



# **The Influence of the Structural Pillars of Digital Academic Entrepreneurship on University Students' Entrepreneurial Intention**

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## **Dedicatória**

À minha família.



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## Resumo

Face ao ambiente dinâmico, complexo e emergente que caracteriza o fenómeno do empreendedorismo académico digital, acelerado após a Covid-19, as tecnologias digitais tornaram-se indispensáveis nos processos educacionais. A partir das linhas gerais das teorias do Comportamento Planeado e Sociotécnica, o objetivo desta investigação foi analisar a influência do empreendedorismo académico digital na intenção empreendedora em estudantes universitários. De uma forma específica, foram realizados quatro estudos, a partir da seguinte questão de investigação: *Quais as influências dos pilares do empreendedorismo académico digital na intenção empreendedora dos estudantes universitários?* Os quatro estudos específicos tiveram por objetivos: (1) Mapear os estudos sobre o empreendedorismo digital, tecnologias digitais e transformação digital, e propor um modelo estrutural de análise para o empreendedorismo académico digital; (2) Propor um modelo conceptual de análise que permita avaliar a dimensão *Soft Skills*; (3) Propor um modelo conceptual de análise que permita avaliar a dimensão *Hard Skills* e (4) Analisar a influência dos pilares (*Hard Skills e Soft Skills*) do empreendedorismo académico digital na intenção empreendedora dos estudantes universitários e de que forma esta relação pode ser mediada pela teoria do comportamento planeado.

A estratégia metodológica adotada na presente investigação foi baseada num estudo exploratório, pois este tipo de estudo visa explicar as razões, ideias e motivações subjacentes ao fenómeno do “empreendedorismo académico digital e sua influência na intenção empreendedora de estudantes universitários. Para validar o modelo estrutural proposto nesta investigação, adotou-se ainda uma abordagem quantitativa, realizada numa amostra final de 761 estudantes universitários portugueses (51%) e brasileiros (49%); também foi utilizado o método de revisão sistemática da literatura, para compreender a amplitude e profundidade do corpo de trabalho existente.

A análise dos dados foi realizada através de análises fatoriais, exploratória e confirmatória, com o uso de modelos de equações estruturais. Os resultados permitem concluir que os pilares do empreendedorismo académico digital *Hard Skills* (Ferramentas de Gestão, Processos Digitais e Produtos Digitais) e *Soft Skills* (Características Individuais, Características Culturais e Partilha de Conhecimento), têm uma influência positiva direta e indireta na intenção empreendedora dos estudantes universitários. As evidências empíricas também sugerem que os efeitos diretos das

*Hard Skills e Soft Skills* são ligeiramente inferiores aos efeitos indiretos totais entre estes pilares e a intenção empreendedora, ao considerar as mediações da Atitude Empreendedora e Controlo Comportamental Percebido, e mesmo ao inserir as Normas Subjetivas como mediador com estas dimensões. Estes resultados levantam uma série de questões pertinentes que merecem a uma reflexão mais profunda e não apenas entre a comunidade científica e académica, mas também entre entidades políticas e governamentais. Esta investigação fornece ainda evidências importantes para expandir a educação empreendedora digital nas instituições de ensino superior, pois contribui para uma melhor compreensão da intenção e dos fatores que antecedem a formação desta intencionalidade entre os estudantes do ensino superior. Outras implicações para a teoria e prática são também apresentadas.

### **Palavras-chave**

Transformação Digital, Empreendedorismo Académico Digital, *Soft skills*, *Hard skills*, Teoria do Comportamento Planeado, Teoria sócio-técnica, Intenção empreendedora, Instituições de Ensino Superior.

# Abstract

In the dynamic, complex and emerging environment which characterises the phenomenon of digital academic entrepreneurship, accelerating in the post Covid-19 period, digital technology has become essential in educational processes. Setting out from the general lines of the Theory of Planned Behaviour and Sociotechnical Theory, this research aimed to analyse the influence of digital academic entrepreneurship on university students' entrepreneurial intention. Specifically, four studies were carried out from the following research question: What are the influences of the pillars of digital academic entrepreneurship on university students' entrepreneurial intention? The four specific studies aimed to: (1) Map studies on digital entrepreneurship, digital technology and digital transformation, and propose a structural model of analysis for digital academic entrepreneurship; (2) Propose a conceptual model of analysis to allow assessment of the Soft Skills dimension; (3) Propose a conceptual model of analysis to allow assessment of the Hard Skills dimension, and (4) Analyse the influence of the pillars (*Hard Skills* and *Soft Skills*-.) of digital academic entrepreneurship on university students' entrepreneurial intention and how that relation can be mediated by the theory of planned behaviour.

The methodological strategy adopted here was based on an exploratory study, as this type of study aims to explain the reasons, ideas and motivations underlying the phenomenon of digital academic entrepreneurship and its influence on university students' entrepreneurial intention. To validate the structural model proposed in this research, a quantitative approach was also adopted, using a final sample of 761 Portuguese (51%) and Brazilian (49%) university students. The systematic literature review (SLR) method was also used to understand the extent and depth of the existing body of work.

Data analysis was carried out through exploratory and confirmatory factor analysis using structural equation models. The results allow the conclusion that the pillars of digital academic entrepreneurship (Hard and Soft Skills) have a direct and indirect positive influence on university students' entrepreneurial intention. The empirical evidence also suggests that the direct effects of Hard Skills (Management tools, Digital processes and Digital products) and Soft Skills (Individual characteristics; Cultural characteristics and Knowledge sharing) are slightly less than the total indirect effects between these pillars and entrepreneurial intention, when considering the mediations

of Entrepreneurial Attitude and Perceived Behavioural Control, and even when inserting Subjective Norms as a mediator with these dimensions. These results raise a number of pertinent questions that warrant deeper reflection, not just in the scientific and academic community, but also among political and government entities. This research also provides important evidence to expand digital entrepreneurial education in higher education institutions (HEI), as it contributes to greater understanding of intention and the factors leading to formation of that intention among higher education students. Other implications for theory and practice are also presented.

**Keywords:** Digital transformation, Academic entrepreneurship, Soft Skills, Hard Skills, Theory of Planned Behaviour, Sociotechnical Theory, Entrepreneurial intention, Universities, HEI.

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# Acronyms

|           |                                 |
|-----------|---------------------------------|
| 3-D print | Three Dimension Printing        |
| AVE       | Average Variance Extracted      |
| CR        | Composite Reliability           |
| EFA       | Exploratory Factor Analysis     |
| HD        | Hard Skills                     |
| HEI       | Higher Education Institutions   |
| IoT       | Internet of Things,             |
| KMO       | Kaiser-Meyer-Olkin              |
| MOOC      | Massive Open Online Courses     |
| MRP       | Manufacturing Resource Planning |
| NGO       | Non-governmental Organization   |
| SEM       | Structural Equation Modelling   |
| SME       | Small and Medium Enterprises    |
| SS        | Soft Skills                     |
| TD        | Digital Transformation          |
| TPB       | Theory of Planned Behaviour     |
| WoS       | Web of Science                  |



# Chapter 1

## 1.1 Introduction

This chapter presents the justification and importance of the topic of Digital Academic Entrepreneurship and Students' Entrepreneurial Intention, as well as the objectives, methodology and theoretical perspectives guiding this research. Finally, the general structure of the thesis is presented.

## 1.2 Justification and Importance of the Study

Digital technology is present in all public and private organisations (Rippa & Secundo, 2019), changing business models and society (Nambisan et al., 2019; Zaheer et al., 2019). This phenomenon is known as digital transformation (DT) and creates a diversity of opportunities for entrepreneurship (Yoo et al., 2010), accelerating the entrepreneurial process (Nambisan, 2017; Yoo et al., 2010).

The entrepreneurial process is formed by joining two factors: the presence of opportunities and entrepreneurial individuals (Venkataraman, 1997). Entrepreneurial individuals must understand the DT context as an opportunity to develop innovative products/services. Indeed, the DT scenario means individuals must develop an entrepreneurial mentality (Jones & Iredale, 2010; Secundo et al., 2019; Tarabasz et al., 2018).

Higher Education Institutions (HEI) have also been affected by these transformations (Marks & AL-Ali, 2020). Regarding entrepreneurial education specifically, the impacts of DT are visible and require new didactic mechanisms that are suitably aligned in terms of the environment, technology and skills. In this way, HEIs prepare to teach entrepreneurship in the digital era (Secundo et al., 2020), bringing students closer to DT, i.e., teaching wide-ranging logic (computational thinking), including simulation tools, methods of analysing data and collecting information, and skills in analysing complex systems that can help to build successful businesses (Kaminsky et al., 2021).

Considering this context, entrepreneurship comes to be designated digital academic entrepreneurship and results from combining traditional academic entrepreneurship and digital technology (Rippa & Secundo, 2019). Digital entrepreneurship is less limited and less defined than non-digital entrepreneurship (Nambisan, 2017), which opens up new perspectives for the teaching of this phenomenon (Ratten & Usmanij,

2021), since digital technology allows the development of innovative teaching methods (Grivokostopoulou et al., 2019).

Digital academic entrepreneurship has become a dynamic field of research (Beliaeva et al., 2019), involving different levels of analysis and providing many opportunities for academics. It includes ideas and concepts from different fields/disciplines (Nambisan, 2017; Nambisan et al., 2017), which makes it an expanding area of research. This includes, for example, studies in the area of digital academic entrepreneurship (Monllor & Soto-Simeone, 2019; Rippa & Secundo, 2019; Toniolo et al., 2020), digital start-ups (Zaheer et al., 2019), female digital entrepreneurship (McAdam, 2020), users' digital entrepreneurship (Pergelova et al., 2019; Schiavone et al., 2019), and digital institutional entrepreneurship (Tumbas et al., 2018).

In this complex and dynamic environment, HEIs still have their role as agents of knowledge and technology transfer (Toniolo et al., 2020), providing students not only with knowledge, theories and technical skills - Hard Skills, but also social skills - Soft Skills, aiming to form an entrepreneurial mentality fostering more agile and adaptable actions by students, in the digital environment (Bauman & Lucy, 2021). However, digital academic entrepreneurship is a challenging topic, as the phenomenon involves various disciplines with little clarity or consensus regarding the boundaries of the research fields, making its terminology extremely dynamic (Zaheer et al., 2019). This means that the results of this field of research are fragmented and included in different study areas, with no clear convergence of borders between them (Cortellazzo et al., 2019; Nambisan, 2017).

In the higher education context, there is a clear lack of research related to digital entrepreneurship and development (Rippa et al., 2022; Rippa & Secundo, 2019; Secundo et al., 2020). This means that studies from a multi-level perspective, capturing the complex relations formed between different actors, including companies, universities, governments, non-profit organisations, NGOs, citizens, local communities, infrastructure, clients and other stakeholders (Beliaeva et al., 2019) are still necessary, showing gaps to be filled.

In these circumstances, this research aims to fill a gap, considering the dynamic, complex and emerging environment that characterises the phenomenon of digital academic entrepreneurship. It is pertinent and useful for HEIs and for all those interested in entrepreneurship education, such as students, educators, researchers and governments. Also emphasized is the relevance of DT in HEIs, after Covid-19,

reinforcing and even making essential the use of that technology in educational processes (Marks & AL-Ali, 2020).

In this context, Munir et al. (2019) tested a model of the relation between personality traits and the Theory of Planned Behaviour (TPB) and Monllor and Soto-Simeone (2019) studied whether exposure to digitally manufactured technology has an impact on the development of business self-efficacy and entrepreneurial intentions among students.

Various studies seek to understand what turns an individual into an entrepreneur (e.g., Armuña et al., 2020; Liu et al., 2021; Lv et al., 2021; Tomy & Pardede, 2020; Wang et al., 2019). These studies indicate that new businesses do not emerge spontaneously and that the entrepreneurial act is the result of planned action. For this reason, the literature has examined business behaviour in terms of the intentionality of that behaviour (Boyd & Vozikis, 1994; Krueger & Brazeal, 1994; Liñán & Chen, 2009; Moriano et al., 2012).

Despite the diversity of studies associating entrepreneurial behaviour with the intentionality of that behaviour, there is little or no research relating sociotechnical theory with entrepreneurial intention, or on the influence Soft Skills and Hard Skills can have in the DT context. This study aims to develop and validate a structural model to analyse the factors influencing digital entrepreneurship in university students. The aim is also to extend the literature on higher education students' entrepreneurial intention, by identifying two constructs (Hard and Soft Skills) that can be used to measure entrepreneurial intention, representing an original contribution to this area of research

### **1.3 Objectives and Research Question**

Considering the gaps mentioned and the theoretical and empirical importance of the relation between digital technology and academic entrepreneurship in HEI students' entrepreneurial intention, the general objective here is to analyse, from sociotechnical theory and the theory of planned behaviour (TPB), the influences of the structural pillars of digital academic entrepreneurship on university students' entrepreneurial intention.

Therefore, this study seeks to answer the following research question: What are the influences of digital academic entrepreneurship on university students' entrepreneurial

intention? More precisely, it aims to fulfil the following specific objectives, through different studies (articles):

a) Map studies on digital entrepreneurship, digital technology and digital transformation, through a bibliometric analysis, and present a proposal for a structural model of analysis for digital academic entrepreneurship (study 1).

b) Propose a conceptual model of analysis to allow assessment of the Soft Skills (SS) dimension – socio-cultural modifications, i.e., identify the bases of SS for digital academic entrepreneurship and how they are formed and related (study 2);

c) Propose a conceptual model of analysis to allow assessment of the Hard Skills (HS) dimension, considering business logic and the entrepreneurial academic process, i.e., identify the bases of HS for digital academic entrepreneurship and how they are formed and related (study 3);

d) Analyse the influence of the pillars (Hard and Soft Skills) of digital academic entrepreneurship on university students' entrepreneurial intention and how that relation can be mediated by the theory of planned behaviour (TPB) (study 4).

Briefly, the study presented here aims to contribute to this area of research by proposing a model representing the structural grounding/pillars of digital academic entrepreneurship based on digital transformation and assess their impacts on university students' entrepreneurial intention.

From the practical point of view, it aims to identify paths to develop Hard and Soft Skills, and consequently stimulate entrepreneurial intention, considering the university context. Using digital environments, these different types of skills can simulate the business situation, exposing students to the risks inherent to the entrepreneurial process. These paths can also give better training and stimulate development of the mentality in students.

## **1.4 Theoretical Foundation**

This section presents the main theoretical perspectives guiding this research: Sociotechnical Theory and Theory of Planned Behaviour (TPB).

### **1.4.1 Sociotechnical Theory**

This research followed the lines of the Theory of Sociotechnical Systems, which addresses the inter-relation between an organisation's social and technical dimensions to respond to a complex and dynamic environment, marked by new technology, from a perspective of open systems (Walker et al., 2008). This vision assumes that the social and the material are inseparable dimensions, i.e., that there is no social without also being material, and no material that is not also social (Orlikowski, 2007).

This theory emerged after the Second World War, a period when industries faced significant changes arising from both the social context and the introduction of new technology brought about by automation (Trist, 1980). In that period, the business environment became more complex and agile, which required organisations to adopt a new stance (Walker et al., 2008).

Sociotechnical theory is based on two principles, (1) the interaction between the social and technical factors that creates the conditions for a good result (or bad result), from the 'cause and effect' relations. Here, the individual does not necessarily behave like a technician, as people are not machines; and can begin to show non-linear behaviour, and (2) optimization of just one element tends to increase the number of unforeseeable non-linear relations that can harm organisational performance. Sociotechnical theory, therefore, is only effective if there is 'joint optimization' of the social and the technical (Walker et al., 2008). These principles were developed in a scenario marked by new technology and increased competitiveness, which allowed the theory of sociotechnical systems to emerge.

Today, this theory is topical once again, stronger and more complex, triggered by digital transformation (DT) and its consequent impacts on society. Corroborating this, Hess et al. (2016), Haefner and Sternberg (2020) and Nambisan (2017) highlight that digital technology changes the concept of uncertainty in the market, stimulating advances in the entrepreneurial process by modifying the complexity of consumption and social trends, and developing a digital economy where knowledge is intensive and also disruptive (Davidson & Vaast, 2010). In addition, the health-related restrictions caused by the Covid-19 pandemic in 2020 led to even faster digital transformation, re-organising society in its way of thinking, acting, producing, consuming and creating new business models (Haefner & Sternberg, 2020; Sá & Serpa, 2020).

The characteristics of this new business environment show, once more, the importance of working towards joint optimization of an organisation's social and technical factors. In recent decades, various authors have aimed to relate the social with the material. For example, the studies by Neumann, Kolak and Auschra (2019), setting out from the socio-technical approach, found strategies to transform healthcare, interconnecting the responsibilities of patients and providers and allowing changes, not only in the state of health of those involved, but also in its context.

In this connection, Rippa & Secundo (2019) also studied the impact of digital technology on academic entrepreneurship in the light of sociotechnical systems and discovered that the greater actors' participation, the greater the evolution in the performance of digital academic business initiatives, giving rise to innovations. Another study confirming the importance of technology and the interdependence of social and technical factors is the one by McAdam (2020), which revealed the transformation experienced by women in Saudi Arabia when using digital entrepreneurship to transform their identities and situations.

Orlikowski (2007) considers it necessary to develop ways of handling materiality in organisational research, as this is fundamental to understand the contemporary forms of an organisation, increasingly made up of multiple, emerging, changing and interdependent technologies.

Briefly, this view of the interdependence between the firm's social and technical factors, submerged in a complex, dynamic environment, was considered the background to this research.

#### **1.4.2 Theory of Planned Behaviour**

This study understands entrepreneurial behaviour from the behavioural approach, using in particular social psychology and supported by the Theory of Planned Behaviour (TPB) by Icek Ajzen (1991). Professor Ajzen was one of the first to study intentions and behaviours, particularly with Fishbein, from the late 1960s (Tornikoski & Maalaoui, 2019) and his seminal article of 1991 has had more than 44.000 indexed citations until today.

That article states that behaviour is preceded by intentions to perform the behaviour and that intentions are determined by a person's attitudes towards the behaviour, by subjective norms and by perceived control (Ajzen, 1991). That assumption has been used successfully to explain and predict behaviour in a wide range of behavioural

domains, from physical activity to drug consumption, recycling to means of travel, safe sex to consumer behaviour, and technology adoption to protection of privacy (Ajzen, 2020) and, needless to say, has also been used to measure entrepreneurial intentions.

Starting a new business is a complex process involving many actions (Gartner, 1985). An entrepreneur does not emerge “suddenly” but passes through a process that requires careful planning (Bird, 1988). Therefore, it is important to understand how entrepreneurial intentions are formed as a way to predict entrepreneurial behaviour (Tornikoski & Maalaoui, 2019).

Here, the Theory of Planned Behaviour seeks to explain and predict how the cultural and social environment affects human behaviour, assessing the individual’s intention as the result of three determinants: (1) the attitude towards the behaviour (personal evaluation), (2) subjective norms (social pressure) and (3) perceived behavioural control (capacity to perform the behaviour) (Cortez & Filho, 2020).

The attitude towards a behaviour is the degree to which a person has a favourable or unfavourable evaluation of the behaviour in question (Ajzen, 1991). In the entrepreneurial context, two people can have a strong belief that entrepreneurship involves facing new challenges, but one of them may see these challenges positively while the other may consider them unpleasant. This means that identical beliefs can develop different attitudes (Moriano et al., 2012). Briefly, individuals’ judgement in relation to behaviour can create a favourable or unfavourable attitude to entrepreneurship.

Subjective norms refer to perception of the social pressure to perform the behaviour in question or not. In other words, it is social groups’ approval or disapproval of performing a given behaviour (Ajzen 1991). This component considers that the social environment the individual belongs to can be a stimulus or a barrier to developing a business career (Moriano et al., 2012; Cortez & Filho, 2020). This is considered the social component of the theory, as it considers the influence of significant others (da Fonseca Oliveira et al., 2016).

Perceived behavioural control (or self-efficacy) refers to the individual’s perception of the ease or difficulty of performing the behaviour and covers past experiences, as well as obstacles anticipated and other factors preventing or stimulating performance of the behaviour (Ajzen 1991). This being so, it is not enough to have a favourable attitude and a supporting subjective norm for an individual to be motivated to engage in

entrepreneurial behaviour. The specific intention to perform the behaviour will only arise if the individual has sufficiently strong perceived behavioural control (Ajzen, 2020).

Generally speaking, the stronger the intention to perform a behaviour, the greater the probability of an individual carrying it out. In this research, intention is considered as a phase of company creation positioned before the entrepreneurial act and formed of motivational factors that influence the entrepreneurial behaviour.

## **1.5 Methodological Procedures**

This section presents the methodology followed in this research. As mentioned, the thesis was constructed by compiling four studies/articles that were elaborated using different methodological approaches, as described below.

### **1.5.1 General Research Approach**

The methodological strategy followed in this research is based, regarding its purpose, on an exploratory study, considering that this aims to explain the reasons, ideas and motives underlying the phenomenon of “digital academic entrepreneurship and its influence on university students’ entrepreneurial intention”. The aim of the exploratory research is also to establish patterns, methods and techniques to guide research and provide information about the subject studied (Yin, 2015).

To validate the structural model proposed in this research, to allow analysis of the influence of the pillars of academic entrepreneurship on students’ entrepreneurial intention, a quantitative approach was adopted. Quantitative methods present numerical indications, the frequency and intensity of behaviour of individuals in a given population and reveal trends in thoughts and opinions (Hammarberg et al., 2016). This methodological approach gives a perception of neutrality, providing a more objective interpretative framework (Smith, 1983) in identifying the relation of “what” affects the phenomenon studied (Brooman & Darwent, 2014).

Considering the methodological assumptions adopted, it is necessary to use rigorous, reproducible methods to include the opinions of various researchers (Snyder, 2019), which should be objective and precise to reduce potential bias (Zupic & Čater, 2015). This research also adopted the systematic literature review (SLR) method, as this meets this requirement and reveals the extent and depth of the existing body of work and can

identify gaps to explore, testing specific hypotheses and/or developing new theories (Xiao & Watson, 2019)

### 1.5.2 Research Context

The creation of biotic and abiotic ecosystems (Song, 2019), associated with digital transformation, reveals the sociotechnical paradigm based on individuals' thought (Elia et al., 2020). Arising from this, the ways of acting, promoting, consuming and creating new businesses are changed (Haefner & Sternberg, 2020). For example, digital technology allows the development of ecosystems in different geographical locations (Autio et al., 2018) and this requires different entrepreneurial skills from the individuals involved (Nambisan & Baron, 2013).

In this context, a new understanding of academic entrepreneurship has also been taking shape (Giones & Brem, 2017; Nambisan, 2017; Rippa & Secundo, 2019; von Briel et al., 2018). Figure 1.1 presents in a simplified way the elements of digital academic entrepreneurship, arising from the intersection of digital transformation and academic entrepreneurship (Nambisan, 2017; Rippa & Secundo, 2019). This intersection creates a socioeconomic and technological phenomenon that changes the traditional forms of academic entrepreneurship (Giones & Brem, 2017; Nambisan, 2017; Nambisan et al., 2017; Rippa & Secundo, 2019).

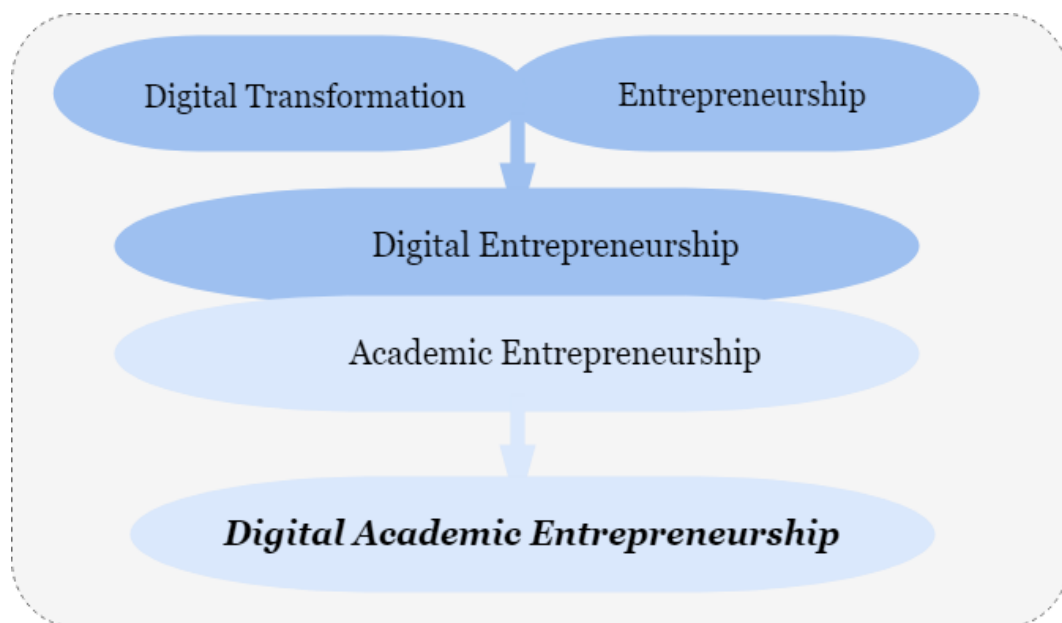


Figure 1.1 Environments of Digital Academic Entrepreneurship

Digital academic entrepreneurship generates many possible combinations of technology and entrepreneurship, and leads scientific research to develop a perspective of social value (Giones & Brem, 2017). This type of digital entrepreneurship is developed and replicated through a perpetual circular movement supported by digital technology, developing a range of institutional relations beyond the individual (Toniolo et al., 2020). In other words, new ideas for products and business models are rapidly created and modified in iterative cycles of experimentation and implementation (Nambisan, 2017; Ries, 2011).

In this context, university students bring new ideas that stimulate the innovate spirit (Toniolo et al., 2020) and promote a chaotic creative environment by engaging in initiatives that are influenced mainly by the possibilities afforded by digital technology (Toniolo et al., 2020).

In this study, digital academic entrepreneurship is understood as entrepreneurship based on digital competences and skills developed in the university environment, irrespective of the associated digital technology. Briefly, it considers the product/service created academically as the result of using digital technology.

Given the above, the unit of analysis adopted in this research, to validate the model proposed, is the students at three state universities, two Brazilian and one Portuguese, and all situated in peripheral regions.

Carrying out the empirical research in more than one country aimed to extend the research context, which is extremely relevant, as this study considers that, whatever the motivation for being an entrepreneur (entrepreneurship through opportunity or need), the perception of personal satisfaction is similar (Amorós et al., 2021) and is viewed from the perspective of well-being in fulfilling one's creative and innovative potential (Leonardi & Barley, 2008). Furthermore, technology use has broken down the concept of geographical barriers to entrepreneurship, as indicated by Giones and Brem (2017).

### **1.5.3 Data-Collection Techniques and Sample**

Two different approaches were adopted in constructing the research: conceptual studies and empirical research. For the conceptual studies, the data were collected from the Web of Science (WoS) database, this being a widely-used database for bibliometric studies in management and providing bibliographic data such as indexed documents including article title, type of article, authors' institutional affiliation, key words, abstract, number of citations, name of the journal, editor's name and address, year of

publication, volume and issue number, and a list of cited references (Zupic & Čater, 2015).

For the first study (article 1), a systematic literature review, the search terms used were: "digital transformation" or "digital tecnolog\*" or "digitalization" and "entrepreneurial\*" added to the key words of: Digital Entrepreneurship; Digital Economy; Innovation; Academic Entrepreneurship. The selection criteria were the title, key words or abstract in peer-reviewed articles published in English, with no restrictions as to the study domain, due to the relevance of the topic for a wide range of disciplines. Recent conference articles, between 2019 and 2020, were added, as these might not have had time to pass through the whole publication process. This resulted in 219 articles which, after quantitative and qualitative analysis, were reduced to a sample of 34 articles.

The second study (article 2) used methodology based on an interdisciplinary review of the literature (Torraco, 2005), supported by a data-collection protocol following the systematic literature review methodology, and simultaneously based on an interdisciplinary analysis. The synthesis followed the principles of an interdisciplinary and integrative review of the literature (Sundqvist-Andberg & Åkerman, 2021). This method was chosen due to it being a new, emerging topic which is not yet consolidated (Snyder, 2019).

The data were collected from three main categories: (1) Digital Transformation and Education, (2) Digital Academic Entrepreneurship and (3) Soft Skills and Education. First a search was made for the title, key words and abstract, of articles published up to July 2021, in English, with no time restriction. This resulted in 113 articles, and after quantitative and qualitative analysis, the final sample contained 32 articles.

The third study (article 3) also used methodology based on an integrative review of the literature (Torraco, 2005), supported by a data-collection protocol following the systematic literature review methodology. The data were collected considering the research question and using the key words: (1) Digital Transformation and Entrepreneurial Education; (2) Digital Academic Entrepreneurship and Skills; (3) Skills and Entrepreneurship Education. The search was limited to articles (empirical and reviews) published in English, with no time restriction, which resulted in a set of 275 articles.

The titles and abstracts of these articles were read to confirm their relevance for the study, using the following criteria for inclusion: the article (1) relates difficult skills with

academic entrepreneurship and/or (2) presents a clear indication that digital transformation can change academic entrepreneurship. The final sample contained 26 articles suitable for analysis.

To carry out the empirical research (article 4), a quantitative approach was chosen. The unit of analysis was university students in two countries (Portugal and Brazil), and the convenience sampling method was used, as is common in this type of research (e.g., Arranz et al., 2017; Carvalho et al., 2019; Fragoso et al., 2019; Locatelli et al., 2021), resulting in 761 valid responses. Data collection for this study involved assessment and approval by the Ethics Committee, together with good data protection practices. A pre-test was carried out with the research instrument, a structured questionnaire which was assessed by six specialists in the area and applied to a small sample (23 post-graduate students), after which the necessary adjustments were made.

Through a Declaration of Free and Clarified Consent, the respondents were informed that their participation in the study was voluntary, that anonymity was assured, and that the data would be treated jointly and used exclusively for the research.

#### **1.5.4 Data Analysis**

The data obtained were subject to different types of analysis, according to the objective established for each study/article. The first study (article 1) consisted of a systematic review of the literature on digital transformation and entrepreneurship, using the co-citation analysis method through VOSviewer software. This choice is justified as the method can determine nuclear structural knowledge about a specific domain (Small, 1973), with it being relevant to identify evidence, changes in paradigms and schools of thought (Zupic & Čater, 2015).

The reliability of the method was achieved by all the articles that presented the strongest link (Nambisan, 2017), due to their seminal contribution to the debate on digital transformation and the uncertain nature of business processes and results. Then, a cluster analysis was carried out, where the following structural elements were crossed: (1) digital technology; (2) unit of analysis of the 34 articles selected; (3) co-citations, (4) results and (5) future research, aiming to understand how digital technology changes entrepreneurship and its impacts. From an analytical process setting out from the research question and considering the observations and assessments of the articles in order to identify patterns, the structural pillars of digital academic entrepreneurship were categorized.

The second study (article 2) explored the relation between socio-cultural modifications-Soft Skills (SS), from an interdisciplinary and integrative review of the literature, the data being subject to content analysis (Hsieh & Kelley, 2019). Seminal articles on Soft Skills and academic entrepreneurship were added through the snowballing process. The coding categories were: (1) individual characteristics, (2) cultural characteristics, and (3) knowledge sharing. This initial coding was carried out using NVivo software. In cases of diverging interpretations, two researchers deliberated and agreed on the categories and coding.

After this, the themes frequently addressed in each category of the first phase of coding were identified, analysing how they were related to digital academic entrepreneurship and SS.

The third study (article 3) explored the relation between Hard Skills (HS) and digital academic entrepreneurship, holistically, where the data were analysed according to their content. Through the snowballing process, seminal articles on Hard Skills and academic entrepreneurship were added. To identify the insights and understand the context of the research question, the selected articles were subject to content analysis, considering the categories defined previously in article 1 for HS, and using NVivo software. In cases of doubtful interpretations, the coding was analysed and deliberated by more than one reviewer.

These three conceptual studies were elaborated in the light of Sociotechnical Theory, which considers the interdependence between social and technical factors within a complex and dynamic environmental context, seeking to understand the interconnections between the pillars of digital academic entrepreneurship.

