

Brazilian medical education and the incorporation of technologies before and during the COVID-19 pandemic

La educación médica brasileña y la incorporación de tecnología antes y durante la pandemia de COVID-19

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ABSTRACT

During the COVID-19 pandemic, the use of information and communication technologies (ICT) was intensified. This study aimed to investigate the incorporation of ICT in the teaching-learning process by teachers, undergraduate and graduate Medicine students from Brazilian public and private institutions, before and during the COVID-19 pandemic. Cross-sectional survey was used to perform this research, with data collection carried out from May to September 2020. Data were analyzed using descriptive statistics and thematic analysis. There were 242 participants: 153 undergraduate students, 19 graduate students, and 70 faculty members. The participants considered that the support provided by their educational institutions in 2020 for the use of ICT was ‘good’ (44.2%, 107/242) or ‘excellent’ (22.3%, 54/242). The technologies most often used in 2020 were

virtual learning environments (79.8%, 193/242) and videoconferences (77.7%, 188/242). The majority of respondents prefer the 'classroom-based' modality (50.4%, 122/242), followed by those who prefer the occasional use of ICT (22.3%, 54/242). The participants registered 171 perceptions related to the use of ICT as a pedagogical resource and its importance during the pandemic. The respondents recognized the complementary use of ICT in their academic activities and considered that the institutional support was adequate. No financial difficulties were reported, but participants mentioned lack of training and limited use of ICT in practical activities. To overcome such gaps, the use of ICT should take into account preferences and specificities of medical education, for which institutions have to prepare themselves pedagogically.

Keywords: medical education; distance education; information technology; medical students; faculty; Internet access; teaching; Brazil; coronavirus; pandemics.

RESUMEN

Durante la pandemia de COVID-19, se intensificó el uso de tecnologías de la información y la comunicación (TIC). Este estudio tuvo como objetivo investigar la incorporación de las TIC en el proceso de enseñanza-aprendizaje por parte de docentes, estudiantes de grado y posgrado de Medicina de instituciones públicas y privadas brasileñas, antes y durante la pandemia de COVID-19. Se adoptó una encuesta transversal para esta investigación, con recolección de datos, realizada de mayo a septiembre de 2020. Los datos fueron analizados mediante estadística descriptiva y análisis temático. Participaron 242 personas: 153 estudiantes de pregrado, 19 estudiantes de posgrado y 70 profesores. Los participantes consideraron que el apoyo brindado por sus instituciones educativas en 2020 para el uso de las TIC fue "bueno" (44,2 %, 107/242) o "excelente" (22,3 %, 54/242). Las tecnologías más utilizadas en 2020 fueron los entornos de aprendizaje virtual (79,8 %, 193/242) y las videoconferencias (77,7 %, 188/242). La mayoría de los encuestados prefiere la modalidad "presencial" (50,4 %, 122/242), seguida de los que prefieren el uso ocasional de las TIC (22,3 %, 54/242). Los participantes registraron 171 percepciones relacionadas con el uso de las TIC como recurso pedagógico y su importancia durante la pandemia. Los participantes reconocieron el uso complementario de las TIC en sus actividades académicas y consideraron que el apoyo institucional fue adecuado. No se informaron dificultades financieras, pero los participantes mencionaron la falta de formación y el uso limitado de las TIC en actividades prácticas.

Palabras clave: educación médica; educación a distancia; Tecnología de la Información; estudiantes de Medicina; docentes; acceso a Internet; enseñanza; Brasil; coronavirus; pandemia.

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Introduction

During the COVID-19 pandemic, the use of information and communication technologies (ICT) in medical education was intensified so that academic activities could continue. Many educational initiatives that emerged in this period were recorded in the scientific literature in the form of articles, notes and comments, which present concerns about the solutions, achieved results and about the impact of these changes on the training of future professionals.⁽¹⁾

Some of the concerns about medical education at this time of transition are related to the design of the available platforms and materials,⁽²⁾ Internet access and impact of the social and family context on attendance of virtual classes,^(2,3,4,5) flexibility and convenience of online teaching, as well as the time spent in it and the interaction it enables,^(5,6) provision of individual feedback to students to attain a more personalized teaching,^(5,6) uses of ICT in practical subjects,^(7,8,9) self-discipline and the need to train teachers for this teaching modality,⁽¹⁰⁾ patient care provided by students using telemedicine,^(9,11) student satisfaction with distance learning,^(10,12) and psychological issues such as depression, anxiety and loneliness.⁽¹³⁾ In addition, it is important to note that, historically, educators have recommended that planning is necessary prior to transition in the continuum from face-to-face to online learning,⁽¹⁴⁾ something that has been greatly accelerated due to the pandemic.

