Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

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Remote Pathology teaching under the COVID-19 pandemic: Medical students' perceptions

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ABSTRACT

Context: The COVID-19 pandemic has forced traditional teaching to be re-structured and delivered online.
Objective: To analyse medical students' perceptions about the benefits and difficulties of the remote teaching of Pathology during the COVID-19 pandemic.
Design: A cross-sectional study was performed with an online survey applied to students from the third and fourth year of medical graduation, who attended the remote teaching of Pathology during the COVID-19 pandemic. Online teaching methods consisted of synchronous activities with live interactive lectures, case-based discussions and asynchronous activities with recorded lectures, tutorials and texts available on the online teaching platform. Students' perceptions about the remote teaching of Pathology were assessed through online survey.
Results: Ninety students (47.4%) of 190 participants completed the questionnaire, 45 were male and 52 in the third year of medical graduation. Perceived conditions that facilitated Pathology learning included the use of the online teaching platform and time flexibility for study. Students regarded live interactive lectures as superior to traditional face-to-face lectures. Perceived conditions that hindered the implementation of the online teaching included difficulty separating study from home activities, lack of motivation and worsening of quality of life due to physical distancing from colleagues and the faculty. Overall, the remote teaching of Pathology was positively valued by 80% of the students.
Conclusion: Online tools allowed the content of Pathology to be successfully delivered to the students during the COVID-19 pandemic. This experience may be a model for future teaching activities of Pathology in health science education.

1. Introduction

The COVID-19 pandemic has forced traditional medical teaching to be re-structured and delivered online [1–4]. Modifications of pedagogical strategies were taking place in medical schools before the pandemic [5-8]. Reduction of the basic sciences schedule with integration in the clinical phase of medical training, replacement of traditional theoretical classes by interactive lectures with the use of technological resources to stimulate student participation, implementation of active teaching methodologies, small groups teaching and the adoption of new technologies for learning Anatomy and Pathology, are examples of pedagogical innovations that were underway in medical education before the pandemic [5-8].

These changes in medical teaching strategies that were taking decades to be implemented in the curriculum were suddenly pushed to the computer screens, without considering the preparation of teachers to enable teaching activities in this new path and the receptivity of students on the other side of the virtual communication environment [1-3].

Feedback from students regarding the learning experiences with virtual resources is essential to assess the effectiveness of online teaching strategies of cognitive contents, such as Pathology, that is usually offered in the pre-clinical training stage of the undergraduate course of Medicine and other courses of the health area.

This study aimed to evaluate medical students' perceptions about the benefits and difficulties of the remote teaching of Pathology performed in 2020 during the COVID-19 pandemic.

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2. Methods

This cross-sectional study was conducted with an online survey applied to 190 medical students from the third and fourth years of the undergraduate course, who attended the online teaching of Pathology in 2020 during the COVID-19 pandemic. These students are from Botucatu Medical School, University of São Paulo State (Unesp) Brazil, where the traditional curriculum in Medicine, consisting of 4 years of basic sciences and clinical disciplines and 2 years of internship has been adopted.

The Pathology content of the traditional medical curriculum included the study of the causes and mechanisms involved in the development of diseases of organs and systems, such as cardiovascular, pulmonary, renal, hematopoietic, gastrointestinal and gynecological, as well as correlations with the clinical manifestations of the diseases. This cognitive content was organized in modules with weekly, theoretical and practical, face-to-face classes and assessments at the end of each module. A similar content was organized and delivered through the virtual mean, as synchronous activities using the Google platform, and asynchronous activities delivered by Moodle, the institutional teaching platform.

2.1. Remote Pathology activities

The remote teaching of Pathology consisted of weekly synchronous activities lasting about 2 h, with live interactive lectures, by Google meet, case based discussions with images and questions, formative assessments, games and on duty of doubts sessions.

The asynchronous activities included recorded lectures, question tutorials, selected book chapters and scientific articles, which were available on demand at, Moodle, the institutional teaching platform, with unlimited access time. Books advised for reading included Robbins and Cotran Pathologic Basis of Disease, 9th edition (Elsevier 2015) and Bogliolo Pathology, 9th edition (Gen 2014).

