DIGITAL TECHNOLOGIES IN DENTISTRY TRAINING: EMERGENCY REMOTE EDUCATION AS A REVEALER OF TEACHERS KNOWLEDGE AND PRACTICES

TECNOLOGIAS DIGITAIS NA FORMAÇÃO EM ODONTOLOGIA: ENSINO REMOTO EMERGENCIAL COMO REVELADOR DE SABERES E PRÁTICAS DOCENTES

TECNOLOGÍAS DIGITALES EN LA FORMACIÓN EN ODONTOLOGÍA: LA ENSEÑANZA REMOTA DE EMERGENCIA COMO REVELADORA DE CONOCIMIENTOS Y PRÁCTICAS DOCENTES

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ABSTRACT: The study aimed to analyze the teacher's knowledge and practices mobilized in Dentistry teaching to implement emergency remote teaching. This is an exploratory case study with a qualitative approach, carried out through interviews with professors and, in addition, field observation and document analysis. Based on Bardin's content analysis, according to the theoretical framework, mainly by Tardif, about teacher knowledge and authors who address incorporating technologies in health education. The results show the influence of life trajectory, professional training, and performance in forming teacher knowledge. Highlights the importance of exercise to broaden the visions towards constructing practices that are more dialogical, participatory, and contextualized to social reality, directing training towards a more generalist, ethical, humanistic, and social transformation perspective, as demand national curriculum guidelines.

KEYWORDS: Dental education. Emergency remote teaching. Pandemic. Teacher knowledge. Digital technology.

RESUMO: *O estudo objetivou analisar os saberes docentes mobilizados no ensino de Odontologia para implementação do ensino remoto emergencial. Trata-se de estudo de caso exploratório, com abordagem qualitativa, realizado por meio de entrevistas, observação de campo e análise de documentos. A análise se baseou na análise de conteúdo de Bardin, a partir das contribuições teóricas, principalmente de Tardif, sobre os saberes docentes e de referenciais que abordam a incorporação das tecnologias no ensino da saúde. Os resultados evidenciam a influência da trajetória de vida, da formação profissional e da atuação na constituição dos saberes docentes. Destaca-se a importância da formação docente e dos saberes experienciais para ampliar as visões no sentido da construção de práticas mais dialógicas, participativas e contextualizadas à realidade social, direcionando a formação para uma perspectiva mais generalista, ética, humanística e de transformação social, como demandam as diretrizes curriculares nacionais.*

PALAVRAS-CHAVE: *Ensino de Odontologia. Ensino remoto emergencial. Pandemia. Saberes docentes. Tecnologia digital.*

RESUMEN: *El análisis tuvo como objetivo examinar los saberes docentes movilizados en la enseñanza de Odontología para la implementación de la enseñanza remota de emergencia. Se trata de un estudio de caso exploratorio cualitativo, realizado a través de entrevistas, observación de campo y análisis documental. La investigación se basó en el análisis de contenido de Bardin, a partir de aportes teóricos de Tardif sobre enseñanza del conocimiento y referencias de la incorporación de tecnologías en la educación en salud. Los resultados muestran la influencia de la trayectoria de vida, la formación profesional y el desempeño en la formación del saber docente. Se repercute la importancia de la formación docente y el conocimiento experiencial para ampliar las visiones hacia la construcción de prácticas más dialógicas, participativas y contextualizadas a la realidad social, orientando la formación hacia una perspectiva más generalista, ética, humanista y de transformación social, tal como lo exigen los lineamientos curriculares nacionales.*

PALABRAS CLAVE: *Enseñanza de la Odontología. Enseñanza remota de emergencia. Pandemia. Enseñanza del conocimiento. Tecnología digital.*

Introduction

The COVID-19 pandemic has presented a scenario of profound challenges for humanity, and education has not been an exception. The suspension of in-person classes demanded that educators mobilize their knowledge for a rapid and creative response to enable the continuity of teaching. Teachers found themselves pressured to quickly adopt alternative methods, means, and tools for instruction. This situation can potentially provoke and foster the emergence of new insights and practices that become integrated into the teaching identity, thereby generating fresh knowledge.

