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ORIGINAL ARTICLE

Digital transformation in school management: the legacy that strategic actions in the 2020s leave for future pandemics

Transformação digital na gestão escolar: o legado que as ações estratégicas na década de 2020 deixam para futuras pandemias

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Abstract: With the outbreak of social withdrawal due to the pandemic, many countries have undergone drastic transformations in various spheres. In education, face-to-face classes were transformed into distance learning. However, this sudden change caused several problems for students and teachers. Given these events, the purpose of this article was to propose exceptional actions to improve the transition from face-to-face classes to virtual classes. For this, the elements that positively and negatively impacted education in the Covid-19 pandemic were identified in the literature. These elements were then clustered into four strategies, these being: redesign of pedagogical practices, psychological and social support, technological infrastructure in virtual teaching, and school management to cope with the pandemic scenario. The multiple case study method was used, investigating five technical schools located in the state of São Paulo (Brazil). With this, it was possible to propose 10 exceptional actions aimed at the transition from face-to-face classes to virtual classes. The main novelty of this article was the proposition of actions to motivate the school community against the impacts of the pandemic, building memory in its agents, making them more prepared for unexpected events.

Keywords: Distance learning; Pandemic; Social distancing; School management; Strategies.

Resumo: Com o afastamento social devido à pandemia, muitos países sofreram transformações drásticas em várias esferas. Na educação, as aulas presenciais foram transformadas em ensino à

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distância. No entanto, esta súbita mudança causou vários problemas a estudantes e professores. Dados estes acontecimentos, o objetivo deste artigo era propor ações excepcionais para melhorar a transição das aulas presenciais para as aulas virtuais. Para tal, foram identificados na literatura os elementos que tiveram um impacto positivo e negativo na educação na pandemia de Covid-19. Estes elementos foram então agrupados em quatro estratégias, sendo estas: redesenho de práticas pedagógicas, apoio psicológico e social, infraestrutura tecnológica no ensino virtual, e gestão escolar para lidar com o cenário pandêmico. Foi utilizado o método do estudo de casos múltiplos, investigando cinco escolas técnicas localizadas no estado de São Paulo (Brasil). Com isto, foi possível propor 10 ações excepcionais que visavam a transição das aulas presenciais para as aulas virtuais. A principal novidade deste artigo foi a proposição de ações para motivar a comunidade escolar contra os impactos da pandemia, construindo memória nos seus agentes, tornando-os mais preparados para acontecimentos inesperados.

Palavras-chave: Ensino a distância; Pandemia; Distanciamento social; Gestão escolar; Estratégias.

1 Introduction

Since the 1970s, there has been a growth in the delivery of education worldwide in the face-to-face format, a model operated by educational institutions until the pandemic of the new coronavirus (Daniel, 2020). With the proliferation of the virus, almost every nation has undergone drastic transformations in the social, educational, political, labor, and economic spheres (Espino-Díaz et al., 2020). In education, face-to-face classes were suspended and they have given way to the Distance Learning (DL) format (Flores & Gago, 2020; Olmos-Gómez et al., 2020). This immediate adaptation has been only possible because global society enjoys hyperconnectivity, especially in the case of more developed countries (Reis et al., 2020b; Rodrigues et al., 2020). The COVID-19 pandemic has driven the most significant disruption of educational systems in history, which has affected approximately 1.6 billion students in more than 190 countries (United Nations, 2020). COVID-19 is caused by Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2), and the primary mode of transmission is through airborne droplets and direct contact (Souza et al., 2020). The World Health Organization (WHO) has determined that the most effective mechanism for containing the spread of the virus is social distancing (Lin et al., 2020; Lombardi et al., 2020).

The rulers took the abrupt decision to change the face-to-face teaching model to DL in order to mitigate the spread of COVID-19 (Daniel, 2020; Rodrigues et al., 2020). For the new E-learning model to be implemented, teachers and other professionals involved in education management had to make quick decisions about the adequacy of the curriculum and syllabus (Donitsa-Schmidt & Ramot, 2020). Another required action was the rescheduling of school calendars, with the necessary changes to readapt to a new distance teaching model. The proposed changes in the traditional face-to-face teaching model made it possible to preserve the health of students, teachers, and other education (Karataş & Tuncer, 2020). This new social context led the educational institutions to promote a relearning process based on resilience, institutional encouragement, and technological support (Rodrigues et al., 2020). Technological devices, which even before the pandemic diminished the feeling of loneliness in people's daily lives, have been essential to this transformation of teaching by allowing the interaction between people at anytime and anywhere (Dwivedi et al., 2020). Students have been deprived of social interaction, being restricted to stay in their homes. They have had the perception of not having enough guidance from their teachers, needing to study with the interface of technological equipment, which ends up overloading their vision, besides losing their feeling of schooling belonging and affecting their mental health (Karataş & Tuncer, 2020). Faced with the change of routine, students have also become vulnerable to stress, panic syndrome, anxiety, depression, loneliness, and uncertainty about their future (Maican & Cocoradă, 2021).

Teachers have faced many difficulties in teaching practical classes since laboratories for activities such as drawing, chemistry, and electronics are essential for transmitting practical knowledge (Cicha et al., 2021). Educational institutions have made curricular adjustments with no perspectives on the face-to-face return (Donitsa-Schmidt & Ramot, 2020; Rodrigues et al., 2020). Since the notification of the first case of COVID-19 in Brazil in February 2020 (Brasil, 2020), Brazilians have started to face several restrictions, such as agglomeration, the flow of people, and periods of public transportation ban (Chinazzi et al., 2020). The growth rates of the virus in Brazil are one of the fastest in the world, have been over 22.4 million cumulative cases and over 619,654 deaths (Johns Hopkins University & Medicine, 2020).

