

WHAT ARE EDTECHS? A SYSTEMATIC LITERATURE REVIEW¹

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ABSTRACT

In contrast to the recurring drop of demand in traditional education institutions, it is noticed a rapid expansion of Edtechs. Considered as educational startups with alternative learning models and innovative methodologies based on multidisciplinary collaboration, we do not know much from a theoretical point of view about their specific characteristics, which contrasts with traditional teaching modalities. This article aims to evaluate the literature about Edtechs, assessing both the adopted concept and the challenges and trends regarding the future of these new educational institutions. The methodology used was a literature review divided into two stages. The first stage was quantitative, focusing on the volume of publications by author, journal, and other descriptive information. The second stage was qualitative, focusing on the content of the published articles. The quantitative analysis allowed us to conclude that studies on the topic are recent and have a growing publication trend, but there is no publication concentration in journals. The qualitative analysis concluded that Edtechs have a social mission to mobilize new technologies to transform and improve the reach and quality of education and student's life and career prospects. This research is relevant for the academic and corporate community interested in the topic, as it consolidates all the scientific knowledge about Edtechs.

Keywords: Edtechs. Concept. RSL.

O QUE SÃO *EDTECHs*? UMA REVISÃO SISTEMÁTICA DE LITERATURA

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Em contraste com a redução recorrente da demanda pelas instituições tradicionais, há uma rápida expansão das *Edtechs*. Consideradas *startups* educacionais com modelos alternativos de aprendizagem e metodologias inovadoras, baseadas na multidisciplinaridade e na colaboração, pouco se sabe, do ponto de vista teórico, sobre suas características específicas, que contrastam com as modalidades tradicionais de ensino. Este artigo tem como objetivo avaliar a literatura sobre *Edtechs*, considerando tanto o conceito adotado quanto os desafios e tendências em relação ao futuro dessas novas instituições de ensino. A metodologia utilizada foi uma revisão de literatura dividida em duas etapas. A primeira etapa foi quantitativa, com foco no volume de publicações por autor, em periódicos e demais informações descritivas. A segunda etapa foi qualitativa, com atenção ao conteúdo dos artigos publicados. A análise quantitativa permitiu concluir que os estudos sobre o tema são recentes e com tendência crescente de publicações, mas não há concentração de publicação em periódicos. A análise qualitativa concluiu que as *Edtechs* têm a missão social de mobilizar novas tecnologias para transformar e melhorar, não apenas o alcance e a qualidade da educação, mas também as perspectivas de vida e de carreira dos estudantes. Esta pesquisa é relevante para toda a comunidade acadêmica e corporativa interessada no tema, pois consolida o conhecimento científico sobre *Edtechs*.

Palavras-chave: *Edtechs*. Conceito. SLR.

¿QUÉ SON LAS EDTECHs? UNA REVISIÓN SISTEMÁTICA DE LA LITERATURA

En contraste con la caída recurrente de estudiantes de instituciones tradicionales, hay una rápida expansión de las tecnologías educativas. Considerados *startups* educativas con modelos alternativos de aprendizaje y metodologías innovadoras basadas en la multidisciplinariedad y la colaboración, poco se sabe desde el punto de vista teórico sobre sus características específicas, en contraste con las modalidades de enseñanza tradicionales. Este artículo tiene como objetivo evaluar la literatura sobre *Edtechs*, valorando tanto el concepto adoptado como los desafíos y tendencias respecto al futuro de estas nuevas instituciones educativas. La metodología utilizada fue una revisión de la literatura dividida en dos etapas. La primera etapa fue cuantitativa y se centró en el volumen de publicaciones por autor, revista y otra información descriptiva. La segunda etapa fue cualitativa, centrándose en el contenido de los artículos publicados. El análisis cuantitativo permitió concluir que los estudios sobre el tema son recientes y con tendencia creciente en las publicaciones, pero no hay concentración de publicaciones en revistas. El análisis cualitativo concluyó que las *Edtechs* tienen la misión social de movilizar nuevas tecnologías para transformar y mejorar, no sólo el alcance y la calidad de la educación, sino también las perspectivas de vida y carrera de los estudiantes. Esta investigación es relevante para toda la comunidad académica y empresarial interesada en el tema, ya que consolida todo el conocimiento científico sobre *Edtechs*.

Palabras clave: *Edtechs*. Concepto. RSL.

