, which presented Cronbach's α values greater than 0.700. All four items from the TAM questionnaire differed significantly from each other ($p < 0.001$, table 1).

Most of the virtual interactions occurred in the first semesters (students from first, second and third semesters of the dental course) (n = 317, 31.9%), and during morning classes (n = 361, 36.3%) through videoconferencing (n = 981, 98.7%). This profile did not change over time since the interruption of face-to-face classes. However, the professors of the evening course showed greater acceptability ($p = 0.009$). The students interacted

mostly (> 20 students interacting) during the morning classes ($p < 0.001$) of basic science lessons ($p < 0.001$) (table 2).

The preference of methods used by the professors to teach during the pandemic were in the following descending order: live video conferencing classes (n = 632, 63.6%) followed by previously recorded video lessons (n = 403, 40.5%), slideshow posted on the virtual learning environment (n = 230, 23.1%), and the availability of articles or documents for study (n = 293, 29.5%). Most of the professors considered interactions to be very good (n = 541, 54.8%) or good (n = 401, 40.6%). In the period of 30-60 days after the interruption of face-to-face classes, there was a significant increase in live video conferencing classes ($p < 0.001$) and a reduction in the availability of content through previously recorded videos ($p = 0.002$). There was also a significant change in the interactions considered to be very good or good ($p = 0.002$). The acceptability of professors was not significantly influenced by the teaching methods, however, it was strongly associated with the perception of quality of the interaction ($p < 0.001$). The number of interacting students was directly associated with live video conferencing classes ($p < 0.001$) and also directly influenced the perception of the professors when considering very good interactions. However, it was inversely associated with previously recorded video lessons ($p = 0.004$) (table 3).

Most virtual classes lasted two hours (n = 839, 84.4%), without any technological problems (n = 575, 57.8%), included up to 20 interactive students (n = 463, 50.5%) and had good acceptability (TAM = 80 or more, n = 711, 72.0%). There was a significant reduction in technological complications in the last 30 days of virtual classes ($p < 0.001$) and a consequent increase in the participation of students during this period ($p < 0.001$). Acceptability was not influenced by the period, duration of activity, or number of students present, but there was an inverse association between acceptability and the presence of technological complications during virtual classes ($p = 0.002$). The number of students interacting was also inversely associated with the presence of technological complications ($p = 0.002$) (table 4).

Table 1. Technology acceptability profile used during virtualisation of face-to-face classes by undergraduate dentistry professors

	Mean±SD	**Cronbach's α**	**Correlation†**
Technology acceptance model (TAM) score	**81.82±11.79**	**0.809***	
TAM-1: I think it is a useful approach for conducting virtual classes	4.22±0.65[a]	0.740**	p<0.001 (r=0.809)
TAM-2: I believe that the method of distance learning is an effective alternative amid situations of face-to-face classes restriction	4.38±0.56[b]	0.794**	p<0.001 (r=0.739)
TAM-3: The use of technologies for conducting virtual classes helped me to better understand the concepts related to the content taught	3.80±0.91[c]	0.770**	p<0.001 (r=0.835)
TAM-4: I would use technologies to conduct virtual classes on day-to-day basis	3.98±0.80[d]	0.730**	p<0.001 (r=0.832)
p-Value‡	***<0.001***		

* Cronbach's Alfa; ** Cronbach's Alfa if the item is deleted; † Spearman correlation; ‡ Friedman/Dunn test, different letters = significant difference between groups.

