

**EVALUATION OF CHANGES IN THE EDUCATION OF DENTAL RADIOLOGY
ADOPTED DURING THE PANDEMIC THROUGHOUT BRAZIL**

***AVALIAÇÃO DAS MUDANÇAS NO ENSINO DA RADIOLOGIA ODONTOLÓGICA
ADOTADAS DURANTE A PANDEMIA EM TODO O BRASIL***

***EVALUACIÓN DE LOS CAMBIOS EN LA ENSEÑANZA DE LA RADIOLOGÍA
DENTAL ADOPTADA DURANTE LA PANDEMIA EN TODO BRASIL***



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How to reference this article:

RODRIGUES, L. G.; RIBEIRO, I. C.; MANZI, F. R. Evaluation of changes in the education of dental radiology adopted during the pandemic throughout Brazil. **Revista Ibero-Americana de Estudos em Educação**, Araraquara, v. 18, n. 00, e023057, 2023. e-ISSN: 1982-5587. DOI: <https://doi.org/10.21723/riaee.v18i00.17252>



| Submitted: 04/10/2022
| Revisions required: 27/01/2023
| Approved: 06/02/2023
| Published: 16/08/2023

Editor: Prof. Dr. José Luís Bizelli
Deputy Executive Editor: Prof. Dr. José Anderson Santos Cruz

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ABSTRACT: This study aimed to characterize the education of Dental Radiology in Brazil during the COVID-19 pandemic. The methodology was developed from an online questionnaire applied from May to October 2021, covering four topics: profile of teachers, difficulties encountered in teaching during the pandemic period, learning acquired in teaching during the pandemic and changes that will remain after the end of the pandemic. The sample was characterized by 61 professors in the area of Dental Radiology who teach in at least one of the three levels of activity in Dental Schools located throughout the Brazilian territory. Most professors worked at the undergraduate level in capitals of the Southeast region with a workload between 20 and 40 hours per week. The pandemic brought several challenges to the classes, which stimulated teachers to implement new learning strategies that may continue to be effective even after the end of the pandemic.

KEYWORDS: COVID-19. Teachers. Education. Radiology. Dentistry.

RESUMO: Este estudo teve como objetivo caracterizar o ensino da Radiologia Odontológica no Brasil durante a pandemia da COVID-19. A metodologia foi desenvolvida a partir de um questionário on-line aplicado no período de maio a outubro de 2021, abordando quatro tópicos: perfil dos docentes, dificuldades encontradas no ensino durante o período pandêmico, aprendizados adquiridos em lecionar na pandemia e mudanças que permanecerão após o fim da pandemia. A amostra foi caracterizada por 61 professores da área de Radiologia Odontológica que lecionam em pelo menos um dos três níveis de atuação em Escolas de Odontologia localizadas em todo o território brasileiro. A maioria dos docentes atuava no nível de graduação em capitais da região Sudeste, com carga horária entre 20 e 40 horas semanais. A pandemia trouxe diversos desafios ao ensino, que estimularam os docentes a implementarem novas estratégias de aprendizado que poderão continuar sendo efetivas mesmo após o fim da pandemia.

PALAVRAS-CHAVE: COVID-19. Docentes. Ensino. Radiologia. Odontologia.

RESUMEN: Este estudio tuvo como objetivo caracterizar la enseñanza de la Radiología Dental en Brasil durante la pandemia de COVID-19. La metodología se desarrolló a partir de un cuestionario en línea aplicado de mayo a octubre de 2021, que abarca cuatro temas: perfil de los docentes, dificultades encontradas en la docencia durante el período de pandemia, aprendizajes adquiridos en la docencia durante la pandemia y cambios que permanecerán después del final de la pandemia. La muestra se caracterizó por 61 profesores del área de Radiología Dental que enseñan en al menos uno de los tres niveles de actividad en Facultades de Odontología ubicadas en todo el territorio brasileño. La mayoría de los profesores trabajaban en el nivel de pregrado en las capitales de la región Sudeste con una carga horaria de entre 20 y 40 horas semanales. La pandemia trajo varios desafíos a la enseñanza, lo que estimuló a los docentes a implementar nuevas estrategias de aprendizaje que pueden seguir siendo efectivas incluso después del final de la pandemia.

PALABRAS CLAVE: COVID-19. Maestros. Enseñando. Radiología. Odontología.