INTRODUCTION

The 4.0 Industrial Revolution era has changed the way we perceive about education. The change is not only in the way of teaching but also in the entire curriculum development, which should complement students' pedagogical dimensions, life skills, and the ability to live together (collaboration) and think critically and creatively. It is necessary to develop interpersonal skills and transversal competencies, as well as invisible competencies that are not related to specific jobs or academic areas (Purwanto *et al.*, 2023)

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In the wake of these changes, Edtech (short term for education technology in English) emerge. According to analysts from marketing agencies and scientists, this is one of the most promising sectors in the global economy, mainly due to the use of innovative pedagogical technologies (Timchenko; Trapitsin; Apevalova, 2020). Keeping up with the ongoing behavioral and technological changes, including from an environmental perspective (Haleen *et al.*, 2022), Edtechs are expanding in the Brazilian market. A mapping conducted by the Brazilian Association of Startups & Center for Innovation in Brazilian Education (2022) identified 813 Edtechs operating in Brazil, with 38% located in the state of São Paulo alone. This number represents a 44% increase compared to the 2020 mapping when 556 Edtechs were detected.

As Edtechs grow, traditional educational institutions, on the other hand, face recurring student losses as companies begin to require a university degree for no longer hiring (Bigarelli, 2018). This phenomenon is happening globally, including in the United States, where 36% of undergraduate students gain statistically significant skills throughout their education, such as critical thinking, analytical reasoning, and communication (Arum; Roska, 2011). The response of these institutions to maintain competitiveness in the market has been the adoption of merger and acquisition strategies rather than innovation in their business model.

However, how exactly do Edtechs promote innovation? First, it is necessary to understand what Edtechs are. The Brazilian Association of Startups (AB Startups) and the Center for Innovation in Brazilian Education (CIEB), for example, define Edtechs as a category of company whose characteristics are the systematic application of technology in practical tasks and the use of technology as a "facilitator of learning processes and

improvement of educational systems, generating effectiveness and efficiency" (CIEB, 2021, p.9). Nevertheless, are Edtechs only application of technology in educational processes?

There is a stream of authors (Lucas, 2014; Ghemawat, 2017; Suárez-Gierrero; Rivera-Vargas; Raffaghelli, 2023) who argue that Edtechs go beyond the application of new technologies because if they were so, we could go back in history and conclude that the first printer invented by Johannes Guttenberg in 1440, Thomas Edison promoting film clips as substitutes for teachers in 1913, Sidney Pressy inventing the first teaching printing machines in 1927, and online education developed at the University of Illinois in the 1960s would be considered Edtechs (Dhawan, 2020). These authors, therefore, believe that Edtechs are not just education startups that apply technologies but are also companies seeking alternative learning models compared to those proposed by universities. In other words, Edtech seeks not only to offer a range of technological products but also to provide courses focused on the specific needs of the job market (Lucas, 2014; Ghemawat, 2017; Tzenios, 2020).

According to Doña-Toledo *et al.* (2017), institutions should be much more than just technology developers. They should deliver a proposal of good reputation, quality, social responsibility, prompt student service, and closeness to students and alums to increase the perceived value for students. Technology is considered an essential tool for the promotion, extension, and sustainability of the educational system, but it is not sufficient in itself to make a significant advancement in the knowledge society since educational processes are multidimensional and, therefore, substantially complex (Suárez-Guerrero Rivera-Vargas; Raffaghelli, 2023).

Given the different perspectives on Edtechs, the question that guides this research is: what is the concept and features of Edtechs? Based on a systematic literature review, this article aims to synthesize and evaluate the literature on the topic logically, transparently, and analytically (Denyer; Tranfield, 2009). In addition to presenting the concept of Edtech through a qualitative analysis, this research seeks to provide a quantitative analysis of articles published on the topic (by year, author, journal, and other specifications) and clarify the proposal of Edtechs for innovation in education.

1 METHODOLOGICAL PROCEDURES

There are guidelines on how to conduct a systematic literature review. The Institute of Educational Sciences of the U.S. Department of Education, through the What Works Clearinghouse Procedures and Standards Handbook, Version 4.0 (2017), recommends a systematic review process in five steps: (a) develop the review protocol, (b) identify the relevant literature, (c) perform an article screening, (d) perform a literature review, and (e) present the results.

We cannot argue that systematic literature review studies have limitations, such as bias due to the analysis of published data alone and bias from screening and coding the available studies. We highlighted the Inclusion criteria to reduce limitations, emphasizing transparency regarding the screening and coding process (Schossler, 2007; Thompson *et al.*, 2012).

Following the footsteps of the American Institute of Educational Sciences, the review bases seek the protocol that the searched articles should be indexed in the Web of Science database and published in peer-reviewed journals. The Web of Science database was selected because it is one of the leading journal repository databases.

We selected articles published in English, Spanish, or Portuguese as a search filter with the term “Edtech” in the article’s title, abstract, or keywords. Regarding the year of publication, we used the broader historical period of the base (1945 to Feb.2021). The search result generated 44 articles published between 2013 and 2021 in 36 different sources, with 201 keywords, 101 authors involved, 14 documents of single authorship, and 30 of multiple authorship.

In the first analysis (quantitative), we used the software RStudio and Vos Viewer. The software assisted in investigating the number of publications per year, relevant journals, most cited authors, the incidence of keywords, construction of keyword trees, and a survey on the evolution of the term Edtech (Ferreira, 2010).

