Technology Integration in Higher Education According to Brazilian Professors

Daniela Vilarinho-Pereira[a] & Denise de Souza Fleith[b]

[a] Instituto de Psicologia, Universidade de Brasília. E-mail: dvilarinho.rezende@gmail.com
[b] Instituto de Psicologia, Universidade de Brasília.

Abstract

Introduction. *There have been increasing calls for the integration of technology for educational purposes in higher education institutions. However, to achieve successful technology integration, several factors must be considered, and it is required significant changes for educators and institutions. Therefore, the present study aimed to investigate the perceptions of university professors about the advantages and disadvantages of technology use for educational purposes and the barriers they encountered in integrating technology in their teaching practices.* ***Method.*** *It was performed a descriptive exploratory study. Nine professors from a Brazilian university were interviewed about their perceptions of technology integration in higher education. The Grounded Theory was used to interpret the qualitative data.* ***Results.*** *The results indicated that the professors identified advantages which were categorized as Compensatory and Potentializing (i.e., Reduction of Space-Time Barriers, Illustration of Theoretical Concepts, Medium of Communication, and Diversity and Dynamization). The disadvantages cited by the participants were related to Teacher-Student Distance and Challenges to Use. Several interviewees described the barriers faced by faculty, from which two categories emerged: Personal Resources (i.e., Difficulty of Adequacy in Technology, Faculty Resistance to Change) and Institutional Resources (i.e., Faculty Training, Technical Support, Infrastructure, Administrative Issues).* ***Discussion and Conclusion.*** *The lack of support from the university administration is one of the biggest difficulties in implementing technology the professors reported. The importance of rethinking the role of the university professor within the context of the digital age is discussed. By exploring these professors' perceptions and experiences, we learned about their conditions and hoped to raise awareness about the changes needed in Brazilian institutions.*

Keywords

Introduction

The economic and social development of any nation depends, to a great extent, on the knowledge generated by its population and institutions. In this respect, higher education plays an important role in building and updating the knowledge resources of a nation. According to the conclusions of the UNESCO World Conference on Higher Education 2009 (UNESCO, 2009), held in Paris, higher education is a public good that should be the responsibility of all governments and economically supported by them. According to the document produced from that conference, from a strategic point of view, higher education is imperative for all levels of education, serving as a basis for research, innovation, and creativity. In recent years, it has been established that research and higher education can contribute to the fight against poverty and to the development of environmental sustainability (UNESCO, 2009).

For a developing country like Brazil, which deals with a variety of social and economic challenges, its population's access to higher education is of extreme relevance. The number of students enrolled in higher education institutions is increasing. According to data obtained by the Higher Education Census (*Instituto Nacional de Estudos e Pesquisas Educacionais* Anísio Teixeira – INEP, 2020), in 2019, a total of 8,603,824 students were enrolled in undergraduate courses, of whom 2,080,146 (24.2%) were in public institutions and 6,523,678 (75.8%) in private institutions, compared to a total of 8,450,755 students in 2018, representig a 1.8% increase in one year. Since 2009, when a total of 5,985,873 students were enrolled, there was a 43.7% increase of inenrollments in one decade.

Despite the increase in enrollments, in 2019, 1,250,076 students graduated, which represented a reduction of 1.1% from 2018, which had 1,264,288 graduates. Another relevant statistic concerns the high dropout rate of students. In 2018, 2,017,555 students dropped out their programs, a number which had risen to 2,230,175 in 2019, a 10.5% increase.

According to Daudt and Behar (2013) and Santos (2014), one of the factors that might influence the high percentage of dropouts is students' frustration with the obsolete teaching methodologies practiced in most institutions, resulting in loss of motivation, which highlights the need for alternative methods that can meet the requirements of students who are highly connected to the digital world. Furthermore, according to the report of the UNESCO World Conference on Higher Education 2009 (UNESCO, 2009), the use of technologies in postsecondary education is critical not only to increase the quality of higher education but to facilitate national and international information sharing and collaborations among institutions of higher learning.

Digital technologies are used as a support for educators' pedagogical practices and as a mediating tool between student and information. According to Coll et al. (2010), the potential of technology is in its symbolic nature. The use of symbols in digital technology allows for the creation of environments which integrate the known semiotic systems and expand the limits of the human capacity to seek, access, present, re-present, process, transmit, and share information. Thus, digital technologies are understood as psychological tools, which people use to mediate their higher mental functions, such as perception, attention, memory, and thinking (Kozulin & Presseisen, 1995; Vygotski, 1984/2007, 1987/2008).

According to Muñoz -Repiso and Tejedor (2011), given the potential of technology as a psychological tool, its implementation in higher education should generate changes in the educational process such as restructuring teaching methods; updating the curriculum; facilitating teacher-student and student-student communications; and enriching information, experiences and resources. In an analysis of two experimental curricula involving technology integration at a European university, Silva et al. (2003) concluded that these technologies presented a potential for change affecting both professors and students, who are required to interact in different environments and with different subject contents; to form new relationships; to share rather than accumuate knowledge; and to assemble and deconstruct information in order to reconstruct it in new spaces, with different meanings and with new ways of organization. As Iniesta-Bonillo et al. (2013) argue, the integration of technology has transformed the educator into a learning mediator and has enabled the student to play a more active role in the construction of his/her knowledge.

