A Review of the Role of Information Technology in Brazilian Higher Educational Institutions during Covid-19 Pandemic

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A R T I C L E I N F O	A B S T R A C T
	This paper presents the results of a documentary research on the use of information technology in emergency remote teaching in 66 higher educational institutions in Brazil. The theoretical background of this study is based on the works of Feenberg, Bagglaey, Veloso & Mill, Castañeda & Selwyn and Hodges. The methodological approach consisted of analyzing reports published by YDUQS, an educational holding responsible for managing all the 66 institutions examined in this research. Such analysis aimed at identifying data concerning investments in information technology and its use throughout the Covid-19 pandemic. Results have revealed that investment in information systems as well as technological mediation of academic routines and pedagogical practices paved the way for a rapid response to the crisis triggered by the pandemic and the maintenance of student satisfaction. Nevertheless, the data available within the reports was not enough to draw conclusions on learning management neither on other pedagogical aspects of emergency remote teaching.

1. Introduction

Remote teaching was the educational alternative when in-person pedagogical activities came to a halt with the social distancing imposed by the COVID-19 pandemic during the years of 2020 and 2021.

In Higher Education, the prevalent trend was the adoption of technological solutions based on videoconference platforms and virtual learning environments, in which synchronous communication in online pedagogical activities was predominant with the shift from the four walls of the conventional classroom to digital settings.

Some institutions that already possessed experience with remote or hybrid learning were able to rely on existing digital content, intensive use of technology, technological infrastructure, and more appropriate methodology to promote both real-time classes as well as opportunities for the development of pedagogical activities in virtual environments.

In light of this context, it is fitting to put under scrutiny the implications of these institutions' total dependence on technological mediation so that classes and pedagogical activities could be preserved during the Covid-19 pandemic.

The present research summarizes the analysis of data on the technological mediation of emergency remote teaching in these 66 Brazilian institutions of Higher Education, managed by the same corporate group.

Thus, the results stem from documentary research aimed at examining the educational consequences of information technology within the context of remote learning.

This work was originally presented in the 17th Iberian Conference on Information Systems and Technologies [1]. This introduction is followed by a theoretical background on e-learning and information technology in the field of education, a section on methodological aspects, and, at last, the results of the present research on the investment and on the use of technologies within the higher educational institutions of the YDUQS group.

2. Remote Teaching and Technological Mediation

2.1. Remote Teaching

Expressions such as *remote teaching* (RT), *emergency remote teaching* (ERT) and emergency remote learning and teaching (ERLT) have become recurrent in contemporary literature to describe online pedagogical activities during the Covid-19 pandemic.

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Initially, in [2] the authors argued that emergency remote teaching (ERT) should not be taken as a byword for online learning or e-learning, while other authors [3] understand remote teaching as equivalent to online learning or e-learning.

The perspective that underscores differences between remote learning and e-learning have prevailed in recent literature on this topic, with only few studies still endorsing their interchangeability. To some extent, the need to set these two concepts apart is, indeed, justified so that the reputation of e-learning is not tainted by the chaos, the improvisation, the frail theoretical background, and the lack of suitable methodologies to cater for students' profiles due to the abrupt adoption of remote learning during the Covid-19 outburst [4].

In addition, their distinctiveness is also be sustained by the fact that private higher educational institutions charge cheaper fees for e-learning, whereas remote learning implicates more costs, with teachers offering synchronous lessons.

In a nutshell, the dissimilarities between remote teaching and e-learning can be described in terms of three major traits of remote teaching: a) the urgent and temporary status of remote learning; b) the transposition of in-person classes into virtual environments; and c) the prevalence of synchronous communication via real time transmission of lectures and video classes.

In turn, e-learning relies on five fundamental prerogatives: a) it must count on didactic and pedagogical frameworks of its own; b) educational contents and activities must be adequately designed; c) pedagogical model and methodologies must cater for students' needs and take their profiles into account; d) students must be familiar with the methodology as well as its technological resources; e) efficient tutoring must supervise and support students' academic performances [5].

In [6] the authors prefer not to set apart the concepts of remote teaching and e-learning based on the assumption that there are more similarities than differences between these two educational modalities. In addition to intrinsic dependence on technology, remote teaching shares other characteristics with e-learning, since in both cases teachers and learners are physically separated and the learning process is mediated by technology.

