HEALTH HIGHER EDUCATION AND THE USE OF TECHNOLOGY DURING THE PANDEMIC OF COVID-19 IN BRAZIL

Maria Cristiane Barbosa Galvão [1]
Universidade de São Paulo
mgalvao@usp.br

Ivan Luiz Marques Ricarte [2]
Universidade Estadual de Campinas
ricarte@unicamp.br

Janise Braga Barros Ferreira [3]
Universidade de São Paulo
janise@fmrp.usp.br

Camilo Darsie [4]
Universidade de Santa Cruz do Sul
camilodarsie@unisc.br

Aldaísa Cassanho Forster [5]
Universidade de São Paulo
acforste@fmrp.usp.br

Marcelo Carneiro [6]
Universidade de Santa Cruz do Sul
marceloc@unisc.br

Samára dos Santos Sampaio [7]
Universidade de São Paulo
sami_sampaio@usp.br

Letícia Silva Barbosa [8]
Universidade de São Paulo
leticiasb@usp.br

Abstract
The COVID-19 pandemic has affected educational institutions worldwide. The objective of this study is to present changes during the pandemic regarding the use of information and communication technologies (ICT) by Brazilian faculty, undergraduate and graduate students in the field of health. A convergent mixed methods study (QUAN+QUAL) with cross-sectional data collection was carried out in 2020. Data were analyzed using descriptive statistics (QUAN) and thematic analysis (QUAL). This study had 1172 participants, comprising 533 undergraduate students, 257 graduate students and 382 lecturers. During the pandemic, the average number of daily hours of ICT use for academic activities increased from 5.90 hours in 2019 to 7.18 hours in 2020 (+21.7%). Virtual learning environments were the most used technology, but technologies that showed largest significant increase in use were videoconference and virtual simulation. Five main themes emerged from the analysis of participants' perceptions: use of ICT for educational activities; comparison and preference of participants regarding teaching modality; changes in education; institutional support for the use of ICT in education; and problems to access the Internet. Some recommendations based on this research include emergency training for the academic community in online teaching; maintenance of online education; inclusion of more interactive technological tools in virtual learning environments; actions to improve Internet connection and access to equipment; and review of the load of academic activities.
Keywords: Higher Education; Health Education; Information Technology; Pandemic; Covid-19.

ENSINO SUPERIOR NO CAMPO DA SAÚDE E O USO DE TECNOLOGIA DURANTE A PANDEMIA DE COVID-19 NO BRASI

Resumo
A pandemia de COVID-19 afetou instituições educacionais em todo o mundo. Este estudo apresenta mudanças ocorridas no uso das tecnologias de informação e comunicação (TIC) por docentes, graduandos e pós-graduandos brasileiros no campo da saúde durante a pandemia. Para tanto, realizou-se estudo convergente de métodos mistos (QUAN + QUAL) com coleta de dados transversal em 2020. Os dados foram analisados por meio de estatística descritiva (QUAN) e análise temática (QUAL). Participaram 1172 pessoas, sendo 533 alunos de graduação, 257 alunos de pós-graduação e 382 professores universitários. Durante a pandemia, o número médio de horas diárias de uso das TIC para atividades acadêmicas aumentou de 5,90 horas em 2019 para 7,18

---

[1] Professora Doutora da Faculdade de Medicina de Ribeirão Preto da Universidade de São Paulo.
[2] Professor Titular da Faculdade de Tecnologia da Universidade Estadual de Campinas.
[3] Professora Doutora da Faculdade de Medicina de Ribeirão Preto da Universidade de São Paulo.
[4] Professor Doutor do Departamento de Ciências, Humanidades e Educação da Universidade de Santa Cruz do Sul.
[5] Professora Associada da Faculdade de Medicina de Ribeirão Preto da Universidade de São Paulo.
[6] Professor Doutor do Departamento de Ciências da Vida da Universidade de Santa Cruz do Sul.
[7] Doutoranda no Programa de Pós-Graduação em Saúde Pública da Faculdade de Medicina de Ribeirão Preto da Universidade de São Paulo.
[8] Graduanda em Informática Biomédica da Faculdade de Medicina de Ribeirão Preto da Universidade de São Paulo.

horas em 2020 (+21,7%). Ambientes virtuais de aprendizagem foram as tecnologias mais utilizadas, mas as que apresentaram o maior aumento significativo no uso foram videoconferência e simulação virtual. Cinco temas principais emergiram da análise das percepções dos participantes: uso das TIC para atividades educacionais; comparação e preferência dos participantes quanto à modalidade de ensino; mudanças na educação; apoio institucional para uso das TIC na educação; e problemas de acesso à Internet. Algumas recomendações baseadas nesta pesquisa incluem treinamento de emergência para a comunidade acadêmica em ensino online; manutenção da educação online; inclusão de ferramentas tecnológicas mais interativas em ambientes virtuais de aprendizagem; ações para melhorar conexão à Internet e acesso aos equipamentos; e revisão da carga de atividades acadêmicas.
Palavras-chave: Educação Superior; Edicação em Saúde; Tecnologia da Informação; Pandemia; COVID-19.

1 INTRODUCTION

The COVID-19 pandemic has affected educational institutions worldwide, including colleges and universities (BRYSON; ANDRES, 2020; CHICK *et al.*, 2020; FITZGERALD; NUNN; ISAACS, 2020; RAMOS-MORCILLO *et al.*, 2020). Aiming to face the situation of contagion, governments and higher education institutions made decisions, such as interrupting their academic activities or transferring them from the traditional modality (face-to-face, classroom-based) to the online one, thus maintaining their activities amid social distance.

In Brazil, Federal Government decrees allowed all higher education institutions to transfer their undergraduate and graduate courses to the online modality during 2020 and 2021 or, alternatively, to suspend their activities, at the discretion of each institution. However, these decrees prohibited the migration of professional internships and laboratory practices to the online modality. Based on these decrees, some institutions suspended their activities, while others transferred them to the online modality.

