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Experiences of undergraduates' emergency remote education in Mexico

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Abstract: Emergency Remote Education started with the COVID-19 pandemic bringing significant changes to learners and teachers. Education was experienced by everyone in unprecedented ways that require research and understanding. This paper presents a quantitative and transactional study aimed at characterising student emergency e-learning experiences during COVID-19 lockdown and comparing them among the five undergraduate educational programmes offered by a public Mexican university. The participants were 969 undergraduate students, who were surveyed onlinfe. For data analysis, we calculated descriptive statistics and performed Kruskal–Wallis tests in SPSS25. Results showed that 1) mobile phones were the most used devices to connect to online classes; 2) Information Technology (IT) courses utilise specialised alternative platforms; 3) Connectivity and device problems, along with family reasons and sickness were the most common reasons for absence; 4) Eyestrain due to continuous usage of electronic devices was a common discomfort among participants; 5) Work overload, problems to understand educational materials and lack of motivation were other common problems; 6) Students had an overall good perception of the synchronous e-learning model implementation and 7) E-learning could be improved mostly through actions on the

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José Balderas-Solís holds a bachelor's degree in information technology. Ramón Ventura Roque-Hernández holds a Phd in Telematics and a Phd in Education. Adán López-Mendoza holds a Phd in International Education. Rolando Salazar-Hernández holds a Phd in Multimedia Technologies. The authors have worked together in educational technology research projects. The results reported in this paper relate to a wider project about emergency remote education in the Mexican context and contribute to the group's background work.

PUBLIC INTEREST STATEMENT

Emergency Remote Education started with the COVID-19 pandemic bringing significant challenges to learners and teachers. Education has been experienced by everyone in unprecedented ways that require research and understanding. This paper describes student emergency e-learning experiences during COVID-19 lockdown and compares them among the five undergraduate educational programmes offered by a public Mexican university. The findings of this research indicate that mobile learning has gained ground, while connectivity and technical problems remain an issue for students. Furthermore, personal and family problems continue to affect students' attendance. In this context, ergonomics emerges as an area of focus since the combination of work overload and prolonged use of devices may cause physical or visual discomfort. Another crucial issue is the instructor's choices about the classes since it was found that well-targeted decisions can enhance the students' learning experience.

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part of the instructor. For instance, focus on the most important topics and materials and provide students with more personalised attention.

Subjects: Educational Research; Teaching & Learning; Teaching & Learning; Schools & Schooling; Information Technology

Keywords: higher education; students; pandemic; COVID-19

1. Introduction

The COVID-19 pandemic has impacted education, creating significant changes in the way students and professors work and interact. According to (Haleem et al., 2020) understanding the pandemic's effects on various areas of modern life is necessary for overcoming the challenges posed to everyone. In the educational arena, one of these challenges was providing continuity in education at all levels. Distance education was one solution. However, (Kaiper-Marquez et al., 2020) differentiated between regular distance education and emergency remote education. The former is usually scheduled, planned and organised in advance; the latter implies an alternate teaching mode instituted in response to crisis. (Tuaycharoen, 2021) also categorised online learning into two different categories—pre- and post-pandemic. (Jeffery & Bauer, 2020) asserted that COVID-19 brought new constraints and assumptions to the educational scenario. This posed a relevant world-wide problem as students in diverse countries and contexts have been experiencing education in fuzzy conditions where the effects of technology have not been completely understood. Thus, research on how education is being conducted through emergency remote education due to COVID-19 is a broad and novel topic that should be examined from different perspectives and contexts.

This paper presents the results of research conducted in a public university in México, where five face-to-face academic programmes are offered: Business Administration (BA), Trade (T), Public Accounting (PA), Law (L) and Information Technology (IT). These programmes had to move online due to the COVID-19 restrictions in March 2020. Microsoft Teams (MSTeams) then became the official communication platform for emergency remote education, which was synchronously administered from Monday to Friday at the regularly scheduled times. Every session was recorded and made available to students for later viewing. This emergency remote education model remains at the time of writing in July 2021. However, professors have become more experienced and better trained in the use of online platforms and tools than they were at the beginning of the pandemic.

This study surveys the perceptions of students regarding their COVID-19 emergency e-learning experience. The research questions were: RQ1–What is the students' emergency remote learning experience characterisation? RQ2–What problems did students encounter in emergency e-learning? RQ3–What are the students' perceptions about their emergency e-learning experience and improvement?