The pandemic challenges, coupled with pre-existing educational difficulties, have proven to be significantly impactful for higher education in the health field, which is centrally focused on developing clinical practice competencies. Within this context, dental education, among other reasons, has been particularly affected, given its reliance on curricula with over 50% practical activities and a high risk of contamination (BENNARDO *et al.,* 2020). To this risk, one can add resistance, limited experience in using digital technologies for teaching, and the complexity of instructing clinical skills through remote models (KLAASSEN *et al.,* 2021).

Teacher training in this area has been insufficient concerning the didactic-pedagogical dimension and the mastery of Digital Information and Communication Technologies (DICT) (DURÃES *et al.,* 2018), contributing to a lack of familiarity with teaching and learning methodologies. Furthermore, dental education, traditionally centered on clinical practice, is still characterized by technicism, a gap between theory and practice, low student autonomy, and a lack of critical engagement with social reality (CARNEIRO *et al.,* 2017), making it even more challenging to overcome difficulties during times of crisis.

Teaching practices perpetuate these paradigms, particularly emphasizing technical-scientific training at the expense of humanistic and social aspects. This divergence is from the necessary profile for meeting the population's demands (REIS; CICILLINI, 2011). Consequently, a transformation of curricula and pedagogical practices is called for, leading to a graduate and faculty profile that is not only rooted in subject-specific knowledge but also the development of a diverse network of pedagogical, philosophical, political, and humanistic knowledge. This approach should guide toward a more participative, dialogic, and contextually relevant education aligned with social and cybercultural demands (FERREIRA; FERREIRA; FREIRE, 2013; DURÃES *et al.,* 2018; SILVA; FREITAS, 2022).

According to Tardif (2014), knowledge evolves and adapts throughout professional practice in response to social demands, taking on new dimensions. It is assumed that the

pandemic has introduced new requirements, potentially resulting in teacher knowledge and practice changes. In this context, there is a dialogue between educators' knowledge and digital culture as teachers, by appropriating and integrating digital technologies and media, articulate their knowledge and develop, among other things, technological expertise. This expertise involves understanding the resources for incorporating them into the classroom and mastering the digital language (MARQUETI; SÁ, 2017).

In light of the need for changes in education and the pandemic scenario that required the generation of knowledge, a process in need of investigation, this study aimed to analyze the knowledge and teaching practices mobilized in the context of the incorporation of digital technologies for the implementation of Emergency Remote Teaching (ERT) in a dentistry undergraduate program at a public federal university.

Methodology

This article presents partial results of a doctoral research project titled "*Tecnologias digitais na formação em Odontologia: ensino remoto emergencial como revelador de saberes e práticas docentes* (Digital Technologies in Dentistry Education: Emergency Remote Teaching as a Revealer of Knowledge and Teaching Practices)." It is an exploratory case study with a qualitative approach. The case study method assists in generating knowledge about significant aspects of experienced events, such as interventions and processes of change (MINAYO, 2014), as is the case with the integration of Digital Information and Communication Technologies (DICT) in dentistry education. The qualitative approach was chosen to explore a structured body of knowledge on the subject, facilitate decision-making, and transform educational practices and scenarios (ESTEBAN, 2017).

The study encompassed individual interviews, carried out in the year 2022, with six professors from the undergraduate Dentistry program of a public federal university. A semi-structured script was used for these interviews, which had been validated through a pilot interview. The aim was to ascertain their perceptions of the Emergency Remote Teaching (ERT) process and the future possibilities. In addition, field observations and document analysis assisted in understanding the context of planning and educational development during this period.

Participants from all faculty departments (Oral Pathology and Diagnosis, Social and Preventive Dentistry, Pediatric Dentistry and Orthodontics, Dental Clinic, and Prosthodontics

and Dental Materials) were included to ensure a broader range of data production. They had taught in fully remote and hybrid courses during the pandemic. The university's Research Ethics Committee approved the study under protocol number 52307721.30000.5286, with approval number 5.077.503, and ethical aspects of research involving human subjects were strictly adhered to.