The choice of the teaching method heavily depends on a number of factors: the teaching context, the adequacy of the method for the type of knowledge to be developed, the skills that students need, the demands of the domain, students' characteristics, the available resources, the support given to students and teachers, and on views and beliefs about what constitutes good teaching (BATES, 2019). Transition from face-to-face teaching to the online modality is not trivial, as online students must accept greater responsibility for their learning, which demands a high level of self-regulation, self-discipline and metacognitive skills (XU; JAGGARS, 2014). In the academic context, studies indicate inequalities in access to hardware, software, data storage capacity and connectivity, especially among students of lower socioeconomic levels, with digital exclusion remaining a reality even among students living in developed countries (GONZALES; CALARCO; LYNCH, 2020). Moreover, studies have found a decrease in undergraduate students' performance in online courses, especially among male, younger, and less favored students, with larger gaps in some academic areas

65

requiring laboratory practices (XU; JAGGARS, 2014). Despite the available knowledge, the pandemic has demanded many changes that have been made without the necessary planning and with little time for reflection.

In this context, the present study sought to explore potential changes during the pandemic regarding the use of information and communication technologies (ICT) by faculty, undergraduate and graduate students in the field of health, including their perceptions of this process, in Brazil.

2. METHODS

Mixed research methods allow studying a problem in depth and provide a better understanding of phenomena than that offered by quantitative or qualitative studies alone. Creswell and Plano Clark (2017), present three mixed methods approaches adopted internationally. The first is the sequential exploratory study (QUAL>QUAN), in which quantitative results are mobilized to confirm or generalize the qualitative results. The second approach is the sequential explanatory study (QUAN>QUAL), in which qualitative results are mobilized to interpret or explain the quantitative results. In a convergent study (QUAN+QUAL), quantitative and qualitative steps are concomitant, that is, the qualitative and quantitative methods document the same phenomena in a complementary way, with the integration of results occurring during data analysis. Mixed methods studies usually require interdisciplinary research teams.

The authors of the present study come from the fields of medicine, nursing, technology, information science and education, and have experience in quantitative, qualitative, and mixed methods research. To develop the study, they opted for a convergent mixed methods design (QUAN+QUAL), which has been widely used in health studies. The team established the quantitative and qualitative research problems taking into account the theoretical framework (BATES, 2019; XU; JAGGARS, 2014; GONZALES; CALARCO; LYNCH, 2020) and considering the project's objective of presenting changes during the pandemic regarding the use of information and communication technologies (ICT) by faculty, undergraduate and graduate students in the field of health, including their perceptions.

Quantitative problems encompassed mapping ICT use before and during the pandemic (2019 and 2020, respectively) to verify whether changes 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

66

learning process, and which teaching modality they prefer. Two researchers applied descriptive statistical analysis to the collected quantitative data.

The qualitative problem approached the academic community's perceptions of the teaching-learning process during the pandemic by asking one single question: during the COVID-19 pandemic, what were your perceptions about the use of ICT in the teaching-learning process? Three researchers performed a thematic analysis of the qualitative data, exporting it to a spreadsheet software, investigating potential emerging themes and identifying representative perceptions.

Finally, two researchers compared similarities and differences between quantitative and qualitative results, and consolidated them in a convergence phase (PLUYE *et al*., 2018).

The study was approved by an Ethics Committee for Research with Human Beings, as required by Brazilian legislation. Participants were recruited through social media and e-mail messages in 2020. The individuals who accepted the invitation to participate in the study also answered questions about their demographic profile, educational institution and scientific field.

The project used the REDCap (Research Electronic Data Capture) platform (HARRIS *et al*., 2019), version 10.3.3 2020, to collect quantitative and qualitative data, and the software R, version 4.0.2 2020, for the statistical analysis.

67

2.1 QUANTITATIVE RESULTS

The demographic profile of the 1172 participants from all Brazilian states is available in Table 1. This group comprises mainly females (853/1172, 72.8%) and Caucasians (803/1172, 68.5%), consistent with what is already known about the local scenario, in which women outnumber men and the white population has more access to higher education. As for their association with educational institutions, most participants are undergraduate students (533/1172, 45.5%), followed by faculty members (382/1172, 32.6%) and graduate students (257/1172, 21.9%), and attend or teach traditional (face-to-face classroom settings) courses (1094/1172, 93.3%) in public institutions (781/1172, 66.6%). Most participants are from the areas of Medicine and Nursing, but there is also a significant participation of individuals from Public Health, Pharmacy, Physiotherapy, Nutrition, Biomedicine, Dentistry, Psychology and Physical Education.

Table 1 - Participants' demographic profile

	Undergraduate students	Graduate students	Faculty	Total
	n = 533	n = 257	n = 382	N = 1172
Age				
Mean ± sd[a]	23.3 ± 6.2	31.0 ± 7.8	43.8 ± 11.4	31.7 ± 12.3
Median	22	29	42	27.5
Gender				
Female	390 (73.2%)	194 (75.5%)	269 (70.4%)	853 (72.8%)
Male	140 (26.2%)	63 (24.5%)	113 (29.6%)	316 (27.0%)
Other	3 (0.6%)	0 (0%)	0 (0%)	3 (0.2%)
Race				
Caucasian	346 (64.9%)	158 (61.4%)	299 (78.3%)	803 (68.5%)
Multiracial	134 (25.1%)	73 (28.4%)	55 (14.4%)	262 (22.4%)
Black	37 (6.9%)	21 (8.2%)	15 (3.9%)	73 (6.2%)
Asian	13 (2.5%)	4 (1.6%)	11 (2.9%)	28 (2.4%)
Indigenous	3 (0.6%)	1 (0.4%)	2 (0.5%)	6 (0.5%)
Institution				
Public	363 (68.1%)	224 (87.2%)	194 (50.8%)	781 (66.6%)
Private	170 (31.9%)	33 (12.8%)	188 (49.2%)	391 (33.4%)
Course				
Medicine	153 (28.7%)	19 (7.4%)	70 (18.3%)	242 (20.6%)
Nursing	86 (16.1%)	39 (15.2%)	93 (24.3%)	218 (18.6%)
Public Health	11 (2.1%)	61 (23.7%)	32 (8.4%)	104 (8.9%)
Pharmacy	31 (5.8%)	25 (9.7%)	36 (9.4%)	92 (7.8%)
Physical Therapy	42 (7.9%)	11 (4.3%)	22 (5.8%)	75 (6.4%)
Nutrition	30 (5.6%)	19 (7.4%)	25 (6.5%)	74 (6.3%)
Biomedicine	33 (6.2%)	10 (3.9%)	12 (3.1%)	55 (4.7%)
Dentistry	14 (2.6%)	11 (4.3%)	30 (7.9%)	55 (4.7%)
Psychology	22 (4.1%)	11 (4.3%)	20 (5.2%)	53 (4.5%)
Phys. Education	24 (4.5%)	13 (5.1%)	14 (3.7%)	51 (4.4%)
Other courses[b]	87 (16.3%)	38 (14.7%)	28 (7.3%)	153 (13.1%)