Research on emergency e-learning due to the COVID-19 lockdown has become more widespread, providing important insights and benchmarks in the educational field. This research is in the Mexican context and provides a reference to characterise and assess e-learning implementations. The study's objective is twofold: first, to characterise students' experiences; second, to compare said experiences in the five educational programmes. The general hypothesis is that differences would be found among the five studied programmes. However, such variations turned out to be not completely clear. The paper is organised as follows: first, motivation and literature review are presented, and the methodology for this research is explained. Results and discussion follow, and finally, some insights and conclusions are offered.

1.1. Contributing to the understanding of a global problem through the study of a local context

The research is based on specific situations related to emergency remote learning. First, mobile devices were used by students to connect to online classes, but actual rates as well as whether

usage was homogeneous along the five educational programmes were unknown. The expectation was that IT students were less likely to use smartphones because they take specialised courses that required specific software for computer programming or process simulation, which was not available for mobile devices. Therefore, in these cases, laptop or desktop computers would be more suitable. A similar situation applied to assignment submission. The faculty used MSTeams as the official learning tool; however, several professors were simultaneously using the Blackboard learning system as their courses were already organised on that platform. Furthermore, some professors did not feel completely comfortable using MSTeams for delivering and grading exams. It was unclear whether every class stuck to the official tools or used alternative means. Regarding students' attendance, professors were reporting absenteeism for synchronous sessions. However, since it was the middle of a lockdown and students were supposed to be at home, why were they skipping classes? Perhaps they were experiencing problems that had not been anticipated. This led to inquiries about the problems students encountered during their online learning process. Finally, there was the issue of students' negative perceptions of emergency e-learning, given that it was not uncommon to receive comments from the students expressing preference for face-to-face course features. This was understandable because they were originally enrolled in face-to-face educational programmes. Thus, it was important to get information about their real experience learning online. Could anything be done to improve these experiences?

1.2. Literature review

In education, software communication tools became essential to continue with regular learning. As (Jacques et al., 2020) showed, proprietary and open access video conferencing and chat applications are used to conduct online educational activities. For instance, software, such as MSTeams, made synchronous work possible (Sepulveda-Escobar & Morrison, 2020).

Students' attitudes and perceptions related to education during COVID-19 confinement have been researched in different fields, including medicine (Byrnes et al., 2020; Kim et al., 2020), chemistry (Rodríguez Núñez & Leeuwner, 2020), sociology (Gillis & Krull, 2020) and higher education (Demuyakor, 2020).

In India, (Roy et al., 2020) noted that internet connectivity is a constraint for emergency remote education, and students thought their sessions could be improved if topics were shorter and better planned. Compacting class duration to focus on quality instead of quantity was done in Oman's universities (Tawafak et al., 2021). In other research from India, (Mohammed Rafi et al., 2020) agreed that network connectivity and power failure were the main barriers for students. Moreover, it was found that eye problems due to the continuous use of devices were another issue, albeit considered the least important. In addition, they observed that almost 90% of students used mobile gadgets to connect to their emergency remote classes, followed by laptops (19.2%), tablets (4.9%) and desktop computers (3.6%). Furthermore, they reported that students had to utilise several different platforms during the same period as each professor chose the most suitable platform for their class. Students submitted their assignments through the online platforms (69.5%) or via email (30.5%). Given these factors, almost half of students surveyed felt overwhelmed by the number of assignments (48%). (Blizak et al., 2020), in Algeria, also found that weak internet connection was the most common obstacle for students, with smartphones as the most used devices (78.7%), followed by laptops (11.1%), desktop computers (7.6%) and digital tablets (2.6%). Conversely, Blizak et al.'s study (Blizak et al., 2020) found that the amount of homework was not a problem, with only 4.7% of participants considering this an issue. With regard to lack of motivation, (Browning et al., 2021) concluded that it was the most frequent feeling among participants during the pandemic as 21% of them mentioned it in their narratives. Meanwhile, Ouma's findings (Ouma & Wang, 2021) indicate that unreliable internet connection and not-recorded synchronous sessions were relevant factors that limited online learning. Likewise, (Al-Sholi et al., 2021) found that technical issues such as connectivity and compatibility,

as well as understanding of the educational materials were critical categories of concerns among students.