While the changes mentioned by Silva et al. (2003) provide several opportunities to reinvent the teaching and learning process, they can also bring heavy challenges to professors who may feel pressured to integrate technology to their practice without adequate support. To meet the requirements for a successful technology integration in the education context, several factors must be considered, such as availability of resources, quality of internet access, educators' knowledge about technology, educators' preparedness to integrate technology, and availability of technical support (Pelgrum, 2001). In addition to these factors, the decision of whether and how to use technology is influenced by the educator's pedagogical beliefs (Ertmer, 2005; Ertmer & Ottenbreit-Leftwich, 2010; Li et al., 2019; Sadaf et al., 2012; Teo et al., 2008). Tondeur et al. (2017) conducted a systematic literature review to investigate the relationship between teachers' pedagogical beliefs and their implementation of technology in their classroom and concluded that failure to consider teachers' beliefs during the process of implementing technology in educational settings tends to result in failure of the changes.

Thus, at a time of major pedagogical transition, it is necessary to understand the professors' beliefs and practices by giving them voice to express their perspectives not just on digital technology per se, but also on the conditions in which they are expected to integrate the technology. Therefore, the aim of present study was to investigate how Brazilian professors perceive the advantages and disadvantages of the use of technologies in higher education, and the barriers they face in implementing them in order to shed light on the challenges they face and raise awareness about the changes needed in Brazilian institutions.

The research questions investigated were as follows:
- What are the advantages of using technology in higher education according to the participants?
- What are the disadvantages of using technology in higher education according to the participants?
- What barriers to the integration of technology do the participants encounter in their teaching contexts?

It is hoped that the the results of this study will inform the efforts of higher education institutions to bring pedagogical practices into line with 21st century learning needs by incorporating technological resources and improving the conditions under which professors face the challenge of integrating technology in their practices.

Method

Participants

Nine professors from a higher education institution in Brazil participated in this study. These professors were referred by unit (e.g., departments, institutes) administrators according to their use of technology in their teaching practices. Eight of the nine were male, and their mean age was 47.25 years (*SD* = 8.24). Their average teaching experience was 18.78 years (*SD* = 10.43). Two professors taught Life Sciences courses; three taught Exact, Technological, and Multidisciplinary Science courses; and four taught Humanities courses. To keep their identities confidential, the participants are identified as P1-P9.

Table 1. Description of the Technologies Used by the Participants in their Teaching Practice.

Participant/ Discipline Taught	Description
P1 (Architecture)	P1 produced video classes and made them available on a dedicated YouTube channel (online video-sharing platform) so students could watch them prior to class. Face-to-face classes were designed to clarify students' doubts in a Flipped Classroom model approach (Bishop & Verleger, 2013). This professor also made use of WhatsApp (mobile instant message application) for teacher-student and student-student communications. Moodle (open-source learning management system) was used to receive student work and architecture software is used by the professor and students.
P2 (Odontology)	P2 used the document camera to film and transmit the procedures he performed on a mannequin to strategically located televisión monitors, so that the whole class could follow the professor's demonstration live. The camera used could transmit a detailed image. In addition, P2 recorded exercise videos and made them available on his YouTube channel, thus allowing students Access at any time or location.
P3 (Computer Science)	Using the Moodle platform, P3 made use of an intelligent system based on a methodology that reversed the roles of professor and students. The student independently accessed the course content and activities, in order to test his/her understanding at times and locations of his/her choice. As the students' performance improved, the level of difficulty of tasks tended to increase. In addition, the student could redo the exercises as many times as s/he wished.
P4 (Social Communications)	P4 used Facebook (social networking site) to mediate teacher-student and student-student communications, in addition to posting materials (videos and texts) of interest to his class and making space for comments. His Facebook page featured short videos taken from YouTube as a basis for classroom discussion.
P5 (Physics)	P5 used Moodle as a repository of disciplinary materials and at the end of the course introduced algebraic computing programs which supported automated algebraic manipulation of the abstract concepts being studied.
P6 (Odontology)	P6 used Moodle as a repository for teaching materials, and Facebook to maintain teacher-student communication. He made videos available on YouTube and used image processing software to illustrate cases for students.
P7 (Psychology)	P7 used Moodle as a repository of texts and exercises for students and PowerPoint presentations for lectures, as well as videos and images to illustrate of subject matter cases.
P8 (Physics)	P8 used the blackboard to present his mathematical statements.
P9 (Psychology)	P9 conducted expository classes in which he made time for dialogue with and among students.

Table 1 presents a description of the technologies used by the participants in their teaching practices. For a diverse perspective on technology integration in Brazil's higher

education, professors who used technology in different ways were selected. Three used technology creatively (P1, P2, P3), four used it traditionally (P4, P5, P6, P7), and two did not use technology (P8, P9) in their teaching practices. Creative use of technology was defined based on Martínez's (2006) conceptualization of creativity in instruction as the introduction into teaching practice of new elements that have value for students' learning and development. Traditional use was defined based on Cysneiros's (1999) concept of "conservative innovation" by which the use of digital technologies changes the aesthetics of the educational practice but keeps the same teaching structure and logic.

Instrument

An exploratory semi-structured interview developed by the authors was carried out with the professors. The purpose of this interview was to explore the participants' perceptions of the advantages and disadvantages of using technology in the educational context, and the barriers to integrating technology in their teaching practices that they encountered. The interview protocol included the following guiding questions: (a) "What are the advantages of using technology in the classroom and for students' activities?"; (b) "What are the disadvantages of using technology in the classroom and for students' activities?"; (c) "What are the aspects that hinder the implementation of technology as a pedagogical resource in your institution?".