a Standard deviation

b Includes participants from the areas of Biology, Biomedical Informatics, Biotechnology, Clinical Analysis, Gerontology, Health Sciences, Integrative Practices, Occupational Therapy, Physiology, Radiology, Social Services, and Speech Therapy.

Source: Research data, 2020.

68

To assess the impact of the pandemic on the use of ICT in education, the answers to two questions were combined, one about the number of hours of daily use of ICT for academic activities in 2019 (before the pandemic) and the other about its use in 2020, during the pandemic. Table 2 summarizes these results. On average, there was an increase from 5.90 hours dedicated to academic activities with ICT use in 2019 to 7.18 hours in 2020, a relative change of +21.7% ($P<.001$). The greatest variations were found in faculty members, from an average of 5.75 hours in 2019 to 7.41 hours in 2020 (+28.9%, $P<.001$), especially among Medicine (5.66 to 7.60 hours, +34.3%, $P<.001$) and Pharmacy (4.75 to 6.89 hours, +45.1%,

$P<.001$) participants. Statistically significant variations were observed also among undergraduate ($+21.4\%$, $P<.001$) and graduate ($+11.3\%$, $P=.03$) students.

Table 2 - Average number of hours of daily ICT use by the 1,172 participants in online education in 2019 and 2020

	2019 (h)	2020 (h)	R.C.[a]	*P*-value
Global results	5.90	7.18	21.7%	<.001
By category				
Undergraduate students	5.93	7.20	21.4%	<.001
Graduate students	6.09	6.78	11.3%	.03
Faculty	5.75	7.41	28.9%	<.001
By age				
Below median (27.5 years)	5.76	7.00	21.5%	<.001
Above median (27.5 years)	6.05	7.36	21.7%	<.001
By gender				
Female	6.05	7.23	19.5%	<.001
Male	5.53	7.07	27.8%	<.001
Other	4.33	5.33	23.1%	.84
By race				
Caucasian	5.70	7.26	27.4%	<.001
Multiracial	6.38	7.08	11.0%	.02
Black	6.63	6.85	3.3%	.70
Asian	5.68	6.68	17.6%	.30
Indigenous	4.67	7.33	57.0%	.08
By type of institution				
Public	5.80	7.01	20.9%	<.001
Private	6.11	7.51	22.9%	<.001
By course				
Medicine	5.66	7.60	34.3%	<.001
Nursing	6.31	6.94	10.0%	.06
Public Health	6.19	7.09	14.5%	.08
Pharmacy	4.75	6.89	45.1%	<.001
Physical Therapy	6.00	7.31	21.8%	.02
Nutrition	5.78	7.45	28.9%	.002
Biomedicine	6.00	7.00	16.7%	.13
Dentistry	5.76	7.04	22.2%	.046
Psychology	6,53	7,68	17,6%	.07
Physical Education	5.98	6.37	6.5%	.61
Other courses	5.99	7.11	18.7%	.009

[a] Relative Change: (hours$_{2020}$-hours$_{2019}$) /hours$_{2019}$.
Source: Research data, 2020.

In relation to supporting online activities, there was an increase in the use of technologies (Figure 1), demonstrating an effort to face the pandemic and to provide online classes in order to prevent crowding. The most used technology was the virtual learning environment (VLE), used by 70.6% (828/1172) of the participants in 2020, with an increase of 15.7% in relation to the use reported in 2019 ($P<.001$). The difference in the use of VLE

69

was noticeably observed among faculty members (+23.3%, *P*<.001) and Physical Therapy (+40%, *P*<.001) and Public Health (+29%, *P*=.02) participants. However, the technologies that showed the greatest variation regarding the use in 2020 in relation to the use reported in 2019 were:

1. Virtual simulation (+97.4%, *P*<.001), with the highest relative change among graduate students (+184,2%, *P*=.04) and Medicine (+161%, *P*=.006) and Nursing (+124,3%, *P*=.04) participants;

2. Videoconference (+64.6%, P<.001), with the highest relative change among undergraduate students (+84.8%, P<.001) and Medicine (+104.5%, P<.001) and Pharmacy (+110%, P<.001) participants;

3. Chat (+49.0%, P<.001), with the highest relative change among faculty members (+63.5%, P<.001) and Pharmacy (+100%, P=.001) and Biomedicine (+120%, P=.02) participants; and

4. Discussion forum (+45.9%, P<.001), with the highest relative change among undergraduate students (+51.4%, P<.001), faculty members (+61.3%, P<.001), and Dentistry participants (+118.8%, P=.03).