The fourth study (article 4) explored the relation between Soft Skills and Hard Skills (pillars of digital academic entrepreneurship) and entrepreneurial intention, mediated by the Theory of Planned Behaviour, through field research with a quantitative approach. This study involved the exploratory factor analysis method, using SPSS (version 28) software. The data were reduced into factors to assess the convergent and discriminatory validity of the dimensions analysed. This was followed by confirmatory analysis, through structural equation modelling (SEM) using AMOS (version 28) software and second degree factor analysis, aiming to reduce the factors and adjust to the model proposed. SEM is a statistical technique that can test the validity of theoretical models based on causal and hypothetical relations (Marôco, 2010) and was adopted to validate the research hypotheses formulated. This is a robust, multivariate

technique that uses path analysis, simultaneous equations and factor analysis in the same model, allowing confirmation of the relation between the constructs studied.

The concatenations of the studies made appear in Figure 1.2, below.

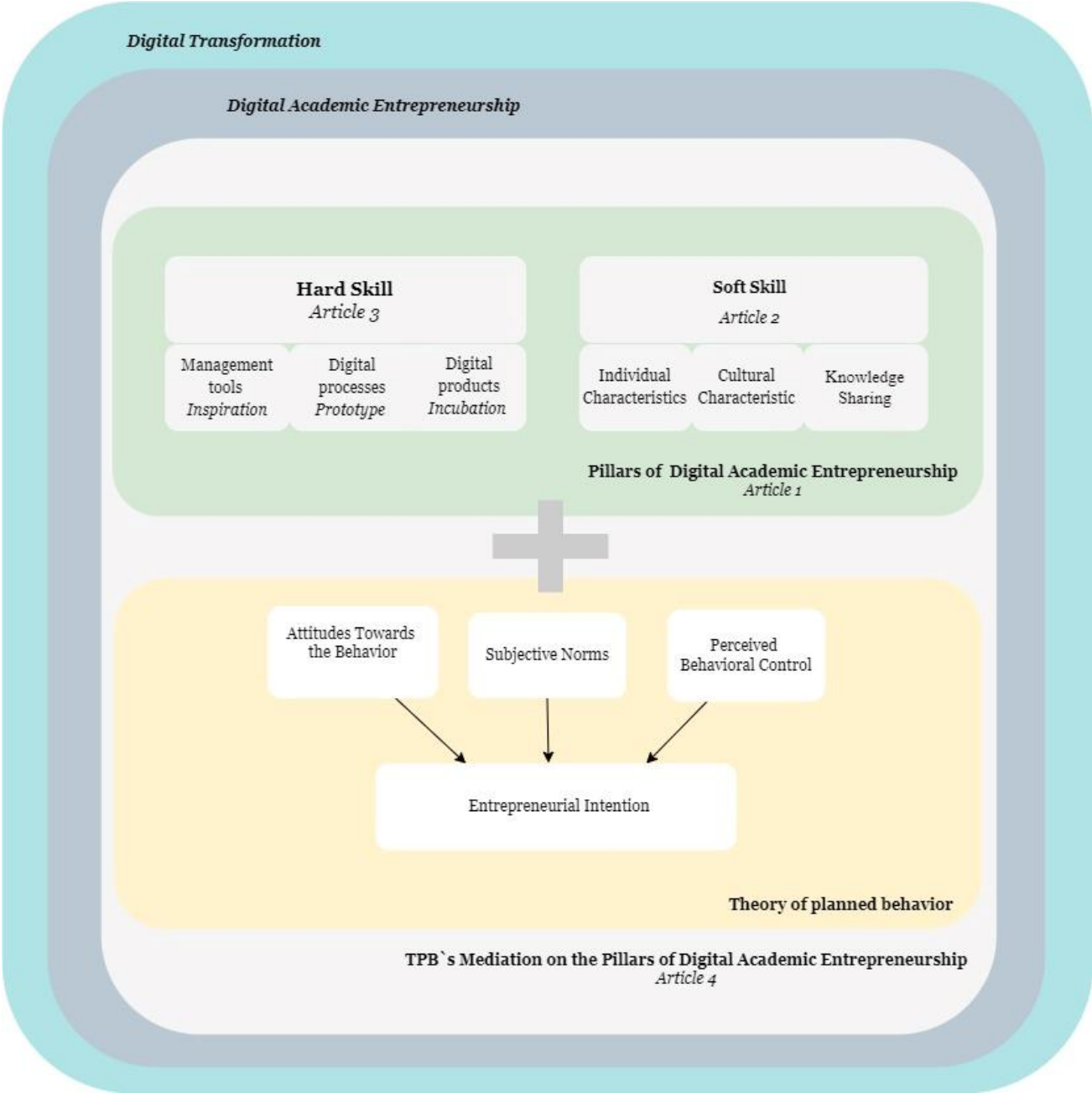


Figure 1.2 Structure of the research.

## 1.6 Summary of the Methodological Procedures and Publications

Tables 1.1 a 1.4 summarize the objectives defined, and the methodological procedures followed in each study/article in this research.

Table 1.1 Methodological Procedures and Publications (Article 1)

| <b>Article 1, Chapter 2</b>  |   |
|--|---|
| <b>Digital Transformation Shaping Structural Pillars for Academic Entrepreneurship: A framework proposal and research agenda</b> |   |
| <b>Theoretical Support</b>   | Sociotechnical Theory   |
| <b>Objectives</b>  | Map the studies on digital entrepreneurship, digital technologies and digital transformation through a bibliometric analysis and present a proposal for a structural model of analysis for academic digital entrepreneurship.   |
| <b>Keywords</b>  | Covid 19 pandemic, digital transformation, academic entrepreneurship, SLR.  |
| <b>Type of study</b>   | Theoretical/Conceptual  |
| <b>Research methodology</b>  | Systematic Literature Review (SLR) using content analysis   |
| <b>Unit of analysis</b>  | Scientific articles   |
| <b>Data collection</b>   | Web of Science (WoS) - 219 documents identified   |
| <b>Sample</b>  | 34 articles   |
| <b>Treatment of the data</b>   | VOSviewer, cocitation analysis  |
| <b>Publication</b>   | Garcez, A., Silva, R., & Franco, M. (2022). Digital transformation shaping structural pillars for academic entrepreneurship: A framework proposal and research agenda. <i>Education and Information Technologies</i> , 27(1), 1159-1182 <a href="https://doi.org/10.1007/s10639-021-10638-5">https://doi.org/10.1007/s10639-021-10638-5</a> |

Table 1.2 Methodological Procedures and Publications (Article 2)

| <b>Article 2, Chapter 3</b>   |  |
|---|--|
| <b>The soft skills bases in digital academic entrepreneurship in relation to digital transformation</b> |  |
| <b>Theoretical Support</b>  | Sociotechnical Theory  |
| <b>Objectives</b>   | Propose a conceptual model of analysis that allows the evaluation of the Soft Skills dimension - sociocultural modifications, based on the structural model presented in article 1.  |
| <b>Keywords</b>   | Soft Skills, Digital academic entrepreneurship, Entrepreneurial mindset, Digital transformation.   |
| <b>Type of study</b>  | Theoretical/Conceptual   |
| <b>Research methodology</b>   | Interdisciplinary literature review, based the protocol for data collection on the methodology of a systematic literature review (SLR)   |
| <b>Unit of analysis</b>   | Scientific articles  |
| <b>Data collection</b>  | Web of Science (WoS) - 113 documents identified  |
| <b>Sample</b>   | 32 articles  |
| <b>Treatment of the data</b>  | NVivo, content analysis  |
| <b>Publications</b>   | <p>Garcez, A., Silva, R., e Franco, M. (2022). A base dos soft skills no empreendedorismo académico digital face à transformação digital”, in Silva, A., Freitas, C., Almeida, F.A. e Franco, M. (Orgs.), <i>Gestão da Informação, Cultura Digital e Lusofonia</i>, Ed. Universidade do Porto, Portugal, Cap. 6, pp. 81-106 (ISBN: 978-989-9082-14-4).</p> <p>Garcez, A., Franco, M., &amp; Silva, R. (2022). The soft skills bases in digital academic entrepreneurship in relation to digital transformation. <i>Innovation and Management Review</i>. <a href="https://doi.org/10.1108/INMR-07-2021-0135">https://doi.org/10.1108/INMR-07-2021-0135</a></p> |

Table 1.3 Methodological Procedures and Publications (Article 3)

| <b>Article 3, Chapter 4</b>   |   |
|---|---|
| <b>The Hard Skills Bases in Digital Academic Entrepreneurship in Relation to Digital Transformation</b> |   |
| <b>Theoretical Support</b>  | Sociotechnical Theory   |
| <b>Objectives</b>   | Propose a conceptual model of analysis to evaluate the Hard Skills dimension, considering the business logic and the business academic process.   |
| <b>Keywords</b>   | Hard Skills, Education, Digital academic entrepreneurship, Digital transformation, Entrepreneurship Education.  |
| <b>Type of study</b>  | Theoretical/Conceptual  |
| <b>Research methodology</b>   | Interdisciplinary literature review, based the protocol for data collection on the methodology of a systematic literature review (SLR)  |
| <b>Unit of analysis</b>   | Scientific articles   |
| <b>Data collection</b>  | Web of Science (WoS) - 275 documents identified   |
| <b>Sample</b>   | 26 articles   |
| <b>Treatment of the data</b>  | NVivo, content analysis   |
| <b>Publication</b>  | Garcez, A., Silva, R., & Franco, M. (2022). The Hard Skills Bases in Digital Academic Entrepreneurship in Relation to Digital Transformation. <i>Social Sciences</i> , 11(5). <a href="https://doi.org/10.3390/socsci11050192">https://doi.org/10.3390/socsci11050192</a> |

Table 1.4 Methodological Procedures and Publications (Article 4)

| <b>Article 4, Chapter 5</b>  |   |
|--|---|
| <b>The influence of the Pillars of Digital Academic Entrepreneurship on University Students' Entrepreneurial Intention</b> |   |
| <b>Theoretical Support</b>   | Theory of Planned Behavior  |
| <b>Objectives</b>  | Analyse the influence of the pillars (Hard and Soft Skills) of digital academic entrepreneurship on students' entrepreneurial intention.  |
| <b>Keywords</b>  | Hard Skills, Soft Skills, Theory of Planned Behaviour, Entrepreneurial Intention, Digital Transformation.   |
| <b>Type of study</b>   | Empirical   |
| <b>Research methodology</b>  | Quantitative research   |
| <b>Unit of analysis</b>  | Higher Education Students   |
| <b>Data collection</b>   | Primary data  |
| <b>Sample</b>  | 761 questionnaires  |
| <b>Treatment of the data</b>   | SPSS and AMOS (SEM)   |
| <b>Publication</b>   | Garcez, A., Franco, M. and Silva, R. (2022). The Influence of the Pillars of Digital Academic Entrepreneurship on University Students' Entrepreneurial Intention. <i>European Journal of Innovation Management</i> (under review) |

## 1.7 Thesis Structure

This thesis was formed by combining articles and is structured in chapters, as described in Figure 1.3.

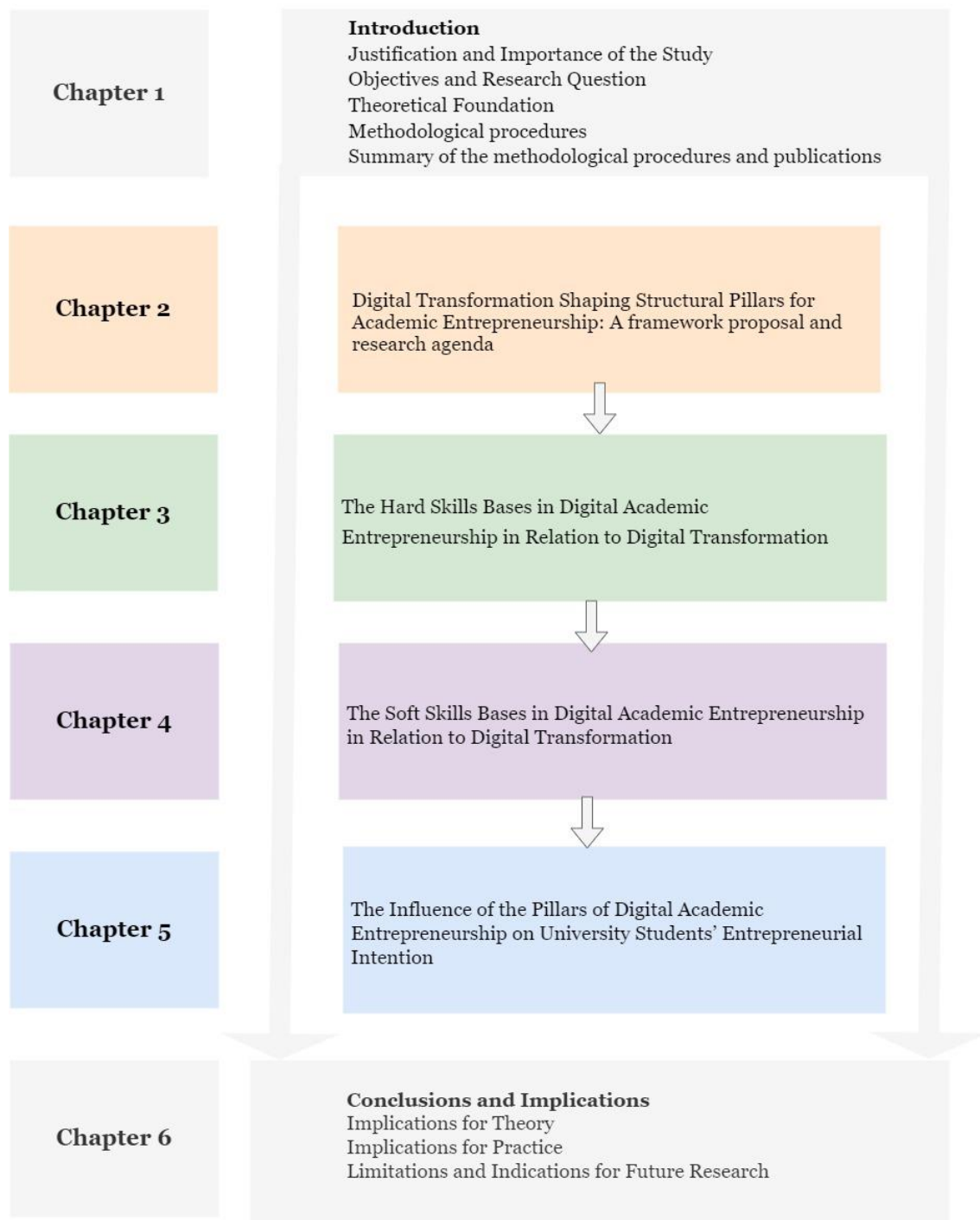


Figure 1.3 Thesis Structure

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## Chapter 2

# Digital Transformation Shaping Structural Pillars for Academic Entrepreneurship: A framework proposal and research agenda

### Abstract

Digital technology always accelerates change, altering organisations culturally, socially and technically. These modifications are known as “digital transformation” (DT). On a much greater scale than DT, the world was changed in 2020 by the COVID-19 pandemic, which re-organised society in the way of thinking, acting, producing, consuming and creating new business. Higher Education Institutions (HEIs) were no different, since these institutions had to make changes to the student-lecturer interaction; teaching-learning, where DT had a relevant role, above all in academic entrepreneurship. Therefore, this study aims to propose a framework showing the structural pillars of the link between digital transformation (DT) and academic entrepreneurship (AC) (DT-AC Framework). This framework identifies the new patterns, methods, skills and other discoveries in aspects such as management, information systems and culture sciences. The intention is not to analyse how the COVID-19 pandemic imposed global structural changes, but because of it, lecturers and students found their DT accelerated and intensified, and so it is necessary to investigate the pillars supporting academic entrepreneurship. The results show that DT was already emerging as a basic element of academic entrepreneurship before the pandemic, but the process has speeded up. This bibliometric study indicates the structural pillars that support entrepreneurship following the Covid19 pandemic, as created from DT in universities, providing an extensive systematic review that indicates the cause and effect of the academic entrepreneurship process.

**Keywords:** Covid19 pandemic, digital transformation, academic entrepreneurship, SLR.

## 2.1 Introduction

The rapid acceleration of digital technology in the last ten years has permeated all organisations (Nambisan, 2017), due to progress in communication, computing and connectivity technology (Bharadwaj et al., 2013), which have stimulated changes in actors, structures, practices, values and beliefs. According to (Hinings, et al., 2018), this has modified, threatened or complemented existing rules in organisations.

Digital technology accelerates changes, altering organisations culturally, socially and technically. This phenomenon is known as "digital transformation" (DT) (Hess et al., 2016). In 2020, due to the COVID-19 pandemic, digital transformation was stimulated, re-organising society in its way of thinking, acting, promoting, consuming and creating new business (Haefner & Sternberg, 2020). This disturbance to systems has changed the concept of uncertainty in the market, stimulating advances in the entrepreneurial process (Nambisan, 2017), as it has modified the complexity of consumption and social trends (Hracs et al., 2013).

For Higher Education Institutions (HEIs), the situation was no different (Sá & Serpa, 2020), since these institutions changed the student-lecturer and teaching-learning interaction, with digital transformation having a relevant role, above all in academic entrepreneurship (Ratten, 2020).

This context has given an even greater stimulus to research in the field of digital entrepreneurship. This topic faces some challenges, since the entrepreneurship phenomenon and digital technology affect various disciplines and there is little clarity or consensus as to the boundaries of research fields, a situation which makes the terminology used extremely dynamic (Zaheer et al, 2019a). It also hinders consistency in the literature with the use of more systematic methods, despite recent developments in research having provided more opportunities.

Based on emerging knowledge about the nature and characteristics of digital technology (Kallinikos et al., 2013; Lyytinen et al., 2016; Yoo et al., 2010), the editable, re-combinable, re-programmable and generating nature of digital technology is understood to have an impact on many aspects of innovation and processes and entrepreneurial results. This technology allows the development of ecosystems in different geographical locations (Autio et al., 2018) and requires different business competences (Nambisan & Baron, 2013), innovation processes (Nambisan et al., 2017) and governance structures (Sussan & Acs, 2017). In this context, the disruptive role of

digital transformation for academic entrepreneurship (Secundo, Rippa, & Cerchione, 2020) is important, since this situation can potentialize digital academic entrepreneurship (Rippa & Secundo, 2019).

Digital technology creates new paradigms by changing the relations between individuals, industry and society (Vial, 2019). This change is supported through use of the internet and digital technology (Lasi et al., 2014), and is known as Digital Transformation (DT) (Vial, 2019). When that DT is associated with entrepreneurship, the phenomenon of Digital Entrepreneurship is created, seeking business results (Nambisan, 2017).

In the context of universities and other higher education institutions, digital entrepreneurship takes the form of “Digital Academic Entrepreneurship”, which results from the intersection of digital transformation and digital entrepreneurship in the academic context (Secundo, Rippa, & Cerchione, 2020).

In this study, Digital Academic Entrepreneurship is understood as entrepreneurship carried out from digital capacities and skills developed in the university environment, irrespective of the associated digital technology, considering the product/service created by the academic, i.e., it is the result of making use of the digital technology taught and developed at universities that can transform the environment.

In this context, the level of digital academic entrepreneurship should permeate the need to enhance existing business theories, from the relations between digital transformation and the entrepreneurial process, and multiple levels of analysis should be incorporated in that relation. Considering the multiple concepts of fields/disciplines, it is easier to recognise the role of digital technology in entrepreneurial transformation (Nambisan, 2017; Rippa & Secundo, 2019). This scenario encourages debate around new skills for digital academic entrepreneurship, adopting a holistic perspective of this phenomenon (Rippa & Secundo, 2019).

Despite social science scholars’ attempts to understand digital entrepreneurship, findings are fragmented and scattered over different disciplines and do not seem to converge on a clear image (Nambisan, 2017; Cortellazzo et al., 2019). There is still a clear lack of studies correlating entrepreneurship and digital evolution (Hsieh & Wu, 2019; Gregoire & Shepherd, 2012) in the HEI context. According to Akhter (2017), there is evidence that digital academic entrepreneurship can have a positive impact on HIEs. Therefore, this study aims to understand the bases for digital academic

entrepreneurship, what they are, how they are formed and how they are related, through a systematic literature review (SLR).

Studies exist in various disciplines with multiple theoretical models (Nambisan et al., 2019; Rippa & Secundo, 2019; Schwarzmüller et al., 2018) of academic entrepreneurship, but the contributions are fragmented. Therefore, this study contributes to present the structural pillars for digital academic entrepreneurship, considering that DT has speeded up in the HEIs context. The methodology used to build the framework was based on an extensive bibliometric analysis which identified two significant relations: digital technology (Hard Skills), the logic of business and the entrepreneurial process and (Soft Skills) digital technology and socio-cultural modifications. A research agenda for further studies in this area is also presented.

**2.2 DT-AC Framework - Construction Methodology**

To achieve the aim defined for this study, the methodology used was the systematic literature review (SLR), through a pre-pandemic bibliometric analysis to help build a guiding framework to link Digital Transformation (DT) and Academic Entrepreneurship (AC) following the covid-19 pandemic. Specifically on this subject, due to the lack of guidance on systematic literature reviews, the researchers decided to apply a critical review (Xiao & Watson, 2019). The methodology adopted to build the DT-AC framework is shown in Figure 2.1.

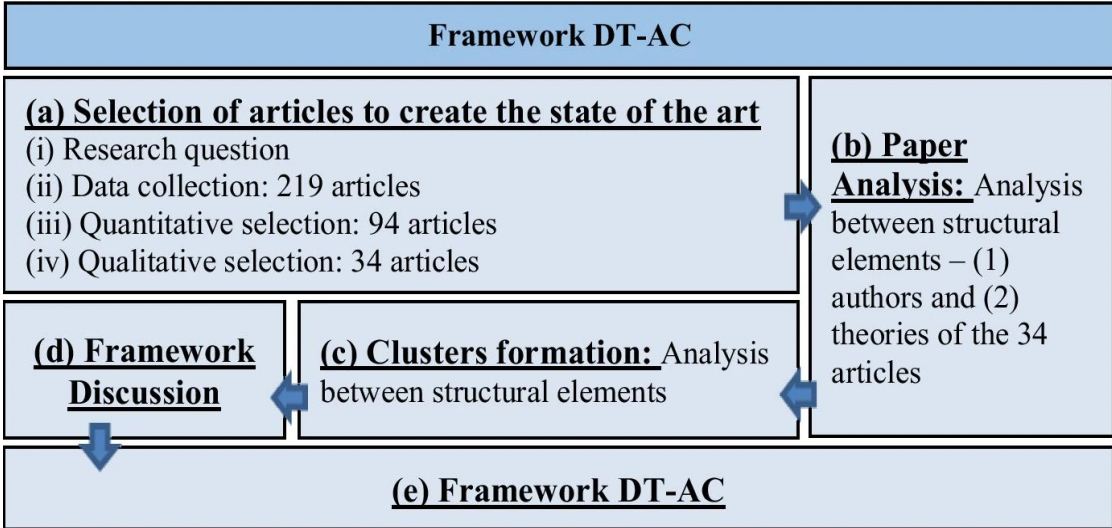


Figure 2.1 DT-AC Framework - construction methodology

Thus, the researchers decided to carry out exploratory qualitative research (Cortellazzo et al., 2019) as presented here.

**(a) State-of-the-Art:** The survey of the state-of-art intended to identify how scientific studies are related to Digital Transformation and Digital Entrepreneurship in Universities, pre-COVID-19, to structure the research field, namely Academic Entrepreneurship post-pandemic.

(i) **Research question:** To serve as a guide to the research, a research question was created: What are the existing links between DT and Academic Entrepreneurship?

(ii) **Data collection.** To form a set of reliable data giving a solid basis for construction of the DT-AC framework, a quanti-qualitative approach was adopted, structured from the coding standard used and proposed by various authors such as (Cortellazzo et al., 2019; Mazzarol, 2015; Zupic & Čater, 2015).

To identify articles, the Web of Science (WoS) database was used, since this is the most commonly used database for bibliometric studies in management and because it provides bibliographic data such as indexed documents, including article title, article type, authors, authors' institutional affiliation, key-words, abstract, number of citations, journal name, publisher's name and address, year of publication, volume and issue number, and a list of cited references is available for analysis (Zupic & Čater, 2015).

Only journal articles were included in this research, since these sources contain validated scientific knowledge (Podsakoff et al., 2005). The search terms used were: "digital transformation" or "digital technolog\*" or "digitalization" and "entrepreneur\*" added to the keywords: Digital Entrepreneurship; Digital Economy; Innovation; Academic Entrepreneurship.

The selection criteria were the title, keywords or abstract and peer-reviewed articles published in English, without restrictions regarding the study domain, due to the relevance in a wide range of disciplines. Other authors such as (Secundo, Rippa, & Cerchione, 2020) have used this procedure.

To prevent the research from being based on only the number of citations, recent conference articles, between 2019 and 2020, were added, as these might not have had time to pass through the whole publication process, and this resulted in 219 articles.

(iii) **Quantitative Selection:** The articles were also selected according to data parameters; number of citations and journal's impact factor, which meant eliminating articles prior to 2017 without citations and articles published in journals with no

impact factor. These criteria were defined so as to select articles with a strong relation between the variables studied (Jayasekara & Abu, 2018) and with a strong scientific basis, as well as aiming to establish precise classification criteria (Acedo et al., 2006) representative of the population. Concluding this stage left 94 articles.

When the criterion was analysis of citations (Figure 2.2), the USA stands out, followed by Denmark and China.

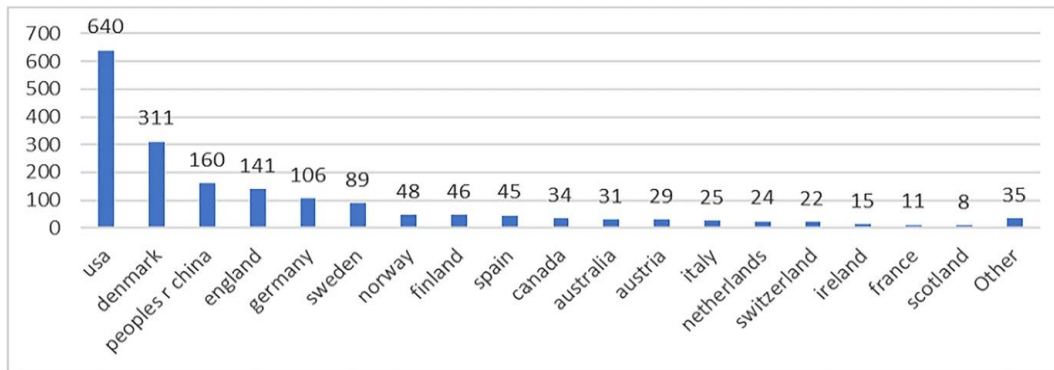


Figure 2.2 Number of citations by country involving work on DT and Entrepreneurship from 1990 to 2020  
**Source:** Research data

Observation of Figure 2.2 reveals the USA in a leading position as regards entrepreneurship and transformation in digital technology. This reflects the initiatives created by that country in stimulating entrepreneurship, for example by attracting global entrepreneurial talent to instigate high-tech undertakings such as eBay (founded in 1995 by Pierre Omidyar, an Iranian businessman born in France) and PayPal (founded by the German Peter Thiel and Ukrainian Max Levchin)(Li, 2018).

Also analysed was the number of citations per year, per author (Table 2.1) and per journal (Table 2.2), showing that the scientific community interested in exploring the adoption of digital technology in the context of entrepreneurship, from 2017 to 2020, cited more than 750 times seminal work from 2010, 2012 and 2014 in their new contributions (Tables 2.1 and 2.2 only show the 10 most cited).

The paper “The industrial dynamics of Open Innovation - Evidence from the transformation of consumer electronics”, exploring the dynamics of innovation as a factor of transformation, is the most cited article with 286 citations, but the most cited paper whose title focuses on Digital Entrepreneurship is “Digital Entrepreneurship: Toward a Digital Technology Perspective of Entrepreneurship”, by Nambisan (2017) with 102 citations.

Table 2.1 Citations per most influential authors Source  
Research data

| Author – Title  | Citation | Journal                                      | Year | Area  |
|---|----------|--|------|---|
| 1 Christensen, JF; Olesen, MH; Kjaer, JS <i>The industrial dynamics of Open Innovation - Evidence from the transformation of consumer electronics</i>                       | 286      | Research Policy                              | 2005 | Business & Economics                                      |
| 2 Nambisan, S; Lyytinen, K; Majchrzak, A; Song, M <i>Digital Innovation Management: Reinventing Innovation Management Research In A Digital World</i>                       | 126      | Mis Quarterly                                | 2017 | Computer;<br>Information; Science<br>Business & Economics |
| 3 Rosenblat, A; Stark, L <i>Algorithmic Labor and Information Asymmetries: A Case Study of Uber's Drivers</i>   | 125      | International Journal of Communication       | 2016 | Communication   |
| 4 Nambisan, S <i>Digital Entrepreneurship: Toward a Digital Technology Perspective of Entrepreneurship</i>  | 102      | Entrepreneurship Theory And Practice         | 2017 | Entrepreneurship  |
| 5 Li, L <i>China's manufacturing locus in 2025: With a comparison of "Made-in-China 2025" and "Industry 4.0"</i>  | 96       | Technological And Social Change              | 2018 | Digital transformation                                    |
| 6 Henfridsson, O; Yoo, YJ <i>The Liminality of Trajectory Shifts in Institutional Entrepreneurship</i>  | 43       | Organization Science                         | 2014 | Business & Economics                                      |
| 7 Li, L; Su, F; Zhang, W; Mao, JY <i>Digital transformation by SME entrepreneurs: A capability perspective</i>  | 33       | Information Systems Journal                  | 2018 | Digital transformation                                    |
| 8 Hracs, BJ; Jakob, D; Hauge, A <i>Standing out in the crowd: the rise of exclusivity-based strategies to compete in the contemporary marketplace for music and fashion</i> | 32       | Environment And Planning A-Economy And Space | 2013 | Environmental Sciences & Ecology;<br>Geography            |
| 9 Hinings, B; Gegenhuber, T; <i>Digital innovation and transformation: An institutional perspective</i>   | 26       | Information And Organization                 | 2018 | Digital transformation                                    |
| 10 Giones, F; Brem, A <i>Digital Technology Entrepreneurship: A Definition and Research Agenda</i>  | 21       | Technology Innovation Management Review      | 2017 | Digital transformation                                    |

Table 2.2 Citations per most influential journals  
Source: Research data

| Ranking | Journal                                      | Nº articles | Citations |
|---------|--|-------------|-----------|
| 1       | Research Policy                              | 3           | 296       |
| 2       | Mis Quarterly                                | 1           | 126       |
| 3       | International Journal of Communication       | 1           | 125       |
| 4       | Entrepreneurship Theory and Practice         | 2           | 120       |
| 5       | Technological Forecasting and Social Change  | 6           | 110       |
| 6       | Organization Science                         | 1           | 43        |
| 7       | Information Systems Journal                  | 1           | 33        |
| 8       | Environment and Planning A-Economy And Space | 1           | 32        |
| 9       | Technology Innovation Management Review      | 8           | 31        |
| 10      | Information and Organization                 | 1           | 26        |

(iv) **Qualitative Selection.** An exploratory qualitative study was also carried out by reading the abstracts and conclusions of the 94 articles selected, from inductive and interactive criteria related to the research question presented in Stage (i), i.e., it was determined whether there was: (1) Discussion about the relation between digital technology, business logic and consequently the entrepreneurial process, and (2) Discussion about the relation between entrepreneurship, digital transformation and entrepreneurial skills, These articles were accepted as relevant to the subject, to establish the state-of-the-art.

If there was no clear relation between these matters in the abstracts and conclusions, the articles were read completely to determine their irrelevance, and if this was confirmed, they were rejected.