Evaluation was performed at the end of each module, as pass or fail, based on student tasks uploaded to Turnitin online platform and on student participation on the synchronous activities.

2.2. The online survey

Students' perception about the remote teaching of Pathology was assessed by a questionnaire specifically designed to evaluate conditions that facilitated or hindered Pathology learning under virtual circumstances.

The questionnaire consisted of two parts: one, to obtain individual sociodemographic information and another, referring to 30 different aspects of the remote teaching and learning process with answers on a five-point Likert-type scale (5: totally agree; 4: agree; 3: neither agree nor disagree; 2: disagree; 1: strongly disagree). The questionnaire was prepared by the study authors, after a literature search about online teaching in medical education and/or COVID-19 [2-4,6-10]. Questions were drafted and discussed, and the consensus on the scope of the statements was approved and included in an Institutional Google forms template.

The students were invited to participate in the online survey at the end of the Pathology course. The questionnaire was sent electronically, together with an informed consent term. The results were obtained through anonymous responses to the form, transferred to Excel spreadsheets and stored in a cloud system (Google Drive).

2.3. Statistical analysis

Descriptive statistics were used to determine the distribution of students' responses for the various questions (frequencies). Fisher test was used to compare each statement by ●gender and year of graduation. The analysis of the distribution of responses per statement was evaluated as follows: the responses of totally agree and agree were categorized as "Agree", the responses of totally disagree and disagree were categorized as "Disagree" and not agree neither disagree were maintained. We established the level of statistical significance as 0.05. All statistical analyses were performed using SPSS Statistics for Windows, Version 22.0 (released 2013, IBM Corp, Armonk, NY).

3. Results

The remote teaching of Pathology was delivered to 190 students in 2020, 93 from the third year and 97 from the fourth year of Medicine. Of these, 90 students (47.4%) answered the questionnaire, 52 (57.8%) from the third year and 38 (42.2%) from the fourth year of Medicine. Half of the students were male, with a mean age of 23.6 ± 2.9 years (Table 1). 93.5% students reported financial support from their family for taking the Medicine course and 74.2% reported monthly family income above 5 salaries (1 salary is approximately US$ 260.00 in 2020).

Most students (93.3%) had no difficulty in accessing the internet and 73.3% had no previous experience with remote learning, but managed to adapt to remote learning with ease (75.5%). Access to digital resources was through their own computer (54.8%) or cell phone and computer for 45.2% students.

Distribution of answers by each statement about the remote teaching of Pathology is presented in Table 2 (Supplementary). Most students (80%) reported being satisfied with the remote teaching of Pathology. Perceived benefits included the use of the virtual teaching platform, pointed out by 83.3% students, which allowed unlimited access to recorded lectures for 91% of them.

Students regarded the live interactive lectures as superior to traditional lectures. Indeed, 55.6% of them suggested that face-to-face classes could be replaced by video classes. Students also enjoyed virtual games, like Kahoot, played during synchronous activities, and for 52.2% of them, games stimulated Pathology learning.

Another perceived advantage of the remote teaching of Pathology was time flexibility for study, reported by 92.3% students of the 3rd year and 73.3% of the 4th year ($p < 0.05$) (Table 3). Most students from both years (68.8%) reported no difficulty communicating with teachers in online activities. Female students (48,9%) felt significantly easier to ask questions in online meetings, using chat or microphone, than in face-to-face classes, compared to 33% male students (p < 0,03) (Table 3).

Most students (71%) reported that they had no difficulty in taking responsibility for their learning of Pathology in online education, but 53.3% of them did not feel motivated with remote teaching of Pathology.

Perceived conditions that hindered learning of Pathology under remote circumstances included difficulty in separating remote study and learning activities from home activities, which was significantly higher for female students (60%) than for males (40%) ($p < 0.05$) (Table 4).

Half of the students did not consider their Pathology learning to have been better in remote conditions and 42.2% reported that the change from face-to-face to remote teaching worsened Pathology learning.

Another perceived difficulty reported by students was a worsening of the quality of life due to physical distance from colleagues and the college environment (68.9%) during social isolation. Physical distance from the teachers compromised learning of Pathology for 30% of the

Table 1
Study sample characteristics.