Procedures

The first step of this study was to contact unit (e.g., departments, institutes) administrators to provide the names of professors who made either creative, traditional, or no use of technology in their instructional practices. Administrators were provided with explanations of creative use, traditional use, and no use of technology so they could refer professors who met these criteria.

In the second stage, we contacted the professors recommended by the administrators to explain the purpose of the study and invite their participation. The participants who accepted the invitation were interviewed individually in private rooms (professors' offices or laboratories) for an average duration of 34.88 minutes (*SD* = 11.75). All interviews were recorded with the participants' permission and later transcribed.

The procedures applied in this study respected the ethical principles of research involving humans and/or animals, in accordance with Resolution nº 466/2012, Resolution nº 510/2016, and Law nº 11.794/2008. The Research Ethics Committee of the Institute of Human Sciences at the University of Brasilia approved this study, under the number 1.253.742 (CAAE: 48077715.0.0000.5540). After being fully informed of the nature of the study, their rights, and what would be expected of them, the participants signed the Consent Form to participate in the study.

Results

Advantages of Using Technology in Higher Education

Participants were asked whether they believed there were advantages to using technology in higher education and, if so, what they were. All the professors said there were advantages and described at least one case in which digital technologies benefitted or could have benefitted their teaching practices, totalling 24 items. From their reports, it was possible to form two categories of advantages: Compensatory and Potentializing.

Compensatory

The Compensatory category includes the advantages related to the use of technology to overcome the difficulties faced by professors in the context of a Brazilian public university. This subcategory was composed of five reports from four participants, which described advantages are related to (a) how students' having access to their own technology devices helped to alleviate the inadequacy of university resources such as limited number of computers and poor quality of internet access in classrooms; (b) how technology could expand the reach of courses to more students, which is especially important when there is a high demand for certain courses that are offered sporadically due to the low number of faculty; and (c) how technology enabled certain practices that would be impossible or very costly in the analog context. This last case was described by P2, who explained that, with the increase in the number of students in each class, as well as the specificity of his discipline, which requires the student to follow procedures performed in very small areas (the teeth), the strategy used before the implementation of digital technology (i.e., document camera) was no longer considered viable: "I believe that these technologies that we have in the laboratory today are what allow the students to follow the techniques that we are presenting in practical classes. Without these information and communication technologies, I couldn't teach my classes anymore. Without having the possibility of transmitting to televisions what we are doing on mannequins, I do not think it is feasible to perform each step of the procedure several times so that all students can observe it or gather all students around the mannequin to see me performing in a very small area (the teeth)". (…). (P2)

Potentializing

The Potentializing category includes advantages provided by technology that promote teaching and learning processes. These reports were divided into four subcategories, namely: Reduction of Space-Time Barriers, Illustration of Theoretical Concepts, Medium of Communication, and Diversity and Dynamization. This category was composed of 19 reports given by seven professors.

Reduction of Space-Time Barriers. Regarding the subcategory Reducing Space-Time Barriers, two professors cited the advantage that digital technologies allowed students to have access to class content at any time and location. This affordance enhanced students' learning by supporting efficient time management and providing multiple exposure to

content, as described in the following statement: "(…) They can watch the video classes on their cell phones; thus, they have access to the content in any moment of the day. (…) They can use their time in a better way, and if they need to review the content, they can see it as many times as necessary." (P1)

Illustration of Theoretical Concepts. The subcategory Illustration of Theoretical Concepts was cited by two professors, according to whom technology helped them to better explain certain concepts and phenomena. P5's report exemplified this idea: "Another advantage is the visualization of some phenomena, (…) you can present a small video on this topic that should probably exist on YouTube or something like that." (P5)

Medium of Communication. The subcategory Medium of Communication can be explained in terms of the transformation in the teacher-student and student-student communications that is produced by the use of digital technologies. Five reports by three participants expressed how this change allowed for less constrained and more equitable communications, as P7 illustrated in identifying an advantage as follows: "Agility in communication and more equal treatment with students, because, in the classroom, there is no way. I have students to whom I pay more attention and those to whom I pay less attention. (…) With the use of technology, I end up treating everyone more or less the same way, and everyone has access to the material, everyone has the available information." (P7)

Diversity and Dynamization. Diversity and Dynamization was a subcategory comprising 10 reports by five participants, commenting on such advantages as the diversity of sources of information and forms of expression afforded by online sharing and the Internet and how the classes become more dynamic with the use of technology, as observed by P6: "This way you optimize your working time, classes become more dynamic. I think that the transmission of ideas is done in a more precise way, besides being faster." (P6)

As noted, the findings show that at all participants reported at least one benefit of the use of technology for educational purposes, and there was a great variability among those identified. A comparison of the two categories shows that the participants perceived more Potentializing ($f = 19$) than Compensatory ($f = 5$) advantages. Additionally, there was a convergence among the participants' perception regarding the subcategory Diversity and Dynamization, which was reported by the largest number of participants ($n = 5$) and had the highest frequency of reports ($f = 10$).

Disadvantages of Using Technology in Higher Education

When asked whether there were disadvantages regarding the use of technology for education and, if so, what they were, seven of the nine professors said there were disadvantages and described at least one case in which digital technologies compromised teaching, totaling 14 reports. Two categories related to the disadvantages emerged from the results: Teacher-Student Distance and Challenges to Use.