Furthermore, both modalities may alternate between synchronous and asynchronous communication, virtual environments and videoconference functionalities or application programs. The prevalence of synchronous communication and videoconference platforms in remote teaching would, therefore, consolidate a type of e-learning, instead of an independent educational modality. Due to prolonged social distancing, educational institutions planned remote teaching or a transition to hybrid teaching, developed specific methodologies and contents for these scenarios, in addition to acquiring suitable didactic materials.

Either standing as an independent educational modality or constituting a type of e-learning, remote teaching during the Covid-19 pandemic must be analyzed in light of the many particularities that marked the uniqueness of this period.

2.2. Information Technology and Education

The use of technology for educational purposes is not limited to information systems nor to the era of digital technologies. In a broad sense, technology has been omnipresent in education ever since resources such as chalk, blackboards, books, pens, and pencils were used in the classroom. In other words, technology in the field of education includes far more than computers and mobile digital resources [7]. That is not to deny the huge impact of digital technologies on educational processes, but to acknowledge the longstanding role technology has played in pedagogical mediation over the course of history.

Thus, the use of technology in remote teaching during the Covid-19 pandemic is necessarily intertwined with the broader history of technology in education – and there are many lessons to be learned from such previous experiences.

Many innovations advertised by the EdTechs date back to projects and experiences developed between the 1920s and the 1950s [8].

The infrastructure in information technology (IT) and the use of diverse technological resources have favored not only teaching in situations in which teachers and students are separated by time and space, but also brought forward alternative (and often more interactive) pedagogical practices from which any educational modality can profit.

New digital technologies have become more interactive and user-centered, offering new possibilities within educational settings [9].

In [10] the authors had already identified technological trends focused on ubiquitous and networked experiences with the massification of mobile devices and the further developments of the Web with novel and diversified forms of representation, stimulating environments, and a global IT infrastructure combining decentralization and interoperability.

In this scenario, information technology has become both integrating and pervasive, which explains its ubiquity in the lives of teachers and students as well as the emergence of demands and possibilities regarding its appropriation and use in formal educational contexts.

Information and communication technologies are not solely devoted to the production and the availability of digital contents in different media and languages. In addition to granting access to texts and video classes, these technologies have allowed users to come up with new ways to represent data, concepts, processes and phenomena. Simulations, animations, and games have propelled more meaningful learning experiences. Virtual and augmented realities have also proved efficient in the educational realm.

Moreover, due to recent advances in terms of artificial intelligence, technology has given rise to new forms of pedagogical planning, student-tailored learning experiences, learning management, as well as innovating tools and procedures for assessment.

Therefore, technology has gone far beyond its primary function of guaranteeing remote interaction among teachers and students, surpassing the mere offer of online education to produce new methodological approaches – useful for both in-person as well as remote learning experiences.

Technology has made feasible the mediation or the rise of different forms of communication, interaction and relationship within academic and educational processes.

Thus, it is possible to promote technological mediation within any sort of pedagogical modality, whether in-person or online, even though technologically mediated education has been mostly associated to e-learning. However, this setting has rapidly changed because of the Covid-19 pandemic.

3. Dependence and Resistance to Technology

3.1. Technological dependence

Social distancing during the Covid-19 pandemic imposed technological dependence as the only means of pedagogical mediation for previously in-person Higher Educational courses. Technological dependence was not restricted to the use of digital platforms nor to the videoconferences that suddenly replaced conventional classrooms. In addition to substituting face to face classes with virtual encounters, it was essential to sustain the entire academic routine digitally, making room for other pedagogical activities in the online environment.

At first, part of Brazilian higher educational institutions halted their academic activities for longer periods – some for a few months – which tended to be a more recurrent choice amongst public institutions [11]. Other institutions, mostly private, resumed their academic activities in virtual environments sooner, some improvising more than others. Learning Management Systems (LMS), once confined to e-learning, were adopted as well as applications for videoconference.

Initially, their technological response was most frequently based on platforms or applications responsible for transmitting live-expositive classes, often lacking previous planning and a more careful design process [12]. Services related to academic activities were preserved and especially enhanced by institutions that already counted on online customer service channels, which allowed students to remain in close contact through the use of applications, in addition to providing support and guidance throughout the implementation of remote classes.

So, institutions which had previously invested on a more intensive use of technology in their pedagogical activities and educational services were able to respond more rapidly and more efficiently to the sanitary crisis.