Introduction

The new Coronavirus (SARS-CoV-2) causes an infectious disease officially known as COVID-19. This new virus was discovered in December 2019 in the city of Wuhan, China (GUAN *et al.*, 2020; VELAVAN; MEYER, 2020). On March 11, 2020, the World Health Organization (WHO) declared that its rapid evolution around the world constituted a pandemic. Thus, on January 30, 2020, the WHO declared a Public Health Emergency of International Concern (LANA *et al.*, 2020).

It is known that dentistry is among the professions with the highest risk of contamination by SARS-CoV-2, due to the large production of aerosols in procedures (MORAES *et al.*, 2020). Given this scenario, it was necessary to change the routine in many aspects of dental services, such as stricter use of personal protective equipment (PPE) and disinfection of environments, and a decrease in the flow of patients, in order to contain the spread of the virus. (MORAES *et al.*, 2020; SAKI; HASELI; IRANPOUR, 2020).

Faced with a pandemic situation, face-to-face educational activities at all levels (basic, fundamental, secondary and higher) were paralyzed worldwide (GROSSI; MINODA; FONSECA, 2020; HUSS *et al.*, 2022; PONTUAL *et al.*, 2020; ZIMMER *et al.*, 2021), including in Health Faculties, such as Dentistry (BENNARDO *et al.*, 2020; CHANG *et al.*, 2021). Assuming that the resumption of school activities would bring changes is fundamental, and therefore biological safety measures must be adopted to minimize the risks of contamination during theoretical classes and practical classes (clinical and laboratory) (GURGEL *et al.*, 2020; MENG; HUA; BIAN, 2020; TOMAZ; DE ARAÚJO SILVA; BORGES, 2021).

The area of Dental Radiology was no different, since Dentistry students have activities in all areas of the university (classroom, laboratory and Dental Clinic). In this way, professors, technicians and students of dentistry can become potential carriers of the disease. Radiological Clinics follow the same guidelines as the regulatory bodies, since imaging exams may be essential to follow a dental treatment (CRAL; LIMA; QUELUZ, 2020; SAKI; HASELI; IRANPOUR, 2020). Therefore, the objective of this work is to evaluate the situation of teaching Dental Radiology in Brazil during the pandemic period.

Materials and methods

The present work was approved by the Ethics and Research Committee through CAAE 45526221.0.0000.5137. All respondents were volunteers and had their professional identity preserved. This is a cross-sectional, quantitative study, with the application of a questionnaire specifically designed to assess the changes caused by the COVID-19 pandemic in the context of teaching dental radiology. For this, interviews were conducted using an online form.

The sample of the present study consisted of 61 professors from the Dental Radiology Area at Dental Schools who teach at least one of the three levels of performance (technical, undergraduate and postgraduate) throughout the Brazilian territory, with representatives from Dental Schools. Dentistry in the five regions of Brazil (North, Northeast, South, Southeast and Midwest) and covering schools located in capitals and cities in the interior.

The questionnaire was applied from May to October 2021 and addresses four main topics. Starting with the characterization of the profile of the teachers interviewed, in which they were asked where they work in terms of the region of Brazil (North, South, Midwest, Northeast or Southeast) and demographic region (capital or other municipalities). Another question was about the school level at which they teach, being able to teach classes at the technical, undergraduate or graduate level, and also about the number of hours they dedicate to education. In addition, theoretical, laboratory and clinical classes were qualified in the pandemic period and in the pandemic easing period, in terms of how they are carried out, which can be synchronous, asynchronous, face-to-face or suspended.

The second part of the questionnaire was aimed at the teachers' perception of their performance, addressing topics such as the difficulties in carrying out remote activities and the didactic techniques included to assist in these classes, as well as the difficulties and participation of the students. In the third part of the questionnaire, the learning acquired in teaching the disciplines of Dental Radiology during the pandemic period was addressed.

Finally, the changes that could become permanent or necessary in the teaching of Radiology and in the treatment of patients during radiological examinations in the post-pandemic period were questioned. At this point, the research group suggested some options and left it open for the interviewee to add his perception on the subject.

The treatment of the results was carried out from the systematization of the data obtained through the tabulation of these, which were typed and filed in Microsoft Office Access 2010 spreadsheets. Soon after, the descriptive statistical analysis was performed, which includes the characterization of the study sample and results using frequency and percentage.