Teacher-Student Distancce

Two participants reported concerns that the use of technology can interfere with the relationship between the teacher and the students and their communications, as P1 commented: "(…) when you use remote technologies, the teacher-student relationship, in a way, becomes a little more distant. When you are with a student in the classroom you know them by face, by name, you know more or less how they behave. When you work with remote platforms, it moves you away a little bit". (P1)

Challenges to Use

Challenges to Use was a category presented by five participants with 12 reports in total. Participants pointed out the harm that misuse of technology can cause. The challenges described included the following: (a) the possibility that students might inadvertently compromise their safety by exposing themselves in social media environments such as Facebook; (b) students may perceive that technology in itself facilitates learning and put less effort into studying and doing their assignments as well as resort to "copy and paste" practices instead of doing the assigned work themselves; (c) students may be so intrigued by the technology that it becomes the focus of their attention rather than the teaching-learning process, which is treated as secondary rather than the central purpose of the course; and (d) students may experience mental or physical health distress due to the technology's overstimulating effects or develop addictive behaviors resulting in loss of control over the time spent using it. P4 temptations of multi-tasking when working remotely, resulting in problems of divided attention: "Dispersion, because you are doing many things at the same time. The social media is open, the email is open while you are doing a task. It affects everyone, it is not just students (…)". (P4)

The results obtained indicated that most participants (n = 7) reported at least one disadvantage of using technology for educational purposes. Only two participants found no disadvantages in using digital technology. It is interesting to note that the category Challenges to Use comprised a higher number of reports (f = 12) from more participants (n = 5) than the category Teacher-Student Distance (f = 2; n = 2).

Barriers to Integrating Technology in Higher Education

Participants were asked what the barriers are of integrating digital technologies in the classroom based on their reality, that is, in a public Brazilian university. There were several reports that described the obstacles faced by faculty and two categories emerged: Personal Resources and Institutional Resources. Eight out of nine participants presented a total of 41 reports.

Personal Resources

The participants presented the barriers related to Personal Resources. The implementation of technology in education requires changes in the behavior of faculty and students. This transformation is not always accepted by some professionals. In other cases,

despite the interest in using technology, the challenges to adapt to the new format make it impossible to develop its full potential. This category, therefore, is composed of two subcategories: Difficulty of Adequacy to Technology and Faculty Resistance to Change. Reports of this nature were identified in the interviews of five professors, thus totaling 10 reports with this content.

Difficulty of Adequacy in Technology. represents the challenges of finding time and mental energy to learn and keep up with the constant emergence of new technologies or versions of existing technologies and changing the attitudes of professors and students toward new forms of teaching and learning made possible by technology. Three participants cited this subcategory, as exemlified by the following: "Modellus [a software], look, you can use it to build small simulators like that, but I heard about this two weeks ago, and to learn how to use it takes time, so we have to balance the time we have to do everything we have to try to do, right?" (P8)

Faculty Resistance to Change. The subcategory Faculty Resistance to Change was mentioned by three professors who produced seven reports, in which they described the resistance of their colleagues and the reasons for such behavior: intergenerational issues, consideration of technology as a fad, reluctance to put effort into learning something new, and conservative mindsets. P1 explained this last situation: "I see more resistance, you know, you have … especially in architecture, even in younger generations you have extremely conservative thinking. So, not always, so to speak, methodological thinking approaches or advances in an attempt to locate [a place for] these technologies. Sometimes it seems that it is stagnant as if everything that was good has already been done, and what is coming is harmful, that is, it will distort, understand? I witness this more, these limitations." (P1)

Institutional Resources

The most cited difficulties in implementing technology were categorized as Institutional Resources. In total, 31 reports were presented by seven professors, who claimed that the university in which they were working did not have the basic conditions for realizing the full potential of digital technologies. These reports were grouped into four subcategories: Faculty Training, Technical Support, Infrastructure, and Administrative Issues.

Faculty Training. Faculty Training was a concern mentioned by three participants, who explained that they did not know how to use all the available technologies or understand their potentials and that they would like to have training for this purpose. Moreover, this difficulty was not limited to lack of training, but also included the quality of training they did receive. The few courses offered by the institution, according to the participants, did not teach them how to use the most advanced features of the technology they had, as reflected in P7's report: "I don't know. Moodle can do much more. Okay, who teaches me? I do what I have been learning, an accumulative knowledge, but if I had someone to help me, teach me, maybe I could explore more. "No, but you can go there and ask for support from the staff." By the time I get to them, I would already have my class done the old way that I always do, and it works, but it could be definitely improved". (P7)

Technical Support. The subcategory of Technical Support, which was needed both when making purchasing decisions and when planning and using the technology, was mentioned in eight reports by three professors. P3 spoke for others when he referred to how the lack of support from technology professionals affected his efforts to integrate technology in his teaching: "I need people to keep this server working, I need people to update that content, to make things work, because I can't do it myself." (P3)

Infrastructure. The Infrastructure subcategory was mentioned in six reports by four participants in relation to the facilities needed to reliably implement technology in their insturctional practices. The described the institution's physical affordances for supporing the use of technology, including both equipment and connectivity, in particular high-speed and stable internet access, as not available in their institution or, when they are, their quality is not adequate. P9, who did not use technology in his teaching, compared the technology infrastructure of public universities to that of private universities, making it clear that he would try to use digital technologies in his classes if there was an adequate infrastructure: "For example, if I knew that, when I arrive at my classroom, the internet would be functioning, there is a series of content on YouTube that I already researched that I could present. But it's so hard. I mean, I have to prepare so much, I have to download these contents to get them to the classroom, and sometimes I cannot work because the projector is not working. I think that these technical difficulties that we have in public universities do not happen in private universities, in which the professor arrives in the classroom, everything is set up and they have good internet access. So, every time I tried to use technology, I missed 30 to 40 minutes of class preparing the equipment". (…) (P9)

