The soft skills bases in digital academic entrepreneurship in relation to digital transformation

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Abstract

Purpose – Digital technology changes the organizational structure of traditional firms, creating opportunities for entrepreneurship. These modifications are known as "digital transformation" (DT). In addition, higher education institutions (HEIs) are altering the form of student–lecturer and teaching–learning interaction, where DT restructures the bases of soft skills (SS). Since SS are difficult to measure, this study aims to analyze the bases of SS for digital academic entrepreneurship, responding to the following research question: What are the bases of digital academic entrepreneurship and how are they formed?

Design/methodology/approach – An extensive integrative review of the literature revealed that due to the editable, re-combinable, reprogrammable and generating nature of digital technology, the basis of DT, it is necessary to develop SS in higher education students.

Findings – The results show that the competencies can be developed considering three major groupings: (1) individual characteristics, (2) cultural characteristics and (3) knowledge sharing.

Practical implications – Since SS are not easily taught, this study shows how the use of digital tools can help and support this type of process. It is suggested, therefore, that those in charge of HEIs should use the pillars presented in the framework proposed here to guide their institutions' strategic planning. With these pillars in mind, the aim is to stimulate an entrepreneurial mentality in students and develop digital academic entrepreneurship.

Originality/value – An innovative conceptual model of digital academic entrepreneurship is proposed from the perspective of SS, where the interlinking of those groupings is permeated by DT, as well as the disruptive role of digital technology, leading to the development of an entrepreneurial mentality in HEI students.

Keywords Soft skills, Digital academic entrepreneurship, Entrepreneurial mindset, Digital transformation

Paper type Conceptual paper

1. Introduction

New digital technologies have changed the organizational structure of companies and created opportunities for the growth of new businesses through innovation (Nambisan & Baron, 2013).

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Therefore, organizations must immediately digitize their processes, products and services to remain competitive (Mancha & Shankaranarayanan, 2020). On this wise, organizations create more agile processes, streamlining and turning more dynamic the decision-making process (Huang, Henfridsson, Liu, & Newell, 2017) and increasing the uncertainty of the entrepreneurial process (Nambisan, 2017). This context of change, through digital technology, is called digital transformation (DT).

DT changes organizations, the market, job types and training needs and has a direct impact on doing business and on the type, quality and direction of teaching in higher education institutions (HEI), as a new collaborator emerges: the individual with an entrepreneurial mentality (Secundo *et al.*, 2019; Toniolo, Masiero, Massaro, & Bagnoli, 2020).

These entrepreneurial-minded individuals are essential for today's digital organizations, as they are reflective agents who perceive an alternative future without forgetting established practices and trajectories (Henfridsson & Yoo, 2014). Companies such as Alphabet, Amazon, Apple, Netflix and Tesla Motors, which depend on digital technology, create opportunities for these knowledge contributors (Mancha & Shankaranarayanan, 2020).

Considering this DT context in the market, HEIs now aim to develop digital academic entrepreneurship in their business and social ecosystems (Toniolo *et al.*, 2020). These ecosystems aim to equip individuals not only with hard skills (a set of competencies recognized as valid, for example, diplomas, certificates and others) but also develop the so-called soft skills (SS) (a set of competencies intrinsic to individuals: motivation, traits, aptitude, aspects of self-image and social role).

Digital academic entrepreneurship is a growing field of study, as seen from the research carried out (e.g., Monllor &Soto-Simeone, 2019; Rippa & Secundo, 2019; Secundo, Rippa, & Cerchione, 2020a; Secundo, Rippa, & Meoli, 2020b; Toniolo *et al.*, 2020). The opportunities created by DT (Giones & Brem, 2017) support this tremendous research interest, where daily interactions between digital technology and entrepreneurship create a new socio-technical paradigm (McAdam, 2020; Elia, Margherita, & Passiante, 2020), transforming not only organizations but also social relations (Nambisan, Wright, & Feldman, 2019). However, scholars must study digital academic entrepreneurship from a multi-disciplinary perspective, including literature from various disciplines such as information systems, political science and psychology. In addition, scholars should analyze this phenomenon at the micro and macro levels (Toniolo *et al.*, 2020). Therefore, this study aims to fill this gap in the literature, by identifying the SS structural pillars of digital academic entrepreneurship. Through identifying these pillars, the study provides an understanding of what happens internally in HEIs concerning each pillar, how they are formed and worked on, and in this way, transferred to the market in the form of academic entrepreneurship (Garcez, Silva, & Franco, 2022).