Table 2. Influence of the virtual lessons content and the method of interaction, technology acceptance by professors and participation of dental students

		Period (days)			TAM			Number of students interacting		
	Total	**1-29 days**	**30-60 days**	**p-Value**	**<80**	**80+**	**p-Value**	**Up to 20**	**>20**	**p-Value**
Total	**994 (100.0%)**	**502 (50.5%)**	**492 (49.5%)**	**-**	**276 (28.0%)**	**711 (72.0%)**	**-**	**462 (50.5%)**	**453 (49.5%)**	**-**
Content of virtual lessons										
Basic sciences	317 (31.9%)	167 (33.3%)	150 (30.5%)	0.815	81 (29.3%)	229 (32.2%)	0.403	119 (25.7%)	186 (41.1%)*	***<0.001***
Basic sciences /pre-clinical content	247 (24.8%)	122 (24.3%)	125 (25.4%)		67 (24.3%)	180 (25.3%)		124 (26.8%)	104 (23.0%)	
Pre-clinical/ Clinical content	149 (15.0%)	75 (14.9%)	74 (15.0%)		50 (18.1%)	99 (13.9%)		106 (22.9%)*	38 (8.4%)	
Clinical content	281 (28.3%)	138 (27.5%)	143 (29.1%)		78 (28.3%)	203 (28.6%)		114 (24.6%)	125 (27.6%)	
Time of lessons and Campus										
Morning (EP Campus[†])	361 (36.3%)	180 (35.9%)	181 (36.8%)	0.806	99 (35.9%)	260 (36.6%)	***0.009***	114 (24.6%)	226 (49.9%)*	***<0.001***
Evening (EP Campus[†])	344 (34.6%)	175 (34.9%)	169 (34.3%)		80 (29.0%)	260 (36.6%)*		218 (47.1%)*	85 (18.8%)	
Evening (B Campus[†])	265 (26.7%)	137 (27.3%)	128 (26.0%)		85 (30.8%)*	179 (25.2%)		120 (25.9%)	131 (28.9%)	
Elective courses	24 (2.4%)	10 (2.0%)	14 (2.8%)		12 (4.3%)	12 (1.7%)		11 (2.4%)	11 (2.4%)	
Method of interaction										
Live Video conferencing	981 (98.7%)	498 (99.2%)	483 (98.2%)	0.152	273 (98.9%)	701 (98.6%)	0.693	460 (99.4%)	444 (98.0%)	0.075
Chat	13 (1.3%)	4 (0.8%)	9 (1.8%)		3 (1.1%)	10 (1.4%)		3 (0.6%)	9 (2.0%)	

[†] EC Campus and B Campus refer to the name of the two campuses at this University Center that have a Dental School. Names have been omitted in order to maintain blind review.
*p<0.05, Fisher's exact test or Pearson's chi-square test (n, %).

Table 3. Influence of the evaluation method of virtual classes during the pandemic, technology acceptance by professors and participation of undergraduate dental students

		Period (days)			TAM			Number of students interacting		
	Total	**1-29 days**	**30-60 days**	**p-Value**	**<80**	**80+**	**p-Value**	**Up to 20**	**>20**	**p-Value**
Methods used to teach										
Articles/PDF document	293 (29.5%)	143 (28.5%)	150 (30.5%)	0.489	71 (25.7%)	222 (31.2%)	0.090	131 (28.3%)	148 (32.7%)	0.150
Slideshow	230 (23.1%)	104 (20.7%)	126 (25.6%)	0.067	58 (21.0%)	172 (24.2%)	0.289	99 (21.4%)	118 (26.0%)	0.097
Previously recorded video lessons	403 (40.5%)	227 (45.2%)*	176 (35.8%)	***0.002***	116 (42.0%)	287 (40.4%)	0.633	220 (47.5%)*	172 (38.0%)	***0.004***
Live Video conferencing	632 (63.6%)	274 (54.6%)	358 (72.8%)*	***<0.001***	180 (65.2%)	452 (63.6%)	0.629	276 (59.6%)	320 (70.6%)*	***<0.001***
Evaluation of virtual classes										
Very bad	2 (0.2%)	2 (0.4%)	0 (0.0%)	***0.002***	0 (0.0%)	2 (0.3%)	***<0.001***	0 (0.0%)	2 (0.4%)	***0.002***
Bad	8 (0.8%)	6 (1.2%)	2 (0.4%)		6 (2.2%)	2 (0.3%)		5 (1.1%)	3 (0.7%)	
Regular	35 (3.5%)	17 (3.4%)	18 (3.7%)		27 (9.8%)	8 (1.1%)		25 (5.4%)	8 (1.8%)	
Good	401 (40.6%)	176 (35.1%)	225 (46.4%)*		147 (53.3%)*	254 (35.7%)		204 (44.1%)*	173 (38.2%)	
Very good	541 (54.%)	301 (60.0%)*	240 (49.5%)		96 (34.8%)	445 (62.6%)*		229 (49.5%)	267 (58.9%)*	