Administrative Issues. The subcategory of Administrative Issues included difficulties and obstacles related to the way Brazilian public universities are managed. Four professors gave 11 reports describing how these barriers hindered in their attempts to implement technology in the classroom. Bureaucratic processes, which aim to prevent corruption, end up stalling progress in this area, as expressed by P1: "There is the barrier of bureaucracy that holds us up. We walk with concrete shoes, and we cannot [move forward]. Instead of helping, it [the Administration] gets in the way, so there are limitations, bureaucratic processes for you to [get through just to] buy basic materials". (P1)

These results indicate that there was consensus among the participants regarding both the Personal Resources category and the Institutional Resources category. Only one participant stated that the basic conditions for the use of technology were provided by his department, so, he experienced no barriers to technology integration. The results also indicated that the participants perceived more barriers related to Institutional Resources (f = 31) than to Personal Resources (f = 10), and Administrative Issues had the highest number of reports (f = 11).

Table 2 shows overall results of the study, including the number of participants commenting and the frequency of reports in each category and subcategory of the professors' perceptions of the advantages of, disadvantages of, and barriers to technology integration in their institution.

Table 2. Number of Participants and Frequency of Reports by Category and Subcategory Related to Professors' Perceptions of the Advantages of, Disadvantages of, and Barriers to Technology Integration.

Categories/Subcategories	Participants (*n*=9)	Reports *f*
Advantages		
Compensatory	4	5
Potentializing		
Reduction of Space-Time Barriers	2	2
Illustration of Theoretical Concepts	2	2
Medium of Communication	3	5
Diversity and Dynamization	5	10
Disadvantages		
Teacher-Student Distance	2	2
Challenges to Use	5	12
Barriers		
Personal Resources		
Difficulty of Adequacy in Technology	3	3
Faculty Resistance to Change	3	7
Institutional Resources		
Faculty Training	3	6
Technical Support	3	8
Infrastructure	4	6
Administrative Issues	4	11

Note: The same professor may have mentioned the same (sub)category more than once during the interview. *n* = number of participants; *f* = frequency of reports.

Discussion and conclusion

The aim of the present study was to investigate perceptions of professors at a Brazilian public university of the advantages and disadvantages of the use of technologies in higher education instruction and the barriers to implementing them. The results, as a reflection of the participants' experiences and their thoughtful assessments, present a variety of advantages, serious disadvantages, and challenging barriers.

Regarding the advantages and disadvantages of using technology in the classroom, it is interesting to note that most participants perceived both benefits and limitations. The extreme dichotomy of perspectives between technology as the salvation for all humanity's problems (utopian rhetoric) and technology as the destroyer of society's well-being (dystopian rhetoric) was not evident among these participants. According to Boyd (2014), the utopian and dystopian rhetorics "are equally unhelpful in understanding what actually happens when new technologies are broadly adopted" (p. 16). Being able to identify the pros and cons of technology can favor its use for educational purposes, since, based on the perceptions reported in this study, professors can make the most of its potential if they can avoid its negative effects when misused or not properly supported.

The ways in which technology can enrich the learning process presented by the participants were categorized as Compensatory and Potentializing. The Compensatory category, which represents the ways in which the participants integrated technology to solve problems related to teaching conditions, such as enabling all students to observe a detailed

demonstration, shows that the use of digital technologies could minimize these problems' negative impact. However, the participants' working conditions were also mentioned as barriers to integrate technology (e.g., Infrastructure and Administrative Issues subcategories). In some cases, technology that was not provided by the university (e.g., students' smartphones), helped professors deal with the lack of institutional resources and also benefit from the advantages of mobile learning (Cochrane & Narayan, 2017).

In general, it was noted that, when participants described the advantages of technology, their examples referred mainly to the ways they found to deal with issues related to classroom routines so as to provide a better learning experience for their students. The particpants' uses of technology revealed their ways of expressing themselves and solving problems in the educational context.

It is worth mentioning that the professors who did not use digital technologies also perceived advantages in their use for educational purposes, indicating that they had been discouraged by barriers, as reported by the professor who cited the inferior infrastructure of public universities as a reason for not making instructional use of digital technologies.

With regard to the disadvantages reported, the categories Teacher-Student Distance and Challenges to Use represent important problems that many researchers have already discussed (e.g., Fried, 2008; Hsu, 2015; McEwan, 2012). It is relevant that the professors were aware of these issues and the need to take them into account while implementing technology.

The most cited category related to the disadvantages was Challenges to Use. This result can be related to the Faculty Training subcategory of the Institutional Resources category. The challenges of integrating technology properly could be overcome or minimized if there were more quality training on how to use technology for educational purposes. Scholars in the field have highlighted the lack of instructors' preparation for implementing technology (Conlon & Simpson, 2003; Joly & Martins, 2008; Kenski, 2011; Palfrey & Gasser, 2011; Pelgrum, 2001). In the present study, this reality emerged as an issue related not only to individual professors but more broadly to their educational institutions.