(Pebriantika et al., 2021) found that mobile learning is an approach that boosted student interest in online classes during the COVID-19 pandemic. It is evident that mobile devices have played an important role during emergency e-learning. However, these devices require other components, such as software platforms, well-designed courses and instructors who can give students positive learning experiences.

2. Materials and methods

2.1. Participants
The survey involved 969 students enrolled in five undergraduate programmes at a public university in México during the fall semester, 2020. The sample size was calculated using EPIDAT 4.2 for a 95% confidence level and a 5% precision. Population and sample details are presented in Table 1.

2.2. Inclusion and exclusion criteria
Inclusion criteria were students enrolled in the fall semester of 2020 and taking regular synchronous online classes in one of the five undergraduate programmes of the university. Inclusion was enforced by using the institutional version of Microsoft Forms, which limits participants to university-registered members. However, anyone with an official account could take the survey. Additional checks were made on the source of the accounts to ensure that only active students were included.

Exclusion criteria were refusal to provide informed consent or inconsistent or incomplete data. Mandatory questions were configured in the questionnaire to achieve complete answer sets for each participant.

2.3. Procedure
A questionnaire was designed and implemented using Microsoft Forms. Once the total sample size was calculated indicating 969 students, the electronic link of the questionnaire was generated and shared with 1,300 students enrolled during the fall semester of 2020 in the five academic programmes. The students were invited to voluntarily participate in this study. Data collection was done electronically during the last two months of 2020. The first 969 valid responses were downloaded to a Microsoft EXCEL workbook. The response rate was 75.38%. Responses were numerically coded and imported to SPSSv25 (Statistical Package for the Social Sciences).

Table 1. Participants in this research					
Academic programme	**Population (Enrolled students)**	**Sample (Number of participants)**	**Age range (years)**	**Age Mode**	**Number of employed students**
Business Administration (BA)	729	231	17–31	21	92
Trade (T)	851	263	17–38	22	115
Public Accounting (PA)	527	222	17–46	20	133
Information Technology (IT)	356	138	18–31	19	50
Law (L)	222	115	17–65	21	55
Total	2685	969			445

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2.4. Data collection instrument

The questionnaire (Table 2) has 18 items in three categories: (1) emergency e-learning characterisation; (2) perceptions on emergency e-learning and (3) perceptions on e-learning experience improvement. Nominal answers were collected through category 1. Five-point scales were used for categories 2 and 3. Items and categories were defined based on the literature review and the opinions of three external experts, who held PhDs and were active in teaching and research during the pandemic.

2.5. Data analysis

The data analyses described in Table 3 were done with SPSS 25. Since no normality could be established in responses, Kruskal–Wallis nonparametric tests were carried out. A confidence level of 95% was used in the hypotheses testing.

2.6. Ethical statement

Every participant was required to provide their informed consent before answering the questionnaire. The research protocol was internally approved by the Autonomous University of Tamaulipas.

3. Results

3.1. Emergency E-Learning characterisation

The distribution of gadgets used to connect to online classes is presented in Table 4. No association between programmes and gadgets was found (Xi^2 = 20.66, df = 12, p = 0.06).

Table 2. The questionnaire used in this research	
Category	**Items**
1. Emergency e-learning characterisation.	Devices used to connect to online classes. Assignment submission methods. Reasons for absence. Problems encountered in emergency e-learning.
2. Perceptions on Emergency e-learning. How much did you like the following aspects of the emergency e-learning model?	Class session schedule. Interactivity with the professor. Assessment Methods. Exam delivery methods. Session length. Session's weekly frequency.
3. Perceptions on E-learning experience improvement. How could your e-learning experience be improved?	Attending additional online sessions when questions arise. Administering online session configurations to avoid student's misbehaviour. Professors should highlight the most important parts of the materials. Having less synchronous sessions. Having more independent work. Shortening the length of the contents to focus on the most important topics. Adding more interactivity to the online sessions. Professors should provide more personalised attention to students.