Six instructors from this program were interviewed, including four women and two men, ranging in age from 37 to 56 years, with teaching experience ranging from 14 to 35 years and tenure in their positions ranging from 7 to 17 years. This profile represented professionals with substantial experience in dental education. It included individuals from all five program departments, providing a comprehensive perspective on the various demands of teaching and internal homogeneities and differentiations within this group. This diversity yielded a wealth of data to comprehend the questions under investigation deeply.

The interviews were conducted individually, either online or in person, according to the interviewee's preference. They were recorded and transcribed in their entirety with participants' consent. Data analysis was carried out using Bardin's (2016) content analysis technique, following the stages of pre-analysis, material exploration, results treatment, and interpretation. The QDA Miner software[3], was employed to facilitate the management and coding of qualitative data. The analysis was grounded in Tardif's theoretical framework on pedagogical knowledge in dialogue with studies addressing technology integration in education and health education. Participants' names were encoded to protect their identities and are presented in this article as Teachers 1, 2, 3, 4, 5, and 6.

Results and Discussion

The content analysis yielded three significant categories: Teaching as a Knowledge-Forming Experience; Teacher Perceptions of Education and Technology; and Prospects for Transforming Teaching Practices.

[3] Software QDA Miner - https://provalisresearch.com/products/qualitative-data-analysis-software/freeware/

Teaching as a Knowledge-Forming Experience

For Tardif (2014), teaching involves mobilizing a wide range of knowledge (Professional, Disciplinary, Curricular, and Experiential), adapted and transformed through and for the job. Therefore, teaching is a space for the reproduction, reflection, and reiteration of what is known in terms of what is known to be done. According to the author, teachers' knowledge is linked to a historical-cultural process and stems from various sources and life experiences, including family, school and university education, institutions, and peers, indicating a clear social origin.

Through the analysis of the teachers' statements regarding the ERE implementation process, it was possible to identify various types of knowledge mobilized based on the teachers' prior conceptions and beliefs, which influence their choices, decisions, attitudes, and pedagogical approaches, even conditioning their thinking about technologies and their appropriation. Similarly, knowledge was developed, with this practice playing a significant role as a formative experience.

A considerable effort was observed among the teachers in planning and implementing technology-mediated teaching in the Dentistry undergraduate program, requiring them to rethink teaching methods and curriculum organization in the midst of the pandemic. To address this, a working group was established, consisting of faculty members from all university departments. In the following statements, it is evident that there was a significant mobilization of curricular and disciplinary knowledge to enable teachers to deal with the urgency of time and the challenge of remotely organizing a predominantly practical curriculum, all while coping with fear due to a relatively unknown disease and uncertainty about the outcomes of this type of teaching on student development.

> I was afraid and very concerned about the teaching aspect, and we worked in the group precisely to ensure we wouldn't lose focus on the nature of the course [...] with more than 50% of its total workload dedicated to practical activities. The students need rigorous practical training in various specialties to become competent dentists. Videos or solely online theoretical classes cannot replace that... So the group focused on studying which courses could go online without any issues and which couldn't because we couldn't be in person (TEACHER 5, our translation).
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> [...] Online theoretical classes posed another challenge because this virtual environment was something we were not accustomed to. Our discipline conducted everything through the AVA platform [Virtual Learning

> Environment - Moodle[4]], which we preferred because it was institutional, from our university. It was a significant challenge for us and the students but it was very productive (TEACHER 6, our translation).

The centrality of clinical practice and the lack of knowledge about the use of technology were two significant challenges identified. In fact, one of the difficulties in integrating ICT into dental education, which became even more evident during the pandemic, is the challenge of teaching clinical practice skills, given the historical emphasis on this aspect of training (KLAASSEN *et al.,* 2021).

As a result, there is great concern among dentists and professional organizations to ensure that technology-mediated processes do not become a substitute for clinical practices (CALDARELLI; HADDAD, 2016). After the Ministry of Education authorized the substitution of in-person classes with online classes during the pandemic in 2020, the Brazilian Association of Dental Education (ABENO) released a statement asserting that distance education was only feasible for elective components and complementary activities (monitoring, scientific initiation, extension, and supervised studies).