The barriers the professors reported facing indicate that despite all the discourse regarding the importance of technology integration in higher education (UNESCO, 2009), the support given by many institutions, particularly public institutions in emerging economies, is insufficient. The most cited difficulties were in the Institutional Resources category, confirming the findings of other studies identifying barriers to technology integration in both K-12 and postsecondary contexts and at both national (Joly & Martins, 2008; Kenski, 2011) and international (Conlon & Simpson, 2003; Palfrey & Gasser, 2011; Pelgrum, 2001) levels. Administrative Issues, the most cited subcategory, seem to be particularly related to the context of public higher education institutions. As noted above, this reality indicates that the focus of the problem is not only on the professor, but on their institutions, especially with regard to infrastructure and working conditions.

At the beginning of this millennium, Cuban (2000) had already highlighted the difficulties faced by educators in educational contexts in which issues of working conditions, such as lack of technical support, are intractable. In this study, the research setting, a public university in

Brazil, had to compete for public financial resources and while dealing with excessive bureaucratic procedures, which hindered advances in the implementation of technology for educational purposes.

The subcategory Faculty Resistance to Change of the Personal Resources category reflects the participants' perceptions of faculty resistance to the use digital technologies. The participants reported that some of their colleagues lacked positive attitudes towards technology, which is consistent with Torff and Tirotta's (2010) finding that attitudes towards technology of even a small proportion of faculty can influence students' levels of motivation. Thus, it may be inferred that, to increase the implementation of technology in the university context, it is necessary not only to provide adequate infrastructure, material resources, technical support, and training in relevant technical and pedagogical skills, but also to help professors develop positive conceptions of and attitudes towards digital technologies. It is important to overcome perceptions influenced by the extreme dichotomy between utopian and dystopian rhetorics as cited by Boyd (2014).

Only one participant reported that he did not face any barriers to implementing technology in his department, showing that faculty within the same institution may have different experiences depending on the department, institute or college in which they teach. However, from the near consensus among the reports of barriers to implementing technology, a question arises: What is the discrepancy between the profile of the university professor that the Higher Education Institutions in Brazil are demanding and the reality of his or her working conditions? A strong institutional principle is the inseparability of teaching, research, and service (Brazil, 1988), a mission that in itself is already a major challenge, in addition to which the faculty in this study reported the need to be constantly updated on ever-developing innovations in technological applications to education. They need to not only to acquire current instrumental and pedagogical knowledge of how to use them but also to be prepared to deal with technical problems that may arise. At they same time, they are still required to deal with complex administrative and bureaucratic issues in the process of acquiring and maintaining these technologies and the knowledge needed to use them effectively. Thus, it is necessary to rethink the role of the university professor within the context of the digital age and their need for support at this time of major transformations.

There are some limitations of this exploratory study. The first is that the results presented here represent the participants' self-reports. Observations of their teaching practices especially with technology use might have yielded deeper insights. Another limitation is that the study is contextualize within only one university, in this case a public and federal university in Brazil, which minimizes the generalization of the results, including to private higher education institutions in the country. However, despite these limitations, the results presented here are consistent with other studies and contribute to a better understanding of the factors that are relevant to consider when integrating technology in higher education contexts, particularly those that are similar to the setting of this study.

Some suggestions for future studies are as follows: (a) evaluation of the roles of university administrators in facilitating or hindering technology integration in higher

education institutions; (b) investigation of the perceptions of professionals in administrative positions regarding the use of technology to support students' learning processes; (c) development of instruments to quantitatively assess professors' and university administrators' perceptions of the use of technology for educational purposes; (d) evaluation of the effects of professors' perceptions of the use of digital technologies on their ways of using technology for educational purposes and on their students' perceptions of their teaching practices; (e) focus group studies involving professors who do and/or do not use digital technologies, with the aim of finding possible solutions to barriers to the integration of technology in the university context: and (f) development and evaluation of training courses in instrumental and pedagogical skills for the use of digital technologies in higher education.

In conclusion, several factors may influence the integration of technologies in educational contexts and its effectiveness in transforming the structures of an education system to be relevant to 21st century learning need. These include institutional resources, the lack of which can discourage professors and stifle their innovative potential. Particularly in public institutions, it is important to rethink bureaucratic structures that obstruct the advancement of universities in the digital age. It is essential for governments to provide continuous incentives for public university to be always up to date with technologies and maintain their smooth implementation.

Another relevant factor is the quired university professor's profile in this context. The lack of institutional support has overloaded professors, who often need, in addition to taking on multiple functions, to use their own resources to implement strategies that they understand to be fundamental for supporting their students' learning processes. These working conditions thwart the potential for technology integration to generate major transformations. It is necessary to develop departments knowledgable the characteristics of digital technologies and ways to support professors' instructional uses of them.

Professors' lack of training in the use of technologies was another disadvantage cited by the participants. To make use of digital technologies, one must know how to integrate them pedagogically in a given course and which aspects of the teaching-learning process can be developed or transformed by their use. One solution could be to include required instructional technology courses in teacher education programs, including at master's and doctoral levels, in addition to continued provision of faculty professional development programs on current affordances and uses of technologies. Master's and doctoral students must be well prepared not only to become researchers but also educators with knowledge about and skills in the use of digital technologies. Such preparatory training would enable professors to feel secure in their ability to use digital technologies as mediators of teaching and learning.

In addition to formal training in the use of technologies, it is important to prepare the professor to accept current changes in the paradigm of education. There can be no transformation in the structure of education if the practices of previous centuries continue to be reproduced, whether with or without digital technologies, if the same conceptions about the teaching-learning process, which no apply in contemporary world, in which the new norm of constant change demands creative thinking. Not only university professors in training, but

also those in professorial position need to participate in discussions of ways to create spaces to rethink teaching practices and conceptions of what it means to teach and learn.