Therefore, this study intends to answer the following research question: *what are soft skills (SS) bases for digital academic entrepreneurship, and how are they formed and related?* Consequently, it aims to propose a model presenting the structural bases of SS in digital academic entrepreneurship, from digital transformation/digital technology and show the relationship between these structural pillars.

2. Literature review

The market, new firms and entrepreneurship have become digital and require SS. These components (for example, creativity and innovation) are more challenging to teach, as they depend on the person's individual and cultural characteristics.

Indeed, this perception of individual and cultural characteristics is crucial for developing entrepreneurship (Nambisan & Baron, 2013) since they allow the development of an entrepreneurial mind. Entrepreneurial-minded individuals select feasible objectives, keep a consistent and persistent focus, accurately interpret their performance and progress feedback and adjust their actions (Nambisan & Baron, 2013).

So HEIs have understood the need to create a type of education where individuals' self-directed learning must be a fundamental competence (Morris & König, 2020). Entrepreneurship education should allow the development of new behaviors, habits and beliefs (Daniel, 2016) in teaching that allows knowledge sharing.

Digital academic entrepreneurship emerges from the potential intersection of academic entrepreneurship and digital technology. Such an intersection creates a socio-economic and technological phenomenon that changes the traditional forms of academic entrepreneurship (Rippa & Secundo, 2019; Giones & Brem, 2017; Nambisan, 2017; Nambisan, Lyytinen, Majchrzak, & Song, 2017). Here, the role of HEIs, as agents of the transfer of knowledge and technology, is fundamental, to stimulate digitalization and innovation in the business ecosystem and society (Toniolo *et al.*, 2020). This phenomenon involves many stakeholders, as the new digital technology makes it possible to identify entrepreneurial opportunities and develop business processes in the university ecosystem (Secundo *et al.*, 2020a, b).

In universities and other HEIs, digital entrepreneurship takes the form of "Digital Academic Entrepreneurship," the result of the intersection of DT and digital entrepreneurship in the academic context. Digital academic entrepreneurship is the type of entrepreneurship carried out from digital skills and competencies (hard skills and SS) developed in the university environment, regardless of the associated digital technology (Nambisan *et al.*, 2017; Rippa & Secundo, 2019).

SS are related to a set of personal competencies, behaviors, attitudes and qualities that allow people to adapt effectively to their environment (Khaouja, Mezzour, Carley, & Kassou, 2019). These characteristics are crucial to developing an entrepreneurial mentality in students (Edelman, Manolova, & Brush, 2008). They also stimulate the development of an entrepreneurial and innovative university focused on business education (Yashin, Klyuev, & Bagirova, 2018).

No institution can achieve entrepreneurship through a single individual's motivation. Entrepreneurship depends on environmental conditions (Franco & Haase, 2009) and cultural factors that influence the decision to embark on a business career (Franco, Haase, & Lautenschläger, 2010). In addition, the combination of digital technology, university research (Giones & Brem, 2017) and stakeholders' knowledge-sharing in developing commercial applications can be a source of income for HEIs (Etzkowitz, 1998). Universities can support this process, as they must add social value (Giones & Brem, 2017), creating collective entrepreneurship.

In this context, behavior and knowledge and the combination of digital technology and university research can result in socio-economic phenomena (Giones & Brem, 2017) that companies can use in commercial applications and generate income for universities (Etzkowitz, 1998). Universities and other HEIs should share that knowledge using various artifacts, including digital ones.

3. Methodology

This study uses the methodology based on an interdisciplinary literature review (Torraco, 2005). We based the protocol for the data collection on the methodology of a systematic literature review. At the same time, the interdisciplinary analysis and synthesis followed the principles of an interdisciplinary literature review (Sundqvist-Andberg & Åkerman, 2021).

New, emerging and not yet consolidated topics (Snyder, 2019), where no strict norms exist, justify the choice of this integrative approach. The authors justify this approach because digital academic entrepreneurship is relatively new (Secundo *et al.*, 2020a, b).