*p<0.05, Fisher's exact test or Pearson's chi-square test (n, %).

Table 4. Influence of the duration of lessons and technological complications during virtual classes on the professors' technology acceptance and participation of dental students

		Period (days)			TAM			Number of students interacting		
	Total	**1-29 days**	**30-60 days**	**p-Value**	**<80**	**80+**	**p-Value**	**Up to 20**	**>20**	**p-Value**
Length of virtual classes										
1h	40 (4.0%)	18 (3.6%)	22 (4.5%)	0.154	10 (3.6%)	30 (4.2%)	0.352	25 (5.4%)	14 (3.1%)	0.324
2h	839 (84.4%)	432 (86.1%)	407 (82.7%)		228 (82.6%)	604 (85.0%)		386 (83.4%)	384 (84.8%)	
3h	70 (7.0%)	27 (5.4%)	43 (8.7%)		26 (9.4%)	44 (6.2%)		30 (6.5%)	35 (7.7%)	
4h	45 (4.5%)	25 (5.0%)	20 (4.1%)		12 (4.3%)	33 (4.6%)		22 (4.8%)	20 (4.4%)	
Technological complications during virtual classes										
No	575 (57.8%)	236 (47.0%)	339 (68.9%)*	***<0.001***	137 (49.6%)	431 (60.6%)*	***0.002***	241 (52.1%)	281 (62.0%)*	***0.002***
Yes	419 (42.2%)	266 (53.0%)*	153 (31.1%)		139 (50.4%)*	280 (39.4%)		222 (47.9%)*	172 (38.0%)	
Number of students interacting										
Up to 20	463 (50.5%)	287 (62.3%)*	176 (38.7%)	***<0.001***	133 (51.6%)	330 (50.2%)	0.703	-	-	-
>20	453 (49.5%)	174 (37.7%	279 (61.3%)*		125 (48.4%)	328 (49.8%)		-	-	
TAM										
<80	276 (28.0%)	137 (27.3%)	139 (28.7%)	0.632	-	-	-	-	-	-
80+	711 (72.0%)	365 (72.7%)	346 (71.3%)		-	-		-	-	

*p< 0.05, Fisher's exact test or Pearson's chi-square test (n, %).

In multivariate analysis, the factors that significantly increased acceptability were the availability of articles or documents for study (p = 0.028), the absence of technological complications during the virtual classes (p = 0.003), and the perception of a good interaction (p < 0.001), the latter being the most strongly associated factor (table 5).

Table 5. Multivariate analysis of periods influencing factors of virtualisation of classes, technology acceptance by professors and participation of undergraduate dental students