Table 3. Statistical analyses conducted in this study		
Analyses	**Statistical approach**	**Studied groups**
Descriptive analysis	Mean, Standard Deviation, Shapiro–Wilk normality tests, contingency tables.	1. Business Administration 2. International Trade 3. Public Accounting 4. Law 5. Information Technology
Comparison of students' perceptions among studied groups	Kruskal–Wallis Tests	

The assignment submission methods are shown in Table 5 (Xi^2 = 80.28, df = 8, p = 0.00). IT students used Blackboard more than expected (standardised residual = 7.7) and used Teams (standardised residual = −2.0) and Email (standardised residual = −5.3) less than expected. On the other hand, BA students used email more than expected (standardised residual = 2.0).

Regarding reasons for absence from classes, participants reported internet connectivity issues (64.60%), device problems (34.16%), family issues (29.62%), sickness (22.19%), employment issues (19.92%) and power supply problems (10.01%). No statistical association was found between programmes and reasons (Xi^2 = 28.05, df = 20, p = 0.11). On the other hand, regarding the most common problems encountered during emergency e-learning, 67% of the participants reported connectivity problems; 41.17%, eye strain due to the continuous use of electronic devices; 36.11%, work overload; 35.91%, problems understanding lesson content; 31.37%, lack of motivation; 25.07%, lack of resources to work at home; 24.35%, lack of interactivity in online classes. There was no statistical association between programmes and problems (Xi^2 = 15.49, df = 24, p = 0.90).

3.2. Perceptions on emergency e-learning
Students' perceptions on emergency e-learning are presented in Table 6. The results of the Kruskal–Wallis tests showed that the only significant difference was in the session's weekly frequency (H = 12.90, df = 4, p = 0.01, Eta-squared = 0.00). Students from the Law undergraduate programme were the most satisfied (mean = 3.97), whereas the least satisfied were from BA (mean = 3.72) and IT (mean = 3.68).

Table 4. Gadgets used to connect to online classes				
Programme	**Tablet**	**PC**	**Laptop**	**Cellphone**
Business Administration (BA)	1.70%	13.90%	68.40%	81.40%
Trade (T)	8.00%	14.80%	63.90%	84.00%
Public Accounting (PA)	3.60%	20.70%	64.40%	84.70%
Law (L)	7.00%	20.90%	63.50%	80.90%
Information Technology (IT)	2.20%	20.30%	66.70%	78.30%

Table 5. Assignment submission methods			
Programme	**Blackboard**	**Email**	**MSTeams**
Business Administration (BA)	17.80%	30.90%	100.00%
Trade (T)	23.20%	30.80%	98.10%
Public Accounting (PA)	29.40%	25.80%	99.50%
Law (L)	18.60%	29.20%	96.50%
Information Technology (IT)	61.60%	8.70%	100.00%

Table 6. Student's perceptions on emergency e-learning. Data are exhibited in the Mean (Std. Deviation) format. A five-point scale was used (1 = lowest, 5 = highest)

Prog.	Class session schedule	Interactivity with the professor	Assessment Methods	Exam delivery methods	Session length	Session's weekly frequency
BA	3.44 (1.04)	3.58 (.95)	3.47 (.97)	3.62 (.88)	3.38 (1.03)	3.72 (.86)
T	3.61 (.99)	3.50 (.85)	3.49 (.87)	3.57 (.92)	3.54 (.94)	3.83 (.77)
PA	3.54 (1.08)	3.59 (.98)	3.61 (.88)	3.60 (1.01)	3.56 (1.06)	3.78 (.87)
L	3.54 (1.02)	3.63 (.93)	3.51 (.98)	3.57 (.99)	3.56 (.95)	3.97 (.85)
IT	3.61 (.97)	3.57 (.95)	3.48 (.94)	3.57 (.92)	3.63 (.91)	3.68 (.84)

Note: Data are exhibited in the mean (std. deviation) format. A five-point scale was used (1 = lowest, 5 = highest). BA = Business Administration, T = Trade, PA = Public Accounting, L = Law, IT = Information Technology.

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3.3. Perceptions on E-learning experience improvement

The description of students' perceptions of how to improve their learning experiences is presented in Tables 7 and Tables 8. According to the Kruskal–Wallis tests, two significant differences were found. The professors should highlight the most important materials (H = 11.17, df = 4, p = 0.02, Eta-squared = 0.00). Law students agreed most (mean = 4.24), whereas Trade students agreed least (mean = 4.06). Another difference was in relation to having less synchronous sessions (H = 14.08, df = 4, p = 0.00, Eta-squared = 0.01). BA students agreed most (mean = 3.37), whereas Law students (mean = 2.97) agreed least.