Figure 1 shows the three stages of the protocol followed in selecting the literature.

Stage 1: formulating a list of potential keywords highlighting the research question to define the limits for the bibliographic search and find the relevant research topics. This stage gathered articles shedding light on digital academic entrepreneurship, from the Web of

Science (WoS) database. We chose this database to maintain the structure of rigid criteria where they compile the data from quality, peer-reviewed journals.

We limited the preliminary search to the article title, keywords and abstract. Based on these keywords and the research question, we identified three main categories: (1) Digital Transformation and Education, (2) Digital Academic Entrepreneurship and (3) Soft Skills and Education.

We limited the principal bibliographic search in July 2021 to articles published in English, with no time restriction, to understand how SS influence digital academic entrepreneurship.

The main body of literature was derived from three search chains, using different combinations of search terms, and resulted in 113 articles, as presented in Table 1.

The articles were also analyzed using the following inclusion criteria: the article (1) relates SS with academic entrepreneurship and (2) presents a clear indication that digital transformation can change academic entrepreneurship. A complete reading of the articles resulted in an initial selection of 38 articles, of which 32 were included in the content analysis.

Stage 2: Here, data analysis followed an inductive approach, i.e. quantitative content analysis (Hsieh & Shannon, 2005). We also added seminal articles on SS and academic entrepreneurship through the snowballing process. The coding categories were (1) individual characteristics, (2) cultural characteristics and (3) knowledge sharing.

In this context, the 32 articles selected in this research are referenced in Table 2, presenting the main subject/problem discussed in each.

Stage 3: identified the frequently addressed topics in each category of the first coding phase, analyzing how these topics were related to digital academic entrepreneurship and SS. The corresponding author performed the initial coding using NVivo software to analyze qualitative data. In cases of diverging interpretations, two researchers deliberated and agreed on the coding categories and codes. Figure 2 shows the categories/topics.

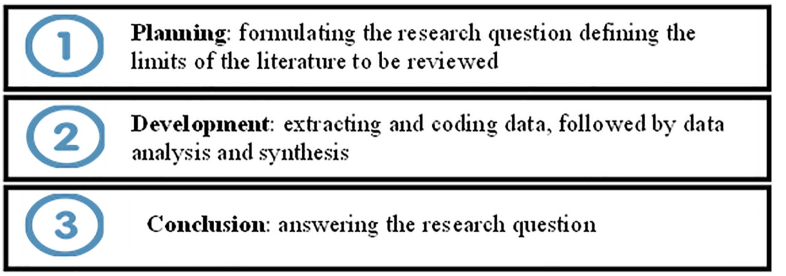


Figure 1.
Protocol for selecting the literature

Topics	Research equation	Initial *n*º of articles (Stage 1)	Final *n*º of articles (Stage 2)
Digital Transformation and Education and entrepreneurship	digital transformation or "digital technolog*" or "digitalization" and "education" and "entrepre*"	56	16
Digital Academic Entrepreneurship	"entrepre* academic digital"	7	7
Soft Skills and Education	"education entrepr*" and "soft skill*" and "compet*"	50	10
	Total	113	32

Source(s): Research Data

Table 1.
Search criteria and quantitative information about the articles selected