Total	
90	
Age (mean ± SD)	
23.6 ± 2.9	
Gender	
Male	45 (50%)
Year of graduation	
3rd	52 (57.8)
4th	38 (42.2)

Table 3
Student's positive perceptions about the remote teaching of Pathology according to year of medical course and gender.

	Year of medical course		Gender	
	3rd *n* = 52	4th *n* = 38	Female *n* = 45	Male n = 45
S1 I am satisfied with my remote learning of Pathology	44 (84.6)	28 (73.7)	38 (84.4)	34 (75.6)
S6 Time flexibility for my study is greater in remote teaching than in face-to-face*	48 (92.3)	28 (73.7)	37 (82.2)	39 (86.7)
S10 Activities in online teaching platform make my learning easier	45 (86.5)	30 (78.9)	37 (82.2)	38 (84.4)
S11 Video classes enhance my access to Pathology content	50 (96.2)	32 (84.2)	42 (93.3)	40 (88.9)
S12 Face-to-face theoretical classes can be replaced by video classes	28 (53.8)	22 (57.9)	27 (60.0)	23 (51.1)
S15 It's easier to ask questions in online meetings, than in face-to-face classes**	25 (48.1)	12 (31.6)	22 (48.9)	15 (33.3)
S14 Game activities stimulate my learning in Pathology	25 (48.1)	22 (57.9)	21 (46.7)	26 (57.8)
S20 I have difficulty communicating with teachers in online meetings	12 (23.1)	6 (15.8)	12 (26.7)	6 (13.3)
S21 It's difficult for me take responsibility for my remote learning	11 (21.2)	7 (18.4)	11 (24.4)	7 (15.6)

Number of "agree" or "totally agree" responses (%).
* $p < 0,04$ for year of medical course.
** $p < 0,03$ for gender.

Table 4
Student's negative perceptions about the remote teaching of Pathology according to year of medical course and gender.

	Year of medical course		Gender	
	3rd n = 52	4th n = 38	Female n = 45	Male n = 45
S25 Physical distance from faculty compromised my quality of life during social isolation	38 (73.1)	24 (63.2)	34 (75.6)	28 (62.2)
S24 Physical distance from peers compromised my quality of life during social isolation	35 (67.3)	27 (71.1)	34 (75.6)	28 (62.2)
S22 I have difficulty separating remote learning study activities from home activities*	24 (46.2)	21 (55.3)	27 (60.0)	18 (40.0)
S8 My interaction with teachers in remote teaching is greater than in face-to-face	9 (17.3)	3 (7.9)	6 (13.3)	6 (13.3)
S4 My learning was hampered by the shift from face-to-face to remote learning	22 (42.3)	16 (42.1)	17 (37.8)	21 (46.7)
S2 I am motivated by the shift from face-to-face to remote learning	19 (36.5)	14 (36.8)	15(33.3)	18 (40.0)
S3 My learning in remote teaching is better than in face-to-face teaching	15 (28.8)	7 (18.4)	8 (17.8)	14 (31.1)
S9 I like to carry out activities in remote teaching more than in face-to-face	15 (28.8)	14 (36.8)	16 (35.6)	13 (28.9)
S23 Physical distance from teachers compromised my learning in remote teaching	16 (30.8)	11 (28.9)	14 (31.1)	13 (28.9)

Number of "agree" or "totally agree" responses (%).
S = statement.
* $p < 0,04$ for gender.

students.

In summary, the main benefits and difficulties about the remote teaching of Pathology reported by medical students are presented in Table 5.

4. Discussion

The present study aimed to evaluate medical students' perceptions about the benefits and difficulties of the remote teaching of Pathology during the social isolation of Covid-19. We carefully recorded and analysed this historic moment of emergency change in medical teaching aiming to improve future pedagogical strategies in Pathology. The online activities were organized in a short period, after the suspension of face-to-face teaching activities in March 2020, in an attempt to preserve the medical curriculum timeline. Remote teaching activities in Pathology included synchronous activities on Google platform and asynchronous activities on the institutional online teaching platform.