70

Figure 1 - ICTs most often used in online education by the 1,172 participants in 2019 and 2020
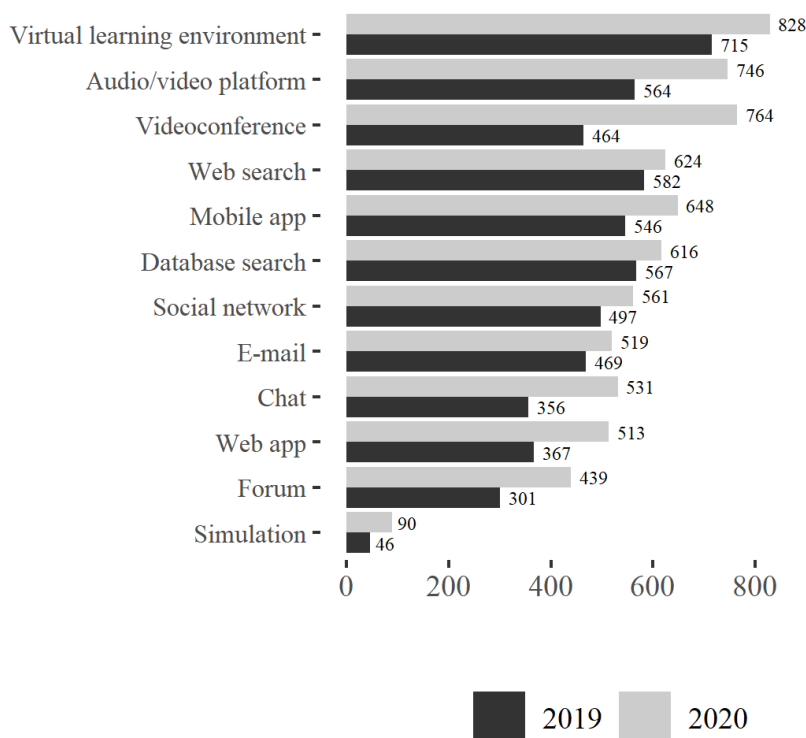
Source: Own elaboration, 2020.

Figure 2 presents the reported Internet access providers. The personal Internet account was the most used option both in 2019 (1004/1172, 85.7%) and 2020 (1047/1172, 89.3%), with a relative change of +4.3% (*P*=.007) among all participants. This variation was greater among faculty members (+7.6%, *P*=.003). Internet access offered by institutions showed a drastic reduction among all users, from 34.2% (401/1172) in 2019 to 12.8% (150/1172) in 2020, a relative change of -62.6% (*P*<.001), most notably among undergraduate students (-67.1%, *P*<.001), showing that college and university campuses were inaccessible to some of the actors.

Figure 2 Internet access provider used by the 1,172 participants in 2019 and 2020
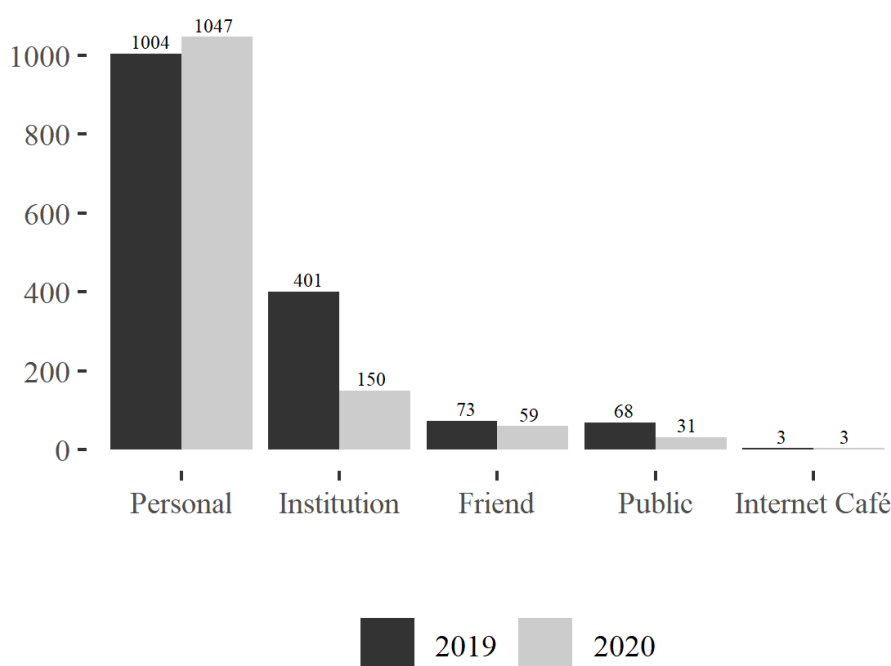
Source: Own elaboration, 2020.

One of the questions asked participants to evaluate the support offered by the institution for the use of ICT in teaching during the pandemic (Figure 3). In a scale from 1 (poor) to 4 (excellent), the average evaluation of the institutional support was 2.63 in 2019 and 2.59 in 2020, a difference that is not statistically significant (-1,5%, *P*=.38). In almost all segments of the demographic profile, there were small relative changes in this evaluation without statistical significance, from -8.5% (*P*=.42) for Asians to +4.2% (*P*=.13) for faculty members. However, a significant reduction was observed among undergraduate students, with a relative change of -3.8% (from 2.61 in 2019 to 2.51 in 2020, *P*=.049), and among

participants aged between 18 and 27, with a relative change of -4.6% (from 2.60 in 2019 to 2.48 in 2020, P=.02). This result suggests the institutions had difficulties in providing adequate support for their younger students.

Figure 3 Evaluation of institutional support regarding use of ICT in online education by the 1,172 participants in 2019 and 2020

Source: Own elaboration, 2020

72

Considering the experience of ICT use before and during the pandemic, the majority of the participants (678/1172, 57.8%) stated they prefer traditional (face-to-face) classes and learning activities (Figure 4). This preference was observed mainly among students, both undergraduate (361/533, 67.7%) and graduate (143/257, 55.6%). Faculty members was the only group in which the preference for face-to-face activities was below 50% (174/382, 45.5%). A minority of participants (50/1172, 4.3%) prefer activities carried out exclusively through non-interactive ICT.

Figur 4 - Participants' (N=1,172) preference regarding the teaching modality

Source: Own elaboration, 2020.