	p-Value	Adjusted OR (95%CI)
TAM > 80		
Days of virtual classes (> 30)	0.996	1.00 (0.72-1.39)
Content of virtual lessons (basic sciences/pre-clinical)	0.215	1.22 (0.89-1.68)
Time of lessons (morning)	0.634	1.08 (0.78-1.49)
Use of articles/documents as teaching method (yes)	***0.028**	***1.96 (1.07-3.57)**
Use of slides uploaded on the virtual learning environment (yes)	0.310	1.39 (0.74-2.62)
Use of previously recorded video lessons (yes)	0.724	1.06 (0.76-1.48)
Live Video conferencing (yes)	0.790	1.05 (0.73-1.52)
Number of students interacting (>20)	0.432	1.14 (0.82-1.59)
Teaching method (Live Video conferencing)	0.882	1.11 (0.28-4.36)
Evaluation of the virtual lesson (very good)	***<0.001**	***3.26 (2.38-4.46)**
Length of virtual classes (>2h)	0.140	1.41 (0.89-2.23)
Technological problems during virtual classes (No)	***0.003**	***1.61 (1.17-2.20)**
Days of virtual classes (>30 days)		
Content of virtual lessons (basic sciences/pre-clinical)	0.497	1.11 (0.82-1.49)
Time of lessons (morning)	***0.040**	***1.38 (1.01-1.88)**
Use of articles/documents as teaching method (yes)	0.958	1.01 (0.59-1.74)
Use of slides uploaded on the virtual learning environment (yes)	0.625	1.15 (0.65-2.04)
Use of previously recorded video lessons (yes)	0.076	1.33 (0.97-1.81)
Live Video conferencing (yes)	***<0.001**	***2.08 (1.48-2.92)**
Number of students interacting (> 20)	***<0.001**	***2.75 (2.03-3.72)**
Teaching method (Live Video conferencing)	0.365	1.82 (0.50-6.69)
Evaluation of the virtual lesson (very good)	***<0.001**	***1.79 (1.33-2.42)**
Length of virtual classes (>2h)	0.587	1.13 (0.72-1.77)
Technological problems during virtual classes (No)	***<0.001**	***2.52 (1.88-3.38)**
TAM (> 80)	0.876	1.03 (0.74-1.42)
Number of students interacting (> 20)		
Days of virtual classes (> 30)	***<0.001**	***2.74 (2.02-3.71)**
Content of virtual lessons (basic sciences/pre-clinical)	***<0.001**	***2.35 (1.73-3.19)**
Time of lessons (morning)	***<0.001**	***3.54 (2.61-4.79)**
Use of articles/documents as teaching method (yes)	0.142	1.51 (0.87-2.61)
Use of slides uploaded on the virtual learning environment (yes)	0.790	1.08 (0.60-1.95)
Use of previously recorded video lessons (yes)	0.198	1.23 (0.90-1.69)
Live Video conferencing (yes)	***0.019**	***1.51 (1.07-2.15)**
Teaching method (Live Video conferencing)	0.182	2.65 (0.63-11.10)
Evaluation of the virtual lesson (very good)	***<0.001**	***1.82 (1.34-2.46)**
Length of virtual classes (>2h)	0.862	1.04 (0.66-1.64)
Technological problems during virtual classes (No)	0.195	1.22 (0.90-1.65)
TAM (>80)	0.436	1.14 (0.82-1.59)

*p<0.05, multinomial logistic regression; OR = Odds ratio; CI 95% = confidence interval 95% of adjusted OR

The variables that were significantly associated with a period of 30-60 days of virtual classes were morning classes ($p = 0.040$), live video conferencing classes ($p < 0.001$), the professor`s perception of a very good virtual class ($p < 0.001$), the absence of technological complications ($p < 0.001$), and the high number of interacting students ($p < 0.001$), the last one being the most strongly associated factor with this period (table 5).

A high participation of students was significantly associated with live video conferencing classes ($p = 0.019$), the professor's perception of a very good virtual class ($p < 0.001$), the period of 30-60 days of virtual classes ($p < 0.001$), basic or preclinical classes ($p < 0.001$), and morning classes ($p < 0.001$), and the last one being the most strongly associated factor (table 5).

4 DISCUSSION

The current study assessed the technology acceptance by professors and dental students' adherence to virtual classes during the interruption of face-to-face classes in the COVID-19 pandemic. Two blocks of questions were performed during 994 virtual classes (mostly video conferences), within 60 days, showing a directly proportional relationship between good acceptance and number of interactions. In addition, absence of technical problems, and availability of required documents were the key to a good acceptance.