In light of studies on medical education during the pandemic carried out in several countries, and in view of the pedagogical challenges of the transition process, this article aims to investigate the incorporation of ICT in the teaching-learning process by teachers, undergraduate and graduate Medicine students from public and private Brazilian institutions before and during the COVID-19 pandemic. This objective was translated in

two research questions. From a quantitative perspective, how much has the COVID-19 pandemic impacted the use of ICT in the academic activities of medical students and teachers in Brazilian institutions? From a qualitative perspective, how did students and teachers perceive and were affected by the use of ICT during the pandemic?

It is important to clarify that there are three education modalities: the classroom-based modality; the blended modality, with both classroom-based and online activities; and online education, with or without student-teacher and student-student interactions.⁽¹⁴⁾ In this study, the expression “*use of ICT*” is employed comprehensively, as medical education institutions have used ICT in different ways to carry out academic activities before and during the pandemic.

The authors believe that this study complements the panorama of international medical education during the COVID-19 pandemic.

Methods

To develop the study, the authors mapped ICT use before and during the pandemic (in 2019 and 2020, respectively) to verify whether changes have occurred. A survey with structured questions addressed the number of hours of daily ICT use for academic activities, the types of ICT that were employed and which Internet access providers were used, as well as the participants’ assessment of institutional support for the use of ICT in the teaching and learning process, and which teaching modality they prefer. Additionally, the survey had one open question that approached the academic community’s perceptions of the teaching-learning process during the pandemic by asking: During the COVID-19 pandemic, what were your perceptions about the use of ICT in the teaching-learning process? The survey and data collection used the REDCap (Research Electronic Data Capture) platform, version 10.3.3 2020.⁽¹⁵⁾

Two researchers applied descriptive statistical analysis to the collected quantitative data using the R software, version 4.0.3, 2020. Statistical significance was calculated using Student’s t-test. The qualitative data were exported to a spreadsheet software and analyzed independently by three researchers, following the content analysis thematic approach.⁽¹⁶⁾ The most frequent themes were identified based on the participants’ comments.

The project was developed in Brazil and data were collected between May 1 and September 30, 2020, when the country was going through the first wave of COVID-19. The research was publicized on social networks and e-mail, and the participants who accepted the invitation constituted a convenience sample, as long as they met the selection criteria: being over 18 years old and acting as a student or teacher in the field of Medicine in a Brazilian higher education institution. It is relevant to inform that the present analysis is part of a larger study where 22 knowledge areas were investigated. Here, the authors isolated Medicine to perform a more detailed analysis of this traditional health field.

Results

The study had 242 Medicine respondents, of whom 153 (63.2%) were undergraduate students, 19 (7.9%) were graduate students and 70 (28.9%) were teachers. There was a predominance of Caucasian (78.5%), female (62.4%) individuals, with a mean age of 30.8 (standard deviation 12.5) years, from public institutions (55.4%). Additionally, most of the participants (85.9%) were from the south and southeast of Brazil, the wealthiest regions of the country. Table 1 summarizes the participants' profile.

Table 1 – Participants' demographic characteristics

	Undergraduate	Graduate	Faculty	Total
Participants	153 (63.2%)	19 (7.9%)	70 (28.9%)	242
Age	23.2 ± 4.2	33.3 ± 10.6	46.8 ± 9.4	30.8 ± 12.5
Gender				
Female	95	13	43	151 (62.4%)
Male	58	6	27	91 (37.6%)
Race				
Caucasian	122	11	57	190 (78.5%)
Multiracial	23	7	8	38 (15.7%)
Black	6	1	1	8 (3.3%)
Asian	2	0	4	6 (2.5%)
Type of institution				
Public	83	15	36	134 (55.4%)
Private	70	4	34	108 (44.6%)

The participants answered questions about the average number of hours they spent per day using technology in their academic activities, before and during the pandemic (fig.). The need to use the Internet was more frequent in the year 2020, with a global average of 7.6 hours per day, when compared to the average of 5.7 hours in 2019, a relative change of +34.2% ($p < .001$). This increase was more noticeable among undergraduate students, with a variation of +35.5% (average in 2019 = 5.7 hours, average in 2020 = 7.8 hours, $p < 0.001$), and among the faculty, with a variation of +45.9% (average in 2019 = 4.9 hours, average in 2020 = 7.1 hours, $p < 0.001$), but was not so evident among graduate students, who reported the same use in 2019 and in 2020, with an average of 8 hours per day.