Since the beginning of the pandemic, many articles have been published relating COVID-19 to the context of education. Mukhtar et al. (2020) explored Pakistani teachers' and students' perceptions of the advantages, limitations, and recommendations for virtual learning during the pandemic period. Putri et al. (2020) identified limitations of the online teaching and learning process at home coordinated by an elementary school in Indonesia. Skulmowski & Rey (2020) analyzed the implementation of digital classes at a University in Germany. Mohmmed et al. (2020) have detected that rapid curriculum transformation due to time constraints occurred without sufficient preparation. Kaden (2020) has described the changes related to school closings in the working lives of high school teachers in rural Alaska (USA) and specified the increase and change in teachers' workloads. Although these case studies contributed to the state of the art in Education and COVID-19, this work adds to these previous analyses the recommendation of guidelines and the identification of drivers and barriers imposed by the COVID-19 pandemic in public technical education in Brazil.

Given the above, the research question that guided the development of this work was “What were the main lessons learned by vocational-technical schools from the urgent migration from face-to-face teaching to DL, influenced by the COVID-19 pandemic”? To answer it, the main objective of the paper is to exceptional actions to improve the transition from face-to-face classes to virtual classes, considering the COVID-19 pandemic and systematizing the main outstanding actions to offer direction to school leaders in future pandemics. Based on the literature and the results of multiple case studies, improvement actions and mitigating actions were proposed to respectively boost good school practices and mitigate critical situations in the educational context. Although this study was delimited to Brazilian technical high schools, the results also contribute to high schools and universities because technical schools bring together both young and experienced students.

2 Theoretical framework

Face-to-face teaching is based on cognitive learning, where the student is stimulated to perceive, integrate, understand, and respond appropriately to the incentives (Kay & Kibble, 2016). According to Gobbi & Rovea (2020), face-to-face teaching is characterized precisely by materializing the space, guaranteeing the durability and continuity of learning. However, in the last decade, with the support of digital tools, DL has been improving and gaining space in educational institutions (Langegård et al., 2021). Until then, online learning was considered only a complement to traditional education (Kurvinen et al., 2020; Zhao et al., 2021). However, the 2020 school year has suffered a shock as it is faced with a worldwide pandemic scenario. Among the bump caused by the COVID-19 is a sudden and total shift to DL (Bansak & Starr, 2021). Besides, schools face four common challenges in distance education: ensuring that rigor is maintained, establishing routines, preserving relationships, and ensuring that resources are available

(Elgart, 2021). The pandemic marks unprecedented challenges and growing demand for distance and online learning strategies to support and replace learning experiences (Osborne et al., 2021; Rad et al., 2021).

The new scenario has demanded adaptations in the observation, planning, and evaluation cycle (Moyo, 2020). The technology integration evidenced by COVID-19 has matured the teaching models (Flores & Gago, 2020). However, the DL context, in terms of knowledge and professional development, has not proved to be capable of entirely replacing actual teaching and learning in practice (Ashokka et al., 2020; Espuny et al., 2021b; Jack et al., 2021). Public and private actors have created programs for reintegration into the classroom, which address health, safety, and learning (Yang et al., 2020). The pandemic scenario has impacted students' assessments. These changes in assessments have made group activities more recurrent, which cannot provide a reliable indicator of teachers to assess the individual performance of the students (Hall et al., 2020). Students in the final grades of the school have faced difficulties in preparing for the exams (Daniel, 2020). The lack of confidence about the flow of information, clear answers about the disease, the volatility of the economy, among other issues, has left many education professionals with negative psychological impacts (Flores & Gago, 2020; Dwivedi et al., 2020). A timid advance toward greater familiarity with digital technologies for education has been noticeable (Buda, 2020; Costa et al., 2021). In addition to technical skills, it is worth noting the teachers' efforts to become familiar with the techniques of communication, innovation, collaboration, flexibility, and planning to deal with new technological models (Hall et al., 2020).

The schools also had to make adaptations to be possible the return to classes. The main ones have been the acquisition of hygiene materials and the purchase of computers and software support (Dwivedi et al., 2020). The São Paulo state government announced the return of approximately one-third of the students on a rotating basis during the 2021 year; that is, each of the three parts of a class would take turns to have face-to-face classes weekly (Buss et al., 2020; Brasil, 2020). The lack of predictability of the return to face-to-face classes negatively impacts students' and teachers' anxiety (Daniel, 2020). At this time, the schools focus on dealing with the emergencies that the pandemic has required in the present, and no strategic planning contemplates future epidemics. However, there is no necessary knowledge on the authorities to draft new laws to deal with chance events, as in the case of the new coronavirus. Therefore, the implementation of durable strategies that are important to meet the long-term interests of citizens is made more difficult (Buss et al., 2020; Brasil, 2020).

The long-term challenges arising from the loss of face-to-face contact hours for students and teachers should rely on continuous evaluation of teaching methods and ensure the quality of the knowledge acquired as a way to measure how these changes over time can impact the lives of these future professionals (Brom et al., 2020; Donitsa-Schmidt & Ramot, 2020). Another challenge for school management is to ensure compliance with the sequence of school calendars to reduce delays without compromising learning (Sintema, 2020). As if that were not enough, it is still essential to deal with the demotivation of DL for both teachers and students because this movement contributes to the increase of school dropouts (Azorín, 2020; Beech & Anseel, 2020).