It is interesting to note that the National Curriculum Guidelines (DCN) for Dentistry courses advocate for education that prepares graduates to "know and apply information and communication technologies" with a profile that is "aware and participative in the face of technological innovations" (BRASIL, 2021, p. 2, our translation). In practice, there still prevails a discourse limiting the use of technologies, even in a crisis moment when the need to implement new teaching methods is urgent.

Despite this concern, which is justifiable given the physical proximity required for some dental activities, the literature has emphasized the possibilities of incorporating ICT into dental education. Contributions include supporting the consolidation of DCN, the flexibility of teaching methods, promoting student interactivity and autonomy, overcoming geographical barriers, and the potential to enhance collaborations between institutions and between universities and health services, thus contributing to the integration of teaching, research, and extension (CALDARELLI; HADDAD, 2016). The incorporation of ICT for the development of educational apps and practical training through simulators, portable manikins, and virtual reality and haptic devices (3D touch interaction) among students has also been mentioned (BRAZ *et al.,* 2018).

[4] Moodle (https://moodle.org/) is the acronym for Modular Object-Oriented Dynamic Learning Environment, an open-source learning support software operating in a virtual environment.

While recognizing the contributions of ICT, dental educators often encounter difficulties implementing new methods and technologies into their professional practice (BRAZ *et al.,* 2018). According to Gontijo *et al.* (2020), t is necessary to overcome teachers' resistance to changes in their work processes and invest in teacher training to make progress in this regard. It is essential to remember that integrating new approaches requires more effort and dedication from the teacher and demands a reevaluation of the curriculum (GONTIJO *et al.,* 2020).

Indeed, mobilizing knowledge to implement Emergency Remote Teaching (ERT) has placed dental educators in contact with existing curriculum challenges, offering an opportunity to (re)think of ways to overcome these issues.

> We are now thinking about general issues that existed even before the pandemic. You have to follow a schedule; in the first part of the course, we conduct a lab practice, and the following week, students are already attending to patients, while the theoretical part comes later. Remote teaching has facilitated because we could provide recorded classes so students could watch and become acquainted with the academic content before the clinical part. But in a routine before the pandemic, this didn't happen (TEACHER 3, our translation).

> The curriculum guidelines are constantly changing. We had one from 2002, and in 2021, a new one was issued [...] During the pandemic, we had issues regarding this, but we had to shift our focus to deal with the pandemic. Now, we are going to finalize the approval of this project to move forward [...] This part is quite tedious; it takes time to get support, and when it's finally approved, it's already obsolete. The current curriculum has very little about technology, but indeed, after these pandemic experiences, we will have to expand that (TEACHER 5, our translation).

> Another change that has always been an issue is the minimum production required for students to develop. We modified it during the pandemic, and it worked out well. So, we made permanent changes. They have a minimum production in the seventh semester, but in the eighth, they don't. They will fully attend to the patient, starting from the patient's needs from scratch until the patient's discharge. Remote teaching brought about some good things, right? (TEACHER 2, our translation).

The experience with remote teaching has enabled the teachers to broaden their perspective on the possibilities of using technology to enhance the teaching process, even stimulating the desire to include content on Information and Communication Technologies (ICT) in the curriculum. This shift aims to make teaching more aligned with contemporary culture. Furthermore, it has allowed for reflection on their practice and the creation of solutions, directing learning from a more comprehensive perspective of the patient and the health-disease process.

When investigating the use of ICT in higher education, Silva and Freitas (2022) identified that technology can drive actions and provoke changes in the context of learning and human development, contributing to the development of knowledge that fosters analytical thinking and has the potential to break away from the traditional transmissive paradigm.

To achieve this, it is necessary to create spaces for debate regarding dental education and enhance the training of teachers. They should develop the theoretical-practical foundation and the didactic-pedagogical principles to engage with modern technologies. This restructuring is crucial to promote digital literacy among educators, enabling them to embrace teaching techniques and methods that support the creation, participation, and problematization of reality. This is particularly important given the significance of developing digital competencies for transforming pedagogical practices in higher education (VIEIRA; PEDRO, 2021).