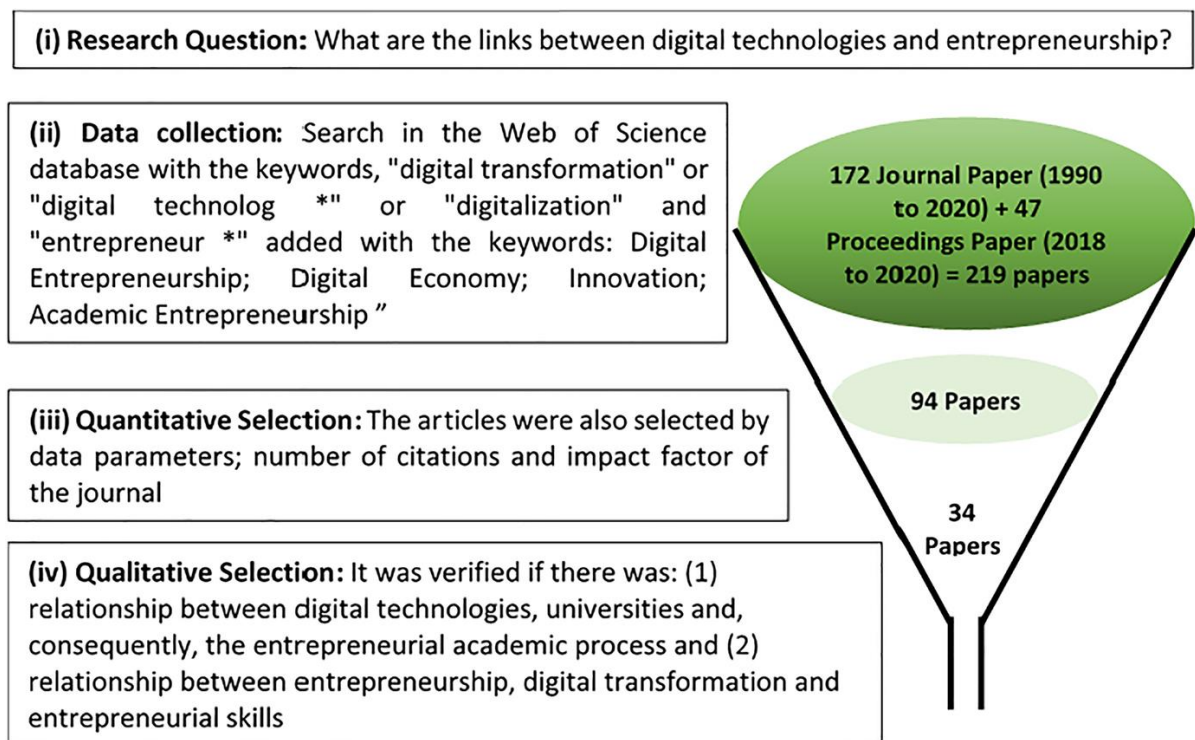


Figure 2.3 Process of choosing the papers establishing the state-of-the-art

Source: Research data

**(b) Paper analysis:** In this phase, an analysis between structural elements was made: (1) authors and (2) theories of the 34 articles selected, in order to understand how these, relate and influence, to represent the research structure of the selected data (Zupic & Čater, 2015), seeking to identify in the articles the themes influencing research most. In this analysis, the co-citation analysis method was used, through VOSviewer software. This choice is justified due to it being a method that can determine the nuclear structural knowledge of a specific domain (Small, 1973), being relevant for evidence, paradigm changes and schools of thought (Zupic & Čater, 2015). After various trials with different cut-off points, it was decided to set this at 5 citations.

The reliability of the study was achieved by all articles presenting the strongest link (Nambisan, 2017), due to its seminal contribution to the debate on digital transformation and the uncertain nature of business processes and results.

Besides reliability through the “strongest link”, the validity of this study is due to (a) the use of various sources of evidence in relation to the phenomenon analysed, as well as

triangulation of sources in searching for more than one bibliographical reference; and (b) being peer-reviewed (one Ph.D. student and one post-Ph.D. researcher).

In this case, the results are supported by socio-material theory (Orlikowski, 1996), (Orlikowski, 1996), which assumes that social and material are considered inseparable terms, i.e., the assumption that there is no social without also being material, and no material that is not also social (Orlikowski, 2007).

Table 3 presents the articles with co-citation frequency above 5 articles, the grouping of relations and the strength of the link between these and the articles at the source of the co-citation. Here, two relations were identified: R1: Digital technology, business logic and entrepreneurial process, and R2: Digital Technology and Digital Entrepreneurship. Therefore, the article selection criterion was supported by the analysis of co-citations presented in Table 2.3.

Table 2.3 Co-citation relation > = 5  
Source: Research data

| Co-cited                 | Relationship | Strength | Citatio<br>n | Articles   |
|--------------------------|--------------|----------|--------------|--|
| Kallinikos et al. (2013) | 1            | 24       | 7            | (Elia et al., 2020; Henfridsson & Yoo, 2014; Nambisan, 2017; Nambisan et al., 2019; Rippa & Secundo, 2019; Song, 2019; Zaheer et al, 2019a)  |
| Tiwana et al. (2010)     | 1            | 19       | 5            | (Elia et al., 2020; Nambisan, 2017; Rippa & Secundo, 2019; Schiavone, Tutore, & Cucari, 2019; Tumbas, Berente, & vom Brocke, 2018)   |
| Yoo et al. (2010)        | 1            | 18       | 8            | (Arvidsson & Mønsted, 2018; Cenamor, et al, 2019; Mancha & Shankaranarayanan, 2020; Nambisan, 2017; Nambisan et al., 2019; Rippa & Secundo, 2019; Song, 2019; Tumbas et al., 2018) |
| Parker et al. (2016)     | 1            | 19       | 5            | (Cenamor et al., 2019; Elia et al., 2020; Nambisan, 2017; Rippa & Secundo, 2019; Song, 2019)   |
| Hull et al. (2007)       | 2            | 15       | 5            | (Beliaeva, Ferasso, Kraus, & Damke, 2019; Elia et al., 2020; McAdam, 2020; Toniolo, et al, 2020; Zaheer et al., 2019a)   |
| Nambisan (2017)          | 2            | 27       | 10           | (Beliaeva et al., 2019; McAdam, 2020; Monllor & Soto-Simeone, 2019; Nambisan et al., 2019; Pergelova, et al, 2019; Rippa & Secundo, 2019; Schiavone et al., 2019; Song, 2019;      |

Table 2.3 Co-citation relation &gt; = 5 (Continued)

|                         |   |    |   |  |
|-------------------------|---|----|---|--|
|                         |   |    |   | Toniolo et al, 2020; Zaheer et al., 2019a)   |
| von Briel et al. (2018) | 2 | 25 | 7 | (Elia et al., 2020; McAdam, 2020; Monllor & Soto-Simeone, 2019; Nambisan et al., 2019; Rippa & Secundo, 2019; Schiavone et al., 2019; Song, 2019)  |
| Giones & Brem (2017)    | 2 | 19 | 8 | (Beliaeva et al., 2019; Elia et al., 2020; Ivanović-đukić, Stevanović, & Rađenović, 2019; McAdam, 2020; Monllor & Soto-Simeone, 2019; Schiavone et al., 2019; Toniolo et al., 2020a; Zaheer et al., 2019a) |

Table 2.4 presents the evidence of how the correlations between R1 and R2 are contextualized, showing that these papers have greater theoretical maturity, as their structure refers to articles relating R1 and R2

Table 2.4 Co-citation relation > = 5  
Source: Research data

| <b>Articles</b>                | <b>Correlation between R1 and R2</b>  |
|--------------------------------|---|
| (Elia et al., 2020)            | Digital technology has an impact on how new undertakings are imagined and created. From four dimensions: (1) digital actors (who), (2) digital activities (what), (3) digital motivations (why) and (4) digital organisation (how)                                |
| (Monllor & Soto-Simeone, 2019) | Practical experience with digital technology in universities can have a positive impact on students' business self-efficacy and on their entrepreneurial intentions   |
| (Nambisan et al., 2019)        | Showing the need to study digital entrepreneurship incorporating multiple levels of analysis, covering ideas and concepts from multiple fields/disciplines, and recognising the role of digital technology in transforming all organisations and social relations |
| (Rippa & Secundo, 2019)        | Setting out from an interpretative framework, presenting justifications for the adoption of digital technology (why), emerging forms of digital academic entrepreneurship (what), stakeholders (who), and processes of academic entrepreneurship (how)            |
| (Schiavone et al., 2019)       | From the socio-material perspective of digital entrepreneurship, exploring how business-people create firms   |
| (Tumbas et al., 2018)          | Studying Chief Digital Officers' search for legitimacy in the institutional environment   |
| (Zaheer et al., (2019a)        | Exploring the factors that contribute to successful digital academic entrepreneurship, presenting the factors that shape the performance of digital academic start-ups.   |

**(c) Cluster formation:** the following structural elements were crossed: (1) digital technology; (2) unit of analysis of the 34 articles selected; (3) co-citations, (4) results and (5) future research, aiming to understand how digital technology alters entrepreneurship and its impacts. Here, an inductive approach was adopted, i.e., there was no preconception of categories. Instead of this, there were observations and assessments, in order to identify patterns.

Table 2.5 Shows the cluster grouping, after various classification cycles

| <b>Current Relationship Cluster</b>  | <b>New Relationship after analysis of structural elements</b>                           |
|--|---|
| Relationship 1: Digital technology, business logic and entrepreneurial process | (1) Management Tools<br>(2) Digital Processes and<br>(3) Digital Products               |
| Relationship 2: Digital technology and socio-cultural modifications            | (4) Individual Characteristics<br>(5) Cultural Characteristics<br>(6) Knowledge Sharing |

**(d) DT-AC Framework:** The results of all the quantitative and qualitative analyses carried out, as per the authors selected, are found to be interlinked, which allowed construction of the structural clusters, as grouped in Figure 2.4.

**(e) Presenting the Framework:** Structural pillars of digital academic entrepreneurship.

The results of the quantitative and qualitative analyses of the data allow formation of the structural pillars linking “Digital Technology” and “Academic Entrepreneurship” post-Covid19, presenting potential directions for coupling, and for future lines of research.

Above any existing relation, the bibliometric analysis and content analysis of the articles led to identification of two pillars, namely (Nambisan, 2017; Nambisan et al., 2019). Based on these two articles and the whole study made, the following is underlined:

### **2.2.1 Relation 1 (R1): Digital technology, business logic and entrepreneurial process.**

The whole body of articles studied clearly indicates how digital technology affects business logic and the entrepreneurial process. This digital technology alters how objects are perceived. For example, a work routine written on paper can be digitalized, and consequently a digital object is easier to edit than a physical one. This means that information can be eliminated or added according to individuals' choice (Kallinikos et al., 2013; Tiwana et al., 2010). Digital objects are interactive, as they accept actions of a contingency nature (depending on individuals' choice), and they are flexible (Kallinikos et al., 2013).

Indeed, as digital objects are flexible (or malleable), they can radically transform entrepreneurship (Nambisan, 2017; Nambisan et al., 2019). Drones, for example, were created for a military application, but are currently used in the real estate sector (aerial videos to show houses), logistics (parcel delivery), agriculture (monitoring crops) and other areas (Nambisan, 2017).

One of universities' roles is to stimulate the use of digital objects, in business ecosystems and society (Toniolo et al., 2020), enabling individuals to use digital tools, such as digital platforms, cloud computing, social networks, 3D printing and data analysis. The aim is to encourage processes of digital innovation (Rippa & Secundo, 2019), from the creation of new services and products, as well as results of academic research, and contribute to changing the traditional way of doing business in the digital era (Toniolo et al., 2020).

#### **R1 and support Pillar 1: Management Tools**

Pillar 1 emerges from the articles (Arvidsson & Mønsted, 2018; Brydges & Sjöholm, 2019; Cenamor et al., 2019; Vorbach et al., 2019) showing the obstacles to measuring the benefits of using management tools (Arvidsson & Mønsted, 2018), but when used correctly these management tools can create new types of professional activities (Brydges & Sjöholm, 2019); improve organisational performance (Cenamor et al., 2019) and stimulate education for entrepreneurship (Vorbach et al., 2019), concluding that Management Tools are one of the pillars supporting R1.

Digital tools (e.g., blogs, social media, management systems -MRP – (Manufacturing Resource Planning) provide new aspects of organisational competitiveness for entrepreneurship. For example, (Arvidsson & Mønsted, 2018) show how employees in a

Norwegian hospital (intra-entrepreneurs), with the support of a digital application, developed time planning and resource analysis, raising competitiveness.

Beliaeva et al., (2019) investigated the client-supplier relation in a firm commercializing management systems, showing the importance of strategic partners in the ecosystem of business innovation.

Studying entrepreneurial SMEs, Cenamor et al (2019) concluded that the lack of resources and skills hindered their growth. In this context, digital platforms have a positive, indirect effect on these firms' performance.

For Brydges & Hracs (2019), the mobility of the creative fashion industry (setting out from independent entrepreneurs who use digital technology and their creative work) allows greater freedom towards self-organisation, as they are freer to decide where, when and how they will live and work. In this connection, Brydges & Sjöholm (2019) study how these digital entrepreneurs in fashion use blogs and social networks to transform their personal style in online business and transform their way of working.

In this context, an opportunity for future research would be to understand how digital academic entrepreneurs manage their personal and professional lives, as well as the need to carry out longitudinal research, to track the evolution of these blogs over time (Brydges & Sjöholm, 2019); and the possible relation between the organisational life cycle and the use of digital technology in universities (Beliaeva et al., 2019).

## **R1 and support Pillar 2: Digital Processes**

Pillar 2 was based on the articles by Brydges and Hracs (2019); Hracs et al. (2013); Pergelova et al. (2019); Rippa and Secundo (2019) and Tumbas et al. (2018), who show how the use of digital technology changes the logic of organisational processes (Tumbas et al., 2018), and how goods are produced, promoted, distributed and consumed (Hracs et al., 2013).

These studies also show that, in the internationalization process, digital processes were accelerated (Pergelova et al., 2019), giving individuals greater freedom to define: where, when and how to work and live (Brydges & Hracs, 2019), This aspect allows acceleration of the process of educating for entrepreneurship (Rippa & Secundo, 2019) allowing the conclusion that Digital Processes is one of the pillars supporting R1.

Digital technology creates new processes and changes business logic, such as how the cultural product market was reconfigured (Hracs et al., 2013), similarly to the market of young activists and business-people in Russia (Suleymanova, 2018), where new organisational functions emerged.

Furthermore, academic entrepreneurship is being sub-categorized as digital academic entrepreneurship (Rippa & Secundo, 2019), and new forms of SME internationalization are being created as a consequence of digital processes (Pergelova et al., 2019).

This gives rise to several opportunities for future research, such as: (i) studying the sustainability and effectiveness of producers' exclusiveness strategies in virtual environments (Hracs et al., 2013); (ii) exploring the digital logic, of the digital entrepreneur in the various organisational roles (Tumbas et al., 2018); (iii) how digital platforms can be tools to democratize academic research, setting out from the socio-technical process (Rippa & Secundo, 2019); (iv) mapping and categorizing all the new, emerging forms of digital academic entrepreneurship, and (v) examining the effect of digital technology in different models of internationalization (Pergelova et al., 2019).

### **R1 and support Pillar 3: Digital Products**

Pillar 3 emerges from several articles (Ho & Lee, 2015; Ivanović-đukić et al., 2019; Rippa & Secundo, 2019; Schiavone et al., 2019) showing that adaptive strategies are created from digital technology, to meet market needs (Ho & Lee, 2015). In this context, new, innovative digital products are being created (Ivanović-đukić et al., 2019). from simple products developed by digital users (Schiavone et al., 2019), to the whole structure of digital academic entrepreneurship (Rippa & Secundo, 2019).

Digital technology creates changes in products, above all mediated by junior firms in universities, generating new paradigms and disturbing the existing industrial organisation, as it changes customers' needs. For (Ho & Lee, 2015), this relation is clear, since an empirical analysis of the photographic industry revealed how the technological transition from analog to digital occurred, supported by the internet and corporate intranets, for audio and video transmission, radically transforming and expanding the environment.

New digital products have created opportunities for entrepreneurs, from creative destruction, providing radically new digital solutions. In this context, (Ivanović-đukić et al., 2019) studied 21 European countries and showed economic development to be the main focus of innovative, digital entrepreneurs. So opportunities for future research

emerge, in analysing strategies for paradigmatic change, setting out from new digital products created from universities (Ho & Lee, 2015) and research to analyse the impact on new, innovative, digital firms (Ivanović-đukić et al., 2019).

### **2.2.2 Relation 2 (R2): Digital Technology and Socio-Cultural Modifications**

In this other consolidated field of research, digital technology has changed how the university student becomes a digital entrepreneur. This change is characterised as a socio-economic and technological phenomenon (Giones & Brem, 2017; Nambisan, 2017), causing cultural modifications. These modifications are supported by the internet, through open-code software and cloud computing (von Briel et al., 2018), which has accelerated in the Covid19 pandemic with the creation of functional strategies, processes and services, reformulating traditional market models and processes.

#### **R2 and support Pillar 4: Individual Characteristics**

Pillar 4 resulted from various articles (Luckman, 2008; Mancha & Shankaranarayanan, 2020; Monllor & Soto-Simeone, 2019; Wallin & Fuglsang, 2017) showing how individuals with digital perception can break with institutional agreements (Wallin & Fuglsang, 2017). Indeed, digital literacy (Luckman, 2008) together with exposure to digital technology, can develop business self-efficacy in individuals (Monllor & Soto-Simeone, 2019), as well as developing entrepreneurial intention (Mancha & Shankaranarayanan, 2020), allowing the conclusion that Individual Characteristics are one of the pillars supporting R2.

Digital technology has broken down barriers at the individual level, transforming university academics in digital entrepreneurs and changing how the users of digital technology present their cultural perceptions and personal preferences (Luckman, 2008), allowing these users to become entrepreneurs (Schiavone et al., 2019). In addition, the commercialization of blogs and/or social media (McIntyre, 2020) make work different and significant (Symon & Whiting, 2019).

This has happened for new entrepreneurs in the health sector (Wallin & Fuglsang, 2017) and in the development of digital start-up entrepreneurs based at universities (Zaheer et al., 2019b). Here, the relation between each entrepreneur's individual characteristics and digital technology merge, with the potential to create digital entrepreneurial ecosystems (Song, 2019).

In this context, digital academic entrepreneurs develop and regenerate themselves through a virtuous cycle setting out from the individual, accessing the network which includes other institutions and a wider ecosystem (Toniolo et al., 2020a). Therefore, it is necessary to study the individual characteristics of the digital academic entrepreneur, namely: entrepreneurial orientation, digital literacy, business self-efficacy and self-efficacy of digital technology (Mancha & Shankaranarayanan, 2020a) and self-efficacy (Mancha & Shankaranarayanan, 2020a; Monllor & Soto-Simeone, 2019).

Future research should: (i) test the role of experimental learning in a simulated environment in universities, changing individual characteristics with the aim of raising the level of digital innovation (Mancha & Shankaranarayanan, 2020a); (ii) analyse the impact of teaching in an academic environment (Mancha & Shankaranarayanan, 2020a); (iii) explore how digital academic entrepreneurship emerges and evolves in different contexts (Toniolo et al., 2020a); (iv) accompany how students with entrepreneurial intentions really become entrepreneurs (Monllor & Soto-Simeone, 2019); (v) study the socio-material relation of digital entrepreneurship (Schiavone et al., 2019), and (vi) show how new undertakings in the area of health are created (Wallin & Fuglsang, 2017).

## **R2 and support Pillar 5: Cultural Characteristics**

Pillar 5 emerged from various articles (Fernandes et al, 2019; McAdam, 2020; Secundo, Rippa, & Meoli, 2020; Sperlich, 2011) showing that the use of digital technology potentializes female emancipation (McAdam, 2020); markets emerge from associations between people and places (Fernandes et al., 2019) and new university ecosystems are created (Rippa & Secundo, 2019). However, it can also make work precarious (Sperlich, 2011), allowing the conclusion that Cultural Characteristics are one of the pillars supporting R2.

Digital technology in universities added to academic entrepreneurship change existing cultures. For (Sperlich, 2011), the market of digital production of films, videos and photography in Austria saw a radical change in the cost of production means, professional functions and work methods, which allows one person alone or a small firm to carry out various or all phases of production.

Complementing this, (Fernandes et al 2019) show that digital technology gives business-people working at the base of the pyramid the possibility of associations between people and places which was previously impossible, allowing a new market,

especially for new university graduates who usually do not have working capital to begin in large firms.

In the same context, (McAdam, 2020) analysed female digital entrepreneurs in emerging economies such as Saudi Arabia, aiming to understand how they use technology to seek opportunities.

## **R2 and support Pillar 6: Knowledge-Sharing**

Finally, Pillar (6) also emerged from various studies (Elia et al., 2020; Henfridsson & Yoo, 2014; Li et al., 2018b; Toniolo et al., 2020), which showed how constant enablement is generated in individuals, from digital technology (Henfridsson & Yoo, 2014), supported: (a) by collective intelligence (Elia et al., 2020), (b) digital ecosystems (Li et al., 2018a, b) and (c) the change in individual and institutional relations (Toniolo et al., 2020), allowing the conclusion that Knowledge-Sharing is one of the pillars supporting R2.

Digital technology added to academic entrepreneurship change how knowledge is shared, both between individuals and between organisations. For (Henfridsson & Yoo, 2014), knowledge-sharing allows an organisation to produce innovative products, through the acquisition and implementation of digital technology. Li et al. (2018a, b) also study how business-people in small and medium-sized firms with limited capacities and resources stimulate digital transformation in their firms, from a digital platform typical of small universities, creating wide-ranging renovation of the organisation.

In these circumstances, some suggestions for future research in this area concern the aim to understand how the process of changing the trajectory of digital institutional entrepreneurship occurs (Henfridsson & Yoo, 2014), and also understand how digital platforms can support SMEs' sustainable growth (Li et al., 2018b).

### **(e) DT-AC Framework**

The results of all the quantitative and qualitative analyses carried out, as per the authors selected, are found to be interlinked, which allowed construction of the structural pillars of digital academic entrepreneurship, as grouped in the framework proposed here (Figure 2.4).

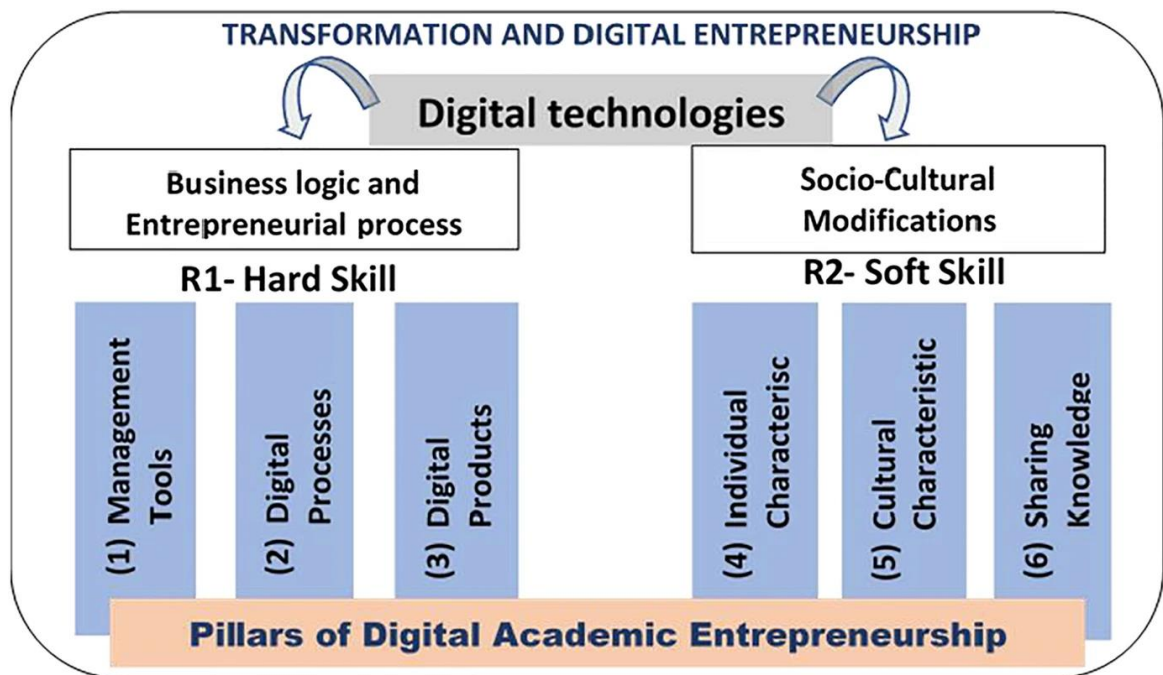


Figure 2.4 Logic of the Structural Pillars of Digital Academic Entrepreneurship

Source: Research data

### 2.3 Conclusions and Contributions

This study built and proposed an innovative framework to explain the relation between Digital Transformation and Academic Entrepreneurship, during Covid19 pandemic, through an extensive literature review, based on pre-pandemic DT. This included a wide, representative set of studies on these two topics, formed of peer-reviewed articles published in journals with an impact factor.

The results obtained revealed two relations: Relation 1 (R1): Digital technology, business logic and academic entrepreneurial process, which covers the Hard Skills field of study, and Relation 2 (R2): Digital Technology and Digital Entrepreneurship, in the Soft Skills field of study.

Indeed, digital transformation (DT) caused by digital technology radically changes organisations and the world in general. In this context, universities also experienced accelerated social, environmental and even cultural changes, which require a change in attitudes, requalification and relearning on the part of academics, employees and human beings in general.

This original study contributes by providing a framework indicating and justifying the link between DT and the academic entrepreneurial process, identifying patterns,

methods, skills and other discoveries in aspects such as management, information systems and culture sciences.

In addition, the framework proposed here shows the pillars supporting R1: (1) Management Tools, (2) Digital Processes, and (3) Digital Products, as well as the pillars supporting R2; (4) Individual Characteristics, (5) Cultural Characteristics, and (6) Knowledge-Sharing, something that shows the complexity of the phenomenon studied here. This study confirms the relation between digital transformation mediated by digital technology and academic entrepreneurship, in a digital economy where knowledge is intensive and also disruptive (Davidson & Vaast, 2010).

The internal relation in each pillar, as well as the interconnections and overlaps between them, were not studied in this work, namely (i) the perception of self-efficacy, (ii) social cognitive theory, (iii) individuals' belief in their capacities, and other aspects that are internal characteristics and form each pillar. Work can be done in the future to expand the framework presented here. Nevertheless, this study contributes to advancing the debate on digital transformation and academic entrepreneurship post-Covid 19.

## **2.4 Limitations and future research agenda**

Like any study, this one is not without limitations. The first concerns the initial selection of articles, since other valuable research related to the topics studied may have been published in other places and were therefore absent from the database used. Secondly, the validity of the evidence collected is limited considering the "new normal" post Covid-19 pandemic. However, the structured methodology of bibliometric content analysis aimed to reduce this shortcoming, as it allows other researchers to replicate the study over time. It is hoped, therefore, that this study contributes to identifying gaps in the debate on digital academic entrepreneurship and can be an inspiration for future research by academics and professionals interested in advancing these promising areas of study.

Future research should therefore make longitudinal studies post Covid-19 to capture the development of digital business behaviour in real time.

In this context, it is suggested that future work should dissect each structural pillar identified here, namely: (1) Management Tools, (2) Digital Processes; (3) Digital

Products; (4) Individual Characteristics; (5) Cultural Characteristic, and (6) Knowledge-Sharing, seeking to understand what happens internally in universities in each of these pillars, how they are formed and worked on and how this is transferred to the market in the form of academic entrepreneurship.

Thus, future research about these structural pillars is necessary to explain the challenges in this research area and which trend topics require more effort from academics, as well as capturing and understanding the overlaps and circularities between pillars. Against this backdrop, Table 2.6 displays the gaps identified in the reviewed papers, emerging as a future research agenda.

It is also necessary to analyse how sociomaterial theory can affect the DT relation, via digital technology and academic entrepreneurship, something referred to by (Nambisan, 2017). In addition, future research can also include topics related to the perception of self-efficacy as part of Bandura's social cognitive theory, which assumes that personal beliefs in individual capacities can be an essential element in developing academic entrepreneurship

Table 2.6 Research agenda  
Source: Research data

| Digital Technology, Business Logic and Entrepreneurial Process |                             |  |  |
|--|-----------------------------|--|--|
| Pillar   | Researchers                 | Gap  | Trends Topics  |
| 1. Management Tools (MT)                                       | (Vorbach et al., 2019)      | Show the relevance of entrepreneurial education, from MOOCs  | Understand the competences, for the use of MT in education for entrepreneurship  |
|  | (Arvidsson & Mønsted, 2018) | Understand the obstacles to measuring the benefits of using MT in organisational innovation                                  | Associate the use of MT with organisational innovation   |
|  | (Cenamor et al., 2019)      | How entrepreneurial SMEs can improve performance through digital platforms   | Relate the use of digital platforms and SME performance  |
|  | (Symon & Whiting, 2019)     | Investigate the role of MT in constituting significant work, in the context of the social entrepreneur                       | Explore how MT can support social entrepreneurship   |
|  | (Brydges & Sjöholm, 2019)   | Understand the opportunities and challenges of using MT.   | Show how digital technology creates new types of professional activities   |
| 2. Digital Process   | (Rippa & Secundo, 2019)     | Lack of studies about the intersection of academic entrepreneurship with digital technology                                  | Investigate how the use of DT accelerates entrepreneurship education   |
|  | (Tumbas et al., 2018)       | Show how new functions created by DT gain legitimacy   | Analyse how the new digital logic creates new functions for the development of organisational innovation                             |
|  | (Hracs et al., 2013)        | How the virtual space can alter how goods are produced, promoted, distributed and consumed.                                  | Show how non-digitals are being adapted to digital strategies with the use of technology   |
|  | (Pergelova et al., 2019)    | The use of digital technology can impact on the internationalization process and whether the results suffer a gender effect. | Understand how digital technology can accelerate the process of HEI internationalization   |
|  | (Brydges & Hracs, 2019)     | In what way DT provides individuals with greater freedom to define: <b>where, when and how to work and live</b>              | Show the importance of online spaces, for work and student mobility<br>Study how DT can add value in a region and spread its culture |
|  | (Suleymanova, 2018)         | Understand how DT can expand cultural consumption and the creation of a regional identity                                    |  |

Table 2.6 Research agenda (Continued)

| <b>Digital Technology and Socio-Cultural Modifications</b> |                                    |  |   |
|--|------------------------------------|--|---|
| <b>Pillar</b>  | <b>Researchers</b>                 | <b>Gap</b>   | <b>Trends Topics</b>  |
| <b>3. Digital Products</b>                                 | (Rippa & Secundo, 2019)            | Intersection of academic entrepreneurship with digital technology  | Show the social and economic benefits of using DT, in creating new products                           |
|  | (Schiavone et al., 2019)           | Explore how entrepreneurs using DT create and commercialize new products   | Relate the socio-material nature of DT and the entrepreneurship of digital users                      |
|  | (Ho & Lee, 2015)                   | How technological innovations are interlinked with changing market needs and adaptive strategies.                                  | Analyse how DT impacts on organisational strategies and the development of new products in HEIs       |
|  | (Ivanović-đukić et al., 2019)      | Show the effect of different types of digital entrepreneurship on economic growth  | Show the factors that influence the development of digital innovative organisations                   |
| <b>4. Individual Characteristics</b>                       | (Monllor & Simeone, 2019)          | Soto- Investigate how exposure to digital technology can develop digital business self-efficacy and the entrepreneurial intention  | Relate DT exposure to the perception of digital self-efficacy and the entrepreneurial intention       |
|  | (Luckman, 2008)                    | Identify digital literacy, which can enable people to create products using DT   | How to enable more people to take advantage of the opportunities provided by DT.                      |
|  | (Mancha & Shankaranarayanan, 2020) | & Explore and understand the antecedents of digital innovation   | Test the role of experimental learning with DT in students' entrepreneurial intention                 |
|  | (Wallin & Fuglsang, 2017)          | Explore how new undertakings can break institutional agreements (i.e. regulations, normative rules and cultural-cognitive beliefs) | Analyse how the actors of innovation negotiate alternatives and paths to the implementation of change |
|  | (Zaheer et al., 2019a)             | Explore factors contributing to the success of digital education start-ups   | Test the factors shaping performance in innovative digital education start-ups.                       |

Table 2.6- Research agenda (Continued)

|                                    |                           |   |  |
|------------------------------------|---------------------------|---|--|
| <b>5. Cultural Characteristics</b> | (Rippa & Secundo, 2019)   | Intersection of academic entrepreneurship with digital technology   | Show the social and economic benefits of using digital technology in university ecosystems   |
|                                    | (Fernandes et al., 2019)  | Investigate how micro-entrepreneurs on the margin of society, from collective efforts and DT, create new markets  | Understand how micro-entrepreneurs manage to make new and powerful associations between people and places, to create an entrepreneurial path from DT |
|                                    | (McAdam, 2020)            | Investigate empirically the emancipatory potential of digital entrepreneurship for women in economically rich countries with restrictive social and cultural practices. | Explore how age, deficiency and social class and religion can be crossed with the liberating potential of digital entrepreneurship                   |
|                                    | (Sperlich, 2011)          | How DT can be a two-edged sword for entrepreneurship, as on one hand it facilitates market entry, and on the other it raises the competition and makes work precarious  | Relate how the autonomy provided by DT in entrepreneurial work can bring benefits, but also costs  |
| <b>6. knowledge sharing</b>        | (Toniolo et al., 2020b)   | Understand how digital academic entrepreneurship is developed, considering individual and institutional relations   | How digital academic spin-offs can contribute to spreading innovation  |
|                                    | (Elia et al., 2020)       | How DT and the digitalization of knowledge are changing entrepreneurship  | Study the impact of collective intelligence on new digital projects  |
|                                    | (Henfridsson & Yoo, 2014) | Show how digital institutional entrepreneurs establish new trajectories   | Explore how digital institutional entrepreneurs constantly reconfigure their identity  |
|                                    | (Li et al., 2018b)        | Understand how digital platforms (Alibaba) create ecosystems with competing firms   | Investigate how digital platforms create and develop their digital ecosystems  |

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## **Chapter 3**

# **The Soft Skills Bases in Digital Academic Entrepreneurship in relation to Digital Transformation**

### **Abstract**

Digital technology changes the organisational structure of traditional firms, creating opportunities for entrepreneurship. These modifications are known as "digital transformation" (DT). In addition, Higher Education Institutions (HEI) 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 analyse 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? 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. The results show that the competences can be developed considering three major groupings: (i) Individual Characteristics, (ii) Cultural Characteristics and (iii) Knowledge Sharing. Since Soft Skills 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.