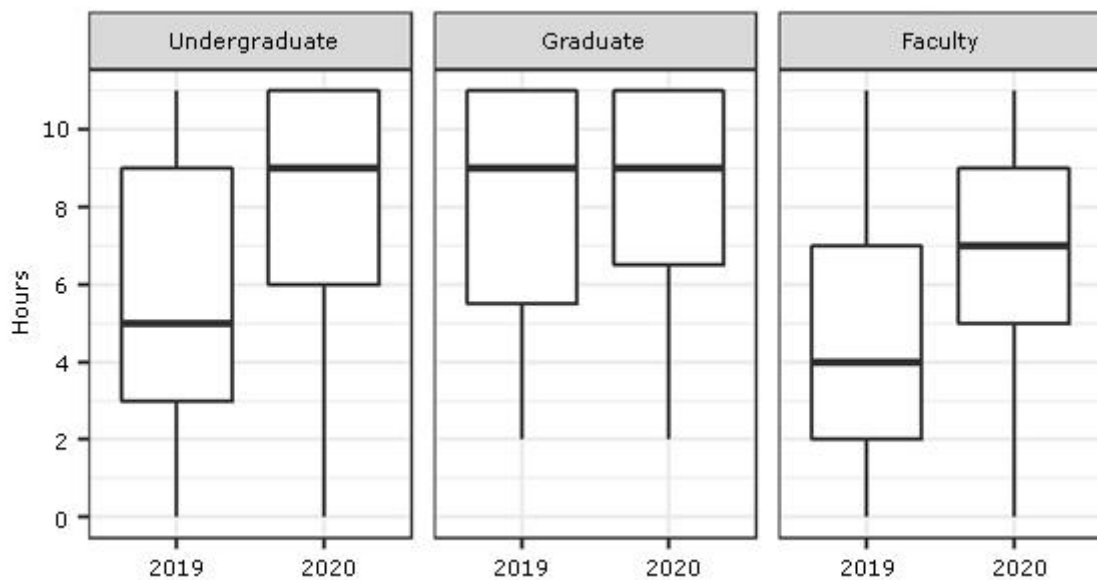


Fig. – Distribution of daily hours dedicated to the use of technologies in 2019 and 2020.

The participants were asked about the technologies they used in their academic activities before and during the pandemic (table 2). The most often used technologies in 2020 were virtual learning environments, marked by 79.8% (193/242) respondents, with an increase of +13.5% in relation to the use reported in 2019 ($p = .02$); videoconferences, marked by 77.7% (188/242) respondents, with an increase of +104.3% in relation to 2019 ($p < .001$); and video and audio platforms, marked by 74.4% (180/242) respondents, with an increase of +40.6% in relation to the use reported in 2019 ($p < .001$). The technology with the highest relative variation was virtual simulation, with a 160% increase in use in 2020 compared to 2019 ($p = .006$). There were also statistically significant variations in the use of online discussion forums (+ 66.7%, $p < .001$) and chat and instant message applications

(+ 52.1%, $p < .001$). Concerning the participants' profile, statistically significant variations were observed in the use of videoconference (+ 125%, $p < .001$) and virtual simulations (+ 122%, $p = .03$) among undergraduate students, and in the use of online discussion forums (+ 164%, $p < .001$) and videoconference (+ 100%, $p < .001$) among faculty.

Table 2 – Changes related to use of technology and Internet providers and evaluation of institutional support for academic activities in 2019 and 2020

	Undergraduate			Graduate			Faculty			Global	
	2019	2020	RC*	2019	2020	RC*	2019	2020	RC*	2020	RC*
Use of technology											
Audio/video platform	87	114	31.0%	12	14	16.7%	29	52	79.3%	180	40.6%
Chat/message	47	68	44.7%	6	8	33.3%	18	32	77.8%	108	52.1%
Database search	84	94	11.9%	9	11	22.2%	25	31	24.0%	136	15.3%
E-mail	55	63	14.5%	7	10	42.9%	35	40	14.3%	113	16.5%
Forum	48	73	52.1%	7	8	14.3%	11	29	164%	110	66.7%
Mobile app	84	101	20.2%	9	10	11.1%	30	37	23.3%	148	20.3%
Social network	57	61	7.0%	10	12	20.0%	25	31	24.0%	104	13.0%
Video conference	53	119	125%	12	15	25.0%	27	54	100%	188	104%
VLE [†]	110	128	16.4%	15	13	-13.3%	45	52	15.6%	193	13.5%
Virtual simulation	9	20	122%	0	2		1	4	300%	26	160%
Web app	64	87	35.9%	6	9	50.0%	23	25	8.7%	121	30.1%
Web search	103	107	3.9%	12	12	0%	28	27	-3.6%	146	2.1%
Internet provider											
Institution	51	28	-45.1%	8	4	-50.0%	29	13	-55.2%	45	-48.9%
Personal	141	139	-1.4%	16	17	6.3%	61	65	6.6%	221	1.4%
Others	17	17	0%	6	4	-33.3%	2	2	0%	23	-8.0%
Institutional support											
Poor	6	8	33.3%	3	4	33.3%	7	8	14.3%	20	25.0%
Fair	40	33	-17.5%	5	3	-40.0%	20	13	-35.0%	49	-24.6%
Good	73	73	0%	8	9	12.5%	25	25	0%	107	0.9%
Excellent	25	30	20.0%	3	3	0%	13	21	61.5%	54	31.7%