In the second analysis, focusing on qualitative aspects, the selection of articles involved an initial stage of identifying adherence to the research question. For this, all the articles’ titles and abstracts were read. At this stage, two articles were excluded from the sample as they focused on techniques for developing technologies for Edtechs and did not help answer the research question about the concept of Edtechs .

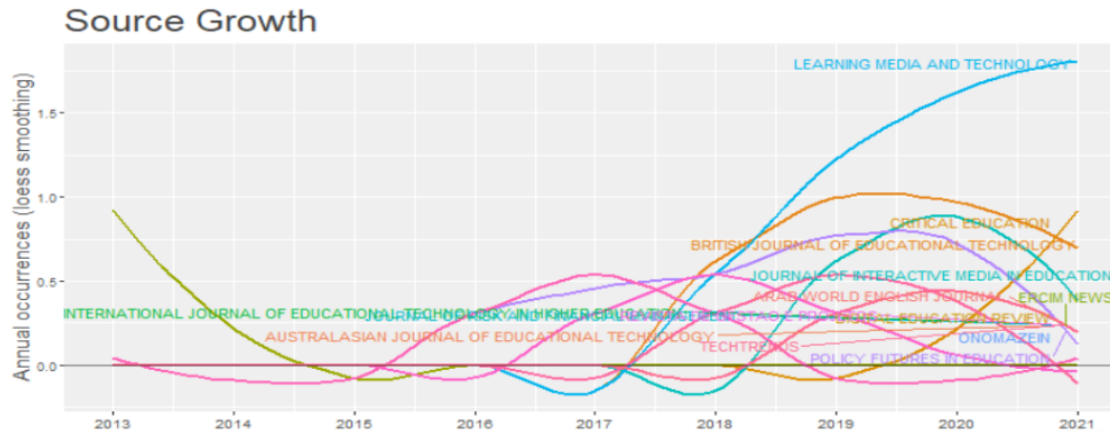
The development of the qualitative analysis of the publications consisted first of classifying them as defined throughout the reading of the titles and abstracts of the articles, namely: "Edtech Concept," "Mindset Change," "Literature Review," "Technology," and "Technology and Learning." Then, the articles were read in full to identify the critical articles that conceptualized Edtech. This reading was also essential to confirm previously established categorizations. With the previous reading of the title and abstract during this process, it was necessary to reshape the categories that were previously built, with the final categorization being Context, Edtech's proposals, and Educational Technologies in Edtech.

2 ABOUT THE STUDIES

Edtech was first used in scientific articles in 2013 and had the highest number of scientific productions in 2019 (13 articles). This demonstrates that the term is recent, and that interest has increased recently. Interestingly, in the first article published, the word Edtech appears only once, and it was used only to mention a site. In this article, it is possible to notice that the author focuses on the educational technologies being applied by educational institutions, not on the concept of Edtech.

Regarding the sources of publication of the articles, there is no concentration of publication in journals. However, it is worth highlighting Learning Media and Technology, which participates with the publication of five articles, and the British Journal of Educational Technology and Policy Futures in Education, with three articles published each. As can be seen in Chart 1, these journals have been showing annual growth outside the average. The other sources (33) have one article published each. As for the four journals with the highest number of publications, three focus on adopting educational technologies. By inference, we concluded that the concept of Edtech emerges from educational technology.

Chart 1 - Annual Growth of Periodicals



Source: elaborated by the authors (2023).

The distribution of publications by the author indicates that in 2013, the production concentration followed a single author (Spector, 2013). However, this concentration has been decreasing over the years, and regarding the country of the corresponding author, noticed that Americans published 26.67% of the articles, 15.56% of the articles published by British, 6.67% by French, 6.67% by Spa in , 4.44% by Brazilians. However, the Brazilian articles still need citations, demonstrating the low relevance of Brazilian productions in the international environment.

Spector's article (2013) is the most cited (30 times). Its most significant contribution, however, is not due to the concept of Edtech, the focus of this literature review, but rather the analysis of technology in facilitating personalized teaching and better assessment of learning through data analysis. Although the author emphasizes the importance of technology, he makes it clear that it is unwise to place faith in educational progress coming only from technologies, regardless of how powerful and promising they are. Collaborating with those interested in the learning process is essential, such as teachers, designers, administrators, policymakers, and parents.

Table 1 - Edtech's literature: Most Cited Authors

Title	Authors (Year)	Total citations
Emerging educational technologies and research directions	Spector (2013)	30
Cruel optimism in edtech: when the digital data practices of educational technology providers inadvertently hinder educational equity	Macgilchrist (2019)	14

Designing educational technologies in the age of AI: A learning sciences-driven approach	Luckin and Cukurova (2019)	13
Broad online learning EdTech and USA universities: symbiotic relationships in a post-MOOC world	Thomas and Nedeva (2018)	8
Technocentrism and social fields in the Indian EdTech movement: formation, reproduction and resistance	Burch and Miglani (2018)	7

Source: elaborated by the authors (2023).