73
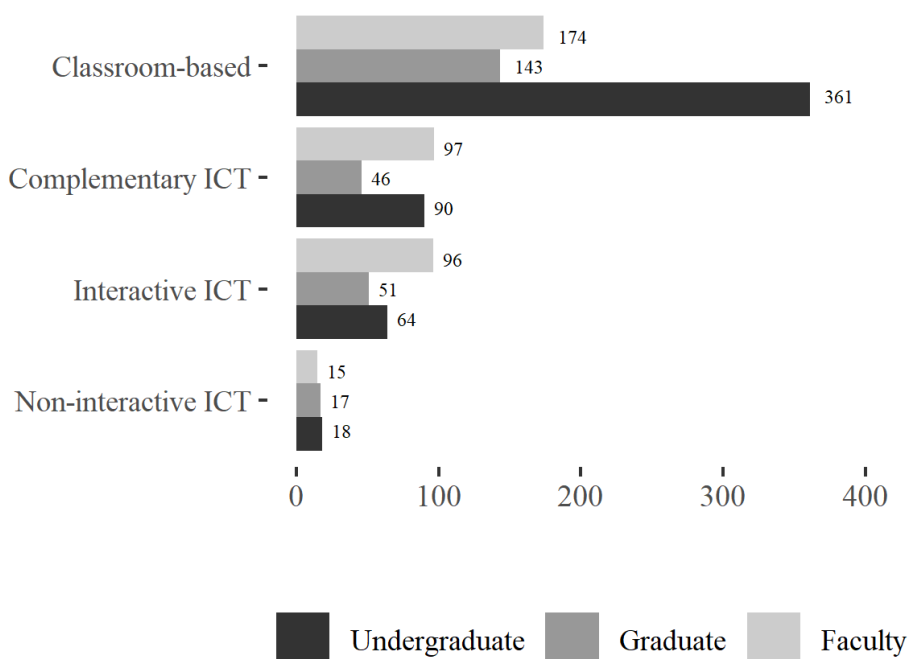
3. QUALITATIVE RESULTS

A total of 857 individuals participated in the qualitative phase: 372 (43.4%) undergraduate students, 301 (35.1%) faculty members and 184 (21.5%) graduate students; 626 (73%) females, 588 (68.6%) Caucasians, 568 (66.3%) participants from public institutions, 172 (20.1%) Nursing participants, and 171 (20%) Medicine participants.

Three researchers independently analyzed all the 1251 registered perceptions. Five main themes emerged from the participants' comments:

1. Use of ICT for educational activities during the pandemic, with 513 (41%) perceptions;
2. Comparison and preference of the participants regarding the teaching modality (face-to-face or distance learning), with 247 (19.7%) perceptions;
3. Changes in education during the pandemic, with 221 (17.7%) perceptions;
4. Institutional support for the use of ICT in education during the pandemic, with 157 (12.5%) perceptions; and
5. Problems to access the Internet during the pandemic, with 113 (9%) perceptions.

In the presentation of representative perceptions, each one received a label formed by letter U for undergraduate students, G for graduate students or F for faculty members, followed by a numerical identifier and a short demographic profile.

3.1 THEME 1: USE OF ICT FOR EDUCATIONAL ACTIVITIES DURING THE PANDEMIC

Participants mentioned several types of ICT used in academic activities during the pandemic, such as videoconference, chat, VLE:

> It depends on the professional mastering the tools. Videoconference classes allow interaction with the audience in a wonderful way. Exercises in the VLE, for example, are good, but they eliminate the contact with and the presence of the lecturer, which are very important in the formation of a role model for the student. [F82, Male, Caucasian, Public University, 44 years old, Medicine.]

Perceptions recorded in this theme also addressed the positive aspects and difficulties in of the use of technologies during the pandemic:

74

> Undoubtedly, the technology is already present in our daily lives and also in the learning process, but during the pandemic it has been essential and has allowed us to use the available resources that until now had been unknown to us. [U1147, Female, Caucasian, Private University, 35 years old, Psychology.]

> Technologies were important and essential during the pandemic process. Difficulties in access, interacting with all students and/or preparing distance classes, giving feedback on activities for students and the evaluation process represent some of the challenges. [F604, Male, Caucasian, Public University, 32 years old, Public Health.]

3.2 THEME 2: COMPARISON AND PREFERENCE OF THE PARTICIPANTS REGARDING THE TEACHING MODALITY

Many perceptions compared classroom teaching and distance learning, highlighting the advantages and disadvantages of each modality. Participants seem receptive to distance learning for theoretical classes, but for practical classes they think that the face-to-face modality is more appropriate. Some records:

> *Distance education is inferior to classroom-based teaching, especially regarding practical subjects. [...] I feel that I have learned infinitely*

less, and I have made an effort to revise the content and follow a study routine. [U203, Female, Caucasian, Public University, 21 years old, Medicine.]

Video classes are a fundamental resource for maintaining the school calendar. [...] Meanwhile, the student-lecturer and student-student interaction has been lost, and also the student-patient interaction in practical activities; that's why I prefer the face-to-face modality. [U202, Male, Caucasian, Public University, 20 years old, Physical Therapy.]

Positive. Technology can facilitate and expedite the teaching-learning process, in addition to allowing remote access. But I still believe in the importance of interaction between students and lecturers, especially in disciplines that require humanized learning in the health field, such as patient assessment, for instance. [G589, Female, Caucasian, Public University, 29 years old, Nutrition.]

3.3 THEME 3: CHANGES IN EDUCATION DURING THE PANDEMIC

Participants highlighted the sudden change in the teaching modality during the pandemic and the multiple academic and personal efforts and adaptations that came from that moment:

75

Due to the obligation of distance learning, the educational institution, students and lecturers were forced to adapt to new forms of teaching, and we realized that technology can help a lot if used properly. I believe that access to technology will become much better from this moment on, even with the end of the pandemic, as we realized that technology can be a great ally, even in areas where it was not used before. [U1426, Male, Multiracial, Private Institution, 21 years old, Medicine.]

The use of these technologies proved to be indispensable, as they became the only type of interaction between students and lecturers. However, as the changes occurred suddenly, I believe that we were not prepared to use these tools. [G349, Female, Caucasian, Public University, 28 years old, Pharmacy.]

Initially, it was a challenging experience, permeated by rejection and difficulty on the part of lecturers, students and institutions. Now that the adaptation process is over, I realize that it has reached a greater acceptance, appreciation and respect. [F828, Female, Caucasian, Private University, 37 years old, Public Health.]

In addition, some perceptions emphasized work overload, and changes in homes and families:

I have always used ICT, but throughout this period, when I have used it exclusively, in a massive, excessive, exhausting way... I spend whole days in front of the computer, every day of the week, without rest or other type of entertainment. The demands are many and constant... I

often have to redo many things, people are much more anxious and demand immediate responses... in short, it has been strenuous! [F1431, Female, Caucasian, Public University, 51 years old, Public Health.]