4. Discussion

4.1. Revisiting the research questions

RQ1–What is the students' emergency remote learning experience characterisation?

Mostly used electronic devices to connect to online classes were cellphones. Laptop and desktop computers were second, and tablets were the least used. This was true even for IT students, whose technical requirements might have varied.

Table 7. Student's perception on E-learning experience improvement (part 1 of 2). Data are exhibited in the Mean (Std. Deviation) format. A five-point scale was used (1 = lowest, 5 = highest)

Prog.	Attending additional online sessions when questions arise.	Administering online session configurations to avoid student's misbehaviour.	Professors should highlight the most important parts of the materials.	Having less synchronous sessions.
BA	3.65(.87)	3.68(1.04)	4.17 (.73)	3.37(1.02)
T	3.51(1.0)	3.57(1.00)	4.06(.71)	3.20(.97)
PA	3.65(.93)	3.64(.92)	4.13(.75)	3.13(1.07)
L	3.39(1.09)	3.77(.94)	4.24(.76)	2.97(1.02)
IT	3.70(.82)	3.78(.95)	4.21(.72)	3.36(.95)

Note: Data are exhibited in the mean (std. deviation) format. A five-point scale was used (1 = lowest, 5 = highest). BA = Business Administration, T = Trade, PA = Public Accounting, L = Law, IT = Information Technology.

Table 8. Student's perception on E-learning experience improvement (part 2 of 2). Data are presented in the Mean (Std. Deviation) format. A five-point scale was used (1 = lowest, 5 = highest)

Prog.	Having more independent work.	Reduce the length of the contents to focus on the most important topics.	Adding more interactivity to the online sessions.	Professors should provide more personalised attention to students.
BA	2.97(.98)	3.92(.78)	3.89(.77)	3.84(.76)
T	2.90(.96)	3.79(.78)	3.73(.81)	3.81(.85)
PA	3.00(.99)	3.87(.89)	3.72(.95)	3.69(.84)
L	2.87(.95)	3.79(.84)	3.83(.92)	3.76(.85)
IT	3.04(1.01)	3.83(.81)	3.80(.79)	3.90(.81)

Note: Data are presented in the mean (std. deviation) format. A five-point scale was used (1 = lowest, 5 = highest).

MSTeams was mostly used for assignment submission. However, except for IT, email was still used to submit assignments in the other academic programmes. IT courses used the Blackboard learning system more than other academic programmes and used email less.

Connectivity issues were by far the most common reason for absence, followed by device problems, family issues and sickness.

RQ2–What problems did students encounter in emergency e-learning?

Internet connectivity remains as the most important problem for students. Surprisingly, eye strain was the second most important problem, followed by work overload, problems in understanding lesson content and lack of motivation.

RQ3–What are the students' perceptions about their emergency e-learning experience and improvement?

Students reported positive views about class schedules, interactivity with the professor, assessment methods, exam delivery methods, session length and frequency. Regarding experience improvement, first, professors should highlight the most important parts of the material. Second, professors should abbreviate the length of the contents to focus on the most important aspects. Also, professors should provide students with more personalised attention and interactivity.

4.2. Interpretation and implication of results

Cellphones were by far the most used devices for online courses. This implies that students might have been taking their classes outside their homes. Thus, students could be paying additional rates for mobile data services, especially due to the high internet data consumption of the video function in MSTeams required for synchronous sessions. This can be an issue in México, where most common mobile plans have limited internet access.

Although MSTeams, the institutional tool, was used by almost all participants, email was also used by almost one-third of the participants, except for IT. On the other hand, the Blackboard learning system was used by more than 60% of the IT participants, whereas no more than 30% of the participants in the other programmes used it. This means that IT students and professors had a different pattern of software and platform usage, moving away from classic tools, such as e-mails and favouring more sophisticated platforms, such as Blackboard.

Technical problems, such as internet connectivity and device issues, were two of the main reasons for students' absence, along with sickness, family and employment-related problems. Thus, technical issues emerge as a new category of reasons for absence, apart from family and job issues that would affect face-to-face courses. It was interesting to discover that eye strain was a common discomfort among the participants. This indicates that visual ergonomics should be encouraged and considered when taking classes from home.