It is curious to note that, after this initial period, articles published in the area were again cited more frequently in 2019. This time with more excellent dispersion (not just emphasizing Spector's publication). Of note in this group are the articles published by Luckin and Cukurova (2019), relating to studies carried out at the accelerator Startup Educate, headquartered in London, to identify a pattern of artificial intelligence implementation by educational institutions. The results suggest that Edtechs seek to improve student outcomes and reduce the performance gap between advantaged and disadvantaged students, provides real-time data for teachers and reduced workload for faculty, and puts spaced learning into practice, which is the principle that learned information when it is taught in short time intervals and repeated several times (Luckin; Cukurova, 2019). In another article by Cukurova, Luckin and Clark-Wilson (2019) involving 96 companies, pedagogical change is identified as the core of the technologies applied by Edtech, both because their design evolves but also for the reason of transforming the students' experience.

Thomas and Nedeva (2018) sought to analyze the symbiotic relationships between Edtechs and educational institutions, such as Coursera, Udacity, and Minerva, allowing the provision of quality education to more people. On the other hand, a group of authors highlights the negative aspects of Edtechs, such as the work of Burch and Miglani (2018), who criticize commercialization and ethnocentrism through the excessive use of quantitative data for learning assessment. Furthermore, they cite the need for more rigorous research on the impact of technology-based interventions on equity, which could be a good gap for future research. In this group of Edtech's critics, the works of Regan and Jesse (2019) on ethics and privacy in big data and learning analysis stand out, as well as those of Regan and Khwaja (2019) on venture investors. Although, according to them, Edtechs improve student learning, presenting students with more engaging classes and allowing personalized instruction, they criticize the commercial nature of these

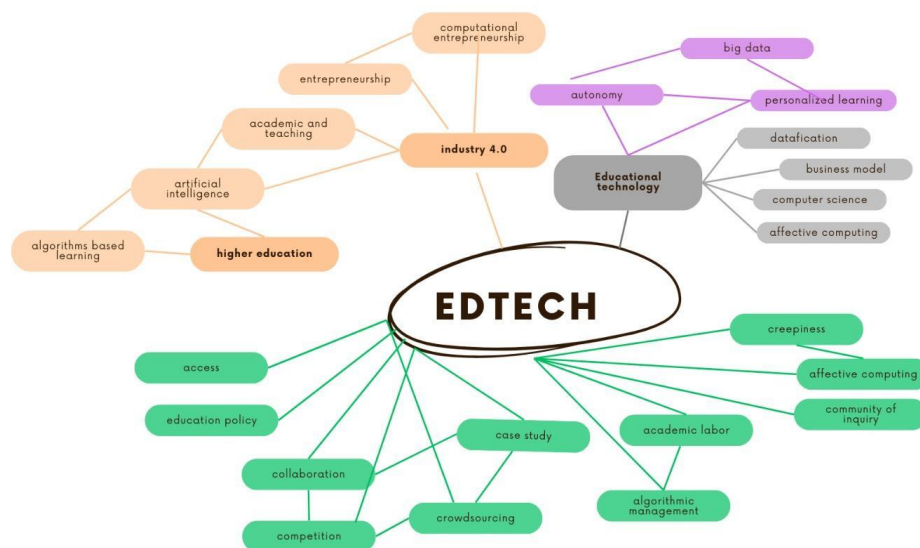
institutions In this line of ethical aspects, they bring exciting questions for discussion, among them the problem of data privacy, since Edtechs collect detailed data from students, teachers, and family members, as well as administrative details about the functioning of institutions of teaching.

In opposition to the ideas of Regan and Jesse (2019), Macgilchrist (2019) states that Edtechs do their best to maintain data privacy by programming anonymously so that it does not even find students' names individually. The author also states that even with data analysis technologies, human decision-making imposes itself on the data provided by the machine, with the man being the focal point.

3 DATA ANALYSIS

A keyword network map was generated before starting the in-depth qualitative analysis of the articles. The objective was to verify the relationships between the words, which may offer additional clues about the Edtech's concept. As presented in Figure 1 most of the words are related to educational technology, Industry 4.0, and behavioral skills (competition, collaboration, for example).

Figure 1 - Edtech's Conceptual Structure Map



Source: elaborated by the authors (2023).

Starting the analysis of the network map with the green block, the term Edtech is related to words that convey the idea of collaboration and the use of technologies, such as algorithm management and affective computing. In addition, it presents connections with educational policies, accessibility, and a critical line on technological literacy.