There is an agreement among students and faculty that the quality of teaching overall has fallen. However, this drop was not because DL was terrible but mainly because the course syllabuses were designed to meet the demands of face-to-face learning. The teachers have realized that in such an unusual moment, they have been required to innovate and use different strategies for their classes (Donitsa-Schmidt & Ramot, 2020). None of the schools have had problems complying with the school calendar, as it allows adjustments and

compensation in asynchronous classes and lectures to compute the total workload. In the first semester of 2020, when the pandemic was decreed, there was more difficulty in meeting the calendar, but in the second semester because the schools were more accustomed to the new format of classes, there was more tranquility. There is a prediction that because of the imposition of the pandemic, there will be long-term harmful effects (Moyo, 2020).

The school dropout has been noticeable in the initial modules, due to the lack of contact and knowledge of the handling of virtual tools, even with the training that was offered to both teachers and students (Azorín, 2020). The pandemic produced a series of upheavals, such as unemployment, eviction, intensified stress due to close contact with family members, and the wear and tear students experienced from sitting for long hours in front of computers (Donitsa-Schmidt & Ramot, 2020). Although schools and teachers have had difficulties aligning themselves to the new study format, they cannot be held solely responsible, because most of the content was transmitted to the students. It was perceived that there was a significant drop in skills and competencies on the part of the students, given the necessary changes. During the pandemic, the need to improve the evaluation methods was perceived to preserve technical rigor (Hall et al., 2020).

These challenges presented in the previous sections highlight the need to remodel the usual pedagogical practices (Khaydarova, 2020). The adoption of new teaching methods is necessary, where the student becomes more autonomous in the search for the absorption of knowledge through interactive models and auxiliary practices, which include the flipped classroom (Chick et al., 2020). Teachers have to reinvent their lesson models in a short period, reinforcing the importance of closer cooperation with other teachers and between different institutions (Azorín, 2020). The pandemic of COVID-19 has made schools even more co-responsible for managing the psychological, sociocultural, and extracurricular factors that directly influence the school life of students and education professionals. School-community-home interaction has become essential to ensure physical and mental safety (Hall et al., 2020). The schools, even without physical contact, try maintaining proximity to the students and emphasize the sense of belonging within the school community (Azorín, 2020).

The pandemic has forced decision-making to become more disruptive, where technological frameworks have been the main tools used (El-Sharkawy et al., 2020; Reis et al., 2020a). This model, called e-learning, made teaching more flexible, video lessons recorded and stored in cloud computing, allowed the student to access the learning content at any time and anywhere (Ivanova, 2020; Murphy, 2020). However, this new demand has also determined governments to mobilize to guarantee minimum conditions of access, equal and quality education (Alvarenga et al., 2021; Appolloni et al., 2021). The context imposed by COVID-19 demands new strategies from school management since it was necessary to develop a coordinated approach (Hargreaves, 2021). To minimize negative impacts, synchronous and asynchronous classes have been held, whose main objective is to maintain the integrity of the formative practices (Iivari et al., 2020; Velle et al., 2020). However, the pandemic did not allow schools to properly prepare for the “new normal”, thus, limiting factors such as lack of time for training, familiarization of teachers with new technological resources (Azorín, 2020; Chick et al., 2020; Dwivedi et al., 2020).

3 Research method

The paper was developed using a qualitative approach from multiple case studies conducted in five Brazilian technical schools, as shown in Figure 1. The multiple case study allows researchers to explore complex phenomena within a specific context, where the researcher has little control (Yin, 2017).

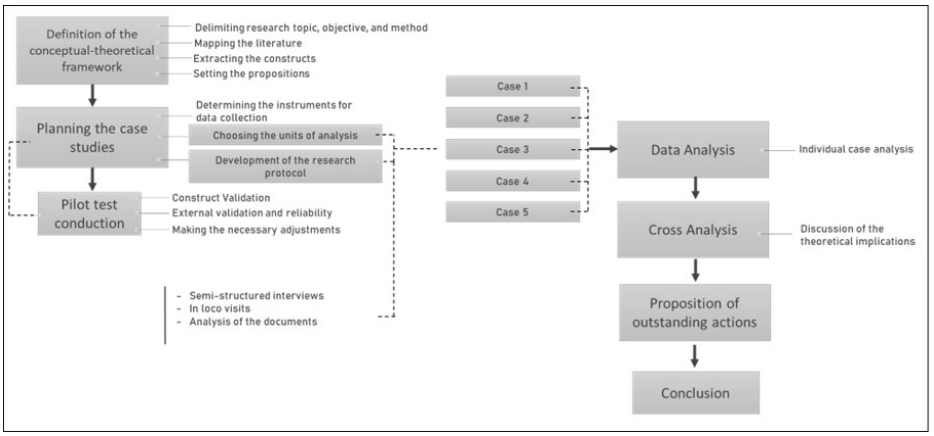

Figure 1. Research method.

The first step of the research was to search for articles containing the terms “COVID-19” and “Education” in the Scopus database. The search was limited to articles published in English. An initial screening of the abstracts' content allowed the rejection of publications that did not approach “COVID-19” and “Education” as the main subject. The content analysis was conducted on the selected articles to identify gaps and extract the main elements of the literature (constructs) to establish the research propositions (Parizotto et al., 2020; Reis et al., 2021). The search platform chosen was Scopus because of its reliability and comprehensiveness of peer-reviewed (Cardoso et al., 2022; Espuny et al., 2021a; Sampaio et al., 2022; Zhu & Liu, 2020).