These institutions managed to increase their investments on technology, paving the way for necessary improvements and for the development of information systems capable of handling an increased demand.

Those that lacked prior experiences with technology in face-to-face classes or that did not have online customer services tended to improvise in their attempts to adjust to the crisis, and often resorted to the suspension of pedagogical activities for a few months or even for the entire term.

Such evidence revealed the technological dependence of these higher educational institutions and their need to invest in IT within the contexts of e-learning as well as in-person classes – the latter adapted to hybrid formats due to pandemic restrictions.

3.2. Between resistance and adoption: the technological dilemma

The strong necessity to resort to technology in the field of education during the Covid-19 pandemic heightened tensions: on one hand, it intensified resistance to technology; on the other, it endorsed the unescapable need to adopt it. This dilemma can be described as a conflict that opposed those who saw online education as a natural (and necessary) development of human communication and those who criticized it for automating and mechanizing the learning process.

To fully understand this debate, it is worth analyzing the controversies that marked the rise of distance education mediated digital technologies, especially the pioneering contributions of Andrew Feenberg to philosophy of technology in the United States.

In the early 1980, distance education chiefly relied on printed materials sent to students and on one-way communication via radio, television, and satellite transmission. Back then, Internet was not an option for the general public and electronic mail was still mainly restricted to computing companies and universities developing research on the new technology.

The first program for online education was created when computers were still regarded as devices for data organization and mathematical calculation. Nevertheless, the use of computers in the realm of education helped pave the way for their reinvention as means of communication [13].

While narrating his experiment with online education, in [13] the author describes that the invention of e-learning was aimed at providing a human interface for distance education, which basically consisted of mailing printed didactic materials to learners.

Feenberg's pioneering experiment lasted for about ten years and was initially characterized by difficulties posed by technological limitations of the time: students, for example, had to flawlessly carry out an entire page of commands just to log in the system. It was also necessary to create a new software just to guarantee asynchronous interactions, such as the simple exchange of messages.

In [13] the author distinguished his demonstrations from the increased interests in large-scale distance education in the 1990s, when the financing crisis that hit universities in the United States motivated the adoption of digital technologies and the choice of the Internet to offer and organize online courses. These attempts in the field of online education sought automating learning through the use of the Internet and completely eliminated classroom interactions.

In [13] the author remembers that David Noble, the Marxist historian that denounced the loss of skilled workers to industrial automation, had become the main critic of online education, and joined him in several debates on the vices and virtues of the new system.

The consolidation of online education had to overcome at least two major challenges: the first stemmed from humanist criticism, which basically rejected any sort of electronic mediation in education; the second came from technocrats, looking forward to

completely eliminating the roles of teachers from the educational scenario. What humanist criticism and technocrat approaches to education brought forward was a deterministic understanding of e-learning as either a dehumanizing modality or a profitable business opportunity [13].

Contrary to such deterministic understandings of technology in the educational realm, the instrumentalist approach conceives technology as a neutral tool – either good or bad depending on its use.

Based on this instrumentalist perspective, adopting technology may enhance interaction and the learning experiences itself, mainly in the field of e-learning. The use of technology is seen as unavoidable, after all technology represents innovation and the new forms of communication.

Beyond the pessimistic resistance or the optimistic and unrestrained adoption of technology, it is possible to implement a critical approach that recognizes both the possibilities of expanding and enriching the learning experience as well as the risks of undermining and reducing the educational practices through technological mediation.

Raising critical awareness on the possibilities and shortcomings of technology is crucial within an educational approach mediated by technological resources. Technology should not be understood as an end itself and its uses must be molded in accordance with the objectives of each pedagogical project.

On the other hand, technology should not be seen as the mere means through which an educational objective can be accomplished: technology itself is embedded in its own social, cultural and economic aspects. In other words, technological appropriation demands acknowledging and addressing sociocultural tensions between the educational and the technological realms.

It is essential to recognize the vital influence of the digital technology industry and the big corporations on the molding of educational policies and on the craft of higher educational thought. In [14] the authors argue that this industry has kept on pushing higher educational reforms partially under the guise of necessary help in times of crisis.

Therefore, the data and the indicators related to technology and education should always be read from this critical viewpoint.