It was evident that the teachers do not consider their knowledge from their initial and continued education sufficient for effective teaching, especially in terms of didactic pedagogical and technological expertise. This epistemological gap leads educators to reproduce practices learned from their everyday experience (DURÃES e*t al.,* 2018). This difficulty hampers their ability to make the necessary changes to train professionals who understand the cultural, social, economic, and political aspects that impact people's living conditions, hindering the provision of comprehensive care to meet the population's needs.

In the context of pedagogical training for Dentistry professors in Brazil, Porto, Villas Boas and Silva (2021) discuss that teaching is not and cannot be seen as a simple activity that any professional with a bachelor's degree focused solely on technical skills and specific professional knowledge, can engage in. According to the authors, a broad spectrum of expertise is required to excel in teaching, encompassing mastery of disciplinary, curricular, pedagogical, technological, experiential, and reflective knowledge. It is through the assimilation of these types of knowledge that "professorship" is established. This term refers to the process of building a teaching identity that directly influences a teacher's perspectives and practices and the profession itself. It evolves in response to the social context in which it operates, involving emotional, cultural, political, social, and academic dimensions (PORTO; VILLAS BOAS; SILVA, 2021).

Consequently, the cyber-cultural context and the necessary educational changes imply a transformation of the teacher's role. This shift goes from being a mere transmitter of knowledge to becoming an orchestrator, a mediator of learning, and a promoter of social interactions. It places value on hybrid experiences and dialogical, contextualized pedagogical

practices to foster more active and participatory learning (PORTO; VILLAS BOAS; SILVA, 2021; SILVA; FREITAS, 2022).

The findings of this study align with the statements of Durães *et al*. (2018) and Porto, Villas Boas and Silva (2021), regarding the education of Dentistry educators. The focus often centers on specific subject knowledge at the expense of didactic-methodological aspects and those related to teaching technologies. Therefore, teacher education needs to be enhanced, encompassing the development of technical and specialized knowledge and pedagogical, philosophical, political, and humanistic insights. This transformation is essential for shifting from traditionally fragmented, technocratic, and uncritical teaching models (FERREIRA; FERREIRA; FREIRE, 2013).

As stated by Pimenta (2012), education requires the mobilization of various types of knowledge, including those from reflective practice, specialized theory, and others that shape the teaching profession. It is attributed to teaching these dynamic forms of knowledge that encompass situations requiring decisions in a complex, unique field fraught with conflicts.

It is important to note that, besides formal education, experiences are a significant locus for developing these knowledge domains. Before the hybrid period, it was observed that remote classes, for the most part, occurred synchronously, organized as a replica of in-person courses, and were recorded for students to watch later. In this sense, teachers drew from a familiar repertoire of knowledge, one they used to create in-person lessons, now augmented with the technological knowledge needed to engage with digital platforms.

Thus, the Emergency Remote Teaching (ERT) experience contributed to expanding teachers' knowledge on various issues.

> It was entirely knowledge-formative. We had to deal with emotional issues, [...] the technology aspect, as we had to make it routine. So we had to adapt, had to learn (TEACHER 4, our translation).

This understanding leads us to the concept of experiential knowledge, which educators develop in their daily teaching routine through a continuous process of reflection on practice. These are the foundations of professional practice and competence (PIMENTA, 2012; TARDIF, 2014).

Evidently, the teachers' engagement with ICTs brought about changes in their relationships with students and colleagues, with technology, and with knowledge. These changes resulted in learning through experiential knowledge. What could have been merely the use of technological artifacts created different ways of relating, expressing, communicating,

accessing, and producing knowledge, thinking, dialoguing, recording, and sharing information. This is considered digital culture, not just technology (BRUNO, 2021). This underscores the role of teaching as a knowledge-forming experience and an impetus for change.

Faculty Perceptions on Education and Technology

When describing their experience with ERT and integrating digital technologies, the faculty members revealed various perspectives on education and using technology for teaching. Their statements describe certain aspects of dental education as perceived by the faculty.