Then, the 30 most cited articles were selected for descriptive content analysis (Appendix A), identifying the terms that represented the concepts that would be empirically verified. A total of 87 terms were mapped, synthesized and systematized into 20 elements and grouped into four strategies, according to the similarity of their characteristics. The case study searches for deepening and explaining how the phenomenon occurs immersed in a real context. The process is rigorous and involves theoretical review, rich and complete data collection from multiple data sources (Prosek & Gibson, 2021; Satolo et al., 2020; Yin, 2017). For validation of the constructs, a pilot test was conducted based on the protocol and quality of the data obtained, considering external validation. The pilot test aims at replicating the results in multiple cases and reliability of the study (Yin, 2017). The outstanding actions identified were the basis for the data collection protocol of multiple case study (Eisenhardt, 2021).

The data collection of the case studies used semi-structured interviews, in loco visits, and documents to analyze the barriers and drivers identified in the literature in the context of five Brazilian technical schools, located in four important regions of the state of São Paulo, according to Appendix B. The semi-structured interviews were conducted with teachers and managers of technical schools to understand their perceptions of the topics researched. The in loco visits were conducted in schools studied, and their contribution was to allow a deeper perception of events in real-time. The documentary analysis was performed by the authors of this study, who analyzed publications on the schools' websites and social media, and official documents (Yin, 2017).

The case studies were conducted between September and October 2020, after the first peak months had passed and before the official vaccine clearance announcements. After leading the five case studies, their cross-analysis was

elaborated, triangulating the information obtained with the different sources of evidence. After this step, the main highlight actions were proposed to enhance good school practices and mitigate critical situations in the transition from face-to-face to DL education due to the Covid-19 pandemic. Finally, the conclusion was prepared, highlighting the main findings, contributions, and suggestions for future studies.

4 Results and discussion

This Section presents and discusses the main results with the multiple case study based on the literature review presented in Section 2.

4.1 Characterization of the schools

The technical schools of the state of São Paulo (Etec) are managed by the Paula Souza State Center for Technological Education (CEETEPS), an autarchy of the state government of São Paulo. This institution manages 221 technical schools with 207 thousand students in 140 courses, covering the industrial, agricultural, and service sectors in the face-to-face, semi-attendance, online, Youth and Adult Education, and technical specialization modalities. With this structure, CEETEPS is the largest technical education institution in Latin America. The five schools chosen for case studies are located in the State of São Paulo – Brazil, as shown in Table 1.

Table 1. Methodology flow.

School	Number of students	Inhabitants by administrative region
A	1600	2,478,107
B	210	1,562,748
C	1100	1,562,748
D	1300	2,964,211
E	2000	14,729,793

4.2 Characterization of the case studies

The case studies in this paper were conducted based on the elements identified in the literature. The 30 most cited articles were analyzed using the COVID-19 approach in the context of education, and the most relevant elements that were identified were grouped into strategy clusters. Information about the publications analyzed is detailed in Table 2.

Table 2. Identifying the elements and strategies on education in the context of the Covid-19 pandemic.

Strategies	Elements / Authors	Chick et al. (2020)	Iyer et al. (2020)	Moorhouse (2020)	Daniel (2020)	Murphy (2020)	Holme (2020)	Tolsgaard et al. (2020)	Sintema (2020)	Saeed et al. (2020)	Hall et al. (2020)	Ashokka et al. (2020)	Arora and Srinivasan (2020)	Azorin (2020)	Velle et al. (2020)	Flores & Gago (2020)	Ivari et al. (2020)	Usak et al. (2020)	Schulze et al. (2020)	Brom et al. (2020)	Brammer e Clark (2020)	Beech & Anseel (2020)	Lim (2020)	Moyo (2020)	Van Nuland et al. (2020)	Dwivedi et al. (2020)	Jack et al. (2021)	Donitsa-Schmidt e Ramot (2020)	Chao et al. (2021)	Iyengar (2020)	Yang et al. (2020)	Total frequency	Percentual
1- Remodeling of pedagogical practices	1 Flipped classroom	x						x			x	x																				4	13%
	2 Practical Classes	x								x		x													x	x	x					6	20%
	3 Professor Collaboration									x				x																		2	7%
	4 Classroom Media									x																						1	3%
	5 Professor Evaluation					x							x		x	x										x						5	17%
2- Psychological and social support	6 Social-Emotional Skills		x					x											x													3	10%
	7 Home-school interaction										x			x																x		3	10%
	8 Sense of belonging													x									x									2	7%
	9 Students' loss of relatives																		x													1	3%
	10 Mental health support	x						x				x		x					x		x					x						7	23%
3- Technological structure in virtual teaching	11 Difficulty of access													x						x					x					x		3	40%
	12 Technology before the pandemic	x						x			x	x	x	x		x	x			x					x			x		x		12	27%
	13 Student/professor social networking	x	x					x					x	x						x	x					x						8	43%
	14 E-learning		x			x		x	x		x	x	x	x	x	x					x					x				x		13	13%
	15 Government encouragement of technological access																								x							1	3%
4- School management to face the pandemic scenario	16 Voluntary networks and school community													x							x					x				x		4	40%
	17 Synchronous and asynchronous classes	x	x	x	x			x				x				x	x				x					x		x	x			12	50%
	18 Professor training	x	x	x				x			x	x	x	x	x	x	x					x		x	x			x				15	13%
	19 Increasing student participation			x		x	x			x	x	x	x			x	x				x						x				x	12	40%
	20 Feedback from students			x								x					x										x					4	13%

The case studies were conducted between the months of October 2020 and January 2021, following the same sequence as the data collection protocol, according to Appendix B.