* Relative change.

[†] Virtual learning environment.

Participants were asked how they obtained access to the Internet before and during the pandemic (table 2). We found that the use of institutional Internet decreased by 48.9% ($p < 0.001$) in 2020 (18.6%, 45/242) when compared to 2019 (36.4%, 88/242), mainly among faculty (-55.2%, $p = 0.003$) and participants from private institutions (-59.3%, $p = 0.004$). The use of private Internet, on the other hand, increased slightly (+1.4%, $p = 0.64$), but not in the same proportion as the decrease, indicating that its use was intense before the pandemic (218/242, 90.1% of respondents in 2019, and 221/242, 91.3% in 2020). Access by other means (public or friends' Internet connection, Internet café) was mentioned by less than 10% (9.5%, 23/242) of participants in 2020.

The participants evaluated institutional support for the use of ICT in the teaching-learning process before and during the pandemic (table 2). Most respondents considered that the institutional support was 'good' (44.2%, 107/242) or 'excellent' (22.3%, 54/242) in 2020, whereas in 2019 support was 'good' for 43.8% (106/242) and 'excellent' for 16.9% (41/242) of the respondents. Only 8.3% (20/242) considered that institutional support was 'poor' in 2020, compared to 6.6% (16/242) in 2019. On a scale from 1 (poor) to 4 (excellent), the global mean was 2.75 in 2019 and 2.85 in 2020, a relative change of +3.4%, not statistically significant ($p = 0.24$).

Considering the previous academic experience and the experience they had during the COVID-19 pandemic, most respondents (50.4%, 122/242) preferred the classroom-based modality, followed by those who preferred the use of ICT as a complementary (22.3%, 54/242) and interactive (20.2%, 49/242) modality, as shown in table 3.

Table 3 – Preferred teaching modality

Modality	Undergraduate	Graduate	Faculty	Global
Classroom-based	80 (33.1%)	9 (3.7%)	33 (13.6%)	122 (50.4%)
Complementary ICT	37 (15.3%)	2 (0.8%)	15 (6.2%)	54 (22.3%)
Interactive ICT	28 (11.6%)	4 (1.7%)	17 (7.0%)	49 (20.3%)
Non-interactive ICT	8 (3.3%)	4 (1.7%)	5 (2.1%)	17 (7.0%)

Of the 242 participants, 171 registered their perceptions in the open question: 105 undergraduate students, 12 graduate students or residents and 54 teachers. The major theme that emerged from the participants' comments was "the characteristics of the use of ICT in the teaching-learning process". The sub-themes were uses of ICT, ICT as a pedagogical resource, support for the use of ICT, and importance of ICT.

Regarding the uses, the participants mentioned that ICT allows the continuity of the activities and enables them to cope with crises; avoids student travel across the territory to have access to education; can be used to complement other teaching approaches, such as in-person classes; can alter the learning time, in some situations saving time, in others demanding more time to carry out the activities. Some representative comments follow, associated with an identification code (using *U* for undergraduate students, *G* for graduate students, and *F* for faculty members) and a short profile containing gender, race, type of institution and age.

It is necessary to use information technology for daily updates. COVID-19 is a mystery; everyday something new is discovered and we must [...] prepare ourselves by gaining knowledge through this methodology. [U88, female, multiracial, private institution, 42 years old]

The technologies enabled that, even remotely, the students could continue with their academic activities and passed. [F1368, female, Caucasian, private institution, 36 years old]

[...] it would be great if the theoretical classes were online, without requiring us to travel to the institution, allowing us to attend the classes comfortably at home, and the practical classes were in the afternoon, in-person. [U1157, male, Caucasian, public institution, 25 years old]

I realize that there are resources that can be easily incorporated into the teaching practice and can be optimized. However, I also recognize that some aspects of the teaching and learning process have the same results when one uses technologies [...]. [F273, male, Caucasian, public institution, 35 years old]