Author/Year*	Subject/problem discussed
Monllor and Soto-Simeone (2019)	Exposure to digital fabrication technology can increase students' business self-efficacy and raise their entrepreneurial intentions
Secundo *et al.* (2020a, b)	Understanding how digital technology can support the entrepreneurial process, stimulating entrepreneurial activity among students
Secundo *et al.* (2021)	Understanding how the COVID-19 crisis can reconfigure traditional education programs and how the pandemic created threats and opportunities for improvement in the educational system
Secundo *et al.* (2020a, b)	Review of the literature on Academic Entrepreneurship according to the perception of the use of digital technology
Toniolo *et al.* (2020)	Study how digital academic entrepreneurship is developed, exploring its evolution
Secundo *et al.* (2020a, b)	Understanding how digital technology can support the entrepreneurial process, stimulating entrepreneurial activity among students
Tomy and Pardede (2020)	Proposing a practical digital application for higher education to raise students' entrepreneurial intention
Rippa and Secundo (2019)	Contribute to building the emerging concept of Digital Academic Entrepreneurship
Linzalone, Schiuma, and Ammirato (2020)	Analyze the role of digital learning platforms to connect Universities and Firms effectively
Goncharov, Sekerin, and Elman (2020a), Goncharov, Sekerin, and Akhyadov (2020b)	Analyze the digital academic opportunities provided to students
Kaminsky, Yereshko, Kyrychenko, and Tulchinskiy (2021)	Understand the real impact of digital technology and intellectual capital in entrepreneurship education
Garcez *et al.* (2022)	Propose a technical framework showing the structural pillars of the link between digital transformation (DT) and academic entrepreneurship
Armuña, Ramos, Juan, Feijóo, and Arenal (2020)	Explore business competencies and their link with entrepreneurial intention concerning joining a business education and an incubation program
Costin, O'Brien, and Hynes (2019)	Present the role and influence of games simulation in the development of cognitive (knowledge and skills) and non-cognitive (attitudes) business competencies
Manning (2018)	Develop a conceptual framework and a set of hypotheses that reflect the dynamic relationships operating within an entrepreneurial land-based university and then conduct empirical research
CharrónVías and Rivera-Cruz (2020)	Propose a framework for the conception of business education programs, combining behavioral and business competencies, through experimental learning
Bischoff, Volkmann, and Audretsch (2018)	Examine business ecosystem stakeholders' collaboration in the business education in European higher education institutions (HEIs)
Butz, Hanson, Schultz, and Warzynski (2018)	Explore the relationship between grit and entrepreneurial intent
Hsieh and Kelley (2019)	Identify the elements of university-based business ecosystems
Miles *et al.* (2017)	Address the role of accelerators as authentic business training programs based on learning

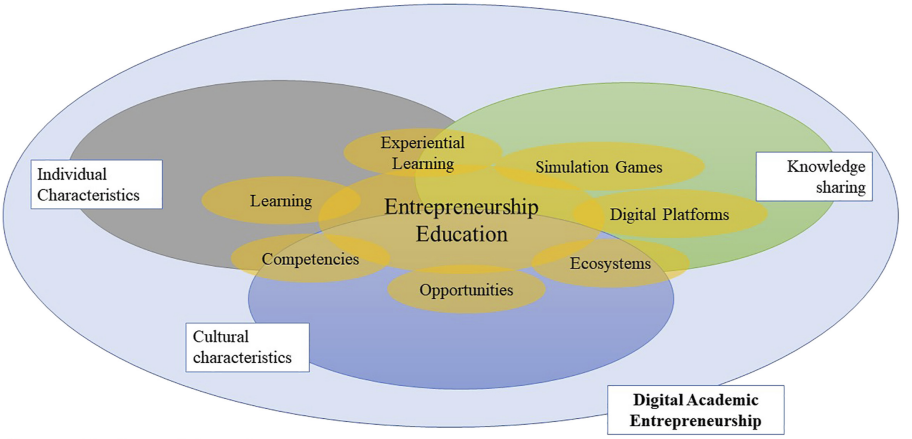
(*continued*)

Table 2.
Problems addressed by each author who supported the research

Author/Year*	Subject/problem discussed
Ndou, Secundo, Schiuma, and Passiante (2018)	Understand the "how, when, why and what" of the entrepreneurial mentality and competencies in technological entrepreneurship as learned in the Entrepreneurship Centers
Donaldson, Villagrasa, and Sánchez (2021)	Study the variable of student motivation – in entrepreneurial education
Gifford (2021)	Detail Customer Development, as a tool for entrepreneurial education
Hägg and Kurczewska (2020)	Develop discussion about the need for and role of orientation in learning and teaching for entrepreneurship education
Mets, Holbrook, and Läänelaid (2021)	Propose a conceptual model to apply Education for Entrepreneurship and Green Transformation Competencies
Peschl, Deng, and Larson (2021)	Outline a pedagogical approach to business education, focusing specifically on students who do not necessarily see themselves as entrepreneurs
Ayob (2021)	Examine the effect of entrepreneurial education on the student entrepreneurship rates
Stenholm, Ramström, Franzén, and Nieminen (2021)	Study how the teaching methods of lecturers and non-entrepreneurs in the management schools adapt unconsciously to the known framework of entrepreneurial competencies
Schou, Bucher, and Waldkirch (2022)	Understand how entrepreneurs grasp the new opportunities of digital learning
Sansone, Ughetto, and Landoni (2021)	Explore the impact of extra-curricular business activities on students' business intentions
Ratten (2020)	Highlight that entrepreneurship education must change based on digital transformation and the recent COVID-19 crisis
Samwel Mwasalwiba (2010)	Make a survey of publications on entrepreneurship education and assess the alignment of perceptions