Interaction tools employed during online presentations are a major criteria for success of the learning process, especially in non-face-to-face formats. Interactions during virtual classes demonstrated an important factor for good acceptability of video conferences, regardless of the method used by the professor. Students' participation, widely used in the face-to-face format[19], appears to be essential for acceptance of the virtual method.

The main barriers to distance learning before the COVID-19 pandemic were reported for the high costs of production of multimedia materials and maintenance of the platform, inadequate technology, and isolation of students in a virtual environment[20,21]. The technical problems factor during the video classes was indirectly related to the satisfaction and quality of perception of the students and professors, indicating that structuring the distance learning method is vital for its operation.

Different distance learning approaches, such as blended learning, were developed by combining observation of web-based seminars with face-to-face follow-up discussions, showing a good rate of acceptance[22]. However, in the current situation, face-to-face meetings are no longer an option. Despite that, the results of the TAM questionnaire in this cross-sectional study showed good acceptability of this learning technology, with an average of 81.82 ± 11.79 (95% CI: 81.05-82.58) ranging from 30 to 100, with a median of 80. The internal validity showed adequate values with a Cronbach's α of 0.809.

Study patterns may be associated with different times of the day, and online students demonstrated late night peak of activity, especially before tests or assessment classes[23]. During the pandemic, night students who attended in evening classes showed a good rate of acceptance in morning classes. Moreover, classes at non-traditional times were not available at the reported meetings; however, within the proposed schedules, morning classes in general ($n = 361$, 36.3%) demonstrated a better perception of acceptance by professors.

Complex lessons and clinical practice classes experienced more barriers during distance learning activities. Face-to-face demonstrations and hands-on tasks are part of daily activities in the learning process in dental

courses[24]. Therefore, these findings demonstrate a correlation with our cross-sectional study, as the basic science classes were well accepted during the evaluation period.

The use of pre-recorded classes is commonly used in e-learning, and an interesting approach is the student's participation in seminars to discuss important matters of the class. However, the use of video conferences increases the interest of students and professors, creating a face-to-face environment, providing debates, questions, and answers in real time[25]. The impossibility of face-to-face meetings during the COVID-19 pandemic was the reason the video conferences were rated with high acceptance by professors and high adherence by students, showing that despite the absence of close contact during virtual classes, videoconferencing was preferred over the recorded classes.

The devastating effects of COVID-19 are still immeasurable[26]. The impact of social distancing on dental education has a revolutionary status[27-29]. Given the speed of COVID-19 arrival, there was a short response time for adoption of distance education through online classes from a traditional on-campus approach[11]. This study showed the results of a dental school that started virtualising classes from the first day of social distancing which was implemented by the state government. An increase in acceptability and number of interactions between 30 to 60 days of suspension of face-to-face classes were observed, showing a positive learning curve and the adequacy of professors.

It is noteworthy that the virtualization of education was a measure adopted due to the isolation restrictions imposed by the COVID-19 pandemic. In Brazil, according to the Federal Council of Dentistry's resolution 197/2019[30], the enrollment and registration of students who graduated from Dentistry courses fully carried out in the Distance Learning modality is prohibited.

5 CONCLUSION

The virtual class technology carried out during the COVID-19 pandemic period was well accepted by professors at a dental school and had good adherence by students, especially in videoconferencing classes.