Regarding the orange block, the concept is related to three main words: higher education, industry 4.0, and entrepreneurship. In higher education, the analysis indicates that it is a business model based on learning through algorithms, assisted by artificial intelligence connected to Industry 4.0. In Industry 4.0, we perceive the relationship between teaching, entrepreneurship, and computational entrepreneurship. Finally, we will treat the blocks in purple and gray as being unique, as they both represent terms about educational technologies. The analysis allows us to conclude that they are business models that apply computer science technologies, such as big data and data analysis, to foster autonomous and personalized learning.

The macro analysis of the map enables us to conclude that even the educational technology reserved for blocks separated from the others (industry 4.0, collaboration, etc.), can be seen that it is always present in the other blocks. Thus, the conclusion is that technology is a crucial factor in Edtech (it works as an engine), but not the only one. When noticing words that suggest personalized, autonomous, and collaborative learning, it is possible to conclude that technology should be applied in a pedagogical proposal. In other words, technology must be seen as a tool that supports a Teaching-Learning value proposition.

Based on the evidence provided in the conceptual map presented (see Figure 1), we will begin the qualitative analysis of the articles published on Edtechs. The objective of the analysis is to identify new emerging categories.

When we delved into the reading of the articles, we realized that the pre-defined categories based on reading the title and abstract were discarded as they were superficial compared to the more profound investigation. It was noticed that the authors portrayed the context in which Edtechs. However, the majority of the articles fails to propose a clear definition of Edtech- in most cases there were only arguments from other authors, without explaining how they were related. The most recurring attempt made by the authors is to highlight the educational technologies applied or developed by Edtechs.

Upon realizing this structure, the following analysis was defined based on the respective aspects: i) context: environment, challenges, and trends; ii) technologies used by Edtech/ and iii) Edtech's purpose and impact.

Knowing the analysis categories, we will start the investigation with the category "Context" and work our way up to "Technologies applied by Edtechs"

4 CONTEXT: ENVIRONMENT, CHALLENGES, AND TRENDS

The COVID-19 pandemic intensified the technological wave in education and created ideal circumstances for online education advocacy groups to impose widespread automation in teaching in higher, elementary, and secondary education institutions (Ovetz, 2020), mainly in respect of decisions for governments to introduce remote and online learning during this period (Joshi *et al.*, 2021). In addition, traditional institutions constantly search for technological services to control their budgets, increasing the prominence of companies that sell educational technologies (Regan; Khwaja, 2019).

By introducing compulsory online classes, schools have sent students to learn at home. Teachers have started teaching working with online platforms out of necessity, opening the scope for exponential profits by companies that offer educational technologies (Moore *et al.*, 2021), and negatively affecting the educational system of countries (Joshi *et al.*, 2021) - constituting a phenomenon that enhances the process of industrialization of education (Mendonça Neto *et al.*, 2018).

It is evident that the pandemic is not the only motivator for the adoption of educational technologies; we live in a world where people expect to work, learn, and study at their convenience in terms of time and place (Spector, 2013). Furthermore, educational technology is sold as a core mechanism for improving access to quality learning for high-poverty populations. However, do technologies improve access to qualified for high-poverty populations?

There is a huge challenge in making educational technology accessible to everyone, mainly due to the lack of good internet connection, especially in less developed countries (Magnus-Ariyeyhner, 2020). Educational inequalities and the digital divide can challenge the stability of a knowledge society and need to be addressed (Spector, 2013). Teachers cannot assume that students have the necessary digital skills to complete

homework online or to participate in blended activities because not all students have the same technological background (Hockly; Dudeney, 2019). Furthermore, the rapid growth of the pace of information, resources, tools, and devices caused overload of work for teachers and students, resulting difficulties to they keep their knowledge and skills updated (Spector, 2013). Many teachers still need to gain skills and knowledge about educational technologies (Luckin; Cukurova, 2019), especially to analyze and understand data from the teaching-learning process (Renz; Hilbig, 2020). An educational marginalization generated by technology is then created, which can be epistemic, linguistic, of gender, or economic (Gallagher; Knox, 2019).

Therefore, while institutions apply educational technologies to scale learning, making courses more accessible, they promote existing socioeconomic inequalities due to the difficulty of using technologies or accessing the Internet (Macgilchrist, 2019; Magnus-Arytey; Cherner, 2020).

Nonetheless we can argue that more traditional educational technologies, such as those that seek to reproduce a video of a class recording or software that reproduces texts for reading, providing questions to fix or even fixed questions for students to answer based on a specific problem, have the potential to reach less favored people, since by scaling education offering, it will enable the institution to reduce the price. However, in addition to the risk of creating the possibility of marginalization for those who do not have the internet or who have difficulties using the platform, it forms a generation of people with a degree not enough skilled to get an adequate job. Bogoviz *et al.* (2019) mentioned this has occurred in traditional higher education institutions.

