



Article

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

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Abstract: Digital transformation (DT) has changed the means and mechanisms for acquiring knowledge, meaning that higher education institutions (HEI) have 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



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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. 2020a; 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. 2020c). 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.

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 trans-disciplinary 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?

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

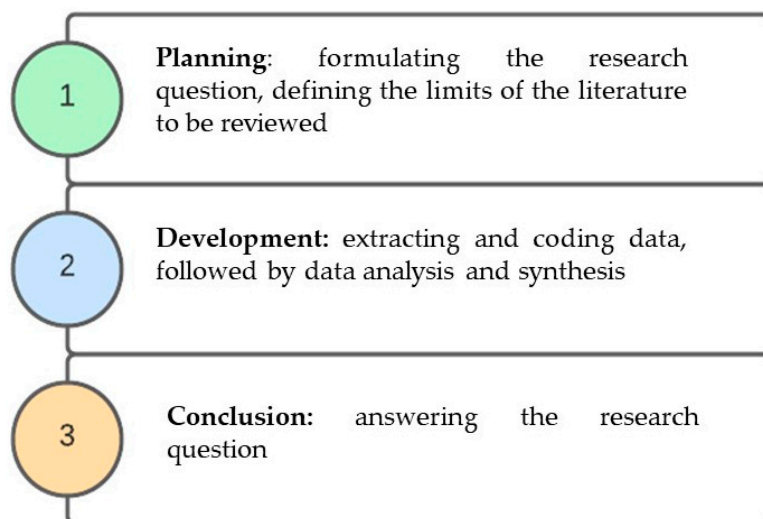


Figure 1. Protocol for selecting the literature.

Stage 1: formulating a list of potential key-words 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 1, presenting the main problem discussed in each one.

Table 1. Problems addressed by each author researching the topic. Source: Research Data.

Authors	Source Title	Article Title	Problem Discussed
Secundo et al. (2020c)	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.
Ratten and Usmanij (2021)	International Journal of Management Education	Entrepreneurship education: Time for a change in research direction?	Present current research trends in education for entrepreneurship.
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	Understand how the COVID-19 crisis can reconfigure traditional programmes of entrepreneurship education.
Jardim (2021)	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.
Rippa and 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
Secundo et al. (2020b)	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.

Table 1. Cont.

Authors	Source Title	Article Title	Problem Discussed
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 and how it evolves.
Muafi et al. (2021)	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 an interpretative framework for digital entrepreneurship.
Oppong et al. (2020)	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.
Garcez et al. (2021)	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
Bauman and Lucy (2021)	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.
Wang et al. (2019)	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.
Farhangmehr et al. (2016)	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.
Sirelkhatim and Gangi (2015)	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.
Yashin et al. (2018)	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.
Liu et al. (2021)	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.

Table 1. Cont.

Authors	Source Title	Article Title	Problem Discussed
Kazakeviciute et al. (2016)	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.
Secundo et al. (2020a)	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
Lv et al. (2021)	Frontiers in Psychology	How Entrepreneurship Education at Universities Influences Entrepreneurial Intention: Mediating Effect Based on Entrepreneurial Competence	Analyse the effect of entrepreneurial education on entrepreneurial intention, from the perspective of the theory of planned behaviour.
Ferreras-Garcia et al. (2021)	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.
Ma et al. (2020)	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.
Wu et al. (2018)	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.
Grivokostopoulou et al. (2019)	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.
Bodea et al. (2015)	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.

Table 1. Cont.

Authors	Source Title	Article Title	Problem Discussed
Rodríguez-López and Souto (2019)	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.
Rippa et al. (2022)	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. 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 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.

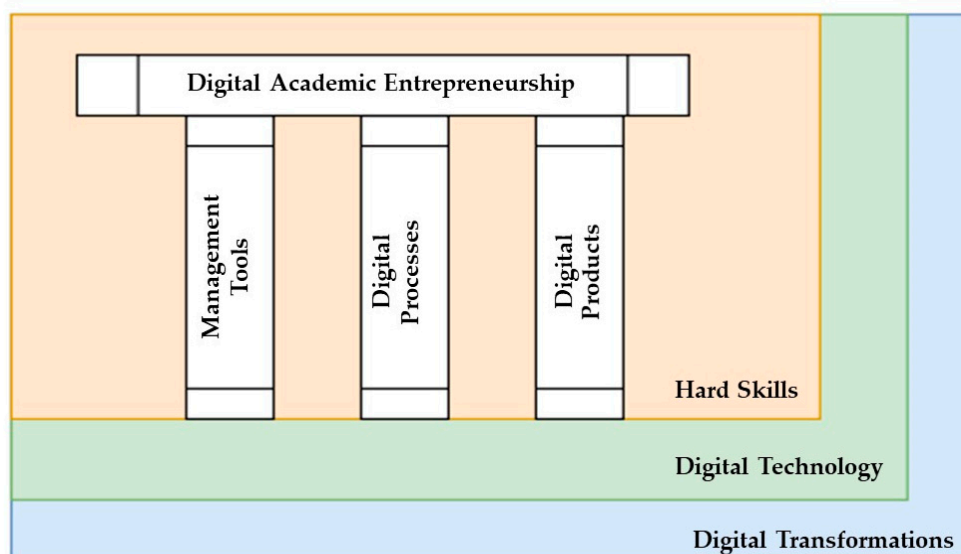


Figure 2. Framework of hard skills for digital academic entrepreneurship. Source: Own elaboration.