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RESUMO

Aceitação de tecnologia por professores e adesão de alunos de graduação em Odontologia a aulas virtuais durante a pandemia COVID-19

O objetivo deste estudo foi analisar a aceitação da tecnologia por professores e a adesão dos alunos de odontologia ao ensino virtual durante o período de distanciamento social devido à pandemia do coronavírus (COVID-19). Este foi um estudo transversal observacional retrospectivo que envolveu a opinião anônima de professores de escolas de odontologia. Após cada aula virtual, os professores preencheram um questionário sobre as atividades remotas (identificação da disciplina, método utilizado, número de alunos, satisfação do professor e questionário do modelo de aceitação de tecnologia) realizado entre 18 de março e 18 de maio (60 dias de virtualização das aulas teóricas durante a interrupção das aulas presenciais). Este estudo mostrou uma boa aceitabilidade desta tecnologia de aprendizagem pelos professores (pontuação TAM 81,82 ± 11,79). Durante a pandemia, aulas de videoconferência ao vivo (n = 632, 63,6%) foram o método de ensino preferido pelos professores, seguido por vídeo aulas previamente gravadas (n = 403, 40,5%). A aceitabilidade dos professores esteve fortemente

associada à percepção da qualidade da interação (p <0,001). A maior participação dos alunos foi significativamente associada às aulas de videoconferência (p = 0,019). A disponibilidade prévia de artigos ou documentos para estudo (p = 0,028) e a ausência de complicações tecnológicas durante as aulas virtuais (p = 0,003) aumentaram significativamente a aceitabilidade. Concluindo, a tecnologia da aula virtual usada durante o período pandêmico do COVID-19 foi bem aceita pelos professores de uma faculdade de odontologia e teve boa aderência dos alunos, principalmente nas aulas de videoconferência.
Descritores: COVID-19. Educação. Multimeio Educacional. Informática Odontológica.

REFERENCES

1. Huang C, Wang Y, Li X, Ren L, Zhao J, Hu Y, et al. Clinical features of patients infected with 2019 novel coronavirus in Wuhan, China. Lancet 2020; 395(10223):497-506.
2. Wilder-Smith A, Chiew CJ, Lee VJ. Can we contain the COVID-19 outbreak with the same measures as for SARS? Lancet Infect Dis. 2020; 20(5):e102-7.
3. The Chinese Preventive Medicine Association. An update on the epidemiological characteristics of novel coronavirus pneumonia (COVID-19). Chin J Epidemiol.2020; 41(2):139-44.
4. Halperin DT, Hearst N, Hodgins S, Bailey RC, Klausner JD, Jackson H, et al. Revisiting COVID-19 policies: 10 evidence-based recommendations for where to go from here. BMC Public Health. 2021;21(1):2084.
5. Li Q, Guan X, Wu P, Wang X, Zhou L, Tong Y, et al. Early transmission dynamics in Wuhan, China, of novel coronavirus-infected pneumonia. N Engl J Med. 2020; 382(13):1199-207.
6. Wu D, Wu T, Liu Q, Yang Z. The SARS-CoV-2 outbreak: what we know. Int J Infect Dis 2020; 94:44-8.
7. Phua J, Weng L, Ling L, Egi M, Lim CM, Divatia JV, et al. Intensive care management of coronavirus disease 2019 (COVID-19): challenges and recommendations. Lancet Respir Med. 2020;8(5):506-17.
8. Viner RM, Russell SJ, Croker H, Packer J, Ward J, Stansfield C, et al. School closure and management practices during coronavirus outbreaks including COVID-19: a rapid systematic review. Lancet Child Adolesc Heal. 2020;4(5):397-404.
9. Pei L, Wu H. Does online learning work better than offline learning in undergraduate medical education? A systematic review and meta-analysis. Med Educ Online. 2019;24(1):1666538.
10. Schneider SL, Council ML. Distance learning in the era of COVID-19. Arch Dermatol Res. 2020; (0123456789):3-4.
11. Quinn B, Field J, Gorter R, Akota I, Manzanares M, Paganelli C, et al. COVID-19: The Immediate Response of European Academic Dental Institutions and Future Implications for Dental Education Eur J Dent Educ. 2020; 24(4):811-4.
12. Turkyilmaz I, Hariri NH, Jahangiri L. Student's perception of the impact of E-learning on dental education. J Contemp Dent Pract. 2019;20(5):616-21.
13. Passos KK, Bezerra HK, Leonel AS, Ramos-Perez FM, Martelli-Júnior H, Machado RA, Bonan PR, Perez DC. Self-regulated learning perception of undergraduate dental students during the COVID-19 pandemic: A nationwide survey in Brazil. J Clin Exp Dent. 2021 Oct 1;13(10):e987-93.
14. Asiry MA. Dental students' perceptions of an online learning. Saudi Dent J 2017;29(4):167-170.
15. George PP, Papachristou N, Belisario JM, Wang W, Wark PA, Cotic Z et al, . Online eLearning for undergraduates in health