I notice a huge energy expenditure, making me more tired than when these activities were performed in person. [G83, Female, Caucasian, Private University, 41 years old, Public Health.]

When everyone is at home, the environment is not very favorable to studies; the tension created by the situation we live in also does not help us to fully concentrate on our studies during the day. [U929, Male, Caucasian, Public University, 19 years old, Physical Education.]

3.4 THEME 4: INSTITUTIONAL SUPPORT FOR THE USE OF ICT IN EDUCATION DURING THE PANDEMIC

Many participants mentioned lack of institutional preparation to face the changes that occurred. There were some comments on deficient institutional planning:

> *The situation of fully virtual teaching, right when the quarantine was decreed, made the lecturers reproduce a good part of the face-to-face activities using the virtual model [...]. Lecturers and students should have been given enough time to rethink the subjects and to plan more adequately. [U699, Female, Multiracial, Public University, 21 years old, Nutrition.]*

> *In my case, my university did not plan nor offered any activity using technology and we have not had classes since last year due to social isolation. Although I think traditional classes are much better, I would like my University to offer some kind of distance learning activity, even if it is not mandatory, just to give students the feeling of belonging to the university and to remove the feeling of abandonment by the institution, which not just me, but other students that I have contact with, are feeling. [U866, Female, Multiracial, Public University, 22 years old, Biomedicine.]*

> *Due to previous experience, I had no problems using the tools. But there was a rush to prepare more approaches using ICT. Around me, however, I noticed several difficulties in fellow lecturers and in the university due to lack of training in recent years and due to the fact that incorporating ICT into the teaching process was not a priority. [F684, Male, Caucasian, Public Health, 49 years old, Biomedical Informatics.]*

76

Participants also commented on lecturers' lack of training to use ICT:

> *Many teachers do not have enough training to use the technologies, which ends up delaying the content that is taught and the progress of the class. Moreover, the Moodle platform is overloaded and often crashes, and there have been reports from people close to us that the*

platform crashed and the person could not complete the test. [U205, Female, Caucasian, Public University, 21 years old, Physical Therapy.]

At the beginning, some teachers were not proficient in classes with information technology; however, with the increase in the number of cases and the worsening of the pandemic, online classes started to happen, and adaptations have been made over the weeks, aiming to prevent the extension of the school calendar. Online classes sometimes hinder concentration and motivation; lecturers and students still need guidance related to this new modality. [G1065, Female, Multiracial, Public University, 24 years old, Speech Therapy.]

During this period, I also had the opportunity to familiarize myself with many available tools, but on my own, because the university was limited in preparing all the lecturers. [F315, Female, Multiracial, Public University, 33 years old, Nursing.]

3.5 THEME 5: PROBLEMS TO ACCESS THE INTERNET DURING THE PANDEMIC

Some participants reported lack of equipment and poor connectivity during the pandemic, showing that access to technology and to the Internet is not universal yet.

77

At my university, the distance learning method was not implemented. I believe that it is not possible to do that, as it has a high number of students who do not have availability and financial conditions to have access to the Internet and to the equipment. [U809, Male, Multiracial, Public University, 21 years old, Pharmacy.]
My learning is not the same as when I had traditional classes. I very often lose connection with the Internet and this ends up impairing my learning during online classes and during online exams too. [U200, Male, Caucasian, Public University, 21 years old, Physical Therapy.]

It was possible to adapt to the doctoral program at home because I have Internet access and a personal computer available, but I believe that many do not have these resources and I have seen little support from the public university and from lecturers regarding students who do not have access conditions. [G535, Female, Caucasian, Public University, 28 years old, Public Health.]

A good part of the students managed to perform the necessary communications, but many did not have a computer and used someone else's access to the Internet. Others did not have cell phones that could download apps for classes. In the digital age, in which people always have their cell phones in their hands, I was surprised by the number of students who had never accessed Skype. [G905, Female, Caucasian, Private University, 51 years old, Biomedicine]

My perception is that we need to have better access to technological equipment. I saw many students using only their cell phones, because

they did not have computers, notebooks, tablets, etc. [F647, Female, Caucasian, Private University, 49 years old, Nutrition.]

We still have many problems related to students' access to the Internet. Access is often poor. [F848, Female, Caucasian, Private University, 36 years old, Medicine.]

The main difficulty is the access and resources available to students. Many of them do not have access to the Internet nor the equipment to meet the demands of the whole family, not even to meet their own needs. It is, after all, a fantastic system, but an excluding one. [F1117, Female, Black, Public University, 39 years old, Physical Therapy.]

4 CONVERGENCE PHASE

The first analysis carried out in the convergence phase was to investigate whether there were any significant differences in the distribution of respondents in the previous two phases. This analysis showed that the distributions of the 1172 participants in the quantitative phase and 857 participants in the qualitative phase were very similar. Both comprised mostly female participants (72.8% in the quantitative phase, 73.0% in the qualitative phase), Caucasians (68.5% and 68.6%), studying or teaching at public universities (66.6% and 66.3%), in the Medicine (20.6% and 20.0%) and Nursing (18.6% and 20.1%) courses.

78

There was convergence in the quantitative and qualitative phases with respect to the types of technologies that were employed. The quantitative phase indicated an increase in the use of different types of technological resources in 2020. The qualitative phase presented the technological resources that were employed and participants' interaction difficulties in the virtual environment.

Considering the quantitative and qualitative data, there was convergence related to the participants' involvement with ICT during the pandemic. While the quantitative phase indicated an increase in the number of hours dedicated to the use of ICT for academic activities, the qualitative phase elucidated how this increase proceeded, emphasizing adaptation efforts, work overload and difficulties associated with teaching and learning in the family environment.

When asked about which education modality they preferred, the participants in the quantitative phase showed preference for classroom teaching. The qualitative phase associated their preference for face-to-face teaching with their interaction difficulties in the virtual environment, mainly in practical activities in the health field. The qualitative data also clarified that the participants are open to the use of ICT in education, as long as it is employed

for theoretical classes. Thus, there is a convergence in the participants' preferences in the quantitative and qualitative data.