The survey found non-neutral levels of acceptance about emergency e-learning. Nevertheless, the top five most voted recommendations for improving the online learning experience centred on the instructor. For instance, professors are expected to highlight the most important parts of the materials, to shorten the contents and focus on the core topics, to provide students with more personalised attention, to add more interactivity to the sessions and to set the session configuration properly. Independent work, tutoring sessions and reducing the number of synchronous sessions received the lowest scores. These results highlight the importance of an active presence

and work by the professors in emergency remote teaching. Their actions and decisions can greatly improve or worsen students' experiences.

According to the analyses performed across the different educational programmes, some statistically significant differences were found in students' perceptions of their emergency e-learning experiences and in how these could be improved. Nevertheless, the effect size, described by the Eta-squared statistic, was exceptionally low. This is confirmed by the small difference in the analysed scores. Thus, no practical implications could be drawn from this context.

4.3. Comparison of the results and the analysed literature

The results of this study matched those of (Blizak et al., 2020; Mohammed Rafi et al., 2020; Roy et al., 2020), with internet connectivity being the main problem reported by students. These are compatible with the findings of (Al-Sholi et al., 2021; Ouma & Wang, 2021) in the same context.

Furthermore, as (Roy et al., 2020) found, participants in this study valued more concise content in their courses. As with (Blizak et al., 2020; Mohammed Rafi et al., 2020), the study's findings indicate that smartphones are the most used devices to connect to online classes. In addition, in line with (Mohammed Rafi et al., 2020), multiple platforms were used in a single period, especially in the IT academic programme. Meanwhile, contrary to (Mohammed Rafi et al., 2020), the results indicate that eye problems were common among students. Moreover, in contrast to (Blizak et al., 2020), but in agreement with (Mohammed Rafi et al., 2020), this study found that work overload was one of the most common problems encountered by students. Our results also agree with those of (Browning et al., 2021) as lack of motivation was identified as a popular feeling among students; almost one-third of them experienced it. Moreover, like (Al-Sholi et al., 2021), we also found that understanding lesson content is a common concern during emergency e-learning.

Finally, our participants' reports of continuous use of Microsoft Teams over several months indicate that this communication platform provides complete and appropriate experiences in synchronous university education models. These results are consistent with the work of (Sepulveda-Escobar & Morrison, 2020).

4.4. Contribution

This research contributes to the understanding of the complex e-learning reality due to the COVID-19 pandemic from the students' perspective. This is important to university management offices, professors, communities and the education sector.

4.5. Limitations

The study included participants from five different educational programmes. However, all students belonged to the same university. The approach only took into consideration the perceptions of students who were able to regularly connect to their online classes during the fall semester of 2020. At that time, it was their second semester taking emergency online classes and they were required to share their experiences in that period.

4.6. Challenges

The research was conducted during the COVID-19 lockdown, when participants and researchers were facing adverse situations in the personal, family, school, health and, in some cases, economic areas. Moreover, many participants reported having a lot of schoolwork. Thus, they were probably in the midst of a sensitive and stressful situation, and despite that, they took the time to participate in this study; some of them after several reminders.

5. Conclusions

Teaching and learning were impacted by the COVID-19 pandemic. Remote education was rede-fined to provide a fallback for the continuity of academic activities. In this process, gadgets,

internet access and online communication platforms were crucial. The scenario revealed by this research in a public university in México indicates that mobile learning has gained ground, while connectivity remains an issue for students. Furthermore, despite the ubiquity of electronic media, personal and family problems continue to affect students' attendance. In this context, ergonomics emerges as an area of focus in emergency remote education since the combination of work overload and prolonged use of devices may cause physical or visual discomfort. Another crucial issue is the instructor's choices about the classes since well-targeted decisions can enhance the students' learning experience.

Within the practical recommendations, teachers should be empathetic to students, as not everyone has access to a stable and good quality internet connection. In addition, students may be in the midst of a considerable workload and thus may be facing physical discomfort. This is not to mention the family and contextual issues that may affect their performance. We strongly believe that more research is needed to understand in greater depth the various educational and social phenomena that occurred or were exacerbated during the pandemic. For example, digital divides, technological appropriation of interactive platforms and other educational solutions, as well as the effects of stress and work overload caused by the remote teaching and learning.

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