Despite technology being considered a way to provoke the marginalization of education, it is only possible to imagine the teaching-learning process by incorporating these technologies. Technologies are firmly integrated into students' lives outside the classroom, so it makes no sense to fail to apply them in the Teaching-Learning process (Spector, 2013; Hockly; Dudeney, 2018). However, for technology to have a real effect on students' lives, it is not enough for institutions to promote "technology for technology's sake", that is, not to apply technology for a pedagogical purpose, because if that happens, they waste their teachers and lose their students (Cherner; Mitchell, 2020).

Therefore, educational institutions should consider that companies require competency-level certificates and the skills acquired throughout the formation rather than

the diploma itself (Delgado-Crespo *et al.*, 2020). The proposal then should focus on improving current education and creating tomorrow's education through innovative digital pedagogies (Romero *et al.*, 2020). In this case, institutions need to adopt approach strategies that encourage and support the critical engagement of educators and students in the use of digital technologies, bypassing easy-to-understand clichés and adopting the complexity of human-technological interweaving (Drumm, 2019).

5 TECHNOLOGIES IN EDTECHS

There is a tendency for authors to conceptualize Edtechs as educational applications or popular applications of educational technology (Carton, 2019; Gonçalves *et al.*, 2020; Magnus-Aryitey; Cherner, 2020; Moore *et al.*, 2021). Others conceptualize it as educational technology (Mendonça Neto *et al.*, 2018; Hockly; Dudeney, 2018; Cherner; Mitchell, 2020; Mcstay, 2020). In a broad definition, Joshi *et al.* (2021) conceptualize it as an educational model of technologies where teaching and assessments are accomplished online. However, the most complete concept was given by Ramiel (2020), according to whom Edtech is an educational technology sector that promotes interventions in educational systems worldwide through disruptive innovations.

A vast group of authors advocate the use of technologies in Edtech. There are several reasons, including the possibility of boosting the growth of blended learning (online and face-to-face), as hardware and software become increasingly accessible regarding knowledge and cost (Hockly; Dudeney, 2018). However, users can also motivate the student. It is precisely the issue that Edtech are focused on; Socrative, Kahoot, and Plickers, for example, are used in classes and prove to be highly motivating learning tools (Delgado-Crespo *et al.*, 2020). In addition, they contribute to the reduction of educational inequality, recognizing the viability of access to education for students who were previously excluded from the system, either for financial reasons or because of the distance from educational centers (Wright; Peters, 2017; Mendonça Neto *et al.*, 2018; Burch; Miglani, 2018).

The educational technology that underpins learning analytics platforms originates in algorithms developed by marketers to direct internet users to personalized paths as they

browse the internet (Buchanan, 2020). Therefore, as in digital marketing, the educational technology applied by Edtech is focused on users.

Edtech, by using technology, promises to solve a long-standing problem in education: providing personalized attention (Mcstay, 2020). The Century platform, for example, personalizes learning for each student, recommending the topics that will most appropriately support them in a learning journey (Luckin; Cukurova, 2019).

Technology-mediated teaching and technology-enhanced learning can offer an adequate type of education at the same level as face-to-face teaching (Assaf, 2020).

It is worth mentioning that Edtech can offer software as a service (SaaS) in the field of incremental education (i.e. e-learning, micro-learning, virtual and augmented reality development, or game-based learning solutions) (Rernz; Hilbig, 2020), and seek to offer educational products and services for a broad range of users, such as children who are learning to read and write to people who desire more advanced knowledge throughout life (Thomas; Nedeva, 2018; Moore *et al.*, 2021).

Furthermore, technological developments such as artificial intelligence, machine learning, and learning analytics inevitably find their way into teaching and learning methods and require the development of data-driven digital business models. Edtechs constantly seek to measure, collect, analyze, and interpret data to develop teaching and learning solutions based on artificial intelligence (Renz; Hilbig, 2020). Data collection can go beyond analysis, such as providing learning alert mechanisms to share with parents and educators (Ruiz-Iniesta *et al.*, 2018). Thus, technologies can combat the restriction pointed out by Moore *et al.* (2021) that application platforms and formats restrict engagement with curriculum and students if they are not applied solely for scaling the business – as in traditional institutions.

Teaching and learning solutions based on artificial intelligence have the potential to drastically change education, mainly because they contribute to personalization (Renz; Hilbig, 2020). However, the solutions must be heavily studied and mostly validated by their users.

6 PURPOSES AND IMPACTS OF EDTECHS

The purposes and impacts of Edtechs are all facets of education, such as learning analytics, creating learning paths, assessment and testing, career planning, curriculum

development, student admissions, developing courseware and learning management systems, mathematical and scientific literacy initiatives, production of educational textbooks, and publication and distribution of research (Thomas; Nedeva, 2018).

However, are the purpose of Edtechs the same as those of traditional educational institutions that apply online learning to scale their businesses?