professions: a systematic review of the impact on knowledge, skills, attitudes and satisfaction. J Glob Health 2014;4(1):1-17.
16. Gupta B, White DA, Walmsley AD. The attitudes of undergraduate students and staff to the use of electronic learning. Br Dent J 2004: 196: 487-92.
17. Schonwetter DJ, Reynolds PA, Eaton KA, De Vries J. Online learning in dentistry: an overview of the future direction for dental education. J Oral Rehabil 2010;37:927-940.
18. Davis FD. Perceived usefulness, perceived ease of use, and user acceptance of information technology. MIS Q Manag Inf Syst. 1989;13(3):319-39.
19. Kobayashi K. Interactivity: A potential determinant of learning by preparing to teach and teaching. Front Psychol 2019;9: 2755.
20. Liu Q, Peng W, Zhang F, Hu R, Li Y, Yan W. The Effectiveness of Blended Learning in Health Professions: Systematic Review and Meta-Analysis. J Med Internet Res 2016;18(1):e2.
21. Childs S, Blenkinsopp E, Hall A, Walton G. Effective e-learning for health professionals and students - barriers and their solutions. A systematic review of the literature - findings from the HeXL project. Health Info Libr J 2005;22 Suppl 2:20-32.
22. Klein KP, Hannum WM, Koroluk LD, Proffit WR. Interactive distance learning for orthodontic residents: Utilization and acceptability. Am J Orthod Dentofac Orthop 2012;141(3):378-85.
23. Tellakat M, Boyd RL, Pennebaker JW. How do online learners study? The psychometrics of students' clicking patterns in online courses. PLoS One 2019;14(3):1-17.
24. Bavaresco CS, Bragança S, Vencato V, Feltes B, Sória GS, Brew MC, et al. Performance of primary healthcare dentists in a distance learning course in pediatric dentistry. Int J Med Inform. 2019;129:296-302.
25. Miller KT, Hannum WM, Morley T, Proffit WR. Use of recorded interactive seminars in orthodontic distance education. Am J Orthod Dentofac Orthop 2007;132(3):408-14.
26. Spagnuolo G, De Vito D, Rengo S, Tatullo M. COVID-19 outbreak: An overview on dentistry. Int J Environ Res Public Health 2020;17(6):1-4.
27. Desai BK. Clinical implications of the COVID-19 pandemic on dental education. J Dent Educ. 2020; 84(5):512.
28. Meng L, Hua F, Bian Z. Coronavirus Disease 2019 (COVID-19): Emerging and Future Challenges for Dental and Oral Medicine. J Dent Res 2020;99(5):481-7.
29. Iyer P, Aziz K, Ojcius DM. Impact of COVID-19 on dental education in the United States. J Dent Educ. 2020;84(6):718-22.
30. Conselho Federal de Odontologia. Resolução 197/2019. [Cited Nov. 19, 2021]. Available from: https://website.cfo.org.br/resolucao-cfo-197-2019/#:~:text=RESOLU%C3%87%C3%83O%20CFO%20197%2F2019%3A%20pro%C3%ADbe,EAD%2C%20e%20adota%20outras%20provid%C3%AAncias.

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