Keywords: Soft Skills, Digital academic entrepreneurship, Entrepreneurial mindset, Digital transformation

### **3.1 Introduction**

New digital technologies have changed the organizational structure of companies and created opportunities for the growth of the new businesses through innovation (Nambisan and Baron, 2013). Therefore, organizations must immediately digitize their processes, products, and services to remain competitive (Mancha and Shankaranarayanan, 2020). On this wise, organizations create more agile processes, streamlining and turning more dynamic the decision-making process (Huang et al., 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 et al., 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 and Yoo, 2014). Companies such as Alphabet, Amazon, Apple, Netflix, and Tesla Motors, which depend on digital technology, create opportunities for these knowledge contributors (Mancha and 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 (a set of competencies intrinsic to individuals: motivation, traits, aptitude, aspects of self-image, social role).

Digital academic entrepreneurship is a growing field of study, as seen from the research carried out (e.g., Monllor and Soto-Simeone, 2019; Ripa and Secundo, 2019; Secundo et al., 2020; 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 et al., 2020), transforming not only organizations but also social relations (Nambisan et al., 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 Soft Skills 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 et al., 2021).

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.

### **3.2 Literature Review**

The world has felt the impact of digital technology since the advent of the computer and the internet, after the Second World War. However, it was from the beginning of the 21st century that the union of technology involving robotics, mechanisation, software, artificial intelligence, the internet of things and other systems led especially to a great transformation in habits, culture and society. We refer to this change as Digital Transformation (DT) (Vial, 2019).

DT has impacted the market and production methods, and in institutions the way of undertaking became digital. Therefore, HEIs face challenging times, as the traditional educational system is often oriented towards teaching, aiming to transmit theoretical and specialized knowledge and focusing on preparing students to work in traditional firms (Haase & Lautenschläger, 2011). HEIs must be prepared to teach Hard Skills, as these competences are based on explicit knowledge, for example, functional knowledge of business and management, business plans (Hägg and Gabrielsson, 2019) and others.

The market, new firms and entrepreneurship have become digital and also require Soft Skills. These components (for example, creativity and innovation) are more difficult to teach, as they depend on the individual and cultural characteristics of each human being.

Indeed, this perception of individual and cultural characteristics is crucial in developing entrepreneurship (Nambisan & Baron, 2013), as these characteristics allow the development

of an entrepreneurial mind. Individuals with an entrepreneurial mind select feasible objectives, keep a consistent and persistent focus, interpret accurately the feedback on their own performance and progress, and adjust their actions (Nambisan & Baron, 2013).

So HEIs have understood the need to create a form of education, where individuals' self-directed learning should be a fundamental competence (Morris & König, 2020). This is education directed towards students' entrepreneurial knowledge, competences and attitudes (Gibb, 2002), irrespective of their future occupation (Jones & Iredale, 2010). Education for entrepreneurship should allow the development of new behaviour, new 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, creating a socio-economic and technological phenomenon that changes traditional forms of academic entrepreneurship (Rippa & Secundo, 2019; Giones & Brem, 2017a; Nambisan, 2017; Nambisan et al., 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 various stakeholders, as new digital technology makes it possible to identify entrepreneurial opportunities and develop business processes in the university ecosystem (Secundo, Rippa, & Cerchione, 2020).

In this context, the term of digital academic entrepreneurship emerges, according to which HEIs should be able to transmit a range of competences, training pro-active, creative individuals with developed individual capacities (Johann et al., 2020) and an entrepreneurial mind (Haase & Lautenschläger, 2011). But what are the bases of those SS in the DT era?

Digital technology can come into three categories - digital artefacts, digital infrastructure and digital platforms (Rippa & Secundo, 2019) which can accelerate how information is distributed (Nambisan, 2017; Nambisan, Lyytinen, Majchrzak, & Song, 2017), and new organisational structures, routines and information flows are created (Orlikowski, 2007), transforming entrepreneurship (Nambisan et al., 2017; Yoo, Henfridsson, & Lyytinen, 2010). In this research, digital technology is seen as tool that can potentialize digital academic entrepreneurship.

The use of DT by individuals, industries and society (Vial, 2019), added to the entrepreneurial mentality, creates the phenomenon known as digital entrepreneurship. This

phenomenon can cause cultural changes (von Briel, Recker, & Davidsson, 2018) and change the entrepreneurial perception of university students (Rippa & Secundo, 2019)

In the context of universities and other HEIs, digital entrepreneurship takes the form of "Digital Academic Entrepreneurship", resulting from the intersection of DT and digital entrepreneurship in the academic context. Digital academic entrepreneurship is the type of entrepreneurship carried out from digital capacities and competences (Hard Skills and Soft Skills) developed in the university environment, irrespective of the associated digital technology.

In this context, Hard Skills are extremely important technical competences for digital academic entrepreneurship, as they give a tangible perception of the viability of transforming or creating new products or services in the digital era, due to their collaborative potential and collective intelligence (Elia et al., 2020). Therefore, these competences are positive for digital academic entrepreneurship (Rippa & Secundo, 2019).

On the other hand, Soft Skills are related to a set of personal competences, behaviours, attitudes and qualities that let people adapt effectively to their environment (Khaouja, Mezzour, Carley, & Kassou, 2019). These characteristics are crucial to develop an entrepreneurial mentality in students (Edelman, Manolova, & Brush, 2008), and to stimulate the development of an entrepreneurial and innovative university focused on business education (Yashin, Klyuev, & Bagirova, 2018).

So individuals' characteristics are a key element, since creating business is a human process that depends on people's behaviour and actions (Baron, Mueller, & Wolfe, 2016), As individuals interpret information and transform it in business opportunities (Mitchell et al., 2007), this process consists of the constant development of values, attitudes, behaviour, ways of perceiving and the surrounding environment (Schaefer & Minello, 2016).

Entrepreneurship cannot be achieved through a single individual's motivation, but rather it 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 and 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 have to add social value (Giones & Brem, 2017), creating collective entrepreneurship.

So, this paper works in the field of digital academic entrepreneurship. It is a question of maximizing the development of digital competences, business behaviour and attributes (Gibb, 1993), to develop in individuals the ability to recognise commercial opportunities (Jones & English, 2004). The success of this process is the product/service created by the academic, the result of using the digital technology developed in universities that has the potential to transform the environment.

In this context, behaviour and knowledge and the combination of digital technology and university research can result in socio-economic phenomena (Giones & Brem, 2017) that can be used in commercial applications and in generating income for universities (Etzkowitz, 1998). That knowledge should be shared using a great variety of artefacts, including digital ones.

### **3.3 Methodology**

This study uses the methodology based on an integrative literature review (Torraco, 2005). The protocol for data collection was based on the methodology of a systematic literature review (SLR), while the integrative analysis and synthesis followed the principles of an integrative literature review (Sundqvist-Andberg & Åkerman, 2021).

The choice of this integrative approach is justified by new, emerging topics that are not yet consolidated (Snyder, 2019), where no strict norm exists. The aim is to analyse the integrative and critical perspective of the literature and understand the main ideas relating to the research question (MacInnis, 2011). This approach is justified due to the topic of digital academic entrepreneurship being relatively new (Secundo, Rippa, & Cerchione, 2020).

This type of methodology is also appropriate as the aim here is not to review and compare methods, but to reach a wide-ranging, multi-disciplinary perception of a controversial, complex and evolving social question, from different perspectives.

Figure 3.1 shows the three stages of the protocol followed in selecting the literature

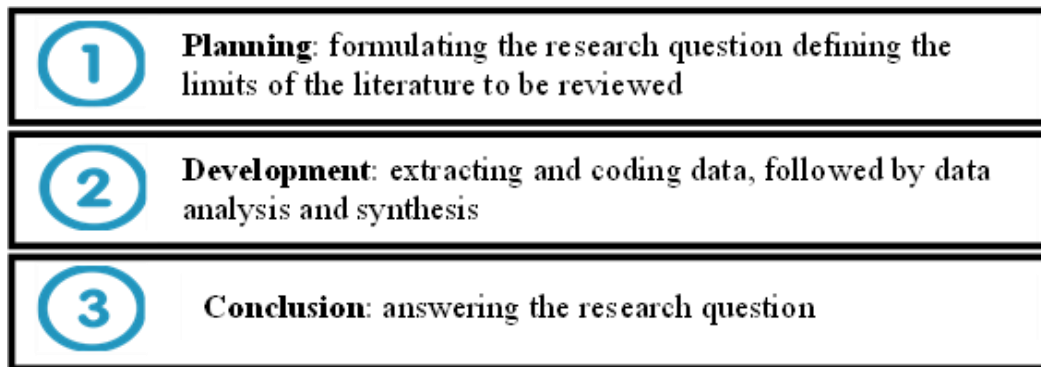


Figure 3.1 Protocol for Selecting the Literature

Stage 1: formulating a list of potential keywords highlighting the research question, in order to define the limits for the bibliographic search and find the relevant research topics. This stage gathered a body of articles shedding light on digital academic entrepreneurship, from the Web of Science (WoS) database. This database was chosen to maintain the structure of rigid criteria where the data are compiled from quality, peer-reviewed journals.

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

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

The main body of literature derived from three search chains, using different combinations of search terms, and resulted in 113 articles, as presented in Table 3.1.

Table 3.1 Search Criteria and Quantitative Information about the Articles Selected

Source: Research Data

| <b>Topics</b>   | <b>Research equation</b>   | <b>Initial n° of articles (Stage 1)</b> | <b>Final n° of articles (Stage2)</b> |
|---|--|---|--------------------------------------|
| 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                                     | 33                                   |

The titles and abstracts of these articles were read to confirm their relevance for the study. If the article seemed relevant, the whole text was read and compared with the research limits. The articles were also analysed using the following inclusion criteria: the article (1) relates Soft Skills with academic entrepreneurship and/or (2) presents a clear indication that digital transformation can change academic entrepreneurship. Complete reading of the articles resulted in an initial selection of 38 articles, of which 32 were included in content analysis.

Stage 2: Here, data analysis followed an inductive approach, i.e., quantitative analysis of content (Hsieh & Shannon, 2005). Through the snowballing process, seminal articles on SS and academic entrepreneurship were also added. 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 3.2, presenting the main subject/problem discussed in each.

Table 3.2 Problems Addressed by Each Author who Supported the Research

|   | <b>Author/ Year</b>                | <b>Review/Journal</b>   | <b>Title</b>   | <b>Subject/problem discussed</b>   |
|---|------------------------------------|---|--|--|
| 1 | Monllor & Soto-Simeone (2019)      | International Journal of Entrepreneurial Behavior & Research    | The impact that exposure to digital fabrication technology has on student entrepreneurial intentions.                          | Exposure to digital fabrication technology can increase students' business self-efficacy, and consequently raise their entrepreneurial intentions.                                       |
| 2 | Secundo, Rippa, & Meoli (2020)     | International Journal of Entrepreneurial Behavior & Research    | Digital transformation in entrepreneurship education centres: preliminary evidence from the Italian Contamination Labs network | Understanding how digital technology can support the entrepreneurial process, stimulating entrepreneurial activity among students.   |
| 3 | Secundo et al.(2021)               | Technological Forecasting and Social Change                     | Threat or opportunity? A case study of digital-enabled redesign of entrepreneurship education in the COVID-19 emergency.       | Understanding how the COVID-19 crisis can reconfigure traditional education programmes and how the pandemic created threats and opportunities for improvement in the educational system. |
| 4 | Secundo, Rippa, & Cerchione (2020) | Technological Forecasting and Social Change                     | Digital Academic Entrepreneurship: A structured literature review and avenue for a research agenda.                            | Review of the literature on Academic Entrepreneurship according to perception of the use of digital technology.  |
| 5 | Toniolo et al. (2020)              | International Journal of Entrepreneurial Behavior & Research    | A grounded theory study for digital academic entrepreneurship  | Study how digital academic entrepreneurship is developed, exploring its evolution.   |
| 6 | Secundo, Rippa, & Meoli (2020)     | International Journal of Entrepreneurial Behavior & Research    | Digital transformation in entrepreneurship education centres: preliminary evidence from the Italian Contamination Labs network | Understanding how digital technology can support the entrepreneurial process, stimulating entrepreneurial activity among students.   |
| 7 | Tomy & Pardede(2020)               | International Journal of Entrepreneurial Behaviour and Research | An entrepreneurial intention model focussing on higher education   | Proposing a practical digital application, for higher education, with the aim of raising students' entrepreneurial intention.  |
| 8 | Rippa & Secundo(2019)              | Technological Forecasting and Social Change                     | Digital academic entrepreneurship: The potential of digital technologies on academic entrepreneurship.                         | Contribute to building the emerging concept of Digital Academic Entrepreneurship.  |

Table 3.2 Problems Addressed by Each Author who Supported the Research (Continued)

|    |   |   |   |   |
|----|---|---|---|---|
| 9  | Linzalone, Schiuma, & Ammirato (2020)               | International Journal of Entrepreneurial Behaviour and Research | Connecting universities with entrepreneurship through digital learning platform: functional requirements and education-based knowledge exchange activities. | Analyse the role of digital learning platforms to connect Universities and Firms effectively.   |
| 10 | Goncharov, Sekerin, & Akhyadov (2020)               | Revista Inclusiones   | Digital academic entrepreneurship: new opportunities for students in the development of the information environment.  | Analyse the digital academic opportunities provided to students.  |
| 11 | Kaminsky, Yereshko, Kyrychenko, & Tulchinskiy(2021) | Information Technologies and Learning Tools                     | Training in digital entrepreneurship as a basis for forming the intellectual capital of nation  | Understand the real impact of digital technology and intellectual capital in entrepreneurship education.  |
| 12 | Garcez et al.(2021)                                 | Education and Information Technologies,                         | Digital transformation shaping structural pillars for academic entrepreneurship: A framework proposal and research agenda                                   | Propose a technical framework showing the structural pillars of the link between digital transformation (DT) and academic entrepreneurship.   |
| 13 | Armuña, Ramos, Juan, Feijóo, & Arenal (2020)        | International Entrepreneurship and Management Journal           | From stand-up to start-up: exploring entrepreneurship competences and STEM women's intention.   | Explore business competences and their link with entrepreneurial intention in relation to joining a business education and incubation programme.  |
| 14 | Costin, O'Brien, & Hynes (2019)                     | Journal of Enterprising Culture,                                | Developing Cognitiveand Non-Cognitive Entrepreneurial Competences through Business Simulation Games.  | Present the role and influence simulation games can have in developing cognitive (knowledge and capacities) and non-cognitive (attitudes) business competences.   |
| 15 | Manning (2018)                                      | Education and Training  | Enabling entrepreneurial behaviour in a land-based university.  | Develop a conceptual framework along with a set of hypotheses that reflects the dynamic relationships operating within an entrepreneurial land-based university in order to then undertake empirical research |

Table 3.3 Problems Addressed by Each Author who Supported the Research (Continued)

|    |  |   |   |   |
|----|--|---|---|---|
| 16 | Charrón Vías & Rivera-Cruz(2020)           | Industry and HigherEducation                | Fostering innovation and entrepreneurial culture at the business school: A competency-based education framework.                          | Propose a framework for the conception of business education programmes, combining behavioural and business competences, through experimental learning.                         |
| 17 | Bischoff, Volkmann, & Audretsch (2018)     | Journal of TechnologyTransfer               | Stakeholder collaboration in entrepreneurship education: ananalysisoftheentrepreneurialecosystemsofEuropeanhighereducationalinstitutions. | Examine business ecosystem stakeholders' collaboration in business education in European higher education institutions (HEI).   |
| 18 | Butz, Hanson, Schultz, & Warzynski (2018)  | Journal of Global Entrepreneurship Research | Beyond the Big Five: does grit influence the entrepreneurial intent of university students in the US?                                     | Explore the relationship between grit and entrepreneurial intent  |
| 19 | Hsieh & Kelley(2019)                       | Entrepreneurship Research                   | A Study of Key Indicators of Development for University-Based Entrepreneurship Ecosystems in Taiwan.                                      | Identify elements of university-based business ecosystems.  |
| 20 | Miles et al. (2017)                        | Education and Training                      | Accelerators as authentic training experiences for nascent entrepreneurs.   | Address the role of accelerators as authentic business training programmes based on learning  |
| 21 | Ndou, Secundo, Schiuma, & Passiante (2018) | Sustainability                              | Insights for shaping Entrepreneurship Education: Evidence from the European Entrepreneurship centers.                                     | Understand the "how, when, why and what" of the entrepreneurial mentality and competences in the field of technological entrepreneurship as learned in Entrepreneurship Centres |
| 22 | Donaldson, Villagrasa, & Sánchez (2021)    | Industry and Higher Education,              | Learner profile mapping: Stimulating autonomous motivation in entrepreneurship education.   | Study the variable of student motivation – in entrepreneurial education   |
| 23 | Gifford (2021)                             | Industry and HigherEducation                | Theory-driven methods for practical entrepreneurship: Hypothesis testing in entrepreneurship education.                                   | Detail Customer Development, as a tool for entrepreneurial education.   |

Table 3.4 Problems Addressed by Each Author who Supported the Research (Continued)

|    |  |   |  |  |
|----|--|---|--|--|
| 24 | Hägg & Kurczewska(2020)                        | Education and Training                            | Guiding the student entrepreneur – Considering the emergent adult within the pedagogy–andragogy continuum in entrepreneurship education. | Develop discussion about the need for, and role of orientation in learning and teaching, for entrepreneurship education  |
| 25 | Mets, Holbrook, & Läänelaid(2021)              | Administrative Sciences                           | Entrepreneurship education challenges for green transformation.  | Propose a conceptual model to apply Education for Entrepreneurship and Green Transformation Competences.   |
| 26 | Peschl, Deng, & Larson (2021)                  | International Journal of Management Education     | Entrepreneurial thinking: A signature pedagogy for an uncertain 21st century.  | Outline a pedagogical approach to business education, focusing specifically on students that do not necessarily see themselves as entrepreneurs                    |
| 27 | Ayob (2021)                                    | Compare   | Entrepreneurship education, institutions and student entrepreneurship: a cross-country analysis.   | Examine the effect of entrepreneurial education on student entrepreneurship rates.   |
| 28 | Stenholm, Ramström, Franzén, & Nieminen (2021) | Industry and Higher Education                     | Unintentional teaching of entrepreneurial competences.   | Study how the teaching methods of lecturers and non-entrepreneurs in management schools adapt unconsciously to the known framework of entrepreneurial competences. |
| 29 | Schou, Bucher, & Waldkirch (2021)              | Small Business Economics.                         | Entrepreneurial learning in online communities.  | Understand how entrepreneurs grasp the new opportunities of digital learning   |
| 30 | Sansone, Ughetto, & Landoni (2021)             | . Journal of International                        | Entrepreneurial intention: Analysis of the role of Student-Led Entrepreneurial Organizations   | Explore the impact of extra-curricular business activities on students' business intention.  |
| 31 | Ratten (2020)                                  | The International Journal of Management Education | Entrepreneurship and management education: Exploring trends and gaps.  | Highlight that entrepreneurship education must change, based on digital transformation and the recent COVID-19 crisis.   |
| 32 | Samwel Mwasalwiba (2010)                       | Education + Training,                             | Entrepreneurship education: a review of its objectives, teaching methods, and impact indicators.   | Make a survey of publications on entrepreneurship education and assess the alignment of perceptions.   |

**Stage 3:** identified the topics that were frequently addressed in each category of the first phase of coding, analysing how these topics were related to digital academic entrepreneurship and SS. The initial coding was performed by the corresponding author, using NVivo software to analyse qualitative data. In cases of diverging interpretations, the coding categories and codes were deliberated and agreed on by two researchers. Figure 3.2 show the categories/topics.

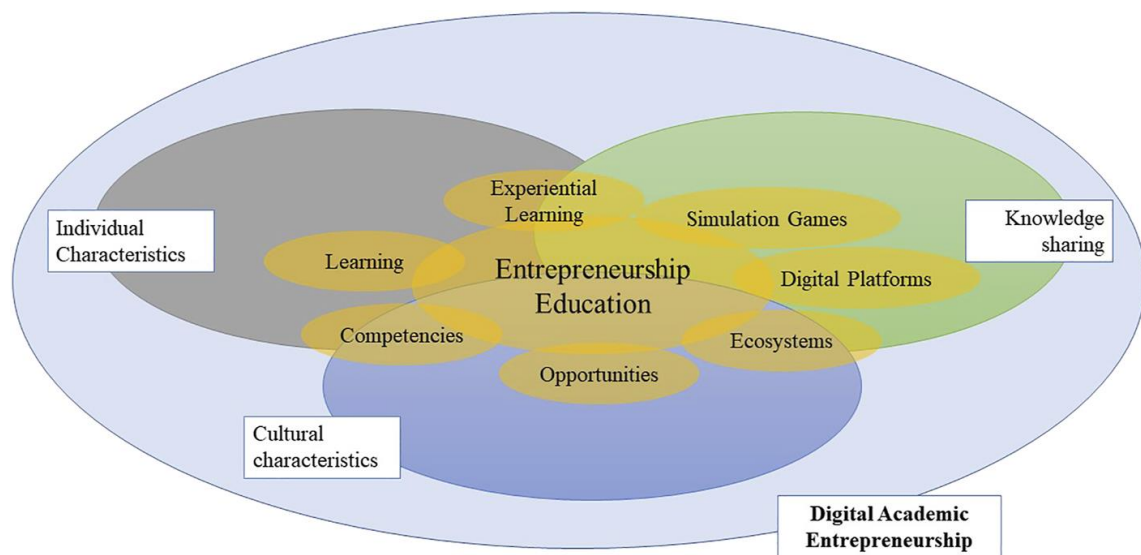


Figure 3.2 Synthesis about Categories/Topics Identified  
Source: Own elaboration

### 3.4 Proposal of a Framework of Soft Skills for Digital Academic Entrepreneurship

New digital technology has been changing organisational structure (Nambisan & Baron, 2013) and a new business spirit can be created (Song, 2019). So the need arises for individuals with 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, Wetsch, Hull, Perotti, & Hung, 2012). In turn, academic entrepreneurship is differentiated from business entrepreneurship in the form and context of business (Secundo, Ripa, & Cerchione, 2020), although both intend to commercialize business opportunities.

In this context, it is vitally important for HEIs to develop entrepreneurial competences in their students, above all the Soft Skills to develop digital academic entrepreneurship. Exhaustive research (a literature review), allowed the construction of the following

framework/model of digital academic entrepreneurship, based on Soft Skills. The model (Figure 3.3) is grounded on three constructs/pillars: (1) Individual Characteristics; (2) Cultural Characteristics, and (3) Knowledge Sharing:

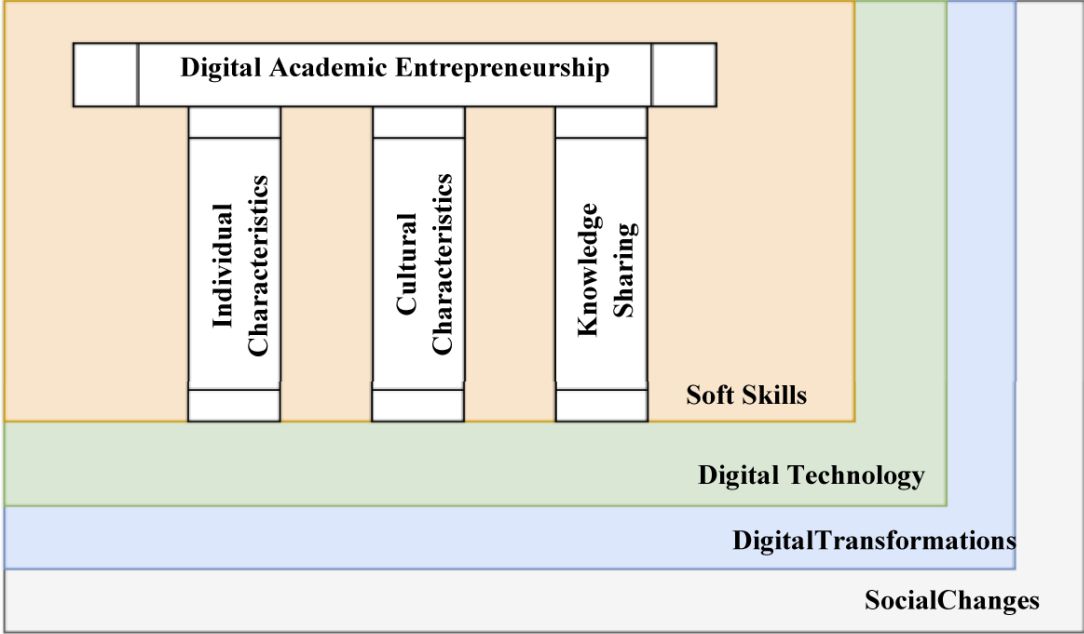


Figure 3.3 Framework of Soft Skills for Digital Academic Entrepreneurship  
 Source: Own elaboration

**Pillar 1 - Individual Characteristics**

For Schumpeter (1942), entrepreneurs are the agents of innovation, and the main activators of economic development, since they identify new opportunities in economic terms or add value to something already in existence. This perception is pertinent for the digital entrepreneur, as in the digital era, reasoning processes require a greater cognitive load (Nambisan & Baron, 2013), which makes the business context more dynamic, unpredictable and non-linear (Huang et al., 2017), leading to the need for individuals with an entrepreneurial mentality.

Entrepreneurial mentality is understood as the ability to be dynamic, flexible and self-regulating in dynamic, uncertain environments. Being entrepreneurial is a human process that depends on individuals’ behaviour and actions (Baron, et al., 2016). This means that the entrepreneur’s cognitive factors can create mental corridors that influence how new information is interpreted (Ward, 2004; Shane, 2000). When individuals interpret this information, they can discover new business opportunities (Mitchell et al., 2007).

Nevertheless, being an entrepreneur is not just a question of accumulating knowledge (Schaefer & Minello, 2016). Psychological factors should also be considered, i.e., how individuals perceive their capacities influences their form of acting (Lent & Hackett, 1987), and consequently, entrepreneurial individuals need to have a more positive perception of their capacities. Studies focused on the entrepreneur's personal characteristics produce a number of theoretical and empirical results in this respect (e.g., Baron, et al, 2016; Cardon & Kirk, 2015; MacKo & Tyszka, 2009; Marques et al, 2018; Zhao, Hills, & Seibert, 2005).

Being an entrepreneur consists of developing values, attitudes and behaviour, having ways of perceiving themselves and the surrounding situation. It includes aspects related to the capacity to innovate, take risks, organise and re-organise social and economic resources in order to transform situations for practical benefit, learn from mistakes and persevere in the face of uncertainties, challenges and opportunities (Schaefer & Minello, 2016).

Therefore, this is one more dilemma of education for entrepreneurship, giving rise to the question of whether entrepreneurship can be taught. On one hand, some studies conclude that psycho-biological changes can only happen from inside to outside, and so no external "instruction" can be given (Andrade, 2012). In this sense, entrepreneurship cannot be taught. On the other hand, some studies based on a behavioural approach show that entrepreneurship can be taught (Haase & Lautenschläger, 2011).

The trait approach seeks to identify differences between entrepreneurs and other individuals, setting out from genetic aspects (Hwee Nga & Shamuganathan 2010; Vega-Gómez et al., 2020), where potential entrepreneurs are assessed through values such as wakefulness, creativity, innovation, pro-activeness, risk tendency and the need for fulfilment, which are the characteristics mentioned by Haase and Lautenschläger (2011). Regarding these factors linked to human personality, Costa and McCrae (1992) defined the "Big Five" (Openness, Conscientiousness, Extraversion, Agreeableness and Neuroticism), which contemporary psychology has identified as human factors providing the entrepreneur with lasting stability (Haase & Lautenschläger, 2011).

As opposed to the trait approach, the behavioural approach tries to provide a more wide-ranging perspective to conceive the nature of business-people and their actions. The proposal by Gartner (1989) considers the evolutionary character of entrepreneurship, where business-people's personality traits are considered as

supporting their action, although the decisive factor is the business-person's behaviour, determined by the environment (Haase & Lautenschläger, 2011).

Hägg and Gabrielsson (2019) show that empirical studies begin to appear in the early 1990s, confirming that entrepreneurship can be taught, a perception that has been complemented since 2010, through recognising 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).

The effectiveness of entrepreneurship education should be ensured by: (1) a classroom culture that promotes collaboration, creativity and autonomy; (2) alignment of methodologies with the norms of education and specific learning content in a coherent, balanced curriculum; (3) lecturers' capacity to adopt a radically different role in the classroom, in which they act more as facilitators of the learning process; and (4) understanding of the conceptual level and a student's antecedents when dealing with students from different courses, in order to promote effective multi-disciplinary teams (Daniel, 2016).

Setting out from this prism, more rational ideas and approaches based on practice were also transformed in teaching methods, such as thought based on design-based thinking and lean start-ups (Johann et al., 2020; Linton & Klinton, 2019; Daniel, 2016), business model canvas (Daly, 2017; Lima & Baudier, 2017; O'Neill, 2015), MOOC platforms (Anand & Kallarakal, 2020; Vorbachet al., 2019; Al-Atabi & Deboer, 2014), Serious Games (Bellotti et al., 2014) and laboratories with digital technology (Secundo, Rippa, & Meoli, 2020). These tools and methodologies create the flows between the various models offering entrepreneurship teaching (Hägg & Gabrielsson, 2019).

Research into business education has not produced any consistent body of knowledge that can give suitable orientation regarding the methods that should be used to teach Soft skills (Hägg & Gabrielsson, 2019). Nevertheless, the development of Soft Skills 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, 2020) and/or create centres for entrepreneurship education equipped with digital technology, using gamification with immersion based on challenges (Buzady & Almeida, 2019), as well as entrepreneurship education programmes using digital technology (Secundo et al., 2021).

This study understands digital academic entrepreneurship in a broad sense, i.e., considering that its premises should promote the ecosystem of developing soft competences in students, due to the heavy load of tacit knowledge needed (Ratten, 2020; Haase & Lautenschläger, 2011), adding the need of relational capital (Toniolo et al., 2020, Cenamoret al., 2019). HEIs should promote: (1) Extra-Curricular activity (for example, participation of the academic association, training courses/laboratories for entrepreneurship, academic mobility, sport or courses to develop personal competences); (2) Participation in the labour market (for example, holiday work, part-time work, work placements in the summer); and (3) Voluntarism (for example, volunteering in cultural, recreational or student associations), which can promote entrepreneurship.

## **Pillar 2 - Cultural Characteristics**

Culture is a set of individual resources to create action strategies (Swidler, 1986), and can be a trigger to perceive entrepreneurial opportunities. Business activity does not depend only on entrepreneurs' individual characteristics (Crecente et al., 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 entrepreneurs are part of, their motivation to create a business may change. In a situation of need, individuals are pushed towards entrepreneurship. This 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).

Entrepreneurship through opportunity has assumptions opposing those of “through necessity”, and occurs more frequently in developed countries, where the state is stronger, being based on innovation (Middermann & Rashid, 2019).

In relation to 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 particularly important 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 in doing so is similar. The main difference lies in profitability (Amorós et al., 2021). The perception of well-being is supported by individuals' satisfaction in fulfilling their creative potential and creating innovation (Ahl & Marlow, 2012), making the relation between culture and technology mutually influential (Leonardi & Barley, 2008). Here, the entrepreneur-opportunity relation can be increased by digital technology (Giones & Brem, 2017).