To facilitate such discussions, some suggestions on how to use technologies in higher education are presented. First, it is important to adopt methodologies that provide freedom of action and interaction for students. To do so, professors should emphasize the use of technologies not only as a means of information and communication, but also as a medium for students to express themselves in activities involving the use of blogs, wikis, videos, and games. Software should be provided that allows students to create texts, music, works of art, or even whole environments, such as the Makerspace, where students can share knowledge and generate new ideas and products. Here it should be emphasized that choices of technology-enhanced teaching strategies should always be linked to clear learning objectives and their uses carefully planned considering the characteristics of the selected digital technology and the skills that it is intended to develop.

Another relevant point is that students should be restricted to the technologies made available to them by professors but should play an active role in identifying and recommending technologies which they believe facilitate their learning processes. This procedure would open space for greater diversification of teaching and assessment methodologies, thus providing a rich environment for the development of students' creativity. In addition, it could contribute to minimizing the overload that professors may experience with the need to be constantly updated on new digital technologies, as students could serve as informants from the digital generation.

Finally, it is important to note that while technology plays an important role in helping human beings in a variety of contexts, it has not yet replaced the role of the educator, and probably never will. The professor's mission to guide students' learning and development will continue to be indispensable. Accordingly, it is recommended that, with regard to the instructional use of technology, professors focus less on their acquisition of technical knowledge and more on their roles as mentors and motivators for their students.

References

Bishop, J. L., & Verleger, M. A. (2013, June 23-26). *The flipped classroom: A survey of the research* [Paper presentation]. 120th American Society for Engineering Education Annual Conference & Exposition, Atlanta, GA, United States.

Boyd, D. M. (2014). *It's complicated: The social lives of networked teens*. Yale University Press.

Brasil. (1988). *Constituição da República Federativa do Brasil de 1988.* http://www.planalto.gov.br/ccivil_03/constituicao/constituicao.htm

Cochrane, T., & Narayan, V. (2017). Design considerations for mobile learning. In C. M. Reigeluth, B. J. Beatty, & R. D. Myers, Instructional-design theories and models: The learner-centered paradigm of education (Vol. IV, pp. 385-413). Routledge.

Coll, C., Mauri, T., & Onrubia, J. (2010). A incorporação das tecnologias da informação e da comunicação na educação: Do projeto técnico-pedagógico às práticas de uso. In C. Coll & C. Monereo (Eds.), *Psicologia da educação virtual: Aprender e ensinar com as Tecnologias da Informação e da Comunicação* (pp. 66-93). Artmed.

Conlon, T., & Simpson, M. (2003). Silicon Valley versus Silicon Glen: The impact of computers upon teaching and learning: A comparative study. *British Journal of Educational Technology, 34*(2)*,* 137-150. https://doi.org/10.1111/1467-8535.00316

Corbin, J., & Strauss, A. (2014). *Basics of qualitative research: Techniques and procedures for developing Ground Theory* (4th ed.)*.* Sage.

Cuban, L. (2000). *So much high tech money invested, so little use: How come?* http://www.faculty.pnc.edu/DPratt/271/cuban.htm

Daudt, S. I. D., & Behar, P. A. (2013). A gestão de cursos de graduação a distância e o fenômeno da evasão*. Educação, 36*(3)*,* 412-421. https://revistaseletronicas.pucrs.br/index.php/faced/article/view/15543

Ertmer, P. A. (2005). Teacher pedagogical beliefs: The final frontier in our quest for technology integration? *Educational Technology Research and Development*, *53(1)*, 25-39. https://doi.org/10.1007/BF02504683

Ertmer, P. A., & Ottenbreit-Leftwich, A. T. (2010). Teacher technology change. *Journal of Research on Technology in Education*, *42*(3), 255-284. https://doi.org/10.1080/15391523.2010.10782551

Fried, C. B. (2008). In-class laptop use and its effects on student learning. *Computers & Education, 50*(3), 906–914. https://doi.org/10.1016/j.compedu.2006.09.006

Hsu, L. (2015). Modelling determinants for the integration of Web 2.0 technologies into hospitality education: A Taiwanese case. *The Asia-Pacific Education Researcher, 24*(4), 625–633. https://doi.org/10.1007/s40299-014-0208-z

Iniesta-Bonillo, M. A., Sánchez-Fernández, R., & Schlesinger, W. (2013). Investigating factors that influence on ICT usage in higher education: A descriptive analysis. *The International Review on Public and Nonprofit Marketing, 10*(2)*,* 163-174. https://doi.org/10.1007/s12208-013-0095-7

Instituto Nacional de Estudos e Pesquisas Educacionais Anísio Teixeira – INEP (2019). *Censo da educação superior 2019: Divulgação dos resultados.* https://download.inep.gov.br/educacao_superior/censo_superior/documentos/2020/Apresentacao_Censo_da_Educacao_Superior_2019.pdf

Joly, M. C. R. A., & Martins, R. X. (2008). Habilidades em tecnologias: Avaliação de professores da educação básica brasileira. *Psicologia e Desenvolvimento Tecnológico. Psicologia para América Latina, 13*. http://pepsic.bvsalud.org/scielo.php?script=sci_arttext&pid=S1870-350X2008000200012

Kenski, V. M. (2011). *Educação e tecnologias: O novo ritmo da informação* (8a ed.). Papirus.