Table 3. Identifying the elements in education in the context of the Covid-19 pandemic in the schools studied.

Strategies	Elements	Schools				
		A	B	C	D	E
1- Remodeling of pedagogical practices	1 Flipped classroom		X	X	X	X
	2 Practical Classes	X	X	X		
	3 Professor Collaboration	X	X	X	X	X
	4 Classroom Media	X	X	X	X	X
	5 Professor Evaluation				X	
2- Psychological and social support	6 Social-Emotional Skills	X				
	7 Home-school interaction	X			X	X
	8 Sense of belonging			X		
	9 Students' loss of relatives	X	X			
	10 Mental health support	X	X		X	X

Table 3. Continued…

Strategies	Elements	Schools				
		A	B	C	D	E
3- Technological structure in virtual teaching	11 Difficulty of access	X	X	X	X	
	12 Technology before the pandemic	X	X	X	X	X
	13 Student/professor social networking	X	X	X	X	X
	14 E-learning			X		
	15 Government encouragement of technological access	X	X		X	
4- School management to face the pandemic scenario	16 Voluntary networks and school community	X	X	X	X	X
	17 Synchronous and asynchronous classes	X		X	X	X
	18 Professor training	X	X	X		X
	19 Increasing student participation	X		X	X	
	20 Feedback from students	X		X		X

The elements that stood out the most were “E-learning,” “Synchronous and asynchronous classes,” and “Future unpredictability.” Each subsection represents one of the systematized strategies, as shown in Table 3. Among the strategies, only the second (Psychological and social support) is indirectly related to school activities that are not linked to pedagogical activities or school management. Following this, the description of each group is presented. The respective discussion is given based on the five case studies and the contextualization with the relevant literature on the topics covered.

4.2.1 Remodeling of pedagogical practices

The flipped classroom model was most used by teachers and showed promising results for projects and theory classes. All schools have adopted this model except School A. However, for a good transition from the face-to-face model to the online model, it is necessary to have experience or support from professionals who master the technological tools of teaching (Ashokka et al., 2020; Chick et al., 2020; Iyer et al., 2020). According to schools A, B, and C, simulation programs and videos of practical situations were used for students to have hands-on experience to replace face-to-face practical classes. Collaboration among teachers was reported in all Etec, with knowledge exchange on social networks, support from those more experienced with the DL model to those who presented difficulties, especially the older ones, to transition from the face-to-face model to the online model occur. The collaboration among teachers sharing experiences, ideas, challenges, and solutions was crucial to confronting COVID-19 (Azorín, 2020). The use of media for lessons, such as videos and PowerPoint presentations, has made them more productive since students no longer spend time-copying content from the blackboard.

4.2.2 Psychological and social support

Most schools have been successful in strengthening the ties between teachers and students through direct contact using “Whatsapp”. According to Iyer et al. (2020), this is necessary to adapt the assessment methods and task presentation to the new reality, helping students and teachers deal with adversities. Besides, the student's lack of interest was a recurrent problem also in the face-to-face model. Only School C declared no significant impact on this item. They strengthened ties with them, seeking to maintain a sense of belonging and minimizing the negative impacts of the pandemic on the students (Azorín, 2020).

The student's and professor's mental health was affected by the pandemic (Schools A, B, D, and E), with many fearing their health and their close relatives. Those who work fear for their jobs, and there are still those who lost relatives or close acquaintances (Schools A and B). This scenario of uncertainties and losses added to the confinement makes the development of psychological illnesses propitious (Schulz et al., 2020).

4.2.3 Technological structure in virtual teaching

The students have faced no difficulty in accessing the lessons and digital materials, except those of School E. For students who have no digital access, physical material was made available for pickup at school. UNESCO admits that few schools take advantage of the technological potential in the teaching environment (Iyengar, 2020). All the Etec offered Microsoft Teams as the main social network for students and teachers, which met the needs of interaction between both. Some teachers also used WhatsApp to send material, YouTube for asynchronous classes, and LinkedIn to share professional materials. Some exciting resources were identified, such as the creation of learning communities involving themes of mutual interest among students and teachers; the availability of recorded classes for students to consult them whenever necessary, and the adaptation of classes to meet the needs of the visually impaired by sending audio messages so that the content could be directed and absorbed by these students. These tools could reduce the impact of pedagogical loss (Ashokka et al., 2020; Lima & Siebra, 2021; Sintema, 2020). The São Paulo government committed to provide chips for students without access to the Internet. However, the concession was promised at the return to school at the end of April 2020, but the provision only occurred between the end of June and July. Students who live in distant areas, such as rural areas, presented great difficulty accessing digital content.

4.2.4 School management to face the pandemic scenario

All schools sought to interact with the community, helping students with socio-economic difficulties. Families with low purchasing power were more exposed to the impacts of the coronavirus from the physical, social, and economic perspectives (Schulz et al., 2020). Regarding the choice between synchronous and asynchronous class models, the teachers had the autonomy to decide, and most teachers opted for the synchronous class model. However, many students attended these classes irregularly and with poor attendance. Moreover, the physical education professor found it difficult to perform their work in the synchronous classes' context. This difficulty is even more significant in Asynchronous classes due to the importance of face-to-face contact. The official criterion adopted to indicate attendance and mitigate the effects of lack of attendance was that teachers were oriented to make available activities. The student could have 30 days to complete them and post them in the virtual environment. The synchronous model was the model most adopted by schools worldwide to maintain affective contact (Flores & Gago, 2020). The synchronous model is directed to the interaction between colleagues and the asynchronous model for students to apply their knowledge to conduct activities (Iyer et al., 2020). The central unit of the Etecs sought to implement a training schedule for teachers to deal with digital tools (except in the perception of School D).