Note(s): * Check full details in References section
Source(s): Research Data

Table 2.



Source(s): Own elaboration

Figure 2.
Synthesis about categories/topics identified

4. Proposal of a Framework of Soft Skills for Digital Academic Entrepreneurship

New digital technology has changed organizational structure (Nambisan & Baron, 2013), and a new business spirit can be created (Song, 2019). So, the need arises for individuals with the capacities to act as agents of innovation. This situation separates and differentiates digital entrepreneurship from the "traditional" form since digital entrepreneurship requires knowledge of digital technology (Hair *et al.*, 2012). Academic entrepreneurship is differentiated from business entrepreneurship in the form and context of business (Secundo *et al.*, 2020a, b), although both intend to commercialize business opportunities.

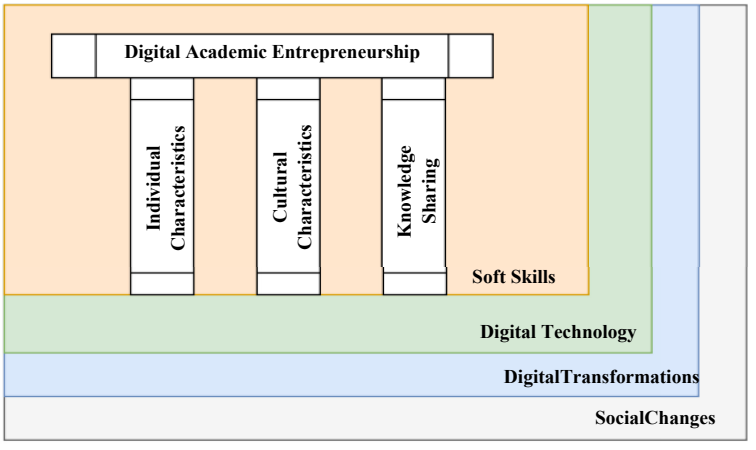
In this context, it is vitally crucial for HEIs to develop entrepreneurial competencies in their students, above all the SS to develop digital academic entrepreneurship. Exhaustive research (a literature review) allowed the construction of the following framework/model of digital academic entrepreneurship, based on SS. We grounded the model (Figure 3) on three constructs/pillars: (1) individual characteristics; (2) cultural characteristics; and (3) knowledge sharing:

4.1 Pillar 1 – individual characteristics

We understand the entrepreneurial mentality as the ability to be dynamic, flexible and self-regulating in dynamic, uncertain environments. Being entrepreneurial is a human process that depends on individuals' behavior and actions (Baron, Mueller, & Wolfe, 2016). The entrepreneur's cognitive factors can create mental corridors that influence how the latest information is interpreted (Shane, 2000). When individuals interpret this information, they can discover new business opportunities.

Nevertheless, being an entrepreneur is not just a question of accumulating knowledge (Schaefer & Minello, 2016). Scholars and academics should also consider the psychological factors, i.e., the way individuals perceive their capacities influences their form of acting (Lent and Hackett, 1987). Consequently, entrepreneurial individuals need to have a more positive perception of their capacities. Studies focused on the entrepreneur's characteristics produce several theoretical and empirical results in this respect (e.g. Baron *et al.*, 2016; Cardon & Kirk, 2015; MacKo & Tyszka, 2009).