> This course has over 50% of its total workload dedicated to practical activities. Dentistry's defining characteristic is the need for students to develop skills and competencies, primarily in practical areas. It's because you need to have the mouth, the saliva, the tongue; you need to learn how to deal with that situation [...]. Furthermore, dental education involves a third party, the patient, and undergraduate students lack experience, so we can't help but be concerned (TEACHER 5).

> A good dental professional, in general, is someone who pays attention to details. Dentistry is a faithful blend of science and scientific knowledge with skill; you need to have skill and emphasize detail and be meticulous (TEACHER 6, our translation).

> How can you teach, [...] if it's not in the patient's mouth? Remote can only handle theory; nothing else stands a chance (TEACHER 3, our translation).

There is a perception of the mouth and clinical practice as central elements, a characteristic of the predominant dental education model that values the profession's more technical aspect. This teaching model is based on and reinforces the biomedical model of healthcare, which overemphasizes individual aspects over the collective, specialization over a generalist approach, a static concept of the health-disease process, curative care over health prevention and promotion, and the commercialization of dental services (FERREIRA, FERREIRA, FREIRE, 2013). Thus, there is a contradiction between the professional profile to be formed within this model and the need to meet societal demands for an education that encompasses the various aspects influencing the health-disease process.

Regarding the pedagogical approaches used in dental education before the pandemic, primarily, the analysis identified the use of computer-assisted lectures and discussions of clinical cases. The study reveals an alignment with the more traditional and technicist pedagogical trend, which is rooted in content transmission, focusing on technical performance-

based learning. However, in some courses, there was an emphasis on competency development and problem-solving.

As per Carneiro *et al.* (2017), dental faculty members tend to adopt this traditional approach due to their educational background. It is imperative to reflect on their teaching practices to move away from transmission-based perspectives and practices to foster the students' critical thinking, curiosity, and autonomy in their learning (CARNEIRO *et al.,* 2017).

Despite the prevalence of traditional practices, there were also indications of efforts to promote a more participatory approach for the students.

> The teacher's role is to teach the student how to study and seek, not to deliver ready-made material. It's great because we can develop problem-solving frameworks in flipped classrooms and motivate the students. I have undergraduate students who have already published articles during their studies. Why? Because we can teach them how to study and learn, rather than just providing handouts, lectures, or PowerPoint slides (TEACHER 4, our translation).

A shift in the role of the teacher is evident, from being a knowledge transmitter to becoming a learning facilitator, as discussed earlier. The use of methodologies, such as problem-based learning and flipped classrooms, mentioned by the teacher, can place dental students in a more active role in the teaching-learning process, stimulating critical-reflexive thinking and encouraging collaborative practices and teamwork (GONTIJO *et al.,* 2020). However, it is crucial to consider that implementing new procedures presents challenges for educators, students, and institutions.

In any case, practices that emphasize a problem-based approach and the contextual production of knowledge can contribute to improvements in dental education. They expand understanding of the social reality and promote a better connection between theory and practice, bridging different areas of knowledge, projects, stakeholders, and social segments. This collaboration can aid in overcoming traditional teaching models that are more transmission-oriented and less contextualized (GONTIJO *et al.,* 2020).

It is important to note that there is a lack of studies reporting problem-based approaches and active teaching methods for Odontology courses (MACIEL *et al.,* 2019), underscoring the need for increased knowledge production and dissemination in this area.

Regarding questions about the use of technology, the accounts suggest that there may be a lag in university discussions and practices concerning the use of ICTs, which became apparent in this urgent scenario.

> During the pandemic, there was a training session organized by two teachers here, basically to learn how to use Google Meet, create a Google Classroom, and use the university's LMS [Moodle]. However, this LMS was so complicated that I preferred others; I never used this one (TEACHER 1, our translation).
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> We faced many difficulties. Our university is often very bureaucratic. Infrastructure needs improvement. It needs improvement; technology is far from ideal (TEACHER 4, our translation).