Most parts of the training sessions were held in pedagogical meetings scheduled before the resumption of classes. Although the efforts and preparation of materials by pedagogical supervisors, this was not enough for a significant part of the teachers to feel secure enough to return their classes in the virtual format. The experienced teachers, who were familiar with digital technologies, were sympathetic to the teachers who presented more difficulties, a positive point to be highlighted (Velle et al., 2020).

The sudden change from a face-to-face model to the distance model has made it evident that many teachers do not have the necessary digital competencies to ensure the good academic performance of the students (Azorín, 2020). Schools A, C, and D have tried performing interdisciplinary and even intermodular projects to minimize these impacts, offering lectures with experienced professionals from the fields that the students study. Additionally, the schools instituted a technology week, so that students could present and watch their peer work, as well as attend events with leading professionals. They also held meetings with class representatives to hear complaints and get feedback from classes. Therefore, the development and updating of teaching plans are fundamental to increase student participation.

Concerning students' feedback on teachers' teaching, the coordinators at schools A, C, and E use the monitoring of student attendance in classes and subjects with low participation, seeking diagnoses to understand the hypotheses. There are only informal channels, such as sending messages through WhatsApp, e-mail, or even the Microsoft Teams social network. Students can speak about any issue that may interfere with the smooth running of the classes. In any case, the teachers try individual conversations with the students to understand if they have difficulties (Moorhouse, 2020). Outside the strictly academic sphere, students have complained of having difficulty concentrating. They recognize that a benefit of the DL model is the saving of transportation costs to get to school (Ashokka et al., 2020).

5 Proposition of outstanding actions

In Brazil, about 500,000 students attend technical-vocational schools (Barreiro & Mogarro, 2021). The Etec's offer public education through technical-vocational courses in different training areas, which are structured based on the concept of technological and integrated curriculum, with the main objective of inserting young people and adults in the labor market and in internationally renowned universities. Our article, corroborates Fernandes et al. (2022) who reinforce that the available literature covering the context of technical-vocational schools, including the context of the COVID-19 pandemic, remains scarce, limiting the ability to understand and address opportunities and challenges arising from technical and public education. Given the characteristics of this school model, it is important to understand the impacts of online classes on the training of these future professionals.

This work evidenced that there were many challenges for students, teachers and managers of technical schools, as well as for the public administration, such as the lack of school planning, difficulties in accessing the Internet and electronic devices, lack of digital skills, and the social and public health insecurity experienced during the pandemic. For the limitation of computers per family, schools should provide asynchronous class alternatives so that students can access the content during periods with less competition among their families (Tolsgaard et al., 2020). Olentsova (2020) explored Russian distance learning during the pandemic period in technical schools and university institutions. The study highlights that distance learning technologies

have helped both technical schools and universities migrate to distance learning, and that this disruptive shift in educational models has spurred positive feedbacks. The article reinforces that the results identified in schools that offer technical courses can be expanded and replicated also for universities, especially in medical, engineering, and technology-focused courses, since both seek specialization, mainly technological, as the basis for training. For Olentsova (2020) distance learning has proven necessary to coexist with other forms of education, that is, not that one can replace the other, but that distance learning in partnership with traditional education can be complementary.

In addition, another challenge evident in technical-vocational schools are the commonly known heavy study load, and excess of activities and school subjects in technical schools (Pacheco et al., 2020; Soares & Almeida, 2020). Such practice is a preparation for students to be suitable for the future, where there is the reconciliation of the university with the labor market, often in a double journey. Fajardo et al. (2022) analyzed the main differences between face-to-face and online assessment, the study highlighted that the lack of physical presence and the teacher's monitoring caused the loss of self-efficacy of the tests, besides the loss of interpersonal relationships to perform the teamwork and coherence between assessment and class, however, it was observed the gain of autonomy so that students could perform the assessments individually. The study reinforces that these results can be used to improve future online assessment methods, especially in technology and engineering courses. Besides that, physical tiredness, and emotional exhaustion, caused by routine, became an essential factor that required teachers to make evaluations easier for the students. One recommendation for the future would be to implement assessments that are not necessarily written tests.

The pandemic period brought to students and teachers fear of being contaminated by the virus, anxiety symptoms, difficulty in feeling belonging to the school environment, generating discouragement to continue the courses, especially in students of night courses, who in many cases were also affected by the economic restrictions imposed by the pandemic. Similar to our article, Fernandes et al. (2022) discussed depressive symptoms and associated factors arising from remote learning in students of a technical-vocational school in Goiás, Brazil, and highlighted the difficulty in developing autonomous learning capacity, the need for the development of new skills by students and teachers, and the indispensability of using digital technologies.