Results

To obtain the study sample, 61 professors who work in courses in the field of Dental Radiology were required. Chart 1 describes the location in which individuals involved in this research act as professors. Data indicate that 40 (65.57%) individuals are from the capital and 21 (34.43%) are located in other municipalities. As for the region of the country, most of the sample is located in the Southeast region, with a total of 28 individuals (45.90%), 18 (64.29%) from the capital and 10 (35.71%) from another municipality. The South region has 17 individuals (27.87%), in which 9 (52.94%) are in the capital and 8 (47.06%) in another municipality. The Midwest region has 5 (8.20%) individuals, all from the capital. In the Northeast, there are 8 (13.11%) individuals, 5 (62.5%) from the capital and 3 (37.5%) from another municipality. The North region had the lowest number of members, with 3 individuals (4.92%), all from the capital. We can observe that in all regions there are always more individuals in the capital than in other municipalities.

Chart 1 - Characterization of the sample

Regions	capital	Other County	TOTAL
Total number of individuals	40 (65.57%)	21 (34.43%)	61 (100%)
Southeast	18 (64.29%)	10 (35.71%)	28 (45.90%)
South	9 (52.94%)	8 (47.06%)	17 (27.87%)
Midwest	5 (100%)	0 (0%)	5 (8.20%)
North East	5 (62.5%)	3 (37.5%)	8 (13.11%)
North	3 (100%)	0 (0%)	3 (4.92%)

Number of individuals (n) with percentage (%)

Source: Prepared by the authors

The performance of professors in courses in the field of Radiology was categorized by course level and number of hours per week, as shown in Chart 2. Most professors work in undergraduate courses in Dentistry, representing 68.20% of the sample. 60.66% work in post-Graduation and only 8.20% in Radiology Technician courses. Regarding teaching hours, it is observed that working between 20-40 hours per week is the most common, representing 42.62% of the sample. Then, 8 hours a week, with 32.79% of the sample, and finally 8-20 hours a week, with 24.59% of the sample. Thus, it is possible to infer that the majority of individuals interviewed are professors who work in undergraduate courses with a weekly workload of 20-40 hours.

Chart 2 - Performance of Professors in Courses in the Radiology Area regarding the level of performance and the workload

Courses	Individuals (n)	percentage
Radiology Technician	5	8.20%
Degree in Dentistry	42	68.85%
Postgraduate (Lato and Stricto Sensu)	37	60.66%
Between 20-40 hours a week	26	42.62%
Between 8-20 hours a week	15	24.59%
Up to 8 hours per week	20	32.79%

Number of individuals (n) with percentage (%)

Source: Prepared by the authors

The data represented in Chart 3 show the types of activities carried out during the pandemic periods in 2021. During social isolation, theoretical classes mostly took place synchronously, representing 77.04% of the sample, on the other hand, face-to-face classes were suspended in that same period. After the period of social isolation, synchronous classes still predominated, being adhered to by 72.13% of respondents, while 36.07% of them resumed activities in person. In acting classes during social isolation, 48 (78.69%) were synchronous, 30 (49.18%) were asynchronous and none were face-to-face. These same classes, after social isolation, became mostly face-to-face, representing 70.49% of the sample, while 39.34% were synchronous and 27.87% were asynchronous. In classes for performing techniques during social isolation, 80.32% were suspended, 11.48% were synchronous and 8.20% asynchronous. After social isolation, these same classes were mostly face-to-face (78.69%), 16.39% remain suspended and 14.75% were synchronous.

After social isolation, the interpretation and execution of techniques classes were developed predominantly in person, while the theoretical class maintained its majority with synchronous classes.

Chart 3 - Activities developed during the Pandemic periods in 2021

Types of activities	synchronous	asynchronous	In person	Suspended
Theoretical classes during social isolation	47 (77.04%)	18 (29.51%)	0 (0%)	2 (3.28%)
Theoretical classes after social isolation	44 (72.13%)	19 (31.15%)	22 (36.07%)	1 (1.64%)
Interpretation classes during social isolation	48 (78.69%)	30 (49.18%)	0 (0%)	6 (9.84%)
Interpretation classes after social isolation	24 (39.34%)	17 (27.87%)	43 (70.49%)	4 (6.56%)
Execution of techniques during social isolation	7 (11.48%)	5 (8.20%)	0 (0%)	49 (80.32%)
Execution of techniques after social isolation	9 (14.75%)	5 (8.20%)	48 (78.69%)	10 (16.39%)

Number of individuals (n) with percentage (%)

Source: Prepared by the authors

In Chart 4, it is noted that a significant number of professors of courses in the area of Dental Radiology did not present difficulties in carrying out remote activities, totaling 28 respondents (45.90%). However, among the 61 interviewees, 33 demonstrate some difficulty during the remote teaching process. Among them, the difficulty due to the students' lack of motivation was the most common, followed by the difficulty due to overwork. The various interruptions during classes and the difficulty with the use of new technologies also had significant numbers. Finally, with less representation, the lack of support from HEIs. It is noteworthy that, once a difficulty was stated, the teacher could select only one option, thus being the one that caused him the most discomfort during remote activities.