4. Method and Analysis of the Results

4.1. Procedures and data obtained

So as to investigate the impact and the results of technological mediation in remote teaching, documentary research was carried out based on data collected by one of the largest higher educational groups in Brazil.

The reports and documents analyzed were: Results Reported 1 T20; Results Reported 3T20; Results Reported 1T21; Results Reported 2T21 & 1S21; YDUQS Ecosystem; and Business Units.

This data was obtained through reports and other documents listing information, indicators as well as operational, academic, and financial analyses of the educational group between 2020 and 2021.

The group identified as YDUQS Participações S.A., a technological holding in the field of education, pulling together a board of trustees comprising 66 higher educational institutions, distributed throughout 52 cities in every state of Brazil. All of them are private institutions characterized according to the Brazilian legislation as non-profit organizations.

The group is listed in the Novo Mercado da B3 (the Brazilian Stock Market) as YDUQ3 and, has also gotten its ADRs (American Depositary Receipts) traded in the North American market under the name YDUQY.

In the beginning of the pandemic, in March 2020, the group comprised 319,000 students in face-to-face courses and 314,000 students in distance education [15].

Since 2018, YDUQS has increased its investments in technology. Nearly half of it was devoted to digital transformation and to enabling technologies.

More than 80% of all procedures related to academic routine and other transactions are carried out digitally aided by applications designed specifically for students and teachers. The application programs are available in any application store and have been rated very positively by their users.

In its digital ecosystem, YDUQS has made remarkable progress in its digital transformation throughout the pandemic and offered services to cater for the demands of the academic community aided by an online model that optimizes students' time and experiences. Besides, YDUQS has also implemented a new virtual classroom (SAVA – Sala de Aula Virtual) for students from online as well as in-person courses.

As part of its digital transformation, two months before the eruption of the pandemic, EnsineMe, the edtech of the group, had already started producing digital content based on pioneering formats and methodologies. Just before the pandemic, YDUQS had started developing and implementing the *Aura* teaching model in its face-to-face graduation courses. Owned by YDUQS itself, this model relies on digital platform, active methodologies and digital contents to support teachers and students in the classroom. Just one year after its implementation, in May 2021, students' approval ratings surpassed 90% according to data collected by an internal survey [16].

In the outset of the pandemic, in the first term of 2020, about 300,000 students from in-person courses migrated to remote teaching with digital classes on the Microsoft Teams platform. Before the Covid-19 outburst, most of these students had already been given access to virtual learning environments with the help of the WebAula platform, where available digital contents and a virtual library complemented their face-to-face learning experiences. The same virtual environment also hosted the online disciplines of in-person graduation courses.

With the pandemic and the implementation of remote teaching, in-person courses were split into two virtual environments: the Teams Platform was used for the transmission of synchronous classes, while the WebAula platform granted access to asynchronous digital contents, such as recorded video classes and other resources.

It took only fifteen days between the suspension of in-person classes and the beginning of remote teaching for graduation courses.

After the first term of 2020, with students from in-person classes studying in entirely virtual environments with remote encounters on the Teams platform, indicators signaled 83% of the students had remained within the institution – a percentage that represented a dropout rate below the expected levels. In the second semester of 2020, in-person courses witnessed a 5.9% decrease in the number of new enrollments, while distance education had a 58% increase [17].

In 2021, in the first term, in-person enrollments recovered and the number of students reached 299,000.

In addition to platforms for remote classes and digital content, students from in-person courses could also rely on the BdQ platform (Banco de Questões), a question database so they could get ready for assessments during the pandemic. The platform had been used previously in face-to-face as well as in remote courses as a source of quizzes and exercises. During 2020, over 4.7 million tests and exercises were done via the BdQ platform.

Furthermore, in the first term of 2021, 43% of the alumni from YDUQS face-to-face courses had access to contents produced in 2020 by the group's edtech, EnsineMe. About 600,000 students from YDUQS from in-person and distance course modalities already had the application program offered by the institution in 2021 [18].

In 2021, YDUQS acquired Qconcursos, an edtech focusing on preparing candidates for admission processes, so that it could progress in providing customized digital learning through adaptative evaluations. Thus, the institutions from the YDUQS group were able to count on various technological resources, as Table I describes.