Being an entrepreneur consists of developing values, attitudes and behavior, having ways of perceiving themselves and the surrounding scenario. It includes the aspects related to the



Source(s): Own elaboration

Figure 3.
Framework of soft skills for digital academic entrepreneurship

capacity to innovate, take risks, organize and re-organize social and economic resources to transform situations for practical benefit, learn from mistakes and persevere before uncertainties, challenges and opportunities (Schaefer & Minello, 2016). Therefore, this is one more dilemma of education for entrepreneurship, giving rise to whether professors can teach entrepreneurship.

Hägg and Gabrielsson (2019) show that empirical studies began to appear in the early 1990s, confirming that professors can teach entrepreneurship. Leading academics and well-known subject-matter experts have been complementing this perception since 2010, by recognizing the capacity of mentors/tutors to facilitate entrepreneurial learning (Hägg & Gabrielsson, 2019). Here, the main methods of teaching entrepreneurship are seminars, case studies and discussions (Samwel Mwasalwiba, 2010).

Effectiveness of entrepreneurship education should be ensured by (1) a classroom culture that promotes collaboration, creativity and autonomy; (2) aligning methodologies with teaching standards and specific learning content within a coherent and balanced curriculum; (3) teachers' ability to adopt a radically different role in the classroom, where they will act more as facilitators of the learning process than as traditional teachers; and (4) understand the student's conceptual level and background when dealing with students from different courses, to promote effective multi-disciplinary teams (Daniel, 2016).

Setting out from this outlook, more rational ideas and approaches based on practice are material that leading academics also transformed in teaching methods. Such as thought based on design-based thinking and lean start-ups (Daniel, 2016), business model canvas (O'Neill, 2015), MOOC platforms (Žur, 2020), Serious Game and laboratories with digital technology (Secundo *et al.*, 2020b). These tools and methodologies create the flows between the various models that offer entrepreneurship teaching (Hägg & Gabrielsson, 2019).

Research into business education has not produced consistent knowledge that can give suitable orientation regarding the methods that professors should use to teach SS (Hägg & Gabrielsson, 2019). Nevertheless, SS can be considered crucial in developing an entrepreneurial mentality (Edelman *et al.*, 2008).

Educators must decide which pedagogical approaches are most suitable for their teaching contexts, where lecturers' focus should be on stimulating practices of "knowing how to do" (Hägg & Gabrielsson, 2019) due to the complexity of entrepreneurship education (Ratten & Jones, 2021).

Universities should hold workshops (Secundo *et al.*, 2020a, b) and create centers for entrepreneurship education equipped with digital technology. They should also use immersion-based gamification on challenges (Buzady & Almeida, 2019) and implement digital technology entrepreneurship education programs (Secundo *et al.*, 2021).

This study understands digital academic entrepreneurship in a broad sense. It considers that its premises should promote the ecosystem of developing soft competencies in students due to the heavy load of tacit knowledge needed (Ratten, 2020; Haase & Lautenschläger, 2011), adding the need for relational capital (Toniolo *et al.*, 2020). HEIs should promote (1) extra-curricular activity (for example, participation in the academic association, training courses/laboratories for entrepreneurship, academic mobility, sport or courses to develop personal competencies); (2) participation in the labor market (for example, holiday work, part-time work and work placements in the summer); and (3) voluntarism (for example, volunteering in cultural, recreational or student associations) promotes entrepreneurship.

4.2 Pillar 2 – cultural characteristics

Culture is a set of unique resources to create action strategies (Swidler, 1986) and can be a trigger to perceive entrepreneurial opportunities. Business activity depends not only on entrepreneurs' individual characteristics (Crecente-Romero, Giménez-Baldazo, & Rivera-

Galicia, 2016) but also on the environment (Franco & Haase, 2009). Cultural factors influence the decision to embark on an entrepreneurial career (Franco *et al.*, 2010).

Depending on the environment in which entrepreneurs are inserted, their motivation to create a business may change. Need situations usually push individuals towards entrepreneurship. It is the best option available (Li, Huang, & Song, 2020), occurring in adverse social and economic environments where opportunities are limited (Angulo-Guerrero, Pérez-Moreno, & Abad-Guerrero, 2017).

Opportunity entrepreneurship has opposite assumptions to those of "out of necessity," and occurs more frequently in developed countries, where the state is more robust and is based on innovation (Middermann & Rashid, 2019).