Still in Chart 4, we can also observe the teachers' responses in relation to the students' participation index, being considered from 1 to 2 as very bad, 3 to 4 bad, 5 to 6 fair, 7 to 8 good and from 9 to 10 great. The predominance was between good (42.62%) and regular (40.98%) participation, showing a median distribution of students. The most extreme options, such as terrible and great, had little representation.

Chart 4 - Perception of teachers regarding their difficulties in carrying out remote activities and regarding student participation

Carrying out remote activities	Individuals (n)	percentage
did not present difficulty	28	45.90%
Yes, use of new technologies	11	18.03%
Yes, lack of HEI support	4	6.56%
yes, overwork	17	27.87%
Yes, several interruptions during classes	12	19.67%
Yes, lack of student motivation	27	44.26%
From 1 – 2 (terrible)	1	1.64%
From 3 – 4 (bad)	6	9.84%
From 5 – 6 (regular)	25	40.98%
From 7 – 8 (good)	26	42.62%
From 9 – 10 (great)	3	4.92%

Number of individuals (n) with percentage (%)

Source: Prepared by the authors

As for the didactic activities developed during the remote classes, as we can see in Chart 5, the debate of clinical cases was predominant (67.21%), followed by quiz (60.66%), games (26.23%) and 11.48% did not develop new techniques for teaching activities.

Chart 5 - Didactic activities developed during remote classes

	Individuals (n)	percentage
Games	16	26.23%
Quiz	37	60.66%
Debate of Clinical Cases	41	67.21%
No new techniques have been developed	7	11.48%

Number of individuals (n) with percentage (%)

Source: Prepared by the authors

In Chart 6, in relation to the supposed changes that will be incorporated into post-pandemic teaching in the teachers' view, it is noted that the option for remote activities is well regarded in the future, such as meeting with the advisor remotely (75.41%), remote theoretical classes (63.93%), presentation of remote works (44.26%), and, finally, remote tests (13.11%). Other relevant changes were the use of digital didactic material (45.90%) and the reduced number of students in face-to-face classes (34.43%). In the options of individual practical activities (6.56%) and digital image acquisition (1.64%) this number was not so expressive. Furthermore, only 3.28% of respondents believe that there will be no changes. Thus, we can infer that most teachers believe that some change will occur in teaching after the pandemic.

Chart 6 - Probable changes that will be incorporated into post-pandemic teaching

	Individuals (n)	percentage
Remote Theoretical Classes	39	63.93%
Remote Tests	8	13.11%
Remote work presentation	27	44.26%
Remote advisor meeting	46	75.41%
Reduced number of students in face-to-face classes	21	34.43%
digital teaching material	28	45.90%
Individual practical activities	4	6.56%
Digital image acquisition	1	1.64%
there will be no changes	2	3.28%

Number of individuals (n) with percentage (%)

Source: Prepared by the authors

Discussion

During investigations in the literature for the present research, no work was identified that evaluated the teaching of Dental Radiology in a quantitative way in the literature, this being the first work to carry out this investigation. It is worth mentioning that the present study was carried out during the period of the COVID-19 Pandemic (May to October 2021), which resulted in data related to this phase.

The sample of this work sought to represent the five regions of Brazil. Today in the country just over 400 Schools of Dentistry are registered, according to the CFO. However, the distribution of these schools is not the same in the Brazilian territory: in 2018, San Martin, Chisini, Martelli, Sartori, Ramos and Demarco found that the North and Midwest regions had lower numbers of Dentistry schools, while in the Southeast and Midwest regions In the South, the highest rates of these Institutions were identified (SAN MARTIN *et al.*, 2018).

This discrepancy was also evident in the present work, in which only 3 participants teach in the North and 5 participants in the Midwest. It is worth noting that all teachers in these regions teach in Capitals. In the other regions (South, Southeast and Northeast) the difference between the capital and other municipalities occurred, but there were participants in both categories, the difference being smaller in the South region.