Our results showed that the students had no difficulty in accessing the internet and although most had no previous experience with remote teaching, the majority was able to easily adapt to the activities of remote Pathology teaching. These data document the viability of virtual media in our academic community not only to meet the emergency-pedagogical needs imposed by social isolation but also for future projects of online medical education.

The main positive aspects of the remote teaching of Pathology highlighted by the students included the use of the institutional virtual teaching platform and time flexibility for study. They regarded that the unlimited access to recorded lectures through the online teaching platform facilitated Pathology learning, as well as the other didactic contents, such as question tutorials, texts and scientific articles related to the subjects under study. Students regarded the live interactive lectures as superior to traditional lectures and suggested the possibility of in-person theoretical classes to be replaced by live interactive lectures. Alternatives to traditional lecture-based courses in medical schools have been widely considered [6-8]. Our results add more evidence on the applicability of online teaching methods in medical education, especially in the pre-clinical years, for the teaching of cognitive disciplines like Pathology.

The majority of students did not have difficulty in communicating with teachers in synchronous activities, but for most of them interaction with teachers was not greater in online activities than in face-to-face meetings. These findings may be related to the lack of preparation of teachers for virtual communication, due to the emergency nature of the change from face-to-face to remote teaching [2,3]. These results highlight the need for establishing pedagogical skills for online teaching.

A key aspect to be achieved in online education is to encourage student engagement in synchronous and asynchronous activities [3,8]. In virtual meetings with large groups, students tend to remain with closed cameras, little responsive to interactions [9]. Teachers should invest in online interaction strategies with students, through questions during lectures, exercises with student participation, small group assignments, virtual games and formative assessments [6,9,11]. In our study, students reported that they enjoyed virtual games, and for 52.2% of them, games stimulated Pathology learning.

Another relevant information is that most students did not have difficulty in taking responsibility for their learning of Pathology in remote conditions. This finding points out the high level of discipline of

Table 5
Students perceived benefits and difficulties about remote teaching of Pathology.

Difficulties	Benefits
Lack of motivation	Satisfaction
Separation study from home activities	Time flexibility for study
Quality of life	Unlimited access to didactic contents
Physical distance from colleagues	Easy learning

medical students with the learning of topics under study, and this autonomous learning profile need to be stimulated with online education strategies. [3,12]

The main perceived conditions that hindered the implementation of the remote teaching of Pathology included difficulty in separating study from home activities, lack of motivation and the quality of learning. Half of the students did not consider their Pathology learning to have been better in remote learning, and 42% reported that switching from face-to-face to remote learning worsened their Pathology learning. These data reinforce the need to improve pedagogical skills to ensure the effectiveness of virtual teaching. [3,9-11]

As expected, students reported a worsening of quality of life due to physical distance from colleagues and the college environment. This may be explained by the negative repercussions of psychological changes due to social distancing, which compromised the ability to cope with daily activities under the pandemic stress [13]. This also reinforces the importance of social interactions for human wellbeing [14].

Despite the unplanned emergency context of transfer from the on-site setting to remote activities, it was possible to assess the benefits and difficulties of the online teaching of Pathology, as shown in Table 5. The overall rate of student satisfaction with the virtual teaching experience was expressive, as reported by 80% of students. Therefore, these findings highlight that Pathology teaching can be improved with online technological resources.

5. Conclusion

In summary, using the available virtual means of communication, teaching platforms and pedagogical resources, it was possible to adequately transmit the Pathology content proposed in the medical curriculum during the isolation of Covid-19. We believe that this virtual teaching experience was useful and provided an opportunity to assess the applicability of online teaching strategies, even in emergency circumstances. This experience can be a model for future virtual teaching activities of Pathology on health science education.

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CRediT authorship contribution statement

Maria Aparecida Marchesan Rodrigues: Conceptualization, Methodology, Writing – original draft. **Denise Zornoff:** Investigation, Resources, Writing – review & editing. **Renata Kobayasi:** Conceptualization, Data curation, Formal analysis, Writing – review & editing.

Declaration of competing interest

The authors declare no conflict of interest.

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