The use of digital technology can allow gender equality in emerging economies, such as in Saudi Arabia, a country with social and cultural characteristics that are restrictive for women (McAdam, 2020), China (Wang & Keane, 2020), Lebanon (Lichy, Farquhar, & Kachour, 2020) and Bulgaria (Pergelova, Manolova, Simeonova-Ganeva, & Yordanova, 2019), where it is a tool supporting social equality (Krieger & Sorgner, 2018) and an agent of cultural change. DT is also found to promote socio-cultural changes, for example, in changing the housewife role, where practices are transformed into commercial products (McIntyre, 2020).

So DT changes society, the economy and entrepreneurship, and can set out from HEIs in this phenomenon known as digital academic entrepreneurship (Rippa & Secundo, 2019). From commercialization and creation of value (Brennan & McGowan, 2006; Etzkowitz, 2017), universities have developed and created patents, licensing, new undertakings, technology transfer and science parks, promoting 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). This can favour not only high-tech entrepreneurship but also 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 competences of socio-cultural involvement and civic impact on students (Pavlova, et al, 2016). Therefore, HEIs should promote in their whole ecosystem the development of soft competences in

students, giving students the perception of the cultural context of entrepreneurship, setting out from: (1) digital competences, (2) the perception of gender equality, and (3) the perception of entrepreneurial opportunities.

### **Pillar 3 - Knowledge Sharing**

The knowledge generated by university research programmes 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). Knowledge can be shared between the university and industry, through patents, academic spin-offs, individuals trained in entrepreneurial action and jobs created in the university's surrounding region (Siegel & Wright, 2015; Somsuk & Laosirihongthong, 2014; Shane, 2004). These actions promote economic development (Goncharov, Sekerin, & Elman, 2020; 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 & Watson, 2017; Kalar & Antoncic, 2015; Siegel & Wright, 2015), and can thereby go beyond the perspective of commercializing science (Giones & Brem, 2017).

In this context, the use of virtual educational platforms can support the development of digital content and its integration, on-line courses, simulators, 3D printers, etc. (Castillo & Watson, 2017). In this way knowledge sharing takes place between the university and entrepreneurs (Linzalone et al., 2020), creating a web-based learning environment, providing just-in-time and personalized learning (Assaf, Elia, Fayyumi, & Taurino, 2009; 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 competences to face new business challenges, meaning the need to use self-learning strategies (Young, 2007). This is a fundamental competence for entrepreneurship (Morris & 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 with the intention of supporting digital entrepreneurship (Goncharov, Sekerin, & Elman, 2020; Schou, Bucher, & Waldkirch, 2021), with flexibility in time and space (Kaminsky et al., 2021), using MOOC (Žur, 2020) and other digital platforms to connect universities and firms (Linzalone et al., 2020).

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

### **3.5 Conclusions, Contributions and Future Agenda**

According to Mancha and Shankaranarayanan (2020), individual characteristics are fundamental for identification of opportunities and adding value to products and services. However, the cultural context that the entrepreneurial individual is part of can be the trigger for entrepreneurial action (Fernandes et al., 2019; McAdam, 2020). This cultural context is complemented by how information is shared, supporting the stability of the process of digital entrepreneurship in dynamic environments (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 ways 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 this 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 individual characteristics to pursue that opportunity (Hannibal et al., 2016). So entrepreneurship education has an important place in HEIs' curricula (Secundo et al., 2020), with lecturers becoming aware of the importance of entrepreneurship within teaching institutions (Goncharov, Sekerin, & Elman, 2020).

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). Considering these 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 Soft Skills are supported by three pillars: (i) Individual Characteristics, (ii) Cultural Characteristics, and (iii) Knowledge Sharing. Individual characteristics involve each individual's skills, their past, their origin, family type and tendency towards risk, and so learning takes place at different levels, regarding speed of acquisition and thoroughness. Taking the autopoiesis concept of Maturana (de Morais et al., 2021), it is understood that instructionism cannot occur, so individual characteristics are developed one by one, which has meant a real gap in entrepreneurship education. Cultural characteristics involve the environment each person is part of and their inter-relations, with the field of the ecology of relationships having a fundamental role here, as well as human relations and anthropology, which can generate different opportunities (de Oliveira et al., 2015). Systemic understanding of these relations is a challenge. Finally, knowledge sharing involves access to Hard Skills techniques, technology and knowledge-disseminating groups.

Since Soft Skills 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.

This study makes contributions to theory and practice. From the theoretical point of view, it contributes to encouraging 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 have a positive impact on 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 organisations' understanding of how to take advantage of "fresh" ideas brought by students from

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, where 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. One concerns not yet analysing the boundaries and overlapping that exist between the three pillars identified, as the database selected did not allow this type of conclusion. The speed with which knowledge is extended may be another limitation as it may be the case that other valuable research related to the topics developed here has been published in other places not listed on the database used (WoS).

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

In conclusion, the particularity of digital academic entrepreneurship opens up various opportunities for research, but future work should recognise the complexity and richness of the topic.

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## Chapter 4

# The Hard Skills Bases in Digital Academic Entrepreneurship in Relation to Digital Transformation

### Abstract

Digital transformation (DT) changed the means and mechanisms for acquiring knowledge, meaning that higher education institutions (HEI) changed the form of student-lecturer and teaching-learning interaction. Digital transformation must have a relevant role in building the Hard Skills (HS) necessary for academic entrepreneurship, where HS are easily taught and measured. This study analyses the basis of HS for digital academic entrepreneurship, answering the following research hypothesis: *What are the Hard Skills - entrepreneurial education - for digital academic entrepreneurship and how are they formed?* An extensive, inclusive literature review revealed that, due to the possibility of editing, reprogramming and generating digital technology, the basis of DT can support the development of HS in higher education students. The results show that HS can be developed considering three major pillars: (i) Management Tools, (ii) Digital Process, and (iii) Digital Products. Since HS are easily taught, this study shows how the use of digital technology can transform this scalable teaching process, in order to reach the maximum number of students. It is therefore suggested that those in charge of HEIs use the pillars presented here in the framework proposed to guide their institutions' strategic planning. With these pillars in mind, the aim is to stimulate the development of innovative business proposals developed in the academic environment and promote digital academic entrepreneurship.

**Keywords:** Hard Skills; Education; Digital academic entrepreneurship; Digital transformation; Entrepreneurship Education.

## 4.1 Introduction

The emergence of a set of digital technologies, digital platforms and digital infrastructure has transformed entrepreneurship (Nambisan et al. 2017; Yoo et al. 2010). These modifications are known as “digital transformation” (DT) where, the concept of digital entrepreneurship emerges from the intersection of digital technology and entrepreneurship. This phenomenon assumes that digital technology modifies the uncertain nature inherent to business processes and results, as well as the ways to deal with that uncertainty (Nambisan 2017).

Digital entrepreneurship is less limited and less pre-defined than non-digital entrepreneurship (Nambisan 2017). This perception emerges due to the flexibility in using digital tools, which influences the capacity to distribute information, reducing traditional business limits (Nambisan 2017; Nambisan et al. 2017). These distinct characteristics are the basis for the appeal from scholars to carry out studies seeking to understand how “digital” transforms entrepreneurship, i.e., this context can give new meaning to existing organisational theories (e.g., Nambisan 2017; Yoo et al. 2010).

In these circumstances, incorporating multiple and crossed levels of analysis in the study of digital entrepreneurship provides numerous opportunities for academics within this area of entrepreneurship, where researchers embrace ideas and concepts from many fields/disciplines (Nambisan 2017; Nambisan et al. 2017). Digital entrepreneurship becomes a growing field of research, for example, in the academic context showing the relevance of education for entrepreneurship, from Massive Open Online Courses (MOOCs) (Vorbach et al. 2019); studying the interaction of academic entrepreneurship with digital technology (Rippa and Secundo 2019); investigating how exposure to digital production technology can develop digital business self-efficacy and the entrepreneurial intention (Monllor and Soto-Simeone 2019); and in testing the role of experimental learning using digital technology and how this can affect students’ entrepreneurial intention (Mancha and Shankaranarayanan 2020).

In this context, several gaps connected to digital academic entrepreneurship are in need of additional research, as this type of digital entrepreneurship has come under the influence of global DT. This means that a multi-level perspective capturing the complex relations formed between actors, including firms, universities, government, NGOs, citizens, local communities, infrastructure, customers and other stakeholders (Beliaeva et al. 2019, is required). In addition, this is a growing field of study, as can be seen from the research carried out (e.g., Monllor and Soto-Simeone 2019; Rippa and Secundo

2019; Secundo et al. 2020; Toniolo et al. 2020; Rippa et al. 2022), due to the opportunities created by DT, where daily interactions between digital technology and entrepreneurship create a socio-technical paradigm (Elia et al. 2020; Rico et al. 2022), transforming not only organizations, but also social relations (Nambisan et al. 2019). Thus, academics should study digital academic entrepreneurship from a multidisciplinary perspective, including literature from various disciplines such as information systems, political science and psychology. In addition, they should analyse this phenomenon at the micro and macro levels (Toniolo et al. 2020).

In these formations, different Soft and Hard Skills are required due to the new socio-technical and economic paradigms emerging from the potential for collaboration and collective intelligence, launching more robust and sustainable business initiatives (Elia et al. 2020). For that reason, there is a need for discussion around Hard skills (HS) for academic entrepreneurship, including a holistic perspective of digitalization and DT in the world (establishing why, what, who and how digital technology will change the processes of academic entrepreneurship—Rippa and Secundo 2019).

A large group of educators argue that it is fundamentally important to develop HS among future entrepreneurs, and these researchers believe that a business-person cannot be successful without instrumental skills (Yashin et al. 2018). Compared to Soft skills, for digital academic entrepreneurship, Haase and Lautenschläger (2011) believe that Hard Skills are more easily taught, as this is a process of providing students with competences to initiate and create a business (Pittaway and Cope 2007), transforming an idea into a business opportunity (Secundo et al. 2021).

Although Hard Skills are more easily taught than Soft skills, there is a wide range of aspects HS can cover: (1) entrepreneurial competencies, (2) marketing competence, (3) business and economic competence, (4) financial competence, (5) accounting affairs competence, (6) management competence, (7) globalisation competence, (8) business law competence, (9) enterprise resource planning competence and (10) information technology competence (Chou et al. 2010). These baselines can be taken as true and influencing the entrepreneurial process. Therefore, this study intends to answer the following research question: What are the foundations of Hard Skills (HS) for digital academic entrepreneurship and how can these be taught? Thus, the objective is to propose a model based on an extensive and inclusive review of the literature and the structural bases of HS in digital academic entrepreneurship, which will stimulate the development of innovative business proposals developed within the academic environment and promote digital academic entrepreneurship.

To answer this research question, we chose to conduct a literature review, supported by a data collection protocol based on the systematic literature review (SLR) methodology. Therefore, data was qualitatively analysed through content analysis from an integrative review of the literature. This approach is justified by the fact that the theme of digital academic entrepreneurship is relatively new (Secundo et al. 2020). The literature was analyzed from an integrative and critical perspective to understand the main ideas related to the research issue. This methodology is appropriate, since the objective is not to review and compare methods, but rather to achieve a comprehensive and multidisciplinary perception of a change in the DT paradigm and development of HS necessary for digital academic entrepreneurship, since this perspective can be controversial and complex and can develop from different perspectives

The remainder of the paper is organized as follows: Section 2 presents a theoretical background about digital academic entrepreneurship and how it relates to entrepreneurial education and HD in the academic environment. Section 3 describes the methodology used in the study. Section 4 presents the results and discussion, and a framework is proposed. Conclusions, implications and future lines of research are presented in Section 5.

## **4.2 Theoretical Background**

Digital academic entrepreneurship emerges from the potential intersection between academic entrepreneurship and digital technology, creating a socio-economic and technological phenomenon that changes traditional forms of academic entrepreneurship (Rippa and Secundo 2019). This perception, already advocated by Schumpeter (1942), refers to innovation as an instrument necessary to ensure competitiveness and economic development. The most important element of an economy is knowledge and technological development, where new innovative companies are an important driver of economic growth. Innovation is the result of an interactive process between market (individuals, organizations, and companies) and non-market institutions (e.g., universities) (Lewandowska et al. 2021).

Here, the role of HEIs, as agents for knowledge and technology transfer, is to promote digitalization and innovation in the business ecosystem and society (Toniolo et al. 2020). This is no easy task due to HEIs' difficulty in applying management techniques and tools used in the external environment (Bischoff et al. 2018), which is constantly changing due to DT.

This difficulty arises because the conventional educational system is oriented towards teaching, aiming to transmit theoretical and specialized knowledge, i.e., focused on preparing students to work in traditional firms. Here, traditional forms of learning are used: lectures, seminars, debates and motivating talks (Haase and Lautenschläger 2011). HEIs look at digital technology as a variety of tools that can support the development of the adoptive learning approach, as it allows the development of climates for understanding and awareness of internal and external aspects of the entrepreneurial process (Ndou et al. 2018). The teaching of digital skills, in the entrepreneurial intention, encourages students to participate in the digital world as active and responsible actors, i.e., it encourages students to use their digital skills critically, and to justify the context in which they are applied (Ilomäki et al. 2016).

In addition, it is important to maintain the structured teaching of HS, as these skills are of great importance for digital academic entrepreneurship, from the combination of disciplinary expertise with interdisciplinary. An example of this would be having a specific scientific domain (programming language) and an extension of management skills, even without mastering all the methods and practices (Rippa et al. 2022). This type of skill gives a tangible perception of new products or services in the digital age (Elia et al. 2020). These HS also aim to help students identify market opportunities, providing tools to allow the development of business ideas and support development of a business plan (Armuña et al. 2020). The aim is to identify market opportunities, specify the technology, organise the operation and create value, i.e., to outline the (industrial) logic by which customers are served and financial capital is generated (Teece 2018).

Good performance is not achieved only by a well-done business plan. For this to occur, second-level dynamic actions are required, which consists of continuously perceiving and seizing opportunities, and periodically transforming them into organisational aspects (Teece 2018). This ability depends on the idiosyncratic characteristics of individuals (Teece 2014). Here, business simulation games, using digital technologies, can contribute to improving internal communication by creating a learning environment (Rico et al. 2022).

In this sense, the HS required for the initial development of a business plan can be expressed principally through concepts (Khaouja et al. 2019), for example, knowledge of statistical and graphic modelling, knowledge of business strategies and legislation, knowledge about using digital technology (Seal et al. 2020). In this context, HEIs' role consists of stimulating the use of digital objects (Toniolo et al. 2020), providing

students with HS through using digital technology. Thus, HEIs' should guide their actions in transdisciplinary competence of green awareness with the objective of promoting responsible business models (Mets et al. 2021).

In these circumstances, HEIs are prepared to teach HS, since these skills are based on explicit knowledge (Hägg and Gabrielsson 2019) and are preparing to teach entrepreneurship in the digital age (Secundo et al. 2020b), seeking to bring students closer to DT, teaching wide-ranging logics (computational thinking), including modelling tools, methods to analyse data and gather information, and skills in analysing complex systems that can help to build successful businesses (Kaminsky et al. 2021).

The concept of entrepreneurial education programmes, in the digital era, considers two aspects: (1) business knowledge (Hard Skills) or (2) behavioural competences (Soft skills). In some cases, they may be of a hybrid nature, where learning tools and the method are chosen to fulfil the desired learning objectives (Charrón Vías and Rivera-Cruz 2020), i.e., curricular content and teaching methods can vary according to the objectives of the programme (Sirelkhatim and Gangi 2015).

In this context, two levels of perception are considered: (1) ontological, defining explicitly what entrepreneurship is, aiming to involve educators and students in the entrepreneurial context, and (2) educational, conceiving tools that respond to five questions: (1) objectives and goals, (2) target public, (3) assessment and appreciation, (4) content and theories, and (5) methods and pedagogy (Fayolle and Gailly 2008).

HEIs create digital environments to stimulate digital academic entrepreneurship, providing students with environments for trial action, for example, computational simulation environments, as these allow the transfer of theoretical/practical knowledge, using digital tools, as well as team collaboration and continuous interaction between the lecturer and students.

The implementation of these environments can represent both an opportunity and a threat; opportunity can arise from collaboration among teams of students working on business ideas when they take on the role of members of a business team. Threats arise from the need to provide students with different contents, according to their previous knowledge, due to different educational backgrounds (Secundo et al. 2021).

Another alternative is to use prototyping to develop digital processes, as this allows ideas for products and business models to be formed rapidly and modified in repeated

cycles of trial and implementation (Nambisan et al. 2017; Ries 2011), which may stimulate students to become entrepreneurs. HEIs provide students with environments where they, staff and lecturers have free access to software and digitally manufactured equipment (for example, 3D printers, laser cutters, CNC lathes and augmented reality simulators). This type of equipment opens up an opportunity for rapid development of prototypes and business ideas (Monllor and Soto-Simeone 2019; Rayna and Striukova 2021).

HEIs also focus their efforts on developing entrepreneurial education programmes contemplating stages of incubation and acceleration (García et al. 2016) as mature, viable digital products are provided to the market. HEIs can support this process, providing students with methods that let them seek financing and supervision of the business for some months before being able to operate independently (Muafi et al. 2021).

In this context, HEIs can use digital technology to support the development of the HS necessary for digital entrepreneurship (Rippa and Secundo 2019). Developing HS in a digital environment gives students the tangible perception of the viability of transforming or creating new products or services in the digital era and minimizing the number of inferences and suppositions regarding the process of digital academic entrepreneurship.

From the contextualisation presented, we realise that these relations are an answer to the research question: what are the bases of Hard Skills (HS) for digital academic entrepreneurship, and how are they formed and related?, in an academic environment based on entrepreneurial education. Thus, the aim is to propose a model based on an extensive and inclusive review of the literature, the structural bases of HS in digital academic entrepreneurship, which will stimulate the development of innovative business proposals developed within the academic environment. The articles analyzed here should answer the following research questions: (1) How are HS related to digital academic entrepreneurship? and (2) How does DT change digital academic entrepreneurship?

### **4.3 Methodology**

This study uses the methodology based on an integrative literature review (Torraco 2005). The protocol for data collection was based on the methodology of a systematic

literature review (SLR), while the integrative analysis and synthesis followed the principles of an integrative literature review (Sundqvist-Andberg and Åkerman 2021).

The choice of this integrative approach is justified by new, emerging topics that are not yet consolidated (Snyder 2019), where no strict norms exist. The aim is to analyse the integrative and critical perspective of the literature and to understand the main ideas relating to the research question (MacInnis 2011). This approach is justified by the topic of digital academic entrepreneurship being relatively new (Secundo et al. 2020a).

This type of methodology is also appropriate, as the aim is not to review and compare methods, but to achieve a wide-ranging and multi-disciplinary perception of a change in the DT paradigm and development of the HS necessary for digital academic entrepreneurship, as this perspective may be controversial and complex and may develop from different perspectives.

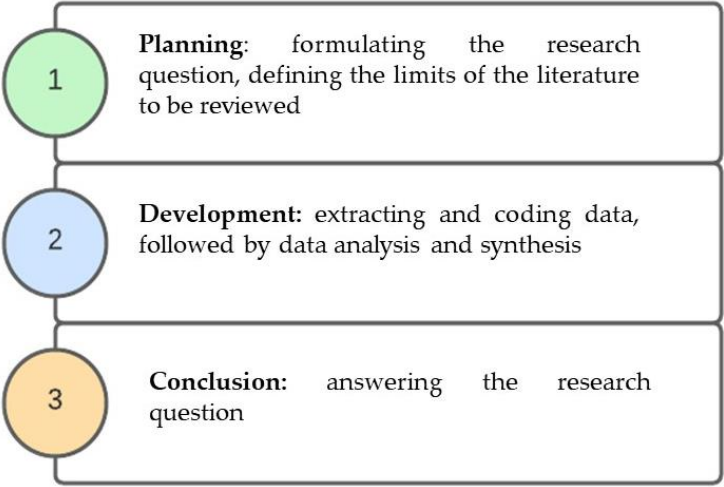


Figure 4.1 Shows the three stages of the protocol followed in selecting the literature

Stage 1: formulating a list of potential keywords highlighting the research question, in order to define the limits for the bibliographic search and find the relevant research topics. This stage involved the gathering of a body of articles shedding light on digital academic entrepreneurship from the Web of Science (WoS) database. This database was chosen to maintain the structure of rigid criteria where the data are compiled from quality, peer-reviewed journals.

The preliminary search was limited to the article title, keywords and abstract. Based on these keywords and the research question, three main categories were identified, without limiting the type of skill, i.e., involving both Hard and Soft Skills.

- 1) Digital Transformation and Entrepreneurship Education;
- 2) Digital Academic Entrepreneurship and Skills;
- 3) Skills and Entrepreneurship Education.

The principal bibliographic search was carried out in March 2022, and the search terms used were: ((TI = (“entrep\* education”) or ALL = (“academic entrepreneurship”)) AND ALL = (“digital technolog\*” or “digitization” or “digital transformation” or “competence\*” or “skill” or “capabilities”). The search was limited to articles (empirical and reviews) published in English, with no time restrictions, to understand how HS influence digital academic entrepreneurship.

The main body of literature was derived from three search chains, using different combinations of search terms, and resulted in 275 articles.

The titles and abstracts of these articles were read to confirm their relevance for the study. If the article seemed relevant, the whole text was read and compared with the research limits. The articles were also analysed using the following inclusion criteria: the article (1) relates Hard Skills with academic entrepreneurship and/or (2) presents a clear indication that digital transformation can change academic entrepreneurship. Complete reading of the articles resulted in an initial selection of 34 articles included in content analysis. These 26 articles selected in this research are referenced in Table 4.1, presenting the main problem discussed in each one..

Table 4.1 . Problems addressed by each author researching the topic.

Source: Research Data

| <b>Authors</b>                    | <b>Source Title</b>  | <b>Article Title</b>   | <b>Problem discussed</b>   |
|-----------------------------------|--|--|--|
| <b>Secundo et al. (2020)</b>      | Technological Forecasting and Social Change                  | Digital Academic Entrepreneurship: A structured literature review and avenue for a research agenda                                       | Understand how digital technology can support digital academic entrepreneurship, from a systematic literature review.  |
| <b>Ratten and Usmanij (2021)</b>  | International Journal of Management Education                | Entrepreneurship education: Time for a change in research direction?   | Present current research trends in education for entrepreneurship.   |
| <b>Secundo et al. (2021)</b>      | Technological Forecasting and Social Change                  | Threat or opportunity? A case study of digital-enabled redesign of entrepreneurship education in the COVID-19 emergency                  | Understand how the COVID-19 crisis can reconfigure traditional programmes of entrepreneurship education.   |
| <b>Jardim and Albright (2021)</b> | Education Sciences   | Entrepreneurial Skills to Be Successful in the Global and Digital World: Proposal for a Frame of Reference for Entrepreneurial Education | Describe and systematize these business skills in the current job market.  |
| <b>Rippa and Secundo (2019)</b>   | Technological Forecasting and Social Change                  | Digital academic entrepreneurship: The potential of digital technologies on academic entrepreneurship                                    | Contribute to building the emerging concept of Digital Academic Entrepreneurship   |
| <b>Secundo et al. (2020)</b>      | International Journal of Entrepreneurial Behavior & Research | Digital transformation in entrepreneurship education centres: preliminary evidence from the Italian Contamination Labs network           | Understand how digital technology can support the entrepreneurial process, stimulating entrepreneurial activity in students.   |
| <b>Toniolo et al. (2020)</b>      | International Journal of Entrepreneurial Behavior & Research | A grounded theory study for digital academic entrepreneurship  | Study how digital academic entrepreneurship is developed and how it evolves.   |
| <b>Muafi et al. (2021)</b>        | Journal of Asian Finance Economics And Business              | Digital Entrepreneurship in Indonesia: A Human Capital Perspective   | Contribute to Digital Entrepreneurship, from the perception of university staff, lecturers and students, intending to propose and interpretative framework for Digital Entrepreneurship. |
| <b>Oppong et al. (2020)</b>       | International Journal of Entrepreneurial Behavior & Research | Potential of digital technologies in academic entrepreneurship - a study   | Identify opportunities and challenges faced by academic entrepreneurs at the initial stage.  |
| <b>Garcez et al. (2021)</b>       | Education and Information Technologies                       | Digital transformation shaping structural pillars for academic entrepreneurship: A framework proposal and research agenda                | Propose a theoretical framework showing the structural pillars between digital transformation and academic entrepreneurship  |

Table 4.1- Problems addressed by each author researching the topic (continued)

|                                      |  |   |  |
|--------------------------------------|--|---|--|
| <b>Bauman and Lucy (2021)</b>        | International Journal of Management Education                | Enhancing entrepreneurial education: Developing competencies for success  | Identify some of the business skills necessary to launch a business undertaking successfully and the current level of skills of recent graduates for business and entrepreneurship programmes.     |
| <b>Wang et al. (2019)</b>            | Frontiers in Psychology                                      | How the New Type of Entrepreneurship Education Complements the Traditional One in Developing Entrepreneurial Competencies and Intention   | Understand the effects of entrepreneurship programmes on students' entrepreneurial skills and entrepreneurial intention.   |
| <b>Farhangmehr et al. (2016)</b>     | Education and Training                                       | Predicting entrepreneurial motivation among university students The role of entrepreneurship education                                    | Understand the main stimulants of business motivation among university students and determine whether business education has a moderating effect on business motivation.                           |
| <b>Sirelkhatim and Gangi (2015)</b>  | Cogent Business & Management                                 | Entrepreneurship education: A systematic literature review of curricula contents and teaching methods                                     | Provide a detailed map of the best practices in terms of content and methods for teaching entrepreneurship.  |
| <b>Yashin et al. (2018)</b>          | Ekonomski Vjesnik  | Designing Entrepreneurial Education In Russia: Hard and Soft Skills   | Analyse entrepreneurship curricula in Russian universities, analysing the credits attributed to developing Hard Skills and those for Soft Skills.  |
| <b>Liu et al. (2021)</b>             | Studies in Educational Evaluation                            | A measurement model of entrepreneurship education effectiveness based on methodological triangulation                                     | Propose a new model to measure the effectiveness of business education regarding three dimensions - business skills, barriers and intentions.  |
| <b>Kazakeviciute et al. (2016)</b>   | Industry and Higher Education                                | Curriculum development for technology-based entrepreneurship education: A cross-disciplinary and cross-cultural approach                  | Analyse internationally recognised entrepreneurial education programmes, to present the inter-disciplinary and transcultural approach to curricular development of technological entrepreneurship. |
| <b>Secundo et al. (2020)</b>         | International Journal of Entrepreneurial Behavior & Research | Entrepreneurship Education Centres in universities: evidence and insights from Italian Contamination Lab cases                            | Understand how digital technology can support the entrepreneurial process, stimulating entrepreneurial activity in students  |
| <b>Lv et al. (2021)</b>              | Frontiers in Psychology                                      | How Entrepreneurship Education at Universities Influences Entrepreneurial Intention: Mediating Effect Based on Entrepreneurial Competence | Analyse the effect of entrepreneurship education on entrepreneurial intention, from the perspective of the theory of planned behaviour.  |
| <b>Ferreras-Garcia et al. (2021)</b> | Studies in Higher Education                                  | Gender and learning results: a study on their relationship in entrepreneurship education and business plans                               | Analyse the business skills acquired by students when they work on a business plan and how they are influenced by gender.  |

Table 4.1- Problems addressed by each author researching the topic (continued)

|   |   |  |   |
|---|---|--|---|
| <b>Ma et al. (2020)</b>                 | Frontiers in Psychology                   | Constructing a Hierarchical Framework for Assessing the Application of Big Data Technology in Entrepreneurship Education                         | Explore how Big Data can support entrepreneurship education, improving traditional entrepreneurship education.  |
| <b>Wu et al. (2018)</b>                 | Sustainability                            | Entrepreneurship Education: An Experimental Study with Information and Communication Technology  | How information and communication technology (ICT) can be used to increase the effectiveness of traditional methods of teaching and training in entrepreneurial skills.   |
| <b>Grivokostopoulou et al. (2019)</b>   | Sustainability                            | Examining the Impact of a Gamified Entrepreneurship Education Framework in Higher Education  | Present how the conception of an educational environment for entrepreneurship, based on the 3D virtual world, can provide immersive and efficient learning activities for entrepreneurship.   |
| <b>Bodea et al. (2015)</b>              | Amfiteatru Economic                       | Simulation-Based e-Learning Framework for Entrepreneurship Education and Training  | Propose an e-Learning framework for entrepreneurship aiming to let students choose relevant characteristics/aspects for a type of business following specific criteria; establish realistic values for different characteristics/aspects of the business. |
| <b>Rodríguez-López and Souto (2019)</b> | Education and Training                    | Empowering entrepreneurial education using undergraduate dissertations in business management and entrepreneurship A five-year study (2012-2016) | Contribute to the discussion on entrepreneurship education, from degree course subjects, aiming to develop business plans.  |
| <b>Rippa et al. (2022)</b>              | European Journal of Innovation Management | Embedding entrepreneurship in doctoral students: the impact of a T-shaped educational approach.  | Explored the effectiveness of a new T-shaped PhD model in STEM PhD students, in the development of multidisciplinary skills supported by entrepreneurial education.   |

Stage 2: Here, the data analysis followed an inductive approach, i.e., qualitative analysis of content (Hsieh and Shannon 2005). The coding categories defined from Garcez et al. (2021) are: (i) Management Tools, (ii) Digital Process, and (iii) Digital Products. Through the snowballing process, seminal articles on HS and academic entrepreneurship were also added, for a total of 20 articles.

In order to identify the insights and to understand the context of the research question, a quantitative content analysis was carried out on the selected articles, using NVivo software, where the most frequent topics per category were grouped into codes. The interpretation of the relationships of each category was performed by the corresponding author. In cases of doubtful interpretations, the codifications were analysed and deliberated upon by more than one reviewer.

#### **4.4 Proposed Framework of HS for Digital Academic Entrepreneurship**

New digital technology has changed the organisational structure (Nambisan and Baron 2013), and therefore, new business structures are being created (Song 2019). For example, the book market has adopted digital technology and reformulated the physical book market, a structure that has existed for more than 200 years (Yoo et al. 2010).

The set of articles analyzed in Table 4.1 indicate that TD affects academic entrepreneurship, since the use of digital objects that are flexible (or malleable) has radically transformed entrepreneurship (Nambisan 2017; Nambisan et al. 2019). Therefore, the HEIs should encourage the use of these digital objects in business ecosystems and in society (Toniolo et al. 2020) to enable individuals to develop digital innovation in universities (Rippa and Secundo 2019), from the creation of new innovative services and products (Toniolo et al. 2020).

Figure 2 identifies the pillars of digital academic entrepreneurship, based on the following HS: (i) Management Tools, (ii) Digital Process, and (iii) Digital Products-. They are also presented how these pillars are constituted and their relationship with HS and how they can be taught. To support HEIs in the development of HS, the development of innovative business proposals in the academic environment is encouraged here and digital academic entrepreneurship is promoted.

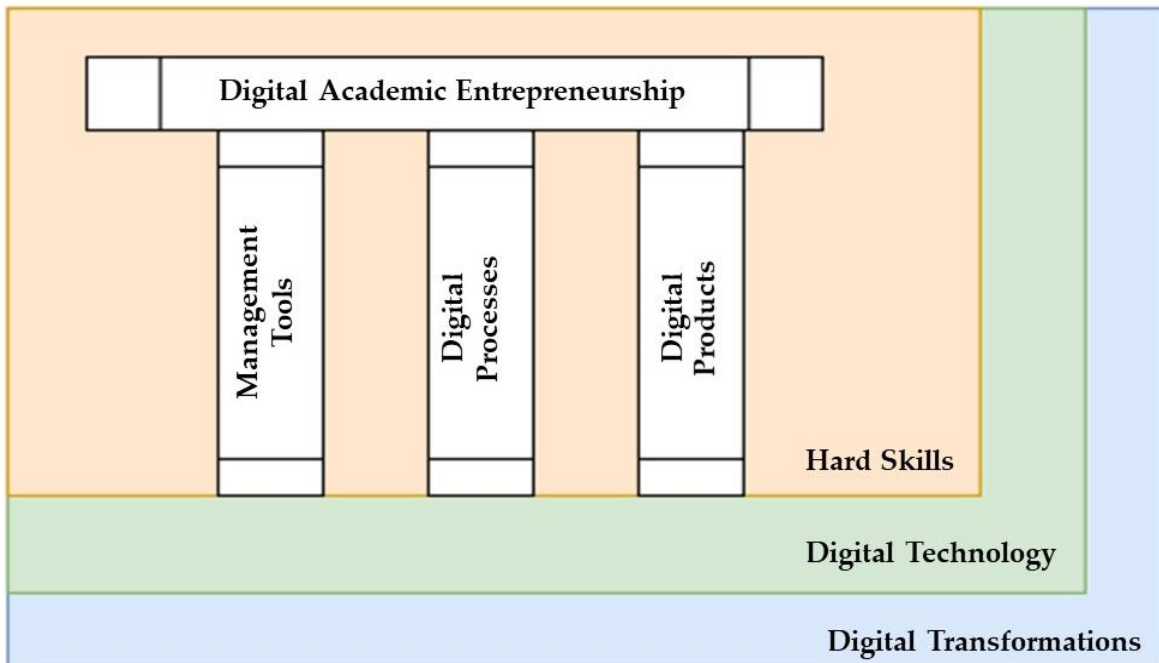


Figure 4.2 Framework of Hard Skills for Digital Academic Entrepreneurship.  
Source: Own elaboration

### **Pillar 1—Management Tools, from Theory to Practice**

The use of digital management tools, such as digital platforms, MOOC, cloud computing, social networks, 3D printing and data analysis, can encourage digital academic entrepreneurship in HEIs (Rippa and Secundo 2019). These tools have communication and collaboration capacities (Bharadwaj et al. 2013) and can have an impact on all stages of the entrepreneurial process, from exploring opportunities to launching the product (Nambisan 2017). They can stimulate entrepreneurship education (Vorbach et al. 2019) and accelerate digital academic entrepreneurship in HEIs (Toniolo et al. 2020).