Still regarding the profile of the sample, it is worth mentioning the presence of few representatives working in technical courses, only 5 individuals. This fact may be directly linked to the small number of Dental Radiology professors who work in these technical courses, since the workload of Dental Radiology is quite reduced and generally taught by non-dental professionals, such as radiology technologists, radiology technicians, biomedical and doctors. Contrary to this reality, the field of Dental Radiology is present in all undergraduate courses in

Dentistry, most of the time taught by professors with specific training in the area, Dental Surgeons with specialization in the field of Radiology.

It is a fact that these professors had several challenges arising from COVID-19, since the need for distance between people and the maintenance of educational activities during the Pandemic changed the teaching process in Radiology and accelerated the use of tele-learning. This fact was evident in the present research, where 70% of the teachers interviewed reported teaching their theoretical classes synchronously. During this period, much was discussed about the effectiveness of teaching methods. However, even before the Pandemic, the literature shows that learning outcomes were similar when comparing tele-learning methods with traditional face-to-face teaching methods (TOMLINSON *et al.*, 2013). It is noteworthy that studies on this subject suffer from the interference of independent variables: we highlight the previous knowledge on the subject and the ability of the participants, especially with the means of technology used (TOMLINSON *et al.*, 2013).

In the teaching of Dentistry, including dental radiology, an aggravating factor can still be highlighted, the need for social distancing during the Pandemic in practical and laboratory classes. In this context, it was observed that a considerable number of teachers reported the suspension of classes in the most severe periods of the Pandemic, adding up to 80% of the sample. It is worth mentioning that the other 20% adapted to teach practical classes due to the need for distancing, Synchronous or Asynchronous. Although virtual teaching mechanisms have been an alternative for learning during the Pandemic, the evaluation of practical performances proved to be fundamental in studies even before the Pandemic, and therefore can be considered indispensable in several disciplines of the Dentistry course (ZAWAWI *et al.*, 2015).

The changes in teaching caused by the Pandemic also affected 54% of the teachers interviewed. Several challenges were reported by teachers in the literature around the world. In this research, the students' lack of motivation and overwork are highlighted. As for the students, their participation during classes stands out, being considered as good or regular by most of the teachers interviewed. Recent data show that dentistry students themselves considered the online teaching alternative to be a good one during this period. However, this same study shows students' preference for face-to-face classes (SCHLENZ *et al.*, 2020).

The use of active methodologies in education was already common before the Pandemic (IYER; AZIZ; OJCIUS, 2020; RAVI, 2020). Faced with the need for remote teaching, the teacher had to adapt the strategies to the virtual scenario so that the student was the protagonist

in their learning process (RECH; PESCADOR, 2022). Given the challenges of this period, didactic methods for learning were explored by Radiology professors also in the remote environment. Clinical Case debates, for example, provide the opportunity to reverse roles and place the student as the protagonist in learning, and this mechanism was the most used by the teachers interviewed. Another method that had high adherence was the implementation of *quizzes*, in which questions are asked interactively, promoting greater engagement of students with the subject.

Final remarks

In studies published after the Pandemic, a tendency to maintain some modalities of online activity can already be observed (LOLLOBRIGIDA *et al.*, 2022). In Dental Schools, we highlight theoretical classes and guidance meetings, which were the most selected options in this research. Since this model needed to be adapted in order to maintain social distancing, educational institutions and teachers had to invest in platforms and materials that enabled remote learning. The use of tele-learning can then be reconfigured and maintained after the Pandemic, now with greater student availability and experience.

ACKNOWLEDGMENTS: The authors would like to thank the Pontifical Catholic University of Minas Gerais – PUC Minas, the PUC Minas Research Incentive Fund – FIP PUC Minas and the Coordination for the Improvement of Higher Education Personnel – CAPES for supporting this research.

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CRediT Author Statement

Acknowledgments: The authors gratefully acknowledge the National Council for Scientific and Technological Development (CNPq) (437861/2018-0) and the Research Support Foundation of the State of Minas Gerais (FAPEMIG).

Financing: This study was partially funded by the Coordination for the Improvement of Higher Education Personnel-Brazil (CAPES).

Conflicts of interest: There are no conflicts of interest.

Ethical approval: This study was approved by the Research Ethics Committee of PUC Minas - CEP Registration No.: CAE 45526221.0.0000.5137.

Availability of data and material: Not applicable.

Author contributions: **Lizandra Gonzaga Rodrigues:** Conceptualization, data collection and general writing. **Isabela de Castro Ribeiro:** Conceptualization and data collection.

Flávio Ricardo Manzi: Conceptualization, statistics and general revision of the text.

Processing and editing: Editora Ibero-Americana de Educação.
Proofreading, formatting, normalization and translation.