If we consider that yes, they are the same, the focus would be only on increasing the number of students, while teachers remain the same amount,, this should probably result in a reduction of professionalism and the quality of content – thus changing the "meaning" of education, which should be the construction of knowledge (Moore *et al.*, 2021). In this way, Edtechs would see education as a commodity, improving the formalization of the educational process and receiving the "scale effect" (Bogoviz *et al.*, 2019), reducing costs as they sell their services or products more. There are examples of these cases, such as EkStep (Indian Edtech), which is testing a technology-based project of a literacy program for future large-scale implementation (Burch; Miglani, 2018). Other examples are even better-known Coursera and Veduca.

It is common knowledge that for some authors, Edtech are interpreted as a form of world domination of education, using the universalist approach to knowledge, ignoring the way knowledge is culturally and relationally constructed (Gallagher; Knox, 2019; Moore *et al.*, 2021). However, is the fact that these companies seek to scale the only aspect worth mentioning? Even if the answer is yes, the search for scale in a highly competitive educational environment requires that Edtechs have some differences from universities since the latter already offer distance education at low monthly fees. To conquer this differential, Edtechs aspire not only to serve or support the educational system but to change it profoundly, to interrupt it through the culture of startups and the high-tech industry (Ramiel, 2020; Gonçalves *et al.*, 2020; Buchanan, 2020). Their structures combine new skills and abilities to be taught (Cherner; Mitchell, 2020).

Edtechs seek different directions to amplify the existing system and uncover "dead" areas unexplored by other institutions, which can expand education possibilities (Ramiel, 2020). The search for profit happens, but at the same time, they work with purposes, delivering value to society, which is the ideal and desired combination in the corporate world (Gonçalves *et al.*, 2020).

Edtechs are looking for solutions to everyday crises, such as low literacy rates in underdeveloped countries and rising employability rates. Thus, they propose a connection between the traditional model of education and real-world experience to enable students to work in an economy that values innovation and leadership (Mendonça Neto *et al.*, 2018; Moore *et al.*, 2021). When offering these solutions, they focus on the user, teachers, and students. These companies always try to think, define, explain, and imagine users: Who are they? What do they want or need? What is their "pain"? What are their habits? (Thomas; Nedeva, 2018; Ramiel, 2017; Mattsson; Andersson, 2019). Therefore, Edtechs offers a simple value proposition that the consumer can understand.

Sensavis (an example already mentioned), with its value proposition captured by the slogan "Teach—Create—Activate," is an example of Edtech that seeks to solve a current problem in education: personalizing teaching while allowing inclusion.

Furthermore, for the value proposition to be adequate to what the consumer needs, Edtechs develop services in cooperation with their consumers. Companies often partner with schools to test new products, with the idea that such tests will improve the products and student learning. They take the opportunity to capture the accumulated experience of educators, the needs and desires of students and teachers; as well as the peculiarities of the local context (Regan; Khwaja, 2019; Ramiel, 2017; Mattsson; Andersson, 2019; Cukurova; Luckin; Clark-Wilson, 2019; Renz; Hilbig, 2020).

Integrating technology also characterizes Edtech pedagogical methods to bring innovation and enhance learning, involving the student more through deeper learning (Howard, 2019; Macgilchrist, 2019; Gonçalves *et al.*, 2020; Cherner; Mitchell, 2020; Renz; Hilbig, 2020). Sensavis, for example, works on three pillars of education: interactivity, audition, and visualization. Tynker, the American Edtech that enables students of all ages to learn to code at home, at school, or on the road, focuses on providing students with a better foundation in computer, programming, and critical thinking skills so that they are prepared to the future (Regan; Khwaja, 2019; Mattsson; Andersson, 2019). These examples make clear that Edtech's central proposal is not the search for profit at any cost but the educational purpose.

But how can Edtechs improve learning? Technology is a key part of this process. These institutions apply technologies to personalize teaching, offering customization to each user and performing learning analyses to individualize student education, offering

differentiated classes based on the pace of individual learning (Carton, 2019; Buchanan, 2020). In addition, they seek at all times to accumulate detailed information about students' data and learning records (including not only grades but also about individual learning and testing standards) to increase the quality of teaching (Burch; Miglani, 2018; Regan; Jesse, 2019). It should be noted that it is not just disseminating content as commodities but personalizing it to each student.

By integrating technology with pedagogical methods, Edtechs promotes the improvement of teaching, which already brings great motivation due to its ability to contribute to changing a social reality (Gonçalves *et al.*, 2020). Therefore, Edtech have a social mission to mobilize new technologies to transform and improve the scope and quality of teaching and student's life and career prospects. Coursera, for example, envisions a world where anyone, anywhere, can transform their lives by accessing the world's best learning experience (Thomas; Nedeva, 2018). Analyzing Coursera's proposal, it is possible to see that EdTts generates more opportunities for people by democratizing quality education. In addition, they seek to improve student outcomes and reduce the performance gap between economically advantaged and disadvantaged students (Luckin; Cukuova, 2019; Gonçalves *et al.*, 2020).