Evidently, developing this process of acquiring technological and pedagogical knowledge during a crisis was quite challenging and involved a more technical perspective. This perspective reinforces the instrumental view that is still prevalent, treating technologies as something separate from the educational process. According to Bielschowsky (2020), the context of precariousness in higher education, with reduced public funding and the market-driven logic imposed on education, leads to a lack of resources for infrastructure and teacher training. This contributes to the absence of a culture of technology integration within universities, which initially posed challenges in developing alternative strategies during the pandemic crisis.

Despite the more instrumental view, it is essential to acknowledge that educators did their best within the existing reality, leading to some significant developments in the field of Odontology education.

> There were many applications for scheduling patient appointments for COVID screening; everything was developed at the College. There's an app where the patient answers questions, and at the end, you know whether they're fit for their appointment or not; a mobile-based screening mechanism without having to call the person; and the notification system, created during the pandemic, which generated a fascinating and positive dynamic. It helped the students' learning in everything (DOCENTE 5, our translation).
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> During the pandemic, we created an English article study group, the GDAI, because we noticed that the lack of speaking, reading, and discussing in English hindered learning. Two students who are fluent in English manage the group, select the article, deliver it to the group, and then discuss the article in English with the group, speaking only in English. I was out of practice, and now I'm talking; I learn daily. We use Zoom for discussions, and materials are posted on Classroom (DOCENTE 4, our translation).

According to the teachers' accounts, the process of integrating digital technologies triggered individual and collective reflections on technology, experimentation with strategies, and the development of technological knowledge. Therefore, it is crucial to investigate what the university has learned to advance these discussions and practices.

Perspectives on the Transformation of Teaching Practices

Digital technologies during the pandemic required the mobilization of various teaching skills, allowing teachers to continue their classes. Strategies mediated by TDIC (Information and Communication Technologies) reduced travel time and expenses for daily allowances and tickets, facilitating classes, meetings, defenses, and national and international technical-scientific events.

The teachers also saw research and the creation of online educational materials as contributions of TDIC to the field of dental education. In addition to enabling active student participation and more excellent authorship, these technologies allowed patients to access health education actions through mobile devices. This allowed them to view and review information at any time, with easy dissemination through the internet, digital media, and social networks. Furthermore, recorded lessons available in virtual environments allowed students to access them at their convenience and review the content, enhancing learning during this period.

The teachers could experience the possibilities and contributions of TDIC that were already reported in the literature for Odontology education, even before the pandemic. These included interactive approaches, the demonstration of concepts and physiological and pathological phenomena that are difficult to visualize, the development of health education activities, tele-dental consulting, collaboration between Higher Education Institutions (HEIs) and healthcare institutions, data sharing for clinical planning, as well as the application of innovative pedagogical practices (CALDARELLI; HADDAD, 2016).

When reflecting on what is here to stay, in other words, the possible transformations in dental education based on the experiences during the pandemic, teachers provide essential insights and considerations for future development.

> We learned much during the pandemic, representing a significant shift in our previously rigid mindset and opening up numerous pathways and possibilities. It will primarily be in-person when we return, but I will continue to teach online. The aspect of lessons with guest lecturers and thesis defenses, all of that is here to stay, it won't change; it has significantly influenced our practices and expanded our horizons. Internally, we still lack access to technology, but there will be an improvement with all this progress. We're already trying, for example, to digitize the necessary patient records, but only come to fruition now (TEACHER 2, our translation).

> We need to continue focusing on learning new technologies and mastering them better. Some teachers are still not proficient in this area. This must happen because it brings improvements. For instance, patient management improved during the pandemic because we developed a system. This system

> didn't exist at the Dental School and should have existed long before because it's fundamental. It didn't exist, but it does now. Prioritizing patients with comorbidities is here to stay. Previously, we didn't have this; a certain number of slots were filled on a first-come, first-serve basis. Now, we will consider these people and give them more attention (TEACHER 5, our translation).

Some projects were propelled by the lessons learned from the Emergency Remote Education (ERE), such as creating electronic patient records, a long-standing requirement they had struggled to implement. Additionally, there's an intent to enhance access to technology and develop technological expertise. Some educators highlight the hybrid model, consisting of online theoretical classes and in-person practical sessions, as a potential future for dental education. This approach could overcome geographical, temporal, and financial challenges while maintaining student engagement.