In Patete & Marquez, (2022) research, how systems and control engineering schools in Venezuela took advantage of the COVID-19 pandemic to adapt as educational structures and solidify the use of promising technologies as a learning tool. Students can develop hands-on activities to solve complex problems, according to their critical ability, with the support of electronic media. To address the students' emotional health, adaptations were necessary in all school structures. These involve the heads of the academic office, the pedagogical coordinator, the guidance counselor, the teachers and other employees at the strategic, tactical and operational levels of an educational organization. Education employees must always be imbued with a quest to improve communication, innovation, collaboration, flexibility, and planning (Hall et al., 2020).

To illustrate the main impacts of the COVID-19 pandemic on schools, the top 10 outstanding actions, with five actions to improve DL and five actions to mitigate critical situations in the educational context in the transition from face-to-face to virtual classes. The outstanding actions were grouped according to the most appropriate strategies (Figure 2), presented in Table 2. Thus, it was possible to highlight the most relevant findings, indicating possible paths that can be followed for the development of DL.

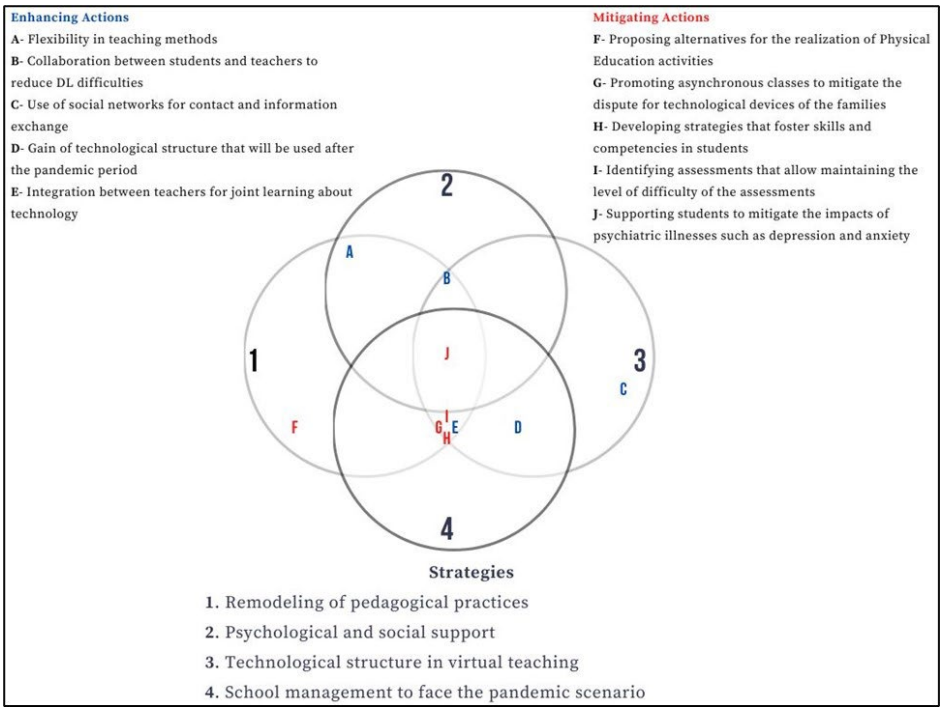

Figure 2. Outstanding actions.

The schools were forced to institute new teaching strategies, contemplating the technological resources at their disposal, the creativity of the teachers, and suggestions from parents and students. If new teaching methods were not adopted, compliance with the school calendar would be jeopardized. With the sudden changes in teaching, a discussion is recommended about which activities should be continued, adapted, eliminated, or even added by the institutions (Tolsgaard et al., 2020). However, it is uncertain whether these integrated structures will be maintained because there is no evidence of the real continuity of this model until now (Murphy, 2020). The difficulties faced by teaching must be overcome with a sense of collectivity on the teaching staff.

The discipline of physical education was one of the most impacted by the pandemic (Iyengar, 2020). One recommendation for schools in this phase is to adopt stretching exercises that can be implemented during long periods of classes to ease postural problems. As for the limitation of computers per family, schools should provide asynchronous class alternatives so that students can access the content during periods with less competition among their families (Tolsgaard et al., 2020). Physical tiredness and emotional exhaustion, caused by routine, became an essential factor that required teachers to make evaluations easier for the students. One recommendation although the fact that this challenge would be to implement assessments that are not necessarily written tests. Students can develop practical activities to solve complex problems, according to their critical ability, with the support of electronic media. To deal with the students' emotional health, adaptations are needed in all school structures. These involve those responsible for the academic secretarial services, the pedagogical coordinator, the guidance counselor, teachers, and other collaborators at the strategic, tactical, and operational levels of an educational organization. Education collaborators must be imbued with a quest to improve communication, innovation, collaboration, flexibility, planning (Hall et al., 2020).

6 Conclusion

The objective of this article was achieved and the main outstanding actions to enhance good school practices and mitigate critical situations in the educational context in the transition from face-to-face to virtual classes were proposed. The theoretical contribution of this research was the articulation of relevant key issues that permeate the educational environment during the coronavirus pandemic. The main contribution applied was the proposition of outstanding actions that can be used by other educational institutions with different educational levels and courses to improve distance learning. The main novelty of this research was the proposition of outstanding actions that can maintain the motivation of students, teachers, and educational collaborators against the impacts of COVID-19, building memory in the agents of education that makes them better prepared for the cases of possible future pandemics.