Kozulin, A., & Presseisen, B. Z. (1995). Mediated learning experience and psychological tools: Vygotsky's and Feuerstein's perspectives in a study of student learning. *Educational Psychologist, 30*(2)*,* 67-75. https://doi.org/10.1207/s15326985ep3002_3

Li, Y., Garza, V., Keicher, A., & Popov, V. (2019) Predicting high school teacher use of technology: Pedagogical beliefs, technological beliefs and attitudes, and teacher training. *Technology, Knowledge and Learning*, *24*(3), 501–518. https://doi.org/10.1007/s10758-018-9355-2

Marshall C., & Rossman G. B. (2016). *Designing qualitative research* (6ᵗʰ ed.). Sage.

McEwan, B. (2012). Managing boundaries in the web 2.0 classroom. *New Directions for Teaching and Learning, 131*(1), 15–28. http://doi.org/10.1002/tl.20024

Muñoz-Repiso, A. G., & Tejedor, R. J. T. (2011). Variables TIC vinculadas a la generación de nuevos escenarios de aprendizaje em la enseñanza universitária. Aportes de las curvas ROC para el análisis de diferencias. *Educación XX1, 14*, 43-78. http://doi.org/10.5944/educxx1.14.2.237

Palfrey, J., & Gasser, U. (2011). *Nascidos na era digital: Entendendo a primeira geração de nativos digitais.* Artmed.

Pelgrum, W. J. (2001). Obstacles to the integration of ICT in education: Results from a worldwide educational assessment. *Computers & Education, 37, 163-178.* https://doi.org/10.1016/S0360-1315(01)00045-8

Sadaf, A., Newby, T. J., & Ertmer, P. A. (2012). Exploring pre-service teachers' beliefs about using Web 2.0 technologies in K-12 classroom. *Computers & Education*, *59*(3), 937–945. https://doi.org/10.1016/j.compedu.2012.04.001

Santos, P. K. (2014). Abandono na educação superior: Um estudo do tipo estado do conhecimento. *Educação Por Escrito, 5,* 240-255. https://doi.org/10.15448/2179-8435.2014.2.17896

Silva, B., Gomes, M. J., Oliveira, L. R., & Blanco, E. (2003). *The use of ICT in higher education: Work in progress at the University of Minho.* http://www.uoc.edu/dt/20137/index.html

Teo, T., Chai, C. S., Hung, D., & Lee, C. B. (2008). Beliefs about teaching and uses of technology among pre-service teachers. *Asia-Pacific Journal of Teacher Education,36*(2), 163–174. https://doi.org/10.1080/13598660801971641

Tondeur, J., van Braak, J., Ertmer, P. A., & Ottenbreit-Leftwich, A. (2017). Understanding the relationship between teachers' pedagogical beliefs and technology use in education: A systematic review of qualitative evidence. *Education Technology Research and Development*, *65*(3), 555–575. https://doi.org/10.1007/s11423-016-9481-2

Torff, B., & Tirotta, R. (2010). Interactive whiteboards produce small gains in elementary students' self-reported motivation in mathematics. *Computers & Education, 54*(2), 379–383. https://doi.org/10.1016/j.compedu.2009.08.019

UNESCO. (2009). *Conferência mundial sobre ensino superior 2009: As novas dinâmicas do ensino superior e pesquisas para a mudança e o desenvolvimento social.* http://portal.mec.gov.br/index.php?option=com_docman&view=download&alias=4512-conferencia-paris&category_slug=abril-2010-pdf&Itemid=30192

Vygostki, L. S. (1984/2007). *A formação social da mente*. Martins Fontes.

Vygostki, L. S. (1987/2008). *Pensamento e linguagem*. Martins Fontes.

Integração da Tecnologia à Educaçao Superior Segundo Professores Universitários

Resumo

Introdução. Observa-se um interesse crescente de que professores e instituições de ensino superior integrem a tecnologia à educação. No entanto, para alcançar uma integração tecnológica bem-sucedida, vários fatores devem ser considerados, sendo necessárias mudanças significativas para educadores e instituições. Portanto, o presente estudo teve como objetivo descrever as percepções de professores universitários sobre as vantagens e desvantagens do uso da tecnologia para fins educacionais e as barreiras encontradas na integração da tecnologia em suas práticas de ensino. *Método.* Realizou-se um estudo exploratório descritivo. Nove professores de uma universidade brasileira foram entrevistados sobre suas percepções sobre a integração da tecnologia no ensino superior. A Teoria Fundamentada nos Dados foi utilizada para interpretar os dados qualitativos. *Resultados.* Os resultados indicaram que os docentes identificaram vantagens categorizadas como Compensatórias e Potencializadoras (ou seja, Redução de Barreiras Espaço-Temporais, Ilustração de Conceitos Teóricos, Meio de Comunicação e Diversidade e Dinamização). As desvantagens citadas pelos participantes foram relacionadas ao Distanciamento Professor-Aluno e Desafios no Uso. Vários relatos citaram barreiras enfrentadas pelo corpo docente e duas categorias emergiram: Recursos Pessoais (ou seja, Dificuldade de Adequação à Tecnologia, Resistência do Corpo Docente à Mudança) e Recursos Institucionais (como Treinamento Docente, Suporte Técnico, Infraestrutura, Questões Administrativas). *Discussão e Conclusão.* A falta de apoio da administração da universidade é uma das maiores dificuldades que os docentes enfrentam na implementação da tecnologia. Discute-se a importância de se repensar o papel do professor universitário no contexto da era digital. Ao explorar as percepções e experiências dos participantes, aprendemos sobre suas condições e esperamos chamar atenção para mudanças necessárias nas instituições brasileiras.