Regarding Internet access, results of the quantitative phase showed a decrease in the access provided by universities and colleges and that participants assumed responsibility for this access with their private resources. Qualitative data indicated that some did not have quality equipment nor Internet connection in their homes, highlighting the importance of institutional access for some segments of the academic community.

Participants evaluated institutional support for the use of technologies as average (between fair and good) in the quantitative phase. The qualitative phase showed that, according to the participants, the institutions failed to offer their faculty and students adequate training for using technologies. These findings show that the quantitative and qualitative data are complementary and not divergent.

5 DISCUSSION

At the beginning of the pandemic, the Brazilian government allowed higher education institutions to suspend classes or to offer online undergraduate and graduate activities, at the discretion of each college or university. Throughout this research, it was observed that the best option for this moment was to continue the activities in the online modality, as this has brought benefits, even if partial, to the academic community and has enabled it to face a pandemic that has extended far beyond the initial expectations. Undergraduate and graduate students whose universities did not opt for the online modality felt alone and abandoned, according to perceptions recorded in this research.

Emergency online education presents, in turn, multiple challenges.

With the pandemic, it became more evident than ever that, in the 21st century, undergraduate and graduate students, as well as faculty members, still do not have in-depth knowledge of online education. Therefore, members of the academic community mentioned, in their perceptions, the need of planning, the necessity of training the actors involved, and the most suitable pedagogical and technological resources for this type of teaching. Even with vaccination, the future is uncertain. The pandemic continues and the institutions can offer training to enable the academic community to face it now and after its end.

This study showed that lecturers and students have difficulty in interacting online. This aspect may derive from the actors' lack of experience in online education and from the inadequacy of emergency technologies with generic virtual learning environments, without the necessary customization for the specificities of the area of health. Online teaching

79

environments should integrate, in a systematic and comprehensive way, telehealth (JUMREORNVONG *et al*., 2020), including teleconsultations, phone and application consultations, virtual simulators (LEE *et al*., 2020; ROONEY *et al*., 2018), virtual and augmented reality (KHAN *et al*., 2018), serious games (MAHEU-CADOTTE et al., 2020) and other technological learning resources.

Low-quality Internet access and lack of equipment affected the provision of online education. Most higher education institutions offer environments with computers, printers and Internet connection, widely used mainly by low-income students. The closure of colleges and universities during the pandemic has curtailed these resources. Furthermore, Brazil has network infrastructure problems. In addition to remote regions without Internet coverage, a massive increase in residential work and, consequently, Internet access in all areas, has resulted in network instabilities for all, regardless of the economic situation.

In the last decade, a movement for affirmative action grew strong in Brazil and demanded that the disadvantaged population, as well as the black, multiracial and indigenous population, should study in colleges and universities. To this end, in addition to pre-defined quotas in admission exams, universities offer these students free food, student housing, daycare assistance or financial support. During the pandemic, many students had to return to their home cities; thus, they may not have adequate spaces to study nor technological infrastructure to perform online activities, not to mention that they had to assume domestic tasks. The closure of daycare centers and schools significantly changed everybody's routine, and students and lecturers had to dedicate themselves equally to academic and family activities. Therefore, online education in homes demanded many efforts and adaptations from students, lecturers, and from those who share their homes.

The study conducted by Van Deursen (2020), highlights that relatively advantaged individuals are more likely to use the information and communication opportunities provided by the Internet to their benefit, while less advantaged individuals are less likely to benefit. Moreover, results from this study showed that undergraduate students were the ones who provided the highest number of reports on impairment caused by the use of ICT during the pandemic, perhaps because they did not have cognitive, psychological and technological tools to use in this unexpected context. Students mentioned problems in adapting to online classes, such as learning difficulties, lack of concentration, difficulty in managing time, lack of interaction in the virtual environment, exhaustion and loneliness, which can reflect both a digital literacy dimension and a psychological dimension of being in social isolation due to

80

the pandemic, as it has been observed in other countries (WANG *et al.*, 2020; SON *et al.*, 2020).

The convergent mixed methods approach (QUAN+QUAL) proved to be productive, elucidating the overall scenario and the participants' perceptions. No divergence was observed (PLUYE *et al.*, 2018) between the quantitative and qualitative data.

Data collection occurred during the first months of the pandemic in Brazil. In this period, higher education institutions were undergoing an organization process to be able to offer their health courses online and it is likely that they will make better use of ICT next year. In addition, it is possible that more institutions and families will seek to support students in relation to computers and Internet access. Regarding the participants, all of them were recruited with the aid of technology (social media and e-mail messages). Therefore, the research did not reach potential participants who have no access to technology.

Reproducing this study after the pandemic will enable to verify what transformations have occurred, as well as the legacy of the pandemic for the advancement of ICT use in teaching and learning. Higher education institutions need to implement actions to integrate ICT into their academic activities effectively, including the training of lecturers and students, and the provision of technological infrastructure and connectivity.

81

6 CONCLUSIONS

The information age has transformed the role of lecturers, who have increasingly become knowledge mediators and content curators in virtual learning environments. The pandemic has enhanced this transformation and has required that students should change their behavior in relation to the use of ICT. After an initial adaptation period, during and after the pandemic, higher education institutions need to improve their technological transition so that all actors can enjoy its benefits – students' independence and learning flexibility are only some of them.

Despite the limitations that may arise, these institutions must create strategies to foster and implement didactic and inclusive online education. The following recommendations stem from this research's results:

1. Emergency training for the academic community in existing online teaching environments and technologies to face the pandemic;

2. Maintenance of online education in the health field during the pandemic;

3. Inclusion of telehealth tools, virtual simulators, virtual and augmented reality in online teaching environments, so that they become more interactive and suitable for health courses;

4. Efforts from governments, companies and the society to ensure network coverage, connectivity and access to equipment for the greatest number of people, especially for the low-income population and for the black, multiracial, and indigenous population;

5. Preparation of guidelines to address the reconciliation between academic activities and domestic activities during the pandemic. Such guidelines can be disseminated through courses, manuals and pamphlets;

6. Review of the load of academic activities by the university community during the pandemic, considering that services such as restaurants, daycare centers and schools are affected.