Concerning female entrepreneurship, women are less present in developed countries. According to the Global Entrepreneurship Monitor (2018), on average, only 20.4% of those between 18 and 64 showing the intention to create a new firm are women. This gap is significant in universities, making it necessary to stimulate the entrepreneurial intentions in all students irrespective of gender. That scenario is changing slowly (Mowery & Sampat, 2005).

Whatever the type of motivation for being an entrepreneur, the perception of personal satisfaction and well-being is similar. The main difference lies in profitability (Amorós, Cristi, & Naudé, 2021). Individuals' satisfaction supports the perception of well-being in fulfilling their creative potential and creating innovation, making the relation between culture and technology mutually influential (Leonardi & Barley, 2008). Here, entrepreneurs can increase the entrepreneur-opportunity relation through digital technology (Giones & Brem, 2017).

Thus, DT changes society, the economy and entrepreneurship and can start from the HEIs in this phenomenon known as digital academic entrepreneurship (Rippa & Secundo, 2019). From commercialization and the creation of value (Etzkowitz, 2017), universities have developed and created patents, licensing, new undertakings, technology transfer and science parks, promoting the local economic development (Rothaermel, Agung, & Jiang, 2007) with an impact on the local culture.

In these circumstances, digital academic entrepreneurship can give a perspective of added social value (Giones & Brem, 2017), i.e. the perception of more collective entrepreneurship that can be created by including different stakeholders (Rippa & Secundo, 2019). It can favor high-tech entrepreneurship and creative entrepreneurship on a small scale (Luckman, 2008).

Indeed, by using digital technology, such as Facebook, university researchers can identify business opportunities at the global level (Rippa & Secundo, 2019). Other social networks can also support the learning of competencies of socio-cultural involvement and civic impact on the students (Pavlova, Prichislenko, Kazin, & Hagen, 2016). Therefore, HEIs should promote the development of SS in their whole ecosystem for students, giving them the perception of the cultural context of entrepreneurship, starting from (1) digital competencies, (2) the perception of gender equality, and (3) the perception of entrepreneurial opportunities.

4.3 Pillar 3 – knowledge sharing

The knowledge generated by university research programs can be used for commercial applications and to generate income (Etzkowitz, 1998), from the attitude of entrepreneurs/researchers who look for business based on knowledge (Lam, 2010). University and industry can share knowledge through patents, academic spin-offs, individuals trained in entrepreneurial action and jobs created in the university's surrounding region (Siegel & Wright, 2015). These actions promote economic development (Goncharov *et al.*, 2020a, b; Rippa & Secundo, 2019; Rothaermel *et al.*, 2007).

The combination resulting from DT and university research can lead to socio-economic phenomena (Giones & Brem, 2017), which can support the dissemination of academic

research (Castillo Holley & Watson, 2017; Kalar & Antoncic, 2015; Siegel & Wright, 2015). Such a combination can thereby go beyond the perspective of commercializing science (Giones & Brem, 2017).

In this context, virtual educational platforms can support digital content development and its integration, online courses, simulators, 3D printers and others (Castillo Holley & Watson, 2017). Therefore, knowledge-sharing occurs between the university and entrepreneurs (Linzalone *et al.*, 2020), creating a web-based learning environment that provides just-in-time and personalized learning (Elia, Secundo, & Taurino, 2009). Social networks also provide opportunities to share entrepreneurial knowledge (Fischer & Reuber, 2011).

Fabrication spaces (fab-spaces) equipped with digital technology can also give students access to numerous types of equipment to make prototypes (Mortara & Parisot, 2016), which can end up disseminating the innovation developed between the university and interested parties (Giones & Oo, 2017).

This knowledge sharing causes, in the digital entrepreneur, the need to develop specific knowledge and competencies to face new business challenges, meaning they need to use self-learning strategies (Young, 2007). It is a fundamental competence for entrepreneurship (Morris and König, 2020). In this case, digital platforms can help to interlink academia and entrepreneurs in self-learning, updating their theoretical knowledge (Linzalone *et al.*, 2020).

For knowledge sharing, HEIs must provide their resources to support digital entrepreneurship (Goncharov *et al.*, 2020a, b; Schou *et al.*, 2022), with flexibility in time and space (Kaminsky *et al.*, 2021), using MOOC (Zur, 2020) and other digital platforms to connect the universities and firms (Linzalone *et al.*, 2020).