Table 1: Students Enrolled in Face-to-Face Courses and Digital Platforms

	2020 First term	2021 First term
Students enrolled in face-to-face courses	300,000	299,000
Platforms	Teams WebAula BdQ	Teams WebAula SAVA BdQ
Students' application programs	Minha Estácio	Minha Estácio Meu Ibmec
Teachers' application programs	Estácio docente	Estácio docente Wyden docente Ibmec docente
Edtechs' internal Hub	EnsineMe	EnsineMe QConcursos

	2020 First term	2021 First term
Pedagogical activities in face-to-face courses	Remote classes	Remote classes. In-person practical classes.

Students' evaluation of educational services throughout the pandemic was, indeed, very positive.

Data from an internal survey – carried out by the institution, updated on April 30th 2021, and published in its financial report – reveals a 17-percentage point improvement in terms of the Net Promoter Score (NPS). When compared to results obtained between 2020 and 2021, the NPS presented a record-breaking 21 percentage point increase.

4.2. Analysis of the results

This data reveals that the educational group targeted by this research quickly responded to the challenge of resuming pedagogical activities of in-person courses due to a favorable internal context.

A greater investment in digital transformation had already been set in motion two years before the Covid-19 pandemic, propelling the process of partial digitalization in face-to-face courses, by offering some online and hybrid disciplines.

Such rapid response to the sanitary crisis is also connected to the prior existence of separate application programs for teachers and students. These applications went through several improvements during the pandemic, which helped the institution resume its typical academic routines.

For some students enrolled in face-to-face, communication with the institution, the supervision of the academic programme, and the possibility of studying while connected to mobile devices granted more flexibility to their learning experiences – an advantage priorly restricted to distance education.

For some teachers, submitting information such as students' grades, attendance records, and the content covered within each class became easier once digitalized. Nevertheless, they had to overcome the challenge of transforming remote teaching into a meaningful virtual encounter, not a depleted replica of a classroom.

In the case of YDUQS, the fact teachers from in-person courses could resort to previously acquired knowledge and experiences with digital resources and online environments. Furthermore, teachers' continuing education helped downplay the need to improvise in the transposition of in-person to online classes

Also, the implementation of a new teaching model (the *Aura* model) in face-to-face courses coincided with the beginning of the pandemic, which helped make the replacement of in-person classes smoother.

The support offered by internal EdTechs provided the institution with digital content produced in the pandemic context, furnishing teachers with the tools and resources they needed to assess students' performances in virtual environments.

Most technological solutions were created and managed internally, which explains the development of technological responses that suited the institutions' pedagogical needs and criteria.

The success of this response to the sanitary crisis is clearly reflected in the internal surveys promoted by YDUQS with the students and in the high levels of retention.

The increase of the satisfaction level of students enrolled in face-to-face courses indicates that the institution adopted adequate technological, didactic and pedagogical solutions.

However, the rapid migration from in-person courses to virtual environments in addition to retention indicators and the high levels of students' satisfaction relates to educational management. But the data presented in this report does not deal, for example, with learning management nor with students' academic performance over the course of the pandemic.

Also, this analysis does not cover the effects of large-scale digitalized learning on the relationships between teachers and students, nor amongst students themselves. These other aspects are extremely relevant; after all, the commercial design of educational systems and softwares has increasingly modelled teaching and learning experiences within universities [14]. Therefore, regardless of teachers' pedagogical intentions, softwares used in the educational process can either limit or expand what can be done within the classroom.

5. Conclusion

Based on the theoretical framework presented and on data regarding the implementation of remote teaching in the institutions of the YDUQS group, it is possible to infer that technology operates in both ways, curtailing or favoring communication, interaction and relationships in educational contexts.

A sound technological infrastructure and the use of different digital resources in the field of education before the pandemic created favorable conditions for a more rapid and less improvised response in the process of transposing conventional face-to-face classes to virtual environments.

Technological mediation by itself does not guarantee neither explains the success of the learning experience, since other aspects also play an important role in the educational process.

Despite being both necessary and relevant, this data is not enough to account for all the different aspects of technological mediation of the pedagogical processes during the Covid-19 pandemic in the higher educational institutions of the YDUQS group.

It is necessary to provide further details for this research so that the analysis can go beyond the macro level and look into variables regarding the implementation of remote learning from a micro perspective.

The analysis of data on academic management must be complemented by specific indicators to account for educational challenges of learning through technological mediation during the pandemic, which is certainly a necessary possibility for further investigation on this theme.

Conflict of Interest

The author declares no conflict of interest.

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