A variety of initiatives using technology are being created to provide tools to support HEIs in developing digital academic entrepreneurship, for example, IBridgeNetwork, which is a digital community that provides support for the discovery of ideas, connecting people and collaboration, and developing technological projects at the initial stage (Secundo et al. 2021); an education center in universities to provide students with access to cloud computing infrastructure and 3D printing services and installations, in order to develop prototypes of both software and hardware (Secundo et al. 2020c).

Another example is the use of virtual reality to support entrepreneurship education, as this tool has the capacity to associate and apply concepts and skills which may be impossible to explain

through words and other techniques (Grivokostopoulou et al. 2019). The use of these methods does not refer to measuring the experience but rather to the reflection arising from the experience itself through reproducing a physical environment in a virtual one (Secundo et al. 2020c).

Entrepreneurship education programmes reflect theoretical-practical matters at the HS level (business plans) so that students can develop the capacity to cope with unpredictable situations (Bauman and Lucy 2021). Traditional methods based on theoretical classes are possible approaches, but do not help students to understand fully the consequences of actions and decisions taken in the organisational context. Therefore, digital technology can provide tools to support this teaching and learning process (Secundo et al. 2021).

From another perspective, digital technology also changes the way opportunities are perceived, a situation that creates the need to develop a new range of digital skills in students to allow the maximum use of management tools and the perception of business opportunities. For example, Brydges and Sjöholm (2019) studied how social networks and blogs have changed the nature of work in the fashion industry. Fernandes et al. (2019) explored how people that own micro-businesses create new tourist markets in the slums of Rio de Janeiro from social networks. McIntyre (2020) examined how the role of housewife can be reconfigured from intimate and commercial practices from digital technology for entrepreneurs, Oppong et al. (2020) analysed how academic businesspeople use media technology to start up their entrepreneurial activities.

Digital management tools are understood as a means to inspire students for entrepreneurship. Inspiring entrepreneurship is an assumption of Souitaris et al. (2007), who introduced an emotional angle to entrepreneurship education, where the inspiration is to change students' heart (emotion) and mind (motivation). This aims to make students understand, feel, analyse and make conscious decisions based on data, and discuss/reflect to acquire knowledge about digital technology and entrepreneurship (Ndou et al. 2018).

The formulation of efficient and effective education structures for entrepreneurship is highly desirable and very challenging (Grivokostopoulou et al. 2019). For that reason, the use of digital management tools for entrepreneurship education considers the possible risk of a lack of self-discipline in students to carry out virtual activities and little inter-activity with other students (Vorbach et al. 2019). This situation means that programmes for entrepreneurship education must use management tools that allow interaction and frequent communication between teams, as successful entrepreneurship education greatly depends on the interaction between peers. This requires a project manager with a pro-active role in accompanying the learning process (Žur

2020), and they must focus efforts on developing students' critical thinking (Ratten and Usmanij 2021).

Briefly, entrepreneurship educators must focus efforts on developing digital management tools to teach entrepreneurship, including: (1) simulation/gamification activities to simulate the unstable entrepreneurial environment, (2) the development of platforms that create the interface between entrepreneurs and students, and (3) the elaboration/use of systems/programmes to develop dynamic business plans that can simulate the variability of organisational factors, intending to make students understand how challenging it is to be an entrepreneur in the digital era.

### **Pillar 2—Digital Processes, from the Idea to the Experimental Product**

Digital technology is changing business logic (Arvidsson and Mønsted 2018), where the capacity for networking must be developed (Cenamor et al. 2019), aiming for a product that transforms organisations and human life. Knowledge allows product ideas and business models to be rapidly formed and modified in repeated cycles of experimenting and implementation (Lyytinen et al. 2016; Ries 2011). Therefore, understanding how DT affects organisations is necessary in the process of creating an undertaking (Rippa and Secundo 2019).

Processes of digital academic entrepreneurship include virtual learning, social media environments, virtual 3D laboratories, and digital accelerator laboratories and spaces (Muafi et al. 2021). Education centres allow for the rapid development of prototypes and ideas, creating the opportunity to conceive models of ideas and products and create physical prototypes, and giving experience of the process of developing and testing business ideas (Monllor and Soto-Simeone 2019). These mechanisms increase business awareness and the effective recognition of opportunities, creating triggers to stimulate the entrepreneurial process (Costa et al. 2018).

Centres of entrepreneurship education are inter-disciplinary, as they aim for the virtuous spreading and sharing of knowledge and experience among participants (Secundo et al. 2020a).

Experimental learning can improve how students observe the world and can support effective recognition of business opportunities (Costa et al. 2018). In this context, the product development process, i.e., transforming ideas into a product, can be rapid when supported by digital technology (Secundo et al. 2020b). Video can be another tool that results in a positive experience in fulfilling a business idea for a product (Manzon 2017).

It is noted that the implementation of digital academic entrepreneurship training is still weak, as the transformation of an idea into a product, by students, is not yet taking place due to the

lack of experience, knowledge and skills of those involved in the process (Muafi et al. 2021). Only with a diversity of ideas and experiences can an idea turn into a product, as this process requires the gathering of inter-disciplinary information to develop the scenarios that can affect the business (Secundo et al. 2021). Here, programmes are developed in a multi-disciplinary way, potentially reaching all students, whatever their scientific background or field of study (Costa et al. 2018).

The development of digital entrepreneurship laboratories, from a multi-disciplinary perspective of knowledge and skills, can be another viable alternative. These laboratories must be conceived with the aim of activating entrepreneurial processes in order to increase the business culture among university students and create an experimental environment to support the process of developing digital products.

### **Pillar 3—Digital Products and Commercialization**

The increased use of digital technology is raising awareness of its importance in society (Nambisan 2017), creating a complex, unpredictable environment favouring the development of innovative products and services (Jardim 2021).

In this connection, HEIs' responsibilities, after inspiring entrepreneurship among students and supporting the development of prototypes, i.e., once the business concept is mature and viable, lie in supporting students in seeking finance (Muafi et al. 2021). HEIs fulfil their aim of creating firms, through students and researchers, to improve a country's economy as a whole (Etzkowitz and Leydesdorff 2000). To do so, HEIs provide students with the skills and installations necessary to create an undertaking (Elia et al. 2017).

After obtaining finance, the business is ready to be launched. The next stage, to be carried out by universities, is the supervision of the business for some months until it can operate independently (Muafi et al. 2021).

After funding, the digital product will be ready for commercialization, as in the following framework (Figure 4.3).

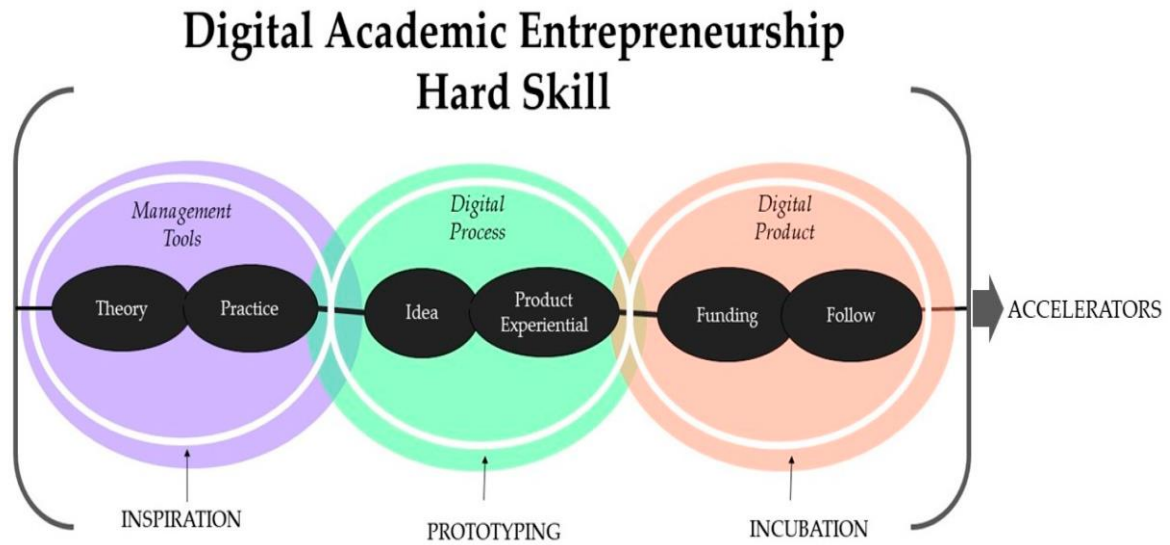


Figure 4.3 Framework proposal

Source: Own elaboration

The digital academic entrepreneur needs to acquire other skills, and acceleration programmes can give budding business the necessary support (Miles et al. 2017). Such programmes provide networking, educational and mentoring opportunities, i.e., supporting development of the business ecosystem (Yang et al. 2018). One of the most important objectives is to promote the company's interactions with the market through short-term programmes (Cohen and Hochberg 2014).

In this stage, digital academic entrepreneurs must consolidate their personal skills, behaviours, attitudes and qualities for effective adaptation to the environment/market (Khaouja et al. 2019), in an ACCELERATOR process, involving the development of values, attitudes and behaviours, (Schaefer and Minello 2016), in order to support digital innovation and regional development in the HEI environment (Rippa and Secundo 2019). At this point, students' 'pivoting' skills (Ries 2011) should be well realised, i.e., they have the ability to test, discard and replace ideas and business models that do not work with better ones.

## 4.5 Conclusions, Contributions and Future Agenda

Entrepreneurship education in HEIs relates to Hard Skills (HS), as these are easily taught (Haase and Lautenschläger 2011; Pittaway and Cope 2007) and are based on explicit knowledge (Hägg and Gabrielsson 2019). This phenomenon is perceived from a multidisciplinary perspective (Rippa et al. 2022). However, DT means that it is necessary to add to academic entrepreneurship a more wide-ranging and dynamic perception (Kaminsky et al. 2021), creating

the need to understand academic entrepreneurship holistically in the digital era (Rippa and Secundo 2019).

Creating a digital environment enables students and teachers to identify market opportunities, specify the technology, organise the operation and create value for society (Teece 2018), as well as encouraging students to participate in the digital world in an active and responsible way to enable them to have an entrepreneurial perception (Ilomäki et al. 2016). Therefore, trial action, promoting the transfer of theoretical/practical knowledge using digital tools (Nambisan et al. 2017; Ries 2011), an environment where students and lecturers have free access to digitally manufactured software and equipment, so that they can transform a business idea into a product (Monllor and Soto-Simeone 2019; Rayna and Striukova 2021), is required. In addition, HEIs should not only support product development, but also direct their efforts to developing complete entrepreneurship education programmes, which include incubation and acceleration environments (García et al. 2016). Therefore, entrepreneurship education has an important place in HEIs, and lecturers should be aware of the importance of entrepreneurship in teaching institutions (Secundo et al. 2020b).

From a thorough study of the literature, this research concludes that HS for digital academic entrepreneurship is supported by three pillars: (i) digital tools, (ii) digital processes, and (iii) digital products.

Digital tools are the means to inspire students towards entrepreneurship, leading them to understand, feel, analyse and make conscious decisions based on data, and also to discuss and reflect in order to acquire knowledge about digital technology and entrepreneurship (Ndou et al. 2018) with the aim of developing students' critical thinking (Ratten and Usmanij 2021). Digital processes provide an opportunity for rapid development of physical prototypes of a business idea (Monllor and Soto-Simeone 2019), creating triggers to carry out the entrepreneurial process (Costa et al. 2018). However, it is not enough to develop a digital prototype and a viable business plan, as support is also needed in seeking finance (Muafi et al. 2021) and developing networking (Yang et al. 2018), i.e., inserting entrepreneurial students in the market (Cohen and Hochberg 2014).

As HS are easily taught, this study shows how the use of digital tools can accelerate the process of teaching them. It is therefore suggested that those in charge of HEIs use the pillars presented here in the proposed framework to guide their institutions' strategic planning. With these pillars in mind, the aim is to stimulate the development of digital tools and effective digital academic entrepreneurship.

The presented design could support HEIs in teaching dynamic skills at the level of business models, at the level operational and routine, but as at the level of microfoundations, to develop in students the ability to make decisions in uncertain (Teece 2018), and more dynamic environments (Nambisan et al. 2019), due to advances in communication technology, computing and connectivity (Bharadwaj et al. 2013).

This study also makes contributions to theory and practice. From the theoretical point of view, it contributes to encouraging the debate on digital academic entrepreneurship from a multi-disciplinary perspective (Rippa and Secundo 2019), and can inspire future study in this area, since digital academic entrepreneurship can have a positive impact on a region's economic and social development. It can add value to products and services, setting out from students' entrepreneurial skills, stimulated by the use of digital technology.

Concerning practice and management, the study can give HEIs indications for structuring entrepreneurship education programmes, as it contributes a systematic flow of skills that should be taught to students, aiming to heighten perception of the entrepreneurial opportunities available in the digital context (Nambisan et al. 2019; Nambisan and Baron 2013; Secundo et al. 2020a; Toniolo et al. 2020).

The study is not without limitations. One concerns the difficulty of analysing the borders and the overlapping between the three pillars identified here, since the database selected did not allow for these types of conclusions. The speed at which knowledge expands could be another limitation, as other valuable studies related to the topics developed here could have been published in places not listed on the database used (WoS).

In this context, three lines of future research are suggested: (i) studying the limits and overlapping of the three pillars of Hard Skills, proposing a qualitative approach resorting to interviews with specialists or a quantitative study using structural equation modelling; (ii) studying how digital academic entrepreneurship is changing the social context, with socio-material theory as the background (Nambisan 2017); and (iii) measuring the intentionality of digital academic entrepreneurship from the relations built in this study supported by the theory of planned behaviour (Ajzen 1991).

HEIs should focus efforts on training talents that have the ability to combine different disciplines. For example, an engineer is expected to be able to develop sustainable mobility solutions that balance environmental, social, and economic aspects, and the manager has to have the ability to lead to work with digital technology (Rippa et al. 2022). Digital technologies make the university an open, flexible and collaborative system, where the development of

knowledge and broad and collaborative international networks are essential elements to create an entrepreneurial university. This new model of educational business leads to social improvements in society and communities (Kripa et al. 2021), where entrepreneurial education can be a tool for developing learning holistically in HEIs (Kozlinska et al. 2020). The full development of individuals from an education that provides the complete involvement of individuals at the level of Hard and Soft Skills is a reality.

Based on the review of the articles, considering the pillars of digital academic entrepreneurship for the development of HS, the following research gaps were identified by pillars. For the pillar of the Management Tool, this pillar should be seen as a process of interconnection between theory and practice, where future investigations should measure the level of HS at the time students start a business education program from digital technologies and compare it with the level at the moment the student leaves the program. With this procedure, the intention is to evaluate the effectiveness of the methods used and whether digital technologies can be different in entrepreneurship education. Gender-related issues can also be seen in business education programmes supported by digital technologies to see if gender interferes with the perception of digital business education. Finally, it would be interesting to compare identical digital business education programmes, but in different cultural and economic contexts, with the aim of assessing whether the entrepreneurial intention of students is altered by context.

Longitudinal studies also become relevant to understand the effects of education for digital entrepreneurship on academic ecosystems. At a more instrumental level, developing active learning methodologies can also make it possible to assess digital business education in the intention, as well as to make educational programmes increasingly dynamic or consolidate theoretical and practical concepts.

In addition, researchers interested in investigating the Digital Process pillar, should understand how a business idea can be transformed into a physical product from prototyping. Thus, future research should measure the perception of the moderating factors of business intention (business self-efficacy, risk perceptions, among others) in students participating in experimental education programs (prototyping) focused on the development of digital products in order to understand the relationship between experimental business learning based on digital technologies and the development of critical and analytical thinking of students. In this way, guidelines and recommendations for the successful adoption of entrepreneurship education programs with regard to the prototyping of entrepreneurship education centers are presented.

For the pillar of Digital Products, research in this pillar should seek to understand how a digital product developed, in an academic environment, can be inserted in the market. In this sense,

future research should understand how HEIs can develop innovative curricula designed by researchers, teachers, entrepreneurs and stakeholders that enable the development of digital products in an academic environment, as well as investigate teaching strategies that allow students to offer learning experiences around real-life scenarios with complex and challenging problems. Here, networks of cooperation between universities and industry with the aim of strengthening academic companies that bring together financial investors is a viable strategy. It is therefore suggested to investigate how participation in global networks of training institutions, research centres and companies can improve knowledge sharing and support digital academic entrepreneurship. These type of studies allow for the comparing and evaluating of the success factors of academic entrepreneurs, with the objective of adding these factors to business education programs.

Finally, this study shows how digital academic entrepreneurship opens up various research opportunities, but future work must recognise the complexity and richness of the topic presented here.

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## **Chapter 5**

# **The influence of the Pillars of Digital Academic Entrepreneurship on University Students' Entrepreneurial Intention**

### **Abstract**

This study aims to analyse the influence of the pillars (Hard and Soft Skills) of digital academic entrepreneurship on students' entrepreneurial intention. This was done by adopting a quantitative methodology involving empirical research with a sample of 761 university students from two countries and adopting structural equation analysis to validate the theoretical model proposed. The results indicate a direct influence between Hard and Soft Skills and entrepreneurial intention, and a positive, indirect influence between these and entrepreneurial intention mediated by the dimensions of the Theory of Planned Behaviour (TPB) – entrepreneurial attitude, subjective norms, perceived behavioural control. Therefore, the pillars of digital academic entrepreneurship have a direct and indirect influence on university students' entrepreneurial intention. This study also contributes to better operationalization of entrepreneurial education in university environments, since the development of Hard and Soft Skills can be planned better based on the model proposed here. Considering the relations between the dimensions of Hard and Soft skills and those of TPB, this study shows there can be an influence on students' entrepreneurial intention.

**KEY-WORDS:** Hard Skills, Soft Skills, Theory of Planned Behaviour, Entrepreneurial Intention, Digital Transformation.

## 5.1 Introduction

Digital technology such as social media, the internet of things (IoT), big data, advanced manufacturing, 3D printing, cloud, cybernetic solutions and Massive Open Online Courses (MOOCs) are present in all public and private organisations (Rippa & Secundo, 2019) and are transforming business and society (Nambisan et al., 2019; Zaheer et al., 2019). This technology reformulates traditional business models, strategies, structures and processes and challenges human capital (Muafi et al., 2021), thereby creating opportunities for entrepreneurship (Yoo et al., 2010).

As technology becomes more accessible (Rippa & Secundo, 2019), there is a faster flow of innovation to develop products (Oskam, 2009). In higher education institutions, this phenomenon is known as digital academic entrepreneurship, which results from combining traditional academic entrepreneurship with digital technology (Rippa & Secundo, 2019). In this context, new ways of teaching entrepreneurship can be developed (Ratten & Usmanij, 2021), since digital technology can lead to innovative teaching methods (Grivokostopoulou et al., 2019).

Business teachers must provide students not only with knowledge, theories and technical skills, but also with social skills, aiming for more agile and adaptable action by students in the environment of digital transformation (Bauman & Lucy, 2021). Considering that disciplinary boundaries are becoming more complex, individuals are called upon to solve problems and consider political, cultural, technological and scientific aspects simultaneously (Conley et al., 2017). Education for digital academic entrepreneurship can support this process (Rippa et al., 2022), developing in students the technical competences – business plan (Hard Skills) and social competences (Soft Skills) considered in this study as the pillars of digital academic entrepreneurship (Garcez et al., 2022a).

Following this perception, a business plan helps students to identify market opportunities, providing tools that allow the emergence of business ideas and support the development of Hard Skills (Armuña et al., 2020). However, good business results are not achieved only through a well-prepared business plan (Garcez et al., 2022); an entrepreneur's success also depends on their special characteristics, Soft skills, which include, for example, communication skills, being willing to accept risks and the capacity to appreciate different perspectives (Yashin et al., 2018).

From the behavioural perspective, various studies seek to understand what makes an individual an entrepreneur (e.g., Armuña et al., 2020; Liu et al., 2021; Lv et al., 2021; Tomy & Pardede, 2020; Wang et al., 2019), indicating that new businesses do not emerge spontaneously and that the entrepreneurial act is the fruit of planned action. For that reason, the literature examines entrepreneurial behaviour in terms of the intentionality of that behaviour (Boyd & Vozikis, 1994; Krueger, Jr. & Brazeal, 1994; Liñán & Chen, 2009; Moriano et al., 2012).

This refers us to the studies by Munir et al. (2019), which tested a model of the relation between personality traits and the Theory of Planned Behaviour (TPB), Monllor and Soto-Simeone (2019), who studied whether exposure to digital manufacturing technology has impacts on the development of students' business self-efficacy and entrepreneurial intentions, and Do and Dadvari (2017), who tested whether the negative aspects of personality, called the dark triad – Machiavellianism, narcissism and psychopathy -, influence higher education students' entrepreneurial intention.

Despite the diversity of research associating entrepreneurial behaviour with the intentionality of that behaviour, none is found to relate socio-technical theory with TPB, namely, Hard and Soft Skills with entrepreneurial intention, and so this gap is identified in the literature. The aim here is to study the influences of Hard and Soft Skills on university students' entrepreneurial intention, to increase understanding of entrepreneurial behaviour, specifically and for the first time in the light of the above theories, and namely the question of skills, to open up paths for better operationalization in order to stimulate the entrepreneurial intention.

This study uses TPB (Ajzen, 1985, 1991) to measure entrepreneurial intention and to test the variables of Hard Skills and Soft Skills. In addition, the dimensions of TPB – entrepreneurial attitude, subjective norm and perceived behavioural control, are presented as mediators that can explain the behaviour of potential academic entrepreneurs in the digital context. This relation was analysed from a structural model that considers digital transformation and entrepreneurial education (Garcez et al., 2022a).

The study aimed to answer the following research question: *What is the influence of the pillars of digital academic entrepreneurship on the entrepreneurial intention of university students and how can that relation be mediated by TPB?* To do so, quantitative methodology was used based on a sample of 761 university students, using a structural equation model to analyse the relations.

Regarding contributions, the study validates an innovative structural model to analyse the factors of digital entrepreneurship that influence university students' entrepreneurial intention. It also extends the literature on students' entrepreneurial intention by identifying two constructs that can be coupled with TPB, representing an original contribution to this area of research. The study can also be used as a basis for developing educational programmes directed towards academic entrepreneurship.

The work is divided in five sections, including this introduction, which defines the issue, the questions, the objective and the relevance of the study. The next section gives a general view of the literature on the intentionality of digital entrepreneurial behaviour and develops the research hypotheses. The third section describes the methodology, sample, general data-collection process and statistical analyses used. The fourth section discusses the results and the fifth and last presents the conclusions and their theoretical and practical implications, as well as the limitations and suggestions for future research.

## **5.2 Literature Review**

### **5.2.1 Entrepreneurial intentionality: Theory of Planned Behaviour (TPB)**

Behavioural psychology considers that human behaviour can be determined by intentionality (Fishbein & Ajzen, 1977); an individual with the intention to perform a given behaviour will be more open to carrying it out (Khriplovich & Pomeransky, 1998). Entrepreneurship is a complex process involving various factors (Gartner, 1985), and so requires careful planning (Bird, 1988). In the field of science, entrepreneurs are studied in terms of intentional actions, i.e., entrepreneurial intentions (Franco et al., 2010).

Science has found support in theoretical models of intentionality to predict entrepreneurial behaviour. The seminal article about entrepreneurial intention is the one by Shapero and Sokol (1982), who present the Theory of the Entrepreneurial Event to explain the decisions of entrepreneurial action, assuming various factors that influence the entrepreneurial intention: (1) perception of viability and (2) desirability of entrepreneurship (Cortez & Filho, 2020); i.e., the greater the possibility of beginning a business, the greater the desire to be an entrepreneur.

Complementing this, the Theory of Planned Behaviour (TPB) by Ajzen (1985), which is broader, seeks to explain and predict how the cultural and social environment affects human behaviour, also based on the assumption of the intention of the behaviour. This theory is marked by three determinants: (1) attitude to the behaviour (personal assessment), (2) subjective norms (social pressure) and (3) perceived behavioural control (capacity to perform the behaviour) (Cortez & Filho, 2020).

TPB has been used successfully to explain and predict behaviour setting out from intentionality, in multiple behavioural domains, from physical activity to drug consumption, including recycling, choice of a means of travel, safe sex and consumer behaviour, and it has been widely applied to forecasting change in behaviour, including behaviour related to the use of technology (Ajzen, 2020).

In the context of entrepreneurship, TPB is frequently used (e.g., Liñán, 2008; Munir et al., 2019; Shi et al., 2020). The first component of this theory is attitude, i.e., how a person assesses the entrepreneurial action. For example, two people can believe strongly that entrepreneurship implies facing new challenges, but one of them can see those challenges positively whereas the other is unhappy about them; people's judgements about behaviour create positive or negative attitudes (Moriano et al., 2012). Summarising, the attitude to entrepreneurial behaviour is determined by a set of beliefs, where the individual's belief in relation to the behaviour will create a favourable or unfavourable attitude.

The second component of TPB, subjective norms, refers to an individual's perception of the social pressure to engage (or not engage) in a certain behaviour (Ajzen, 2020). Moriano et al. (2012) consider that the social environment an individual is part of can create motivation or an obstacle to developing a business career. This is considered the social component/dimension of the theory, as it takes into account the influence of people who are important to the individual (da Fonseca Oliveira et al., 2016).

However, a positive attitude and a supporting subjective norm only give the individual motivation to engage in the entrepreneurial behaviour, but the specific intention to follow the behaviour only emerges when the individual has strong behavioural control (Ajzen, 2020). Therefore, the third component of TPB is behavioural control, i.e., an individual's capacity to regulate their actions for a certain behaviour. Briefly, the belief of behavioural control is feeling able to perform the behaviour. i.e., having the personal competences and resources necessary to become an entrepreneur (Ajzen, 2020).

From the above, TPB provides coherent theoretical support to understand the entrepreneurial intention, considering not only personal but also social factors (Krueger et al., 2000). These factors are important for this study, since it aims to analyse the influence of the pillars of digital academic entrepreneurship on students' entrepreneurial intention from a socio-material perspective of digital transformation (Nambisan, 2017), including therefore the individual beliefs at the basis of digital academic entrepreneurship (Garcez et al., 2022a).

### **5.2.2 Intentionality of Digital Entrepreneurial Behaviour: Research hypotheses**

Although the relation between entrepreneurial intention and students' skills is a well-established area of research (e.g., Dwi Riyanti et al., 2016; Liñán, 2008; Oosterbeek et al., 2010; Vega-Gómez et al., 2020), the context of digital transformation changes the entrepreneurial logic and processes, transforming entrepreneurship and society (Nambisan, 2017; Nambisan et al., 2019).

This environment leads Higher Education Institutions (HEI) to encourage the use of digital technology in their ecosystems (Toniolo et al., 2020) to promote digital innovation processes (Rippa & Secundo, 2019). These processes create new services and products from the results of academic research and contribute to changing the traditional way of doing business (Toniolo et al., 2020). Nevertheless, there is little debate about the links between digital transformation and academic entrepreneurship (Garcez et al., 2022a). In this connection, Garcez et al. (2022a) worked on the concept of structural pillars of digital academic entrepreneurship, which are the Hard and Soft Skills.

Hard skills are the competences necessary to manage a business (Bauman & Lucy, 2021) and these can be developed from methods aiming to promote critical thought in students (Ratten & Usmanij, 2021). Digital technology can support this process using methods conceived to inspire students through an environment of diversified ideas and experiences (Secundo et al., 2021). The use of digital management tools, such as digital platforms, MOOC, cloud computing, social networks, 3D printing and data analysis, can also encourage digital academic entrepreneurship in HEIs (Rippa & Secundo, 2019).

Inter-disciplinary centres of business training are another alternative to develop entrepreneurship, as they create a connection between knowledge and experience

among participants (Secundo et al., 2020), from experimental learning (Costa et al., 2018), supporting the implantation of ideas in products (Secundo et al., 2020). Business plan competitions can also support that process, since the exchange between universities and stakeholders can create a virtuous circle to develop entrepreneurship (Rippa & Secundo, 2019).

In this context, Hard Skills in higher education students can be developed through the following process (Garcez et al. , 2022b): (1) **Inspiration (Management tools)** which is the beginning of the entrepreneurial process, where new business ideas emerge from combining theory and practice; then, possibilities are identified, the probable structure of the material is defined and a preliminary work group is planned to prepare an initial business plan; (2) **Prototyping (Digital processes)**, in this phase a small-scale business plan is implemented and the market is assessed based on a test product; some measures are necessary here, such as small financial investment, to obtain the resources needed for the initial execution and development of procedures and models to scale; and (3) **Incubation (Digital product)**, the time when the future entrepreneur goes directly to the market in search of investment, and here, the university must accompany the process; also the phase in which legal obligations become important to protect the idea. These obligations involve registering the product, requesting financial support, creating the juridical entity, acquiring the necessary equipment, hiring staff and full-time commitment to the new undertaking.

Then again, it is important to develop Soft Skills to increase the perception of entrepreneurial opportunity (Teece, 2018), but these competences depend on individuals' characteristics (Teece, 2014) and how they share knowledge (Secundo, Mele, et al., 2020). Those in charge of entrepreneurial education should equip students with theoretical and technical skills at the same time as supporting the development of Soft Skills (Bauman & Lucy, 2021). However, Soft Skills are complex due to being intangible/qualitative and difficult to measure (Yashin et al., 2018).

Here too, digital technology can support this process by creating virtual scenarios that simulate a business's internal and external environment (Giones & Brem, 2017), promoting a collective environment that can involve different stakeholders (Rippa & Secundo, 2019). This perspective is positive for both high-tech entrepreneurship and creative entrepreneurship undertaken by small entrepreneurs (Brydges & Hracs, 2019; Fernandes et al., 2019; Luckman, 2008; McAdam, 2020).

The main methods for teaching Soft Skills are seminars, case studies and discussions (Samwel Mwasalwiba, 2010), where there must be a classroom culture that promotes collaboration, creativity and autonomy. In addition, methodologies must be aligned with teaching norms and specific learning content in a coherent, balanced curriculum. Lecturers must be able to adopt a radically different role in the classroom, where they will act more as facilitators of the learning process than as traditional lecturers. To do so, it is essential to understand the student's conceptual level and training, especially when dealing with students from different courses, to promote effective multi-disciplinary teams (Daniel, 2016). To support this process, centres for entrepreneurship education must be equipped with digital technology (Secundo, Rippa, et al., 2020), since Soft Skills have a high proportion of tacit knowledge and this type of environment can develop this type of knowledge (Haase & Lautenschläger, 2011; Ratten, 2020; Toniolo et al., 2020). In this way, an adaptable and personalized learning environment is created (Elia et al., 2009).

Still in the field of education, digital platforms can be useful in connecting students with more experienced entrepreneurs (Linzalone et al., 2020). This connection is important due to the need for constant development of the competences necessary to cope with new digital challenges (Young, 2007). According to Morris and König (2020), this constant search is a fundamental competence for entrepreneurship.

This study understands digital academic entrepreneurship in a broad sense. It is considered that HEIs should promote the ecosystem of developing transversal competences in students due to the heavy load of tacit knowledge necessary for entrepreneurship (Haase & Lautenschläger, 2011; Ratten, 2020). These competences can be stimulated from extra-curricular activities, allowing students to develop their competences.