Acknowledgements

82

REFERENCES

BATES, A. W. **Teaching in a digital age**: Guidelines for designing teaching and learning. 2 ed. Vancouver: Tony Bates Associates, 2019. Disponível em: pressbooks.bccampus.ca/teachinginadigitalagev2. Acesso em: 19 nov. 2020.

BRYSON, J. R.; ANDRES, L. COVID-19 and rapid adoption and improvisation of online teaching: curating resources for extensive versus intensive online learning experiences. **Journal of Geography in Higher Education**, Oxon, v. 44, n. 4, p. 608-623, 2020. DOI: 10.1080/03098265.2020.1807478. Disponível em: https://www.tandfonline.com/doi/full/10.1080/03098265.2020.1807478. Acesso em: 19 nov. 2020.

CHICK, R. C. *et al*. Using technology to maintain the education of residents during the COVID-19 pandemic. **Journal of Surgical Education**, New York, v. 77, n. 4, p. 729-732, 2020. DOI: 10.1016/j.jsurg.2020.03.018.

CRESWELL, J. W.; PLANO CLARK, V. L. **Designing and conducting mixed methods research**. 3. ed. Thousand Oaks: Sage, 2017.

FITZGERALD, D. A.; NUNN, K.; ISAACS, D. Consequences of physical distancing emanating from the COVID-19 pandemic: an Australian perspective. **Paediatric Respiratory Reviews**, Oxon, v. 35, p. 25-30, 2020. DOI: 10.1016/j.prrv.2020.06.005. Disponível em: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7289084/. Acesso em: 19 nov. 2020.

GONZALES, A. L.; CALARCO, J. M.; LYNCH, T. Technology problems and student achievement gaps: a validation and extension of the technology maintenance construct. **Communication Research**, Thousand Oaks, v. 47, n. 5, p. 750-770, 2020. DOI: 10.1177/0093650218796366.

HARRIS, P. A. *et al*. The REDCap consortium: Building an international community of software partners. **Journal of Biomedical Informatics**, San Diego, v. 95, p. 103208, 2019. DOI: 10.1016/j.jbi.2019.103208. Disponível em: https://www.sciencedirect.com/science/article/pii/S1532046419301261?via%3Dihub. Acesso em: 19 nov. 2020.

JUMREORNVONG, O. *et al*. Telemedicine and medical education in the age of COVID-19. **Academic Medicine**; Philadelphia, v. 95, n. 12, p. 1838-1843, 2020. DOI: 10.1097/ACM.0000000000003711. Disponível em: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7489227/. Acesso em: 19 nov. 2020.

KHAN, R. *et al*. Virtual reality simulation training for health professions trainees in gastrointestinal endoscopy. **Cochrane Database of Systematic Reviews**, Hoboken, v. 8, n. 8, CD008237, 2018. DOI: 10.1002/14651858.CD008237.pub3. Disponível em: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6513657/?report=classic. Acesso em: 20 maio 2020.

LEE, J. *et al*. Effective virtual patient simulators for medical communication training: a systematic review. **Medical Education**, Hoboken, v. 54, n. 9, p. 786-795, 2020. DOI:

83

10.1111/medu.14152. Disponível em: https://onlinelibrary.wiley.com/doi/full/10.1111/medu.14152. Acesso em: Acesso em: 20 maio 2020.

MAHEU-CADOTTE, M. A. *et al*. Efficacy of Serious Games in Healthcare Professions Education: a systematic review and meta-analysis. **Simulation in Healthcare**, Philadelphia, v. Publish ahead of print, 27 out. 2020. DOI: 10.1097/SIH.0000000000000512.

PLUYE, P. *et al*. A World of Possibilities in Mixed Methods: Review of the combinations of strategies used to integrate qualitative and quantitative phases, results and data. **International Journal of Multiple Research Approaches**, Bloomington, v. 10, n. 1, p. 41-56, 2018. DOI: 10.29034/ijmra.v10n1a3.

RAMOS-MORCILLO, A. J. *et al*. Experiences of nursing students during the abrupt change from face-to-face to e-learning education during the first month of confinement due to COVID-19 in Spain. **International Journal of Environmental Research and Public Health**, Basel, v. 17, n. 15, p. 1-15, 2020. DOI: 10.3390/ijerph17155519. Disponível em: https://www.mdpi.com/1660-4601/17/15/5519. Acesso em: 20 maio 2020.

ROONEY, M. K. *et al*. Simulation as more than a treatment-planning tool: a systematic review of the literature on radiation oncology simulation-based medical education. **International Journal of Radiation Oncology Biology Physics**, New York, v. 102, n. 2, p. 257-283, 2018. DOI: 10.1016/j.ijrobp.2018.05.064.

SON, C. *et al*. Effects of COVID-19 on college students' mental health in the United States: Interview survey study. **Journal of Medical Internet Research**, Toronto; v. 22, n. 9, p. e21279, 2020. DOI: 10.2196/21279. Disponível em: https://www.mdpi.com/1660-4601/17/15/5519. Acesso em: 20 nov. 2020.

VAN DEURSEN, A. J. Digital inequality during a pandemic: Quantitative study of differences in COVID-19-related Internet uses and outcomes among the general population. **Journal of Medical Internet Research**, Toronto, v. 22, n. 8, p. e20073, 2020. DOI: 10.2196/20073. Disponível em: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7446757/. Acesso em: 20 nov. 2020.

WANG, X. *et al.* Investigating mental health of US college students during the COVID-19 pandemic: Cross-sectional survey study. **Journal of Medical Internet Research**, Toronto; v. 22, n. 9, p. e22817, 2020. DOI: 10.2196/22817.

XU, D.; JAGGARS, S. S. Performance gaps between online and face-to-face courses: Differences across types of students and academic subject areas. **Journal of Higher Education**, Oxon, v. 85, n. 5, p. 633-659, 2014. DOI: 10.1353/jhe.2014.0028. Disponível em: https://www.jmir.org/2020/9/e22817/. Acesso em: 20 nov. 2020.

84