About ICT as a pedagogical resource, the participants mentioned that online teaching shifts the emphasis from teacher-centered learning to student-centered learning; furthermore, it can be interactive and allows instant feedback to facilitate learning and to improve social and cognitive skills and study habits. Some of the comments were:

In the era in which we live, much of the theoretical content in the area of Medicine can be self-learned, as long as there is guidance and a script provided by professionals from the institution. Nowadays, the teacher has to be seen as a catalyst and a guiding tool rather than the source of information. In this context, information technology is capable of providing these means and can be utilized in a good way through platforms, videoconferences, scientific data pages, specialists' podcasts, etc. [U222, male, Caucasian, public institution, 26 years old]

An opportunity to systematically reevaluate the learning processes. In their feedback, the students reported that theoretical activities in a virtual environment were successful. [F1486, female, Caucasian, private institution, 50 years old]

It depends on the professional mastering the tools. Videoconference classes allow interaction with the audience in a great way. Exercises in the VLE, for example, are good, but they eliminate the contact with and the presence of the teacher, which are very important in the formation of a role model for the student. [F82, male, Caucasian, public institution, 44 years old]

Regarding support for the use of ICT, the participants mentioned that health education institutions should provide training for teachers and students to use online teaching platforms. Some of the comments were:

When well used, ICT was enough to meet the theoretical needs of my course. However, many teachers and students are not sufficiently prepared to use this teaching modality. [U1450, female, Caucasian, private institution, 22 years old]

The distance learning process demands more time to prepare the material. It is disappointing from the point of view of satisfaction related to students' performance. Overall, the student only does what is required and does not dedicate the necessary time. Moreover, during the evaluation process, the students complain excessively, because they are not prepared for this type of situation. [F572, male, Caucasian, public institution, 58 years old]

Regarding the importance of ICT, the participants stated that technology facilitates the achievement of transformative education and the creation of a workforce based on the needs of the future. Some representative comments were:

I thought that the experience was very good, the discussion of clinical cases was very productive, with the students participating much more compared to classroom-based teaching. I think this technology is here to stay and it is better aligned with the new trends of young individuals using technology in all segments of life. [F896, female, Caucasian, public institution, 64 years old]

The technological support for the communication and teaching process is a useful and effective tool to be used in pandemic times and, who knows, in the future, to better disseminate knowledge. [G1178, female, multiracial, public institution, 27 years old]

Throughout the thematic analysis, we found that the participants used the terms ‘*distance education*’, ‘*online teaching*’ and ‘*remote teaching*’, a fact that may indicate terminological variation, cultural variation, or even, as advocated by several authors^(14,17,18), the use of different approaches adopted by institutions to provide teaching during the pandemic period.

Discussion

Many newspaper reports emphasized that, in Brazil, students did not have access to the Internet and that, therefore, they were unable to participate in online classes during the COVID-19 pandemic.⁽¹⁹⁾ This issue was also discussed in studies about medical education in the UK,⁽⁴⁾ Mexico⁽³⁾ and Indonesia.^(2,5) However, these statements were not confirmed in the community we studied, perhaps because most Brazilian individuals in the medical field come from a wealthier social class in comparison with other knowledge areas.

Concerning the quantitative data, most participants prefer classroom-based teaching or classroom-based teaching using ICT. The qualitative data suggest that participants recognize in ICT a possibility of complementing the professional training received through classroom-based teaching or of having access to theoretical content. They also

recognized that ICT use requires the training of students and teachers and pedagogical adequacy, as some authors have already indicated.^(10,14,18)

Unlike what some international studies have found, the thematic analysis we performed did not identify themes related to financial difficulties in the use of ICT; psychological issues, such as stress, depression and loneliness, in the coping with COVID; patient care through telemedicine; or practical classes using ICT. Even during the pandemic, many experiences have been reported in the literature on the inclusion of ICT in practical activities and patient assistance.^(2,5,7,18,20,21)

Conclusions

The respondents recognized the complementary use of ICT in their academic activities and considered that the institutional support was adequate. No financial difficulties were reported to acquire equipment or to have Internet access, but participants mentioned lack of training and limited use of ICT in practical activities. These deficiencies may indicate important limitations in the Brazilian medical education. To overcome such gaps and to improve the use of ICT after pandemics, one should take into account preferences and specificities of the medical education community, for which institutions have to prepare themselves pedagogically and continuously.

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Declaration of interest

The authors declare no conflict of interest.

Ethical approval

This study received certificate number CAAE:31043720.7.0000.5440 from the Brazilian Ethics Committee for Research with Human Beings.