According to Garcez et al. (2022), soft competences for digital academic entrepreneurship are perceived through three dimensions: (1) **Individual characteristics (CI)**, i.e., how individuals perceive their capacities influences their way of acting; considering the digital context, it is necessary to understand how students take to digital technology, i.e., how at ease they feel with that technology; (2) **Cultural characteristics (CC)**, business activity depends not only on entrepreneurs' personal characteristics, but also on the environment they are part of; cultural factors interfere in how individuals face entrepreneurial opportunities. Therefore, determining how higher education students perceive entrepreneurial opportunities is of fundamental importance for successful academic entrepreneurship; and (3)

**Knowledge sharing (PC)**, where the university and industry share knowledge through patents, academic spin-offs and qualified individuals. These actions promote economic development, and when combined with digital technology can lead to socio-economic phenomena which, in turn, support the spread of knowledge. It is extremely relevant, therefore to understand how knowledge-sharing actions can influence higher education students' entrepreneurial intentions.

Analysing Hard and Soft Skills from the perspective of TPB, according to Souitaris et al. (2007) and Zhang et al. (2014), these are expected to have direct effects on entrepreneurial intention, supporting entrepreneurship education for higher education students, in the current context of digital transformation. While understanding the influence of both types of skills, it is highlighted that, in the case of Soft Skills, as these potentialize the development of transversal competences in students, they also present a certain risk by being difficult to measure, since they are concentrated on know-how (Hägg & Gabrielsson, 2019). Considering these interconnections, the following two research hypotheses are proposed:

*H1a: Hard Skills have a direct and positive relation with Entrepreneurial Intention.*

*H2a: Soft Skills have a direct and positive relation with Entrepreneurial Intention.*

Some studies have used the dimensions of TPB to measure entrepreneurial intention (e.g., Gorgievski et al., 2018; Liñán & Chen, 2009; Moriano et al., 2012) due to their predictive capacity. However, considering the complexity of the business process, various studies (e.g., Carr & Sequeira, 2007; Munir et al., 2019; Roy et al., 2017) have used this theory of planned behaviour as a mediating factor, aiming to potentialize the predictive value of the research models. Therefore, considering the evidence presented in the literature, this study also took TPB as a potential mediator in the intentionality of entrepreneurial behaviour. Taking these assumptions into account, the following hypotheses are proposed:

*H1b: Perceived Behavioural Control (self-efficacy) mediates indirectly the relation between Hard Skills and Entrepreneurial Intention.*

*H2b: Entrepreneurial Attitude mediates indirectly the relation between Soft Skills and Entrepreneurial Intention.*

According to Bandura (1977), the better individuals' perception of self-efficacy within a given domain, the greater the probability of them performing a task successfully. Neves

and Faria (2009) underline that self-efficacy is an assessment of confidence in one's personal competence to perform a specific task successfully. Boyd and Vozikis (1994) present self-efficacy as a construct that provides an important explanatory factor of entrepreneurial intention regarding the probability of such intentions resulting in entrepreneurial action. However, Bandura (1982) emphasizes that self-efficacy is acquired gradually through developing complex cognitive, social, linguistic and physical skills through experience.

Therefore, the concept of self-efficacy comes close to the perspective of Hard Skills, since there are based on the competences necessary to manage a business (Bauman & Lucy, 2021). It introduces an emotional and inspirational perspective that leads students to understand, feel, analyse and take decisions based on data, considering all the aspects of entrepreneurship (Ndou et al., 2018). Appropriate perception of those capacities is essential for entrepreneurial behaviour.

Regarding Entrepreneurial Attitude – how a person assesses the entrepreneurial act - (Gorgievski et al., 2018), this is understood to tie in with Soft Skills, since it has a major role in taking advantage of, and promoting social interactions. Considering the context of digital transformation, where changes occur rapidly and continuously and new opportunities are constantly appearing, the development of Soft Skills allows more appropriate assessment of the entrepreneurial act, which is extremely relevant for the entrepreneurial intention.

On the other hand, subjective norms express how society influences personal intentions, restricting or encouraging a behaviour (Ajzen, 1991, 2020), although concerning its predictive power, in isolation, this dimension is not representative (Krueger et al., 2000). The literature shows that subjective norms can have an indirect influence through perceived behavioural control and entrepreneurial attitude, with an impact on entrepreneurial intention (Liñán et al., 2011; Liñán & Chen, 2009; Lopes et al., 2022). Based on this evidence, the last two hypotheses are formulated:

*H3a: Subjective Norms and Perceived Behavioural Control mediate indirectly the relation between Hard Skills and Entrepreneurial Intention.*

*H3b: Subjective Norms and Entrepreneurial Attitude mediate indirectly the relation between Soft Skills and Entrepreneurial Intention.*

### 5.2.3 Structural Research Model

Considering the multiple factors that affect digital academic entrepreneurial intention, it is crucial to use models that can confirm the causal relations of this behaviour. These models must assess each factor and its impact on higher education students' entrepreneurial intention, capturing the critical perceptions of the underlying processes, for example, recognition of entrepreneurial opportunities. Models of intentions also provide an opportunity to raise the capacity to explain and predict entrepreneurial behaviour (Ajzen, 1991; Krueger et al., 2000). This study measured the factors affecting entrepreneurial intention using structural equation modelling (SEM), a statistical technique that can test the validity of theoretical models based on causal and hypothetical relations (Marôco, 2010). To guide this research, a structural model was proposed, drawn up from the literature review and the research hypotheses formulated and presented in Figure 5.1.

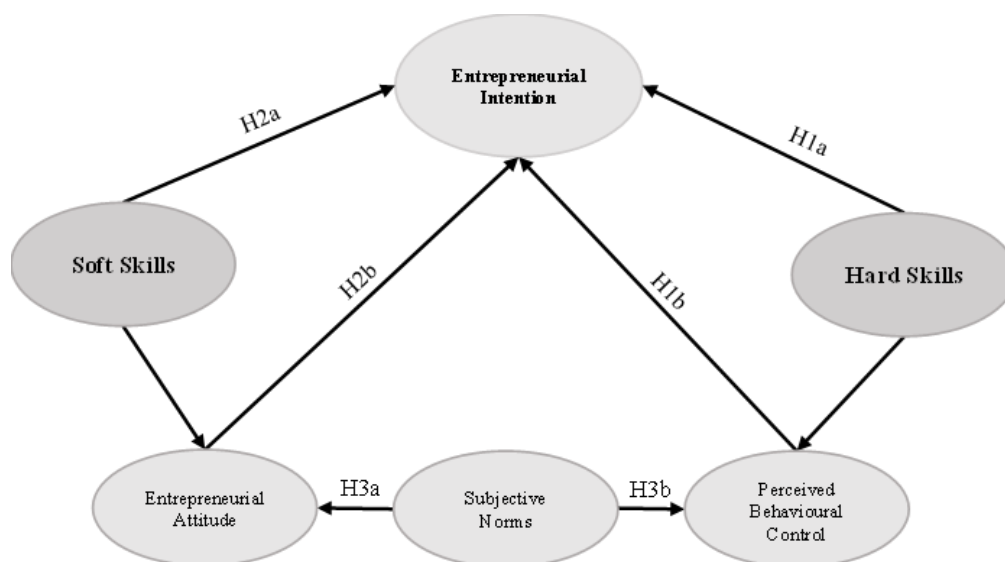


Figure 5.1. Structural research model.  
Source: Own elaboration.

## 5.3 Methodology

### 5.3.1 Operationalization of the Constructs/Dimensions

As mentioned above, intentions are formed by a combination of motivational factors that influence a person's behaviour, affecting their effort and willingness to plan and perform a given task (Ajzen, 1985, 2020). Digital entrepreneurial education is less limited and less pre-defined due to the flexibility of digital technology and its capacity to distribute information (Nambisan, 2017; Nambisan et al., 2017), which created new

socio-technical and economic paradigms that emerge from the potential of collaboration and collective intelligence (Elia et al., 2020). Therefore, considering the hypotheses proposed, the structural model presented in Figure 5.1 and an adaptation of the research instrument developed by Moriano et al. (2012), which was subsequently validated in the Portuguese context by da Fonseca Oliveira et al. (2016), a questionnaire (see Appendix A) was drawn up for this research. This data-collecting instrument incorporated explanatory, mediating and response variables, and for measurement, a seven-point Likert-type response scale was used (1 – Disagree greatly to 7 – Agree completely or 1 – Extremely insignificant to 7 – Extremely important 1 – Completely improbable to 7 – Completely probable) in all the constructs except for Hard Skills.

The constructs and dimensions used were:

**Entrepreneurial attitude** This variable was sub-divided in two dimensions: assessment of the individual's belief (favourable or unfavourable) about the behaviour (variables AE1 to AE6), being asked: *Does becoming an entrepreneur sound positive to you?* The second dimension refers to assessment of the desire for the target behaviour (AE1a to AE6a), asking, for example: *Please indicate to what extent that behaviour is desirable for your life in general.*

**Subjective norm** This variable was also sub-divided in two dimensions: assessment of perception of the opinions of social groups of reference regarding whether the individual should engage in the behaviour (variables NS1 to NS3), asking, for example: *Please indicate to what extent you believe your parents, friends and colleagues would agree, or not, with your choice of becoming an entrepreneur.* The second dimension determined the importance of the opinion of the social group of reference (variables NS1a to NS3a), asking: *Indicate to what extent what they think is significant for you, if you decided to follow a career as a business-person?*

**Perceived behavioural control** These are beliefs about the individual's control in relation to the behaviour (variables CCP1 to CCP5), asking, for example: *If you created your own business, to what extent would you manage to perform tasks such as drawing up a planning agenda?*

**Entrepreneurial Intention** Questions related to students' entrepreneurial intention were asked (variables IE1 to IE4); for example: *Do you think you will create your own company in the future? If you had the opportunity to choose freely the career to follow, what would you prefer? Considering your actual situation and the limitations*

*in relation to your options, indicate your probable career? How probable is it that you will create your own company in the next 5 years?*

To evaluate the pillars of digital academic entrepreneurship, according to the orientations of Garcez et al. (2022) and Garcez et al. (2022b), the following constructs/dimensions/variables were considered:

**Hard Skills** It was decided to adapt the scale proposed by Rauch and Hulsink (2015), with a structure suggested by Garcez et al. (2022b) and including the behaviour associated with the creation of new undertakings. Participants were presented with the following statement: "Although currently you may not be starting a business, it would be interesting to see if you have taken any steps towards creating a business in the last academic year" and the students were asked if they had taken any of the steps presented related to the use of management tools (variables FGI1 to FGI7), the prototyping process (variables DPP1 to DPP4) and the incubation process (variables DPI1 to DPI7).

**Soft Skills** To measure perception of technological self-efficacy as an individual characteristic facilitating digital entrepreneurship (variables CI1 to CI7), the instrument developed and tested by Cassidy and Eachus (2002) was used. To assess cultural characteristics related to the opportunity to develop a product (variables CC1 to CC6), the instrument used by Mancha and Shankaranarayanan (2020) was adapted. To operationalize the variable of 'sharing of entrepreneurial knowledge', the metric proposed by Arranz et al. (2017) was adopted, where knowledge-sharing is measured by students' frequency in participating in extra-curricular activities (variables PC1 to PC9). The coding of the variables in the study is summarised in Table 5.1.

Table 5.1 Coding of the variables in the study  
Source: Own elaboration

| Variables  | Theoretical<br>grounding of the<br>scale used          |
|--|--|
| <b><i>Dimensions of the theory of planned behaviour</i></b>  |  |
| <i>Business Attitude (AE)</i>  |  |
| AE1. Facing new challenges.  |  |
| AE2. Creating new jobs.  |  |
| AE3. Being creative and innovative.  |  |
| AE4. Obtaining high income.  |  |
| AE5. Accepting calculated risks.   |  |
| AE6. Being my own boss (independent).  |  |
| <i>Subjective Norms (NS)</i>   |  |
| NS1. Closest family members.   |  |
| NS2. My closest friends.   |  |
| NS3. My closest classmates.  |  |
| <i>Perceived Behavioural Control (CCP)</i>   |  |
| CCP1. Defining a business idea and company strategies.   |  |
| CCP2. Writing and elaborating a business plan (market research, financial analysis, etc.).   | (da Fonseca Oliveira et al. 2016; Moriano et al. 2012) |
| CCP3. Negotiating and maintaining supporting relations with potential investors and banks.   |  |
| CCP4. Recognising a market opportunity to develop new products and/or services.  |  |
| CCP5. Relationships with key people to obtain the necessary capital for the business.  |  |
| <i>Entrepreneurial Intention (IE)</i>  |  |
| IE1. Do you think in the future you will create your own company?  |  |
| IE2. If you had the opportunity to choose freely a career to follow, what would you prefer?  |  |
| IE3. Considering your real situation and the limitations regarding your options (for example, lack of money), indicate your probable career? |  |
| IE4. How likely is it that you will create your own company in the next 5 years?   |  |
| <b><i>Hard Skills</i></b>  |  |
| <i>Management Tools (Inspiration) -FGI</i>   |  |
| FGI1. Have you spent a lot of time thinking about starting a business  |  |
| FGI2. Have you organised an initial team?  |  |
| FGI3. Have you defined market opportunities?   |  |
| FGI4. Have you prepared a business plan?   | (Rauch and Hulsink 2015)                               |
| FGI5. Have you chosen a name for the business?   |  |
| FGI6. Have you looked for premises and equipment?  |  |
| FGI7. Have you begun marketing or promotional activities?  |  |

Table 5.1 Coding of the variables in the study (continued)

*Digital processes (Prototyping)- DPP*

- DPP1. Have you invested your own money in a business?  
 DPP2. Have you saved money to invest in a business?  
 DPP3. Have you acquired raw material, inventory or supplies?  
 DPP4. Have you developed models or procedures for a product/service?

*Digital products (Incubation) – DPI*

- DPI1. Have you applied for licences or patents?  
 DPI2. Have you requested and received financial help?  
 DPI3. Have you created a juridical entity?  
 DPI4. Have you done any registering with the tax authorities?  
 DPI5. Have you acquired or rented important items, such as equipment, premises or goods?  
 DPI6. Have you taken on staff?  
 DPI7. Have you worked full-time on the business?

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*Soft Skills*

*Individual Characteristics – CI*

- CI1. I like working with digital technology  
 CI2. Digital technology gives me a lot of problems  
 CI3. Digital technology makes me much more productive  
 CI4. Most digital technology I have experience with has been easy to use  
 CI5. Generally, I find it easy to learn about and use new software or an online application  
 CI6. Some digital technology definitely facilitates learning  
 CI7. Digital technology helps me to save a lot of time

(Cassidy and Eachus  
2002)

*Cultural Characteristics- CC*

- CC1. I am able to see new market opportunities for new products and services.  
 CC2. I am able to think of new ways to improve existing products  
 CC3. I am able to conceive products that solve current problems  
 CC4. I can create products that satisfy customers' unmet needs  
 CC5. I can bring concepts of products to the market on time  
 CC6. I do not identify opportunities for new products and services

(Mancha and  
Shankaranarayanan  
2020)

*Knowledge Sharing- PC*

- PC1. Conferences and seminars focused on entrepreneurship.  
 PC2. Visits to companies.  
 PC3. Simulation games and business plans.  
 PC4. Entrepreneurship projects.  
 PC5. Laboratories devoted to entrepreneurship.  
 PC6. Seminars organised by the university aiming to develop the entrepreneurial spirit and values.  
 PC7. Project in cooperation with firms in the region.  
 PC8. Online seminars and training on entrepreneurship.  
 PC9. Volunteering.

(Arranz et al. 2017)

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### **5.3.2 Sample, Data Collection and Treatment**

Considering the study's exploratory approach and the fact that a sample of university students is particularly useful to examine entrepreneurial intentions, as indicated by Rodrigues et al. (2019), a convenience sample of university students was used; 812 questionnaires were collected, of which 51 were discarded due to having incomplete answers. This left a sample of 761 questionnaires from Portuguese (51%) and Brazilian (49%) students. It is worth underlining that carrying out the study in more than one country aimed to expand the research context. This is extremely relevant, since the study considers that irrespective of the type of motivation to be an entrepreneur (entrepreneurship through opportunity or need), the perception of personal satisfaction is similar (Amorós et al., 2021) and is supported on the perspective of well-being from fulfilling one's creative and innovation potential (Leonardi & Barley, 2008). In addition, the use of technology breaks down the concept of geographical barriers to entrepreneurship (Giones & Brem, 2017).

To test the suitability of the sample size for the method of analysis, G\*Power software was used, adopting the following criteria: effect size ( $f^2$ ) of 0,15; level of significance ( $\alpha$ ) of 0,05; 0,95 power of test (Lopes et al., 2022). Considering these criteria, the size of the sample would be 166 responses. Therefore, the final sample was much larger than that required by the method.

Regarding the sample, the participants are distributed over the following areas of study: 29,1% from business, 30,5% from engineering and 40,5% from other areas. Including undergraduate and post-graduate students from different areas gave an inter-disciplinary view of their entrepreneurial perspectives, as indicated by Mayhew et al. (2012). Ages ranged from 17 to 73, with an average of 23,26. The other descriptive data of the sample are presented in Table 5.2.

Table 5.2 Characterisation of the sample

Source: Own elaboration

|  |        |
|--|--------|
| Questionnaires                           | 812    |
| Discarded questionnaires                 | 51     |
| Total number of useful questionnaires    | 761    |
| <b><i>Degree</i></b>                     |        |
| Bachelor                                 | 79,20% |
| Masters                                  | 16%    |
| Other                                    | 4,80%  |
| <b><i>Work Experience</i></b>            |        |
| Yes                                      | 48,60% |
| No                                       | 51,40% |
| <b><i>Entrepreneurship education</i></b> |        |
| Yes                                      | 36,30% |
| No                                       | 63,70% |
| <b><i>Faculty Discipline</i></b>         |        |
| Business                                 | 29,10% |
| Engineering                              | 30,50% |
| Other                                    | 40,50% |
| <b><i>Gender</i></b>                     |        |
| Female                                   | 43,22% |
| Male                                     | 55,12% |
| Other                                    | 1,66%  |

Data-collection for this study involved the approval of the Ethics Commission (see Appendix B). In the first phase, the research was submitted to the ethics commission for assessment and approval, together with good practices for data protection. A pre-test of the questionnaire was carried out to validate the research instrument. This involved passing the questionnaire to specialists in the area and applying it to a small sample of students, after which the necessary adjustments were made.

As for obtaining permission to carry out the research in the universities, e-mails were sent to the universities requesting their authorization. Three Portuguese and two Brazilian universities were contacted, of which three agreed to collaborate in the study.

Concerning application of the questionnaires and organisation of the data, having obtained authorization from the institutions, the last stage involved contacting lecturers, to ask for permission to apply the questionnaires to the students in the classroom. This approach was chosen to ensure the sample's diversity and

representativeness. Data were collected through printed or virtual questionnaires which were completed voluntarily and anonymously, between May and October 2022.

Finally, the data were organised using Microsoft Excel 2016 and exported to AMOS software (v.26, SPSS, da IBM, Chicago, IL), where structural equation modelling was used to test the relations of the proposed model (Figure 5.1). A model is a representation of the theory (Jr. J. F. Hair et al., 2000) and the theory is a conceptual scheme based on statements assumed to be true (Malhotra, 2012). In social sciences, application of a structural equation model allows effective development of analysis and sets theory against practice, which results not only in optimizing theoretical models but also leads to optimization of the instruments used to diagnose the actual situation (Tarka, 2018).

## **5.4 Data Analysis and Discussion of the Results**

As mentioned, the data were analysed through the technique of structural equations (SEM) in two stages. First, the theoretical measuring model adopted was assessed through exploratory factor analysis, which allowed distributing the variance of the observable variables among the factors, aiming to test whether the data fitted the theoretical model. In the second stage, the structural model was checked to reveal the relation between the constructs, these being confirmed through the adjustment indices (Hair et al., 2009).

### **5.4.1 Assessment of the Theoretical Model**

Aiming to determine the proportion of data variance that can be considered common to all the variables, the Kaiser-Meyer-Olkin (KMO) test was performed, obtaining the figure of 0,894. For this test, values close to 1 indicate the sample's suitability for applying exploratory factor analysis (EFA). In addition, Barlett's sphericity test was performed, presenting zero level of significance, which also demonstrates the suitability of the sample (Hair et al., 2009).

After performing these tests, EFA was performed based on the theoretical construction, which indicated the existence of ten latent factors (see sub-section 3.1), namely, Entrepreneurial Attitude, Subjective Norm, Perceived Behavioural Control (self-efficacy), Entrepreneurial Intention, Hard Skills (Management Tools, Prototyping Processes and Incubation) and Soft Skills (Individual Characteristics, Cultural Characteristics and Knowledge-Sharing).

These factors explained 68,5% of the variance, having excluded the items with factor loadings under 0,5, which were: in Entrepreneurial Intention, variable IE3; in Management Tools, variables FGI1, FGI6 and FGI2; in Prototyping Processes, variable DPP2; in Incubation, variables DPI2 and DPI7. Considering Soft Skills, in Individual Characteristics, variables CI1, CI2, CI3 and CI7; in Cultural Characteristics, variables CC1 and CC6; In Knowledge-Sharing, variables PC1, PC2, PC3 and PC9.

The reliability of the dimensions was confirmed through the Cronbach alpha, with values varying from 0,74 to 0,87. According to Hair et al. (2009), acceptable minimum values are between 0,6 (for exploratory research) and 0,7. Also calculated were average variance extracted (AVE) and composite reliability (CR), where acceptable minimum values are 0,5 for the former and 0,7 for the latter. In this study, the values found were from 0,5 to 0,62 for AVE and from 0,8 to 0,95 for CR. All the data from the reliability test and factor loadings are presented in Table 5.3.

As seen, the theoretical proposition of the ten latent factors was confirmed by the grouping carried out through exploratory factor analysis with good indicators of reliability, which allowed going on to confirmatory analysis, as presented in the next section.

Table 5.3 Factor loadings ( $\lambda$ ), Cronbach alpha ( $\alpha$ ), CR and AVE

Source: Own elaboration

| Hard Skills |           |          |          |           | Soft Skills |           |          |          |           | Theory of Planned Behaviour |           |          |          |           |
|-------------|-----------|----------|----------|-----------|-------------|-----------|----------|----------|-----------|-----------------------------|-----------|----------|----------|-----------|
| Items       | $\lambda$ | $\alpha$ | CR > 0,7 | AVE > 0,5 | Items       | $\lambda$ | $\alpha$ | CR > 0,7 | AVE > 0,5 | Items                       | $\lambda$ | $\alpha$ | CR > 0,7 | AVE > 0,5 |
| FGI3        | 0,76      | 0,80     | 0,80     | 0,50      | CI4         | 0,86      | 0,74     | 0,83     | 0,622     | AE3                         | 0,77      | 0,78     | 0,80     | 0,50      |
| FGI4        | 0,76      |          |          |           | CI5         | 0,83      |          |          |           | AE4                         | 0,75      |          |          |           |
| FGI5        | 0,64      |          |          |           | CI6         | 0,66      |          |          |           | AE5                         | 0,71      |          |          |           |
| FGI7        | 0,64      |          |          |           | CC2         | 0,73      | 0,87     | 0,89     | 0,659     | AE6                         | 0,57      |          |          |           |
| DPP1        | 0,78      | 0,78     | 0,75     | 0,50      | CC3         | 0,85      |          |          |           | NS1                         | 0,77      | 0,84     | 0,86     | 0,67      |
| DPP3        | 0,73      |          |          |           | CC4         | 0,84      |          |          |           | NS2                         | 0,85      |          |          |           |
| DPP4        | 0,58      |          |          |           | CC5         | 0,82      |          |          |           | NS3                         | 0,82      |          |          |           |
| DPI1        | 0,76      | 0,86     | 0,86     | 0,56      | PC4         | 0,74      | 0,86     | 0,88     | 0,603     | CCP3                        | 0,84      | 0,86     | 0,84     | 0,63      |
| DPI3        | 0,80      |          |          |           | PC5         | 0,82      |          |          |           | CCP4                        | 0,78      |          |          |           |
| DPI4        | 0,79      |          |          |           | PC6         | 0,77      |          |          |           | CCP5                        | 0,76      |          |          |           |
| DPI5        | 0,58      |          |          |           | PC7         | 0,77      |          |          |           | IE1                         | 0,75      | 0,81     | 0,79     | 0,56      |
| DPI6        | 0,78      |          |          |           | PC8         | 0,78      |          |          |           | IE2                         | 0,83      |          |          |           |
|             |           |          |          |           |             |           |          |          |           | IE4                         | 0,65      |          |          |           |

### 5.4.2 Validation of the Structural Model

After confirming the theoretical model, the structural model was tested using Structural Equation Analysis, through AMOS, in order to study the pertinence of the data for the hypotheses formulated. Consequently, the maximum likelihood estimation method was used. Considering the need to make the model simpler and more operational, it was decided to perform second order factor analysis, which according to Hair et al. (2009) adds a second layer that is generated by the latent, first order factors (first layer), which in turn originates in the measured variables. This sequencing is described in Figure 5.2.

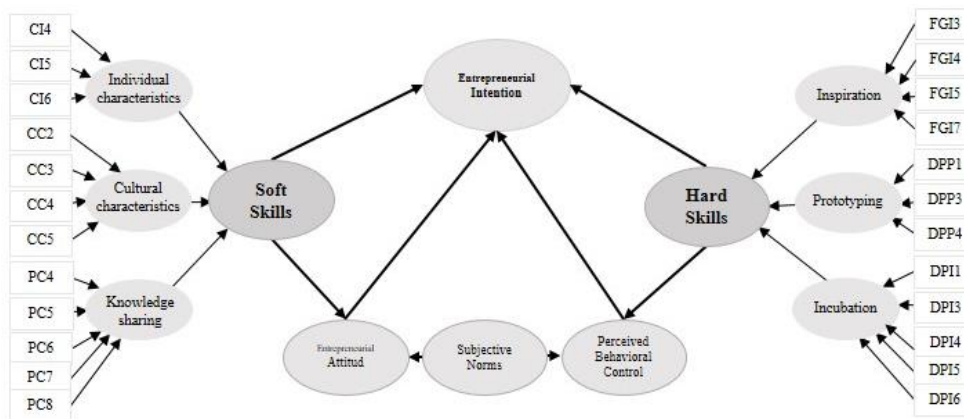


Figure 5.2. Second order factor analysis.  
Source: Own elaboration.

According to the results presented in Table 5.4, the model presented satisfactory adjustment indices, showing its suitability, and consequently, its internal and external consistency.

Table 5.4 Model's adjustment  
Source: Own elaboration

| Adjustment | Results | Literature (Hair et al., (2010)) |
|------------|---------|----------------------------------|
| GFI        | 0,903   | Above 0,9                        |
| RMSAE      | 0,044   | Under 0,08                       |
| IFI        | 0,933   | Above 0,9                        |
| TLI        | 0,926   | Above 0,9                        |
| CFI        | 0,933   | Above 0,9                        |
| PGFI       | 0,773   | Above 0,6                        |
| PNFI       | 0,807   | Above 0,6                        |
| PCFI       | 0,843   | Above 0,6                        |

Figure 5.3 presents the relation between the six constructs forming the proposed final structural model: Hard Skills, Soft Skills, Entrepreneurial Attitude, Subjective Norms, Perceived Behavioural Control and Entrepreneurial Intention.

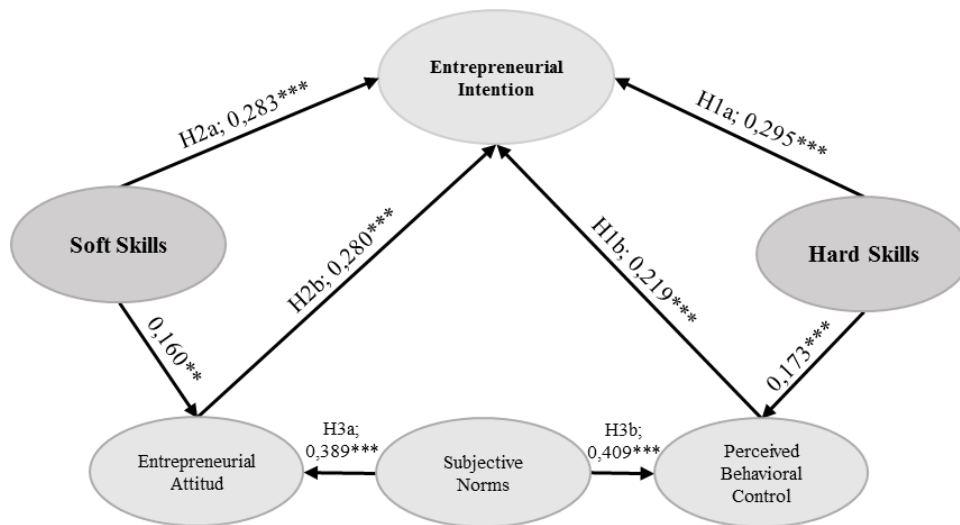


Figure 5.3. Structural research model with coefficients  
Own elaboration.

Table 5.5 Model's adjustment

| Entrepreneurial Intention                     |               |                 |              |
|---|---------------|-----------------|--------------|
|   | Direct effect | Indirect effect | Total effect |
| Hard Skills -> CCP -> IE                      | 0,295***      | 0,037***        | 0,332***     |
| Soft Skills -> AE -> IE                       | 0,283***      | 0,045**         | 0,328***     |
| Soft Skills <-> NS <-> AE -> IE <sup>1</sup>  | 0,283***      | 0,017**         | 0,300***     |
| Hard Skills <-> NS <-> CCP -> IE <sup>1</sup> | 0,295***      | 0,015***        | 0,310***     |

p \*\*\* < 0.01; \*\* < 0.05 e \* < 0.10

Note: <sup>1</sup>Calculation of the indirect effects of the mediations NS and AE between SS and IE, and NS and CCP between HS and IE was made through multiplication of the direct effects found in those relations, following Hair et al. (2009).

Analysing the research hypotheses, as observed in Figure 5.3 and Table 5.4, H1a: Hard Skills have a direct effect on Entrepreneurial Intention, and H1b: Perceived Behavioural Control (self-efficacy) mediates indirectly in the relation between Hard Skills and Entrepreneurial Intention, presenting statistical significance for both, at a 1% level, considering the direct effect of 0,295 between Hard Skills and Entrepreneurial Intention, and an indirect effect of 0,037 and total effect of 0,310 between Hard Skills

and Entrepreneurial Intention, having Perceived Behavioural Control as a mediator. Therefore, both hypotheses are accepted.

Agreeing with these results, the studies by Wang et al (2019) showed that educational programmes to encourage creativity and entrepreneurship have a positive impact on entrepreneurial intentions. Lv et al. (2021) analysed business education and entrepreneurial intention and also showed that entrepreneurship teaching, business plan competition and support for business practice have a positive impact on entrepreneurial intention. The study by Rauch and Hulsink (2015) showed that entrepreneurship education increases perceived behavioural control, and that entrepreneurial intentions are higher at the end of the study programme.

For research hypotheses H2a: Soft Skills have a direct impact on Entrepreneurial Intention, and H2b: Entrepreneurial Attitude mediates indirectly the relation between Soft Skills and Entrepreneurial Intention, statistical significance was also found for both, with the direct relation being at the 1% level and the indirect relation at 5%, finding a direct effect of 0,283 between Soft Skills and Entrepreneurial Intention, and an indirect effect of 0,045 and total effect of 0,328 between Soft Skills and Entrepreneurial Intention, having Entrepreneurial Attitude as a mediating factor. These two hypotheses are also supported.

Corroborating these results, Monllor and Soto-Simeone (2019) provide evidence that exposure to, and experience of digital technology, in business education programmes, have a positive impact on students' intentions to become entrepreneurs. In addition, Arranz et al. (2017) analysed the effect of curricular and extra-curricular activities on entrepreneurial intention and showed these activities affect entrepreneurial attitude positively. Therefore, entrepreneurship education is seen to influence entrepreneurial intention, inspiring and awakening emotions in students, and changing their mentality in relation to entrepreneurship (Souitaris et al., 2007).

Considering hypothesis H3a: Subjective Norms and Perceived Behavioural Control present an indirect mediating effect between Hard Skills and Entrepreneurial Intention, with a positive, indirect effect of 0,016 and a total effect of 0,310, at a 1% level of statistical significance, between Hard Skills and Entrepreneurial Intention, mediated by Subjective Norms and Perceived Behavioural Control.