This research indicates a greater dissatisfaction on behalf of the students than on behalf of the teachers and that the information and communication technologies were indispensable for the continuity of the teaching activities. The main limitation of this study was the low frequency of the elements identified in the articles, mainly because it is a recent field of research and that the central issues are not yet mature and homogeneous. Therefore, more studies on the innovations and government initiatives that were used to minimize the impacts of COVID-19 on educational aspects are needed. It is recommended as future studies, research that is directed to other periods of education, such as early childhood, elementary school, and university. It is also recommended to apply quantitative tools that evaluate the most prevalent elements that impact COVID-19 in the context of education. Finally, studies with a broad sample directed at teachers and students are suggested for a more detailed understanding of the effects caused by the pandemic.

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Authors contribution

Jacqueline de Almeida Barbosa Franco was responsible for designing and writing this study. Maximilian Espuny was responsible for designing and writing this study. José Salvador da Motta Reis was responsible for designing and writing this study. Gabriel Miranda Monteiro Diogo was responsible for designing and writing this study. Luis Alberto Bertolucci Paes was responsible for designing and writing this study. Ana Carolina Ferreira Costa was responsible for translate in English this study. Thaís Vieira Nunhes was responsible for revision text this study. Luís César Ferreira Motta Barbosa was responsible for revision text this study. Andréia Marize Rodrigues was responsible for supervision this study. Rosane Aparecida Gomes Battistelle was responsible for supervision this study. Otávio José de Oliveira was responsible for supervision this study.

Appendix A. Most cited articles in 2020.

Title	Total citations (10/14/2020)
Using Technology to Maintain the Education of Residents During the COVID-19 Pandemic	57
Impact of COVID-19 on dental education in the United States	19
Adaptations to a face-to-face initial teacher education course 'forced' online due to the COVID-19 pandemic	12
Education and the COVID-19 pandemic	7
COVID-19 and emergency eLearning: Consequences of the securitization of higher education for post-pandemic pedagogy	5
Journal of Chemical Education Call for Papers: Special Issue on Insights Gained while Teaching Chemistry in the Time of COVID-19	5
How we make choices and sacrifices in medical education during the COVID-19 pandemic	4
Effect of COVID-19 on the performance of grade 12 students: Implications for STEM education	4
COVID-19: Finding silver linings for dental education	4
Training disrupted: Practical tips for supporting competency-based medical education during the COVID-19 pandemic	3
Coordinated responses of academic medical centres to pandemics: Sustaining medical education during COVID-19	3
Impact of pandemic covid-19 on the teaching – learning process: A study of higher education teachers	2
Initial teacher education in England and the Covid-19 pandemic: challenges and opportunities	2
Teacher education in times of COVID-19 pandemic in Portugal: national, institutional and pedagogical responses	2
Digital transformation of everyday life – How COVID-19 pandemic transformed the basic education of the young generation and why information management research should care?	2
Beyond COVID-19 supernova. Is another education coming?	2
New playmaker in science education: COVID-19	2
Moving Health Education and Behavior Upstream: Lessons From COVID-19 for Addressing Structural Drivers of Health Inequities	1
Mandatory Home Education During the COVID-19 Lockdown in the Czech Republic: A Rapid Survey of 1st-9th Graders' Parents	1
COVID-19 and Management Education: Reflections on Challenges, Opportunities, and Potential Futures	1
COVID-19 and Its Impact on Management Research and Education: Threats, Opportunities and a Manifesto	1
Ethics Education for Successful Infectious Disease Control of COVID-19	1
COVID-19 and the future of practicum in teacher education in Zimbabwe: rethinking the 'new normal' in quality assurance for teacher certification	1
COVID-19 and its effects on teacher education in Ontario: a complex adaptive systems perspective	1
Impact of COVID-19 pandemic on information management research and practice: Transforming education, work and life	1
Live-Streaming Surgery for Medical Student Education - Educational Solutions in Neurosurgery During the COVID-19 Pandemic	1
Opportunities and challenges: teacher education in Israel in the Covid-19 pandemic	1
Creation of an Interactive Virtual Surgical Rotation for Undergraduate Medical Education During the COVID-19 Pandemic	1
Education as the path to a sustainable recovery from COVID-19	1
Preparedness of medical education in China: Lessons from the COVID-19 outbreak	1

Appendix B. Data collection protocol.

Strategies	Topic	Elements	Data Collection Instrument				
			Semi-structured interview			On-site observation	Documentary analysis
			Upper Management	*Management*	*Operational*		
1. General Description of the Schools	1,1	Number of students	x				x
	1,2	Regional supervision					x
	1,3	Inhabitants per administrative region					x
2- Remodeling of pedagogical practices	2,1	Flipped class		x	x	x	
	2,2	Practical classes		x	x		
	2,3	Teacher collaboration	x	x	x		
	2,4	Media for class		x		x	
	2,5	Teacher evaluation	x	x			x
3- Psychological and social support	3,1	Socioemotional skills		x			
	3,2	Home-school interaction	x	x			x
	3,3	Sense of belonging	x	x			
	3,4	Students' loss of relatives	x	x	x		
	3,5	Mental health support	x	x	x		x
	3,6	Actions against vulnerability due to poverty	x	x			x
4- Technological Structure in virtual teaching	4,1	Difficulty in accessing classes	x	x	x		x
	4,2	Technology before the pandemic	x	x	x	x	
	4,3	Student/teacher social networking	x	x	x	x	
	4,4	E-learning	x	x	x	x	
	4,5	Government encouragement of technological access	x				x
5- Solutions for school management	5,1	Voluntary networks and school community	x	x			x
	5,2	Synchronous and asynchronous classes	x	x	x	x	
	5,3	Teacher training	x	x			x
	5,4	Increase student participation	x	x	x		x
	5,5	Feedback from students	x	x	x		x