The possibilities for monetizing services are many. Edtech sells technological services for public and private education (Moore *et al.*, 2021), publishing services for teachers and companies that want to offer training, and content distributed in the form of newsletters powered by teachers, blog posts, and news summaries (Carton, 2019).

Edtechs also seek to integrate partners necessary for the existence of their businesses. The notion of "community" is at the heart of business models (Carton, 2019). Software developers must work directly with educators to create applications built around pedagogy, with the teacher being a key agent in content creation (Carton, 2019; Magnus-Aryitey; Cherner, 2020). Partnerships with leading universities allow leveraging brands, reputations, and course materials.

Regarding the Edtech ecosystem, Cukurova, Luckin and Clark-Wilson (2019) defined it as composed of a golden triangle: developers, researchers, and users (students and/or educators). The researchers seek to communicate the results of their research with companies and education professionals to demonstrate the impact. Developers are looking to check the research evidence and find out what teachers and students think

about the effectiveness of their product. Users, in turn, seek to discover which technologies work to deliver the best learning outcomes.

Edtechs have growth opportunities and can test and innovate products, services, and processes (Gonçalves *et al.*, 2020). This fact is due to the points mentioned above, as well as to how work is organized and the profile of its employees. The organization of work at Edtech takes place through squads composed of multidisciplinary professionals, who focus on problem-solving (Gonçalves *et al.*, 2020), as well as a profile focused on curiosity, engagement, and excitement (Ramiel, 2017). Collaboration is critical to the success of Edtech (Delgado-Crespo *et al.*, 2020; Gonçalves *et al.*, 2020), but technology is no less critical. Technologies are, in fact, a condition of existence for these companies, as they allow the personalization of teaching, among other things.

7 FINAL CONSIDERATIONS

The main conclusion of this review of literature is that the concept of Edtech can be interpreted as recent and multifaceted. Data from publications on the subject indicate that it is recent, with the first publication in 2013, although the objective of conceptualizing the term still needs to be determined. The publications grew yearly and reached the highest level in 2019 (13 articles). Regarding the sources of publication of the articles, there is no concentration of publication in journals. However, it is worth highlighting Learning Media and Technology, British Journal of Educational Technology and Policy Futures in Education, as references for publication. The analysis of the publications distribution by author points out that in 2013, production concentrated on a single author, but this concentration has been decreasing over the years. The authors who most publish on the subject are Americans, followed by British.

Based on keyword analysis, we can summarize the main characteristics that define an Edtech through the following propositions:

Proposition 1: Edtechs are based on the offering of solutions to current problems in education, based on the real-world experience of users;

Proposition 2: The solutions offered by edtechs are based on cooperation with the entire ecosystem;

Proposition 3: The results of the solutions offered by Edtechs are autonomous and personalized learning together with follow-up to improve the quality of teaching and learning.

The search for the concept of Edtech led to the conclusion that the focus on technology can be attributed to companies that apply technologies in learning analysis, to create learning paths, evaluate the teaching-learning process, carry out career planning, develop curriculum, carry out admission of students, develop didactic material, among other products/services. These companies are responsible for promoting interventions in educational systems worldwide through disruptive innovations.

When noticing words that suggest personalized, autonomous, and collaborative learning, it is possible to conclude that technology should be applied in a pedagogical proposal and looking for social impact, such as improvement of literacy rates in underdeveloped countries and increased employability rates. Technology is an important factor in Edtech (it works as an engine), but not the only one. However, to be an Edtech, more than applying technology in educational processes is required.

This systematic review of literature can help not only researchers understand the Edtech concept but also entrepreneurs and managers, helping school managers understand the current context in the education sector and be the basis for adopting trends driven by Edtech. In addition, Edtech have a social mission to mobilize new technologies to transform and improve not only the scope and quality of higher education but also students' life and career prospects.

Despite the relevant contributions of this research, some research opportunities remain open. One such opportunity is conducting empirical research to investigate how Edtechs are implementing their proposals in practice, focusing on the challenges faced and successes achieved.

Furthermore, there is a dearth of rigorous research on the impact of technology-based interventions and their implications for equity. This should be conducted first by qualitative research involving educators, students, and school administrators to explore their perceptions, attitudes, and experiences regarding the use of educational technologies is also relevant

Additionally, future research should be conducted regarding implementation of the business models of these companies, since they need integration both with partners,

providers of specific skills the company lacks, students and educators; These collaborations require an entire new approach to structure business. both

Since Edtechs develop disruptive technologies, new studies are needed to verify the viability of changes through digitalization, such as the barriers that these companies may face and even practical studies to show how they managed to overcome these barriers.

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