Finally, regarding hypothesis H3b: Subjective Norms and Entrepreneurial Attitude have an indirect mediating effect between Soft Skills and Entrepreneurial Intention,

observing a positive, indirect effect of 0,017, with statistical significance at 5%, and a total effect of 0,300 between Soft Skills and Entrepreneurial Intention, mediated by Subjective Norms and Entrepreneurial Attitude. Also in this case, both hypotheses were confirmed.

The findings regarding these last two hypotheses agree with the results obtained by Tsai et al., (2016), where subjective norms have an impact on attitudes in relation to entrepreneurial behaviour and perceived behavioural control, which was also found by Lopes et al. (2022). Differently, but complementarily, Vafaei-Zadeh (2022) concluded that choice of a cyber-business career depends more on personal considerations than on social or normative concerns. This finding confirms a weak direct relation between Subjective Norms and Entrepreneurial Intention, but highlights the mediating role, showing the possibility that a certain behavioural variable is already present in the desirability of implementing the action. This weak direct influence between Subjective Norms and Entrepreneurial Intention was also found by Liñán and Chen (2009), who confirmed the influence on entrepreneurial attitude and self-efficacy.

The effects of Subjective Norms on Entrepreneurial Intention, although indirect, highlight the importance of universities and lecturers as references and influencers for entrepreneurship, since students can consider them as mentors or take their advice into account when deciding about setting up a business.

## **5.5 Conclusions and Implications**

This study aimed to analyse the relations between the pillars of digital academic entrepreneurship – Hard and Soft Skills – and the Entrepreneurial Intention shown by university students and how this relation is mediated by TPB. The empirical research confirmed that Hard Skills, i.e., business logic and the entrepreneurial process, characterised by the use of management tools, prototyping and incubation, have a direct, positive and significant influence, and also an indirect influence, when mediated by Perceived Behavioural Control and Subjective Norms, on the participants' Entrepreneurial Intention. A similar situation occurs with the pillar of Soft Skills, which considers socio-cultural modifications through identifying Individual and Cultural Characteristics and Knowledge-Sharing, where there is also a direct and positive significant influence, as well as an indirect one, through the mediation of Entrepreneurial Attitude and Subjective Norms on Entrepreneurial Intention.

These results lead to the conclusion that the pillars of digital academic entrepreneurship – Hard and Soft Skills, have a direct and indirect, positive influence on university students' entrepreneurial intention. The results also underline that the direct effects of Hard and Soft Skills are slightly less than the indirect total effects between these pillars and Entrepreneurial Intention, when considering the mediations of Entrepreneurial Attitude and Perceived Behavioural Control, and even when inserting Subjective Norms as a mediator together with these variables.

These differences between direct and indirect effects, although subtle, possibly arise from the complement generated by the dimensions of the Theory of Planned Behaviour (entrepreneurial attitude, perceived behavioural control and subjective norms) for Hard and Soft Skills, providing an environment that can stimulate the entrepreneurial intention.

This study presents implications for theory and practice. The implications are related specially to encouraging and promoting entrepreneurship education in university environments, since this can mean better operationalization of the Theory of Planned Behaviour, through using the pillars of digital academic entrepreneurship. By presenting more objective and operational characteristics, these pillars can indicate directions for HEIs seeking an optimized model in order to intervene more directly in their students' entrepreneurial intention.

The use of digital environments that allow simulation of the business situation, exposing students to risks inherent to the decision-making process and allowing insertion in an entrepreneurial culture, gives better training and an additional stimulus to take advantage of opportunities arising both during and after completing their courses. That technology and business simulation environments make it possible to avoid financial losses and even lower entry costs, by allowing analysis of scenarios before implementing them.

According to Armuña et al. (2020), regarding the difficulties of finding a precise framework of competences in the literature that could be analysed and taught to develop entrepreneurial skills in students, what is found is literature presenting a complex mix of variables, antecedents, moderators and mediators whose combinations are not yet able to provide an ideal predictive model (Donaldson, 2019). This aspect underlines the fact that there are no ready solutions for entrepreneurship education and that actions formed should consider the diverse scenarios and variables (Jones et al., 2012).

This study makes its contributions by indicating directions, via the development of Hard and Soft Skills, for better operationalization of the entrepreneurial education process. It does not claim to offer a finished solution, but use of the strategies indicated by the model validated here can help to direct construction of those skills, reducing the uncertainties surrounding the complexity of entrepreneurship education.

Considering the planning of actions associated with entrepreneurship education, which must consider the different contexts and variables, it stands out that the model proposed here, through its relations mediated by TPB, is able to capture personal perceptions, both in the aspect of beliefs and judgements about entrepreneurial action and in the question of the vision of self-efficacy, mediated by subjective norms, together with the skills of planning, prototyping and incubation, and the individual characteristics associated with information technology, cultural characteristics and the capacity to share knowledge. Therefore, this inter-connection between the facets of the business environment and personal and social skills favours a synergistic effect for entrepreneurship education.

Moreover, the digitalization context strengthens this need to incorporate the variability, materiality, urgency and wealth of the socio-technical phenomenon called digital innovation (Nambisan et al., 2017), making an additional contribution to the dynamism of the entrepreneurship education environment.

This study is not without limitations. One is the use of a convenience sample covering just two countries. It is suggested that future research should increase the number of countries participating and even replicate this model in other regions or countries, something that would contribute to its validation process and improvement. Comparative studies between regions and countries could also be carried out.

A future agenda could also consider inserting control variables, such as work experience as an autonomous/independent worker or as an employee, the use of laboratories and/or innovation centres at the university, country of origin/entrepreneurial culture (employee), gender, age and others. A final recommendation is to carry out studies evaluating the differences between students at private and state HEIs and between students following more practical education (Polytechnic Institutes) and more theoretical courses (Universities).

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## Chapter 6

### Conclusions and Implications

This research aimed to analyse the influence of digital academic entrepreneurship on university students' entrepreneurial intention. To do so, an exploratory study was carried out through a systematic literature review and empirical research with a final sample of 761 Portuguese (51%) and Brazilian (49%) university students.

The SLR allowed construction of a structural model of the pillars of digital academic entrepreneurship. This model was validated based on a quantitative study, through exploratory and confirmatory factor analysis, using structural equation models. The results indicated validity of the model proposed and confirmed the influence of the pillars of digital academic entrepreneurship on university students' entrepreneurial intentions.

Considering the specific objectives proposed for this research, the first was to map studies on digital entrepreneurship, digital technology and digital transformation (DT) and propose a structural model of analysis for digital academic entrepreneurship. The results showed that the links between DT and academic entrepreneurship are extremely significant, with major changes perceived in the way of thinking, interacting and doing business.

Specifically, it was concluded that academic entrepreneurship can be developed based on two types of relations, called Hard and Soft Skills, to indicate technical and social characteristics, respectively. The structural model proposed includes the structural pillars of digital academic entrepreneurship. This model is based on the interdependence of Hard and Soft skills for understanding and development of the entrepreneurial experience, being in line with sociotechnical theory. In addition, the results of this study confirm the relation between digital transformation mediated by digital technology and academic entrepreneurship, in a digital economy where knowledge is intensive and also disruptive (Davidson & Vaast, 2010).

The second specific objective was to propose a conceptual model of analysis in order to evaluate the Soft skills dimension (socio-cultural modifications), from the structural model proposed and presented in study/article 1. The results of this study indicated that the bases of Soft skills for digital academic entrepreneurship are anchored on the

social perspective and can be grouped in three main dimensions: a) Individual characteristics, b) Cultural characteristics, and c) Knowledge sharing. The conceptual model proposed considers these dimensions to indicate paths to develop Soft skills. It is also concluded that the creation and appropriate evolution of these skills assumes an interdependence between these factors and requires immersion in a dynamic, stimulating environment, marked by digital transformation, socio-cultural interactions and knowledge sharing. Furthermore, it should be underlined that the teaching of Soft skills is a challenging field of education, where digital tools can facilitate this teaching process. Indeed, business education is dominant in HEI curricula, and lecturers are aware of the importance of knowledge of management within HEIs (Goncharov et al., 2020).

The third specific objective was to propose another conceptual model of analysis in order to assess the Hard Skills dimension, considering business logic and the entrepreneurial academic process. The results showed that these Hard Skills for digital academic entrepreneurship are based on the technical perspective and can be structured in three dimensions (business logic and entrepreneurial process): a) Management tools, b) Digital processes, and c) Digital products. The conceptual model proposed considers these dimensions aiming to indicate strategies for teaching and developing Hard Skills.

It was also observed that appropriate construction of these skills must consider the interdependence between these factors and allow entrepreneurial experiences, in a dynamic, complex environment, considering digital technology, business logic and the academic business process. Unlike Soft skills, Hard Skills were found to be more easily taught, being based on explicit knowledge. This phenomenon must be perceived from a multi-disciplinary perspective, aiming for holistic development of academic entrepreneurship.

The fourth and final specific objective was to analyse the influence of the pillars (Hard and Soft Skills) of digital academic entrepreneurship on university students' entrepreneurial intention. Therefore, setting out from the conceptual models developed in the previous studies, the results of the empirical research validated the theoretical structural model proposed, showing the variables forming the pillars of digital academic entrepreneurship. This model was also mediated by the dimensions of the Theory of Planned Behaviour (TPB) (Ajzen, 1991, 1985) : (1) entrepreneurial attitude, (2) subjective norm, and (3) perceived behavioural control. More precisely, these three dimensions were used as mediators to assess the influence of Hard and Soft Skills on

university students' entrepreneurial intention. The results indicated acceptance of the hypotheses formulated, concluding that entrepreneurial intention is positively influenced by the pillars of digital academic entrepreneurship.

These results also lead to the conclusion that the pillars of digital academic entrepreneurship - Hard and Soft Skills – have a positive, direct and indirect influence on university students' entrepreneurial intention. The empirical evidence also suggests that the direct effects of Hard and Soft Skills are slightly less than the total indirect effects between these pillars and entrepreneurial intention, when considering the mediations of Entrepreneurial Attitude and Perceived Behavioural Control, and even when inserting Subjective Norms as a mediator together with these dimensions.

## **6.1 Implications for Theory**

This research was guided by the lines of Sociotechnical Theory and the Theory of Planned Behaviour. By proposing and validating a model associated with these theoretical perspectives, the study extended and strengthened the debate about these approaches.

Regarding Sociotechnical Theory, the discussion converges on confirming the importance of considering the interdependence between the social and technical dimensions in creating and implementing a business, considering a complex, dynamic environment, where organisations and people need to perform their activities while maintaining permanent interaction between the external and internal environments.

Then again, the Theory of Planned Behaviour (Ajzen, 1991) seeks to explain and predict how the cultural and social environment affects human behaviour, serving as a mediator between the pillars of digital academic entrepreneurship and entrepreneurial intention. Indeed, this theory had its function confirmed in a new study context (Portugal and Brazil). Moreover, the effective mediation meant two new constructs – Soft and Hard Skills - can be joined to this theory, regarding the debate on and understanding of university students' entrepreneurial intention and behaviour.

As for digital academic entrepreneurship, this study also extends the debate on this topic by proposing and validating an innovative structural model to analyse the factors of digital entrepreneurship that influence university students' entrepreneurial intention. More precisely, new knowledge was generated here from the literature, through identifying the two constructs, Hard and Soft Skills, and the possibility of

joining them to the Theory of Planned Behaviour for better understanding of entrepreneurial intention. Moreover, better understanding of the Hard and Soft dimensions in digital academic entrepreneurship opens up new paths for their improved operationalization, in order to stimulate entrepreneurial intention in the academic context.

## **6.2 Implications for Practice**

From the practical point of view, the main implications of this study regard operationalization of the phenomena of digital academic entrepreneurship and entrepreneurship education. The results obtained clarify the paths to develop Hard and Soft Skills, and consequently, stimulate entrepreneurial intention in the university context.

In this scenario, when HEIs promote knowledge transfer, an entrepreneurial mentality is spread in the whole ecosystem. Creation of a digital environment lets students and lecturers identify market opportunities, specify technology, organize the operation and create value for society (Teece, 2018), besides encouraging students to participate actively and responsibly in the digital world with an entrepreneurial perception.

Another practical contribution of this study that can be underlined is related to encouraging and promoting entrepreneurship education in university environments. By presenting more objective and operational characteristics, the pillars of digital academic entrepreneurship can guide HEIs towards an optimized model, so as to intervene more directly in their students' entrepreneurial intention, in a digital context.

Strategies such as using digital environments that allow simulation of the business situation, exposing students to the risks inherent to the decision-making process and allowing insertion in an entrepreneurial culture, can provide better training and an added stimulus to seize the opportunities that arise during and after completing their courses. Moreover, technological and business simulation environments can mean avoiding financial losses and even lower entry costs, allowing the analysis of scenarios prior to implementation. In addition, besides supporting product development, HEIs can direct their efforts towards developing complete educational programmes for entrepreneurship including incubation and acceleration environments.

Regarding implications applied to the context, developing an entrepreneurial mentality and skill can bring benefits, both for HEIs, by extending their possibility of

sustainability, and for society, by promoting a strategy of social value creation (Giones & Brem, 2017). This situation arises from the potential opportunities for regional development from job creation and the development of regional infrastructure, which can improve the population's quality of life.

In general, this study makes contributions in this area of research, indicating directions, via the development of Hard and Soft Skills, for better operationalization of the entrepreneurship education process. The aim here is not to provide a complete solution, but rather the use of strategies indicated by the model proposed and validated, which can help to guide construction of these competences, reducing the uncertainties surrounding the complexity of entrepreneurship education. It is suggested, therefore, that those in charge of HEIs should use the pillars presented in the model proposed here to guide their institutions' strategic planning. Bearing these pillars in mind, the objective is to stimulate the effective development of digital academic entrepreneurship.

In this context, it is also important to introduce public policies that can develop the digital environment, where students and lecturers can identify market opportunities, specify technology, organise the operation and thereby create value for society, encouraging students to participate actively and responsibly in the digital world. This type of action allows the transfer of theoretical/practical knowledge, in an environment where students and lecturers have free access to software and equipment. HEIs should concentrate efforts on training talents that can combine different disciplines. For example, an engineer should be able to develop sustainable mobility solutions, balancing environmental, social and economic aspects, and a manager should be able to work with digital technology (Rippa et al., 2022).

The development of new educational models, supported by digital technology, should be supported by entrepreneurship education, as this tool allows holistic learning (Kozlinska et al., 2020). In addition, the impact of these actions can affect regional development due to the direct effect on job creation and infrastructure development, improving the population's quality of life from a new business mentality.

### **6.3 Limitations and Indications for Future Research**

This study is not without limitations. Concerning the initial selection of articles, choosing a single database (WoS) could have meant other valuable studies related to

the topics were not analysed due to being published elsewhere. Difficulty was found also in analysing the overlapping borders between the pillars of Soft Skills.

Another limitation could be associated with using a sample of convenience covering only university students in two countries. A suggestion is for future research to expand the geographical area, increasing the number of regions and/or countries participating, even replicating the model validated here. This type of study will allow validation of the model in other geographical contexts, reinforcing the results achieved here. Comparative studies could also be made between regions and countries.

A future agenda could consider the inclusion of control variables, such as work experience as self-employed or as an employee, the use of laboratories and/or innovation centres at universities, country of origin/business culture (worker), gender, age and others. Another recommendation would be to assess the differences between students at private and state HEIs, and between students following more practical training (Polytechnic Institutes) and more theoretical courses (Universities). A final suggestion is to study the limits and overlapping of the pillars of digital academic entrepreneurship, using a qualitative approach and resorting to interviews with specialists.

The pillars presented here should also be understood as a process of interconnection between theory and practice. Therefore, future research should also measure the level of Hard and Soft Skills, when students begin a programme of entrepreneurship education setting out from digital technology and compare this with the level achieved on completing the programme. This type of study could assess the efficacy of the methods used and whether digital technology can change students' entrepreneurial intention.

Questions related to gender can also be studied in business education programmes, supported by digital technology, to determine whether gender interferes with the perception of digital business education. In addition, it would be interesting to compare identical programmes of digital business education, but in different cultural and economic contexts, to determine whether students' entrepreneurial intention is changed by the context.

Longitudinal studies would also be relevant to understand the effects of digital entrepreneurship education in academic ecosystems. At a more instrumental level, developing active learning methodologies can make it possible to assess the influence of

digital business education on the intention, and make educational programmes increasingly dynamic or consolidate theoretical and practical concepts. Moreover, researchers interested in studying the pillars of digital entrepreneurship should consider the bonus digital technology can present, as this possibility of transforming a business idea into a physical product can be achieved, from prototyping processes in a digital environment. Future research should measure perception of the moderating factors of business intention (business self-efficacy, perception of risk, and others) among students participating in experimental education programmes (prototyping) focused on developing digital products, in order to understand the relation between experimental business learning, based on digital technology, and the development of critical, analytical thought in students.

Another relevant point is understanding how a digital product, developed in an academic environment, can be introduced to the market. Future research should determine how HEIs can develop innovative curricula formed by researchers, lecturers, business-people and other stakeholders to allow the development of digital products in an academic environment. It should also investigate teaching strategies that give students learning experience in real-life scenarios with complex, challenging problems.

Forming cooperation networks between universities and industry, in order to strengthen academic firms that join investors focused on developing a sustainable entrepreneurial ecosystem, opens the way to study how participation in global networks of training institutions, research centres and firms can improve knowledge-sharing and support digital academic entrepreneurship. This type of study can compare and evaluate the success factors of academic entrepreneurs, with the aim of adding these factors to business education programmes.

Students should be inspired towards entrepreneurship, leading them to understand, feel, analyse and take conscious decisions based on data (Ndou et al., 2018) so as to develop their critical thought (Ratten & Usmanij, 2021). Digital processes provide an opportunity for the rapid development of physical prototypes of a business idea (Monllor & Soto-Simeone, 2019), triggering the business process (Costa et al., 2018). However, it is not enough to develop a digital prototype and a viable business plan. There must also be support in seeking finance (Muafi et al., 2021) and developing networks, i.e., introducing entrepreneurial students in the market.

As HS are easily taught, this study shows how using digital tools can speed up the process of teaching them. Therefore, it is suggested that those in charge of HEIs should

use the pillars presented here in the structure proposed to orient their institutions' strategic planning. With these pillars in mind, the aim is to stimulate the development of digital tools and effective digital academic entrepreneurship.

The project presented could support HEIs in teaching dynamic skills in relation to business models, operations and routines, but as concerns micro-foundations, to develop in students the capacity to make decisions in uncertain (Teece, 2018) and more dynamic (Nambisan et al., 2019) environments, due to advances in communication technology, computers and connectivity (Bharadwaj et al., 2013).

Finally, it is hoped this research will contribute to identifying gaps in the debate about digital academic entrepreneurship and that it can inspire future work by academics and professionals interested in progressing in these promising areas of study.

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## ***Appendix A - Survey***

## ARTE I (Competências)



| 1. Por favor, identifique o seu nível de concordância em relação às seguintes declarações:   | Discordo<br>Extremamente | Concordo<br>Extremamente |   |   |   |   |   |
|--|--------------------------|--------------------------|---|---|---|---|---|
| 1. Gosto de trabalhar com tecnologia digital   | 1                        | 2                        | 3 | 4 | 5 | 6 | 7 |
| 2. A tecnologia digital causa-me muitos problemas  | 1                        | 2                        | 3 | 4 | 5 | 6 | 7 |
| 3. A tecnologia digital torna-me muito mais produtiva  | 1                        | 2                        | 3 | 4 | 5 | 6 | 7 |
| 4. A maioria das tecnologias digitais, com que tenho tido experiência, têm sido fáceis de utilizar   | 1                        | 2                        | 3 | 4 | 5 | 6 | 7 |
| 5. Normalmente, eu acho fácil aprender e a utilizar um novo 'software' ou aplicação "online"   | 1                        | 2                        | 3 | 4 | 5 | 6 | 7 |
| 6. Algumas tecnologias digitais facilitam definitivamente a aprendizagem   | 1                        | 2                        | 3 | 4 | 5 | 6 | 7 |
| 7. A tecnologia digital ajuda-me a poupar muito tempo  | 1                        | 2                        | 3 | 4 | 5 | 6 | 7 |
| 8. Eu consigo ver novas oportunidades de mercado para novos produtos e serviços.   | 1                        | 2                        | 3 | 4 | 5 | 6 | 7 |
| 9. Eu consigo pensar em novas formas de melhorar produtos existentes   | 1                        | 2                        | 3 | 4 | 5 | 6 | 7 |
| 10. Eu consigo conceber produtos que resolvam problemas atuais   | 1                        | 2                        | 3 | 4 | 5 | 6 | 7 |
| 11. Eu posso criar produtos que satisfaçam as necessidades não satisfeitas dos clientes  | 1                        | 2                        | 3 | 4 | 5 | 6 | 7 |
| 12. Eu posso trazer conceitos de produtos para o mercado em tempo útil   | 1                        | 2                        | 3 | 4 | 5 | 6 | 7 |
| 13. Eu não identifico as oportunidades de novos produtos e serviços  | 1                        | 2                        | 3 | 4 | 5 | 6 | 7 |
| 14. As horas de treino/formação em empreendedorismo que recebi, durante os meus estudos universitários, foram adequadas  | 1                        | 2                        | 3 | 4 | 5 | 6 | 7 |
| 15. As horas de treino/formação em empreendedorismo que recebi, como parte dos programas de treino de professores e pesquisadores da minha universidade, foram suficientes | 1                        | 2                        | 3 | 4 | 5 | 6 | 7 |
| 16. As horas de treino/formação em empreendedorismo que recebi, fora da universidade, foram suficientes  | 1                        | 2                        | 3 | 4 | 5 | 6 | 7 |
| 17. A minha universidade dá boa formação à sua equipa de ensino e investigação para eles desenvolverem o seu potencial empreendedor  | 1                        | 2                        | 3 | 4 | 5 | 6 | 7 |
| 2. Com que frequência participa nas seguintes atividades?  | Nunca                    | Frequentemente           |   |   |   |   |   |
| 1. Conferências e seminários dedicados ao empreendedorismo.  | 1                        | 2                        | 3 | 4 | 5 | 6 | 7 |
| 2. Visitas a empresas.   | 1                        | 2                        | 3 | 4 | 5 | 6 | 7 |
| 3. Jogos de simulação e planos de negócios.  | 1                        | 2                        | 3 | 4 | 5 | 6 | 7 |
| 4. Projetos de empreendedorismo.   | 1                        | 2                        | 3 | 4 | 5 | 6 | 7 |
| 5. Laboratórios dedicados ao empreendedorismo.   | 1                        | 2                        | 3 | 4 | 5 | 6 | 7 |
| 6. Palestras desenvolvidas pela universidade com o objetivo de desenvolver o espírito e valores empreendedores.  | 1                        | 2                        | 3 | 4 | 5 | 6 | 7 |
| 7. Projeto em cooperação com empresas da região.   | 1                        | 2                        | 3 | 4 | 5 | 6 | 7 |
| 8. Palestras e formações 'online' sobre empreendedorismo.  | 1                        | 2                        | 3 | 4 | 5 | 6 | 7 |
| 9. Voluntariado.   | 1                        | 2                        | 3 | 4 | 5 | 6 | 7 |

**3. Por favor, indique respondendo sim ou não, às seguintes perguntas:**

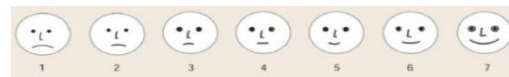
*Embora atualmente possa não estar a iniciar um empreendimento, seria interessante verificar se envolveu em quaisquer passos para a criação de empreendimentos, no último ano académico.*

|  | Sim                   | Não                   |
|--|-----------------------|-----------------------|
| 1. Passou muito tempo a pensar em começar um negócio?                            | <input type="radio"/> | <input type="radio"/> |
| 2. Organizou uma equipa inicial?   | <input type="radio"/> | <input type="radio"/> |
| 3. Definiu oportunidades de mercado?   | <input type="radio"/> | <input type="radio"/> |
| 4. Preparou um plano de negócios?  | <input type="radio"/> | <input type="radio"/> |
| 5. Selecionou um nome para o negócio?  | <input type="radio"/> | <input type="radio"/> |
| 6. Pouçou dinheiro para investir num negócio?                                    | <input type="radio"/> | <input type="radio"/> |
| 7. Investiu o seu próprio dinheiro num negócio?                                  | <input type="radio"/> | <input type="radio"/> |
| 8. Procurou instalações e equipamento?   | <input type="radio"/> | <input type="radio"/> |
| 9. Candidatou-se a licenças ou patentes?   | <input type="radio"/> | <input type="radio"/> |
| 10. Requereu e recebeu apoio financeiro?   | <input type="radio"/> | <input type="radio"/> |
| 11. Criou uma entidade jurídica?   | <input type="radio"/> | <input type="radio"/> |
| 12. Fez algum registo junto das autoridades fiscais?                             | <input type="radio"/> | <input type="radio"/> |
| 13. Adquiriu ou alugou itens importantes, como equipamento, instalações ou bens? | <input type="radio"/> | <input type="radio"/> |
| 14. Adquiriu matérias-primas, inventário ou fornecimento?                        | <input type="radio"/> | <input type="radio"/> |
| 15. Desenvolveu modelos ou procedimentos para um produto/serviço?                | <input type="radio"/> | <input type="radio"/> |
| 16. Iniciou atividades de 'marketing' ou promocionais?                           | <input type="radio"/> | <input type="radio"/> |
| 17. Dedicou-se a tempo inteiro ao negócio?                                       | <input type="radio"/> | <input type="radio"/> |
| 18. Contratou empregados?  | <input type="radio"/> | <input type="radio"/> |

**PARTE II (valorização da aprendizagem e atitude empreendedora)**



|  | Extremamente Insignificante |                       |                       | Extremamente Importante |                       |                       |                       |
|--|-----------------------------|-----------------------|-----------------------|-------------------------|-----------------------|-----------------------|-----------------------|
| <b>1. Tornar-se empresário significaria para si:</b> |                             |                       |                       |                         |                       |                       |                       |
| 1. Enfrentar novos desafios.                         | <input type="radio"/>       | <input type="radio"/> | <input type="radio"/> | <input type="radio"/>   | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| 2. Criar novos empregos.                             | <input type="radio"/>       | <input type="radio"/> | <input type="radio"/> | <input type="radio"/>   | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| 3. Ser criativo e inovador.                          | <input type="radio"/>       | <input type="radio"/> | <input type="radio"/> | <input type="radio"/>   | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| 4. Obter elevados rendimentos.                       | <input type="radio"/>       | <input type="radio"/> | <input type="radio"/> | <input type="radio"/>   | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| 5. Assumir riscos calculados.                        | <input type="radio"/>       | <input type="radio"/> | <input type="radio"/> | <input type="radio"/>   | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| 6. Ser meu próprio patrão (independente).            | <input type="radio"/>       | <input type="radio"/> | <input type="radio"/> | <input type="radio"/>   | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |



| <b>2. Por favor, indique em que medida é desejável para a sua vida, em geral:</b> | <i>Totalmente<br/>indesejável</i> | <i>Extremamente<br/>desejável</i> |
|---|-----------------------------------|-----------------------------------|
| 1. Enfrentar novos desafios.  | (1) (2) (3) (4) (5) (6) (7)       |                                   |
| 2. Criar novos empregos.  | (1) (2) (3) (4) (5) (6) (7)       |                                   |
| 3. Ser criativo e inovador.   | (1) (2) (3) (4) (5) (6) (7)       |                                   |
| 4. Obter elevados rendimentos.  | (1) (2) (3) (4) (5) (6) (7)       |                                   |
| 5. Assumir riscos calculados.   | (1) (2) (3) (4) (5) (6) (7)       |                                   |
| 6. Ser meu próprio patrão (independente).   | (1) (2) (3) (4) (5) (6) (7)       |                                   |

| <b>3. Por favor, indique em que medida concordaria, ou não, com as seguintes declarações, caso decidisse ser empreendedor</b> | <i>Extremamente<br/>Discordo</i> | <i>Extremamente<br/>Concordo</i> |
|---|----------------------------------|----------------------------------|
| 1. Os meus familiares mais próximos pensam que eu deveria seguir uma carreira como empresário.                                | (1) (2) (3) (4) (5) (6) (7)      |                                  |
| 2. Os meus amigos mais próximos pensam que eu deveria seguir uma carreira como empresário.                                    | (1) (2) (3) (4) (5) (6) (7)      |                                  |
| 3. Os meus colegas de turma próximos pensam que eu deveria seguir uma carreira como empresário.                               | (1) (2) (3) (4) (5) (6) (7)      |                                  |

| <b>4. Agora, indique até que ponto é significativo o que pensam, se decidisse seguir uma carreira como empresário</b> | <i>Extremamente<br/>Insignificante</i> | <i>Extremamente<br/>Importante</i> |
|---|--|------------------------------------|
| 1. Os membros familiares mais próximos.   | (1) (2) (3) (4) (5) (6) (7)            |                                    |
| 2. Os meus amigos mais próximos.  | (1) (2) (3) (4) (5) (6) (7)            |                                    |
| 3. Os meus colegas de turma próximos.   | (1) (2) (3) (4) (5) (6) (7)            |                                    |

| <b>5. Se criasse o seu próprio negócio, até que ponto conseguiria executar as seguintes tarefas:</b> | <i>Nunca</i>                | <i>Decisivamente</i> |
|--|-----------------------------|----------------------|
| 1. Definir ideia de negócio e estratégias da empresa.  | (1) (2) (3) (4) (5) (6) (7) |                      |
| 2. Escrever e elaborar um plano de negócio (pesquisa de mercado, análise financeira, etc.).          | (1) (2) (3) (4) (5) (6) (7) |                      |
| 3. Negociar e manter relações de apoio com potenciais investidores e bancos.                         | (1) (2) (3) (4) (5) (6) (7) |                      |
| 4. Reconhecer oportunidade de mercado para o desenvolvimento de novos produtos e/ou serviços.        | (1) (2) (3) (4) (5) (6) (7) |                      |
| 5. Relacionar-se com pessoas chave para obter capital necessário para o seu negócio.                 | (1) (2) (3) (4) (5) (6) (7) |                      |



Definitivamente  
Não

Definitivamente  
Sim

6. Pensa que no futuro irá criar a sua própria empresa?

① ② ③ ④ ⑤ ⑥ ⑦

Ser empregado por  
conta de outrém

Eu preferia criar o  
meu próprio negócio

7. Se tivesse a oportunidade de escolher livremente a carreira a seguir, o que preferia?

① ② ③ ④ ⑤ ⑥ ⑦

Ser empregado por  
conta de outrém

Criar o meu próprio  
negócio

8. Tendo em conta a sua situação real e as limitações em relação às suas opções (por exemplo, falta de dinheiro), indique qual a carreira provável?

① ② ③ ④ ⑤ ⑥ ⑦

Totalmente  
improvável

Totalmente  
provável

9. Com que probabilidade considera criar a sua própria empresa, nos próximos 5 anos?

① ② ③ ④ ⑤ ⑥ ⑦

### PARTE III- Dados para Codificação

1. Qual sua instituição de ensino superior?

4. Qual o grau de ensino que frequenta?

Licenciatura

①

Mestrado

②

Doutoramento

③

2. Género:

Feminino

①

Masculino

②

Outros

③

5. Experiência Profissional?

Sim

①

Não

②

3. Qual o seu curso?

6. Frequentou unidades curriculares (Ucs) ou formações de empreendedorismo?

Sim

①

Não

②

Idade: \_\_\_\_\_

## ***Appendix B - Ethics Committee***



Comissão de Ética  
Universidade da Beira Interior

comissaodeetica@ubi.pt  
Convento de Santo António  
6201-001 Covilhã | Portugal

## **Parecer relativo ao processo n.º CE-UBI-Pj-2022-039-ID1373**

Na sua reunião de 23 de maio de 2022, a Comissão de Ética apreciou a documentação científica submetida referente ao pedido de parecer do projeto **“Pilares para o Empreendedorismo Académico Digital em Instituições do Ensino Superior Portuguesas”**, da proponente **Ana Paula Braga Garcez**, a que atribuiu o código n.º CE-UBI-Pj-2022-039.

Na sua análise não identificou matéria que ofenda os princípios éticos e morais, sendo de parecer que o estudo em causa pode ser aprovado.

Covilhã e UBI

A Presidente da Comissão de Ética

Assinado por: **ANA LEONOR SERRA MORAIS DOS SANTOS**

Num. de Identificação: 11274197

Data: 2022.05.26 09:13:55+01'00'



(Professora Doutora Ana Leonor Serra Morais dos Santos)

(Professora Auxiliar)