Mattos *et al.* (2020) reported positive outcomes in applying a hybrid methodology in dental education. However, the authors emphasize the need to enhance the quality of education by shifting the teaching process towards a more bidirectional and dialogic model, avoiding using a new model to replicate transmissive practices.

According to Goldstein *et al.* (2021), creative solutions in dental schools and positive results were observed in implementing Emergency Remote Education (ERE). They mainly highlight simulation activities in clinics and laboratories, which were crucial for final-year students to practice and maintain clinical skills to graduate. Furthermore, these activities allowed teachers to test new protocols and devices with technology, which could be applied after schools reopened, generating knowledge and contributions to the academic community (GOLDSTEIN *et al.,* 2021).

Thus, the pandemic scenario generated instability and opportunities for learning and mastery of digital technologies, including ways to adapt the remote delivery of clinical skills education.

According to Goldstein et al. (2021), dental schools should prepare for a potential future need for social distancing and harness the educational inclusion potential of technology integration. The authors emphasize the feasibility of a student completing part or all of the first year of the dental curriculum virtually, potentially reducing travel and housing expenses as well as institutional structural costs, making the program more accessible to disadvantaged populations. This would depend on changes in legislation, rules, and university culture (GOLDSTEIN *et al.,* 2021).

Furthermore, it is essential to consider the findings regarding the pedagogical potential of digital technologies for the development of more autonomous, problem-based, and dialogic teaching and learning strategies, promoting the development of communication, digital, and relational competencies.

Dental schools are responsible for investing in the acquisition and production of technological devices, student support policies, and teacher training to provide robust and comprehensive educational experiences for students (MOORE *et al.,* 2021). To do so, institutions require political, governmental, and financial support.

While recognizing the importance of students as the focus of education, this study focused on analyzing the teacher's perception as a fundamental agent of change in educational practices. It is recommended that further research be conducted on this topic to expand understanding in this area.

Final considerations

This study focused on digital technologies in dental education, assuming the implementation of remote education during the pandemic as a scenario to discuss teachers' knowledge and practices. The research showed that the integration of TDIC for implementing Emergency Remote Education (ERE) mobilized various teacher knowledge obtained throughout the teachers' personal and professional history, particularly curriculum and subject-specific knowledge. It also stimulated the development of pedagogical and technological expertise, with this practice playing a crucial role as an experience that shapes knowledge.

Historically prevalent in Odontology education, traditional and instrumental views of education and technology were identified. Teacher training and experiential knowledge are essential to broaden perspectives toward constructing more dialogic, participatory, and contextually relevant practices aligned with social reality. This orientation directs education toward a more comprehensive, ethical, humanistic, and socially transformative perspective in line with national curriculum guidelines.

Regarding the prospects for transforming practices, the research revealed that teachers who previously used some technologies merely for disseminating information and events at the institution expanded their focus to more systematic health education activities across various media. This included the development of networked communication, pedagogical, and authorship competencies with their students and colleagues. These findings also underscore the

gaps and challenges institutions face, such as the need for investment in education and the development of policies that ensure the public university's whole exercise of its social role.

In this way, it is understood that incorporating digital technologies for the continuity of education demanded adaptations in dental education, which led to changes in actions and agents and generated knowledge not only about the tools and teaching methods but also produced reflections on the teaching-learning process as a whole. It reinforces that knowledge is produced in the daily teaching routine, in a permanent process of reflecting on practice, influencing the development of new ways of teaching, and undergoing modifications in a dynamic process of mobilization and knowledge construction (PIMENTA, 2012; TARDIF, 2014).

Finally, it is worth noting that professional teacher knowledge, which arises from action, exists within a collective framework within the professional culture, is a form of knowledge that must be public, needs to be published, and cannot remain confined only within educational institutions, as it does not exist if not publicly exposed (NÓVOA, 2022). In this way, it is hoped that the results of this study and others will bring valuable contributions to the understanding of teacher conceptions, practices, and learning and the appreciation of teacher knowledge and education.

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