Therefore, in their whole ecosystem, HEIs should promote knowledge sharing and the development of soft competencies for students, through (1) the use of digital artifacts (platforms, simulation games and others); (2) activities outside the classroom (seminars, technical visits); and (3) participation in university-firm projects.

5. Conclusions, contributions and future agenda

According to Mancha and Shankaranarayanan (2020), individual characteristics are fundamental for identifying opportunities and adding value to the products and services. However, the cultural context to which the entrepreneurial individual belongs can be the trigger for entrepreneurial action (McAdam, 2020). This cultural context is complemented by how information is shared, supporting the stability of the process of digital entrepreneurship in dynamic environments (Li, Su, Zhang, & Mao, 2018; Toniolo *et al.*, 2020).

HEIs are an integral part of this context due to the new paradigm designated as the Entrepreneurial University (Rothaermel *et al.*, 2007). This type of university seeks to increase its financial sustainability and raise its social impact through entrepreneurship (Etzkowitz & Leydesdorff, 2000). In this university context, DT can support this process by stimulating entrepreneurial capacities in individuals.

Furthermore, entrepreneurship education is beneficial in such a context, since two elements are initial conditions in this process: (1) the emergence of an opportunity to be exploited economically and (2) an individual with the intention and who holds the characteristics to pursue that opportunity (Hannibal, Evers, & Servais, 2016). So, entrepreneurship education is prominent in the HEIs' curricula (Secundo *et al.*, 2020a, b), and the lecturers become aware of the entrepreneurship importance within the teaching institutions (Goncharov *et al.*, 2020a, b).

In a university environment, where the culture of entrepreneurship is structured on a solid basis, HEIs can ensure their sustainability, abandoning the perspective that digital academic entrepreneurship only concerns the commercialization of university research and understanding that this can be a broader strategy involving the creation of social value

(Giones & Brem, 2017). Given the abovementioned ideas, digital academic entrepreneurship should be discussed from a holistic perspective (Rippa & Secundo, 2019).

From an integrative study of the literature, this study concluded that three pillars support SS: (1) individual characteristics, (2) cultural characteristics and (3) knowledge sharing.

Since teaching SS is challenging, this study shows how digital tools can help and support this process. Therefore, we suggest that those in charge of HEIs use the pillars presented in the framework proposed here to guide their institutions' strategic planning. With these pillars in mind, the aim is to stimulate an entrepreneurial mentality in students and develop digital academic entrepreneurship.

This study makes contributions to theory and practice. From the theoretical point of view, it encourages the debate on digital academic entrepreneurship from a multi-disciplinary angle (Rippa & Secundo, 2019) and serves as an inspiration for future studies in the area. Digital academic entrepreneurship can positively impact regional development due to its direct effect on job creation and the development of regional infrastructure that can improve the population's quality of life.

At the practical and management level, the study also contributes to organizations understanding of how to take advantage of "fresh" ideas brought by students from the knowledge shared in HEIs. This knowledge transfer allows an entrepreneurial mentality that can be spread through the whole ecosystem, promoting business innovation and the creation of new digital undertakings. All those involved will have the opportunity to understand the phenomenon of digital entrepreneurship from a micro and macro perspective (Toniolo *et al.*, 2020).

This study is not without limitations. We are also concerned about not analyzing the boundaries and overlapping between the three identified pillars, as the selected database did not allow this type of conclusion. The speed with which knowledge occurs may be another limitation as it may be the case that other researchers have published valuable research related to the topics developed here in other places not listed on the database used (WoS).

Three suggestions for future research are as follows: (1) investigate the limits and overlapping of the three pillars of SS, proposing a qualitative approach resorting to interviews with specialists or a quantitative study using structural equation modelling; (2) study how digital academic entrepreneurship changes the social context, with socio-material theory as the background (Nambisan, 2017); and (3) measure the intentionality of digital academic entrepreneurship, from the relations constructed in this study supported by the theory of planned behavior (Ajzen, 1991).

In conclusion, the particularity of digital academic entrepreneurship opens countless research opportunities, but future work should recognize the complexity and richness of the topic.

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