4.1. 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 centre 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. Petersson 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 interactivity 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.

4.2. 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.

4.3. 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 3).

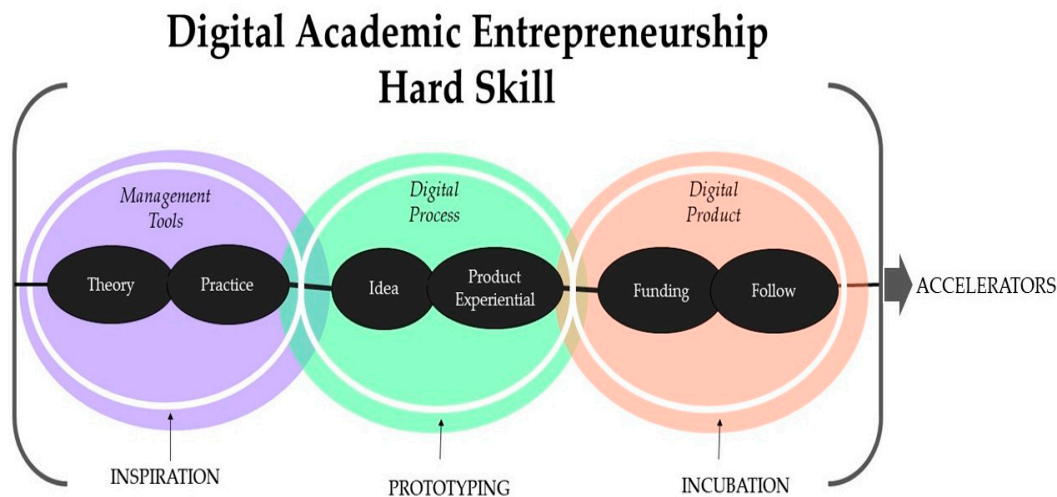


Figure 3. Framework proposal.

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.

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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References

- Ajzen, Icek. 1991. The theory of planned behavior. *Organizational Behavior and Human Decision Processes* 50: 179–211. [\[CrossRef\]](#)
- Armuña, Cristina, Sergio Ramos, Jesús Juan, Claudio Feijóo, and Alberto Arenal. 2020. From stand-up to start-up: Exploring entrepreneurship competences and STEM women's intention. *International Entrepreneurship and Management Journal* 16: 69–92. [\[CrossRef\]](#)
- Arvidsson, Viktor, and Troels Mønsted. 2018. Generating innovation potential: How digital entrepreneurs conceal, sequence, anchor, and propagate new technology. *Journal of Strategic Information Systems* 27: 369–83. [\[CrossRef\]](#)
- Bauman, Antonina, and Carol Lucy. 2021. Enhancing entrepreneurial education: Developing competencies for success. *International Journal of Management Education* 19: 100293. [\[CrossRef\]](#)
- Beliaeva, Tatiana, Marcos Ferasso, Sascha Kraus, and Eloi Junior Damke. 2019. Dynamics of digital entrepreneurship and the innovation ecosystem: A multilevel perspective. *International Journal of Entrepreneurial Behaviour and Research* 26: 266–84. [\[CrossRef\]](#)
- Bharadwaj, Anandhi, Omar A. El Sawy, Paul A. Pavlou, and N. V. Venkatraman. 2013. Digital Business Strategy: Toward a Next Generation of Insights. *MIS Quarterly* 37: 471–82. [\[CrossRef\]](#)
- Bischoff, Kathrin, Christine K. Volkmann, and David B. Audretsch. 2018. Stakeholder collaboration in entrepreneurship education: An analysis of the entrepreneurial ecosystems of European higher educational institutions. *Journal of Technology Transfer* 43: 20–46. [\[CrossRef\]](#)
- Bodea, Constanța-Nicoleta, Radu Ioan Mogoș, Maria-Iuliana Dascălu, Augustin Purnuș, and Narcisa Georgeta Ciobotar. 2015. Simulation-Based E-Learning Framework for Entrepreneurship Education and Training. *Amfiteatru Economic Journal* 17: 10–24.
- Brydges, Taylor, and Jenny Sjöholm. 2019. Becoming a personal style blogger: Changing configurations and spatialities of aesthetic labour in the fashion industry. *International Journal of Cultural Studies* 22: 119–39. [\[CrossRef\]](#)
- Cenamor, Javier, Vinit Parida, and Joakim Wincent. 2019. How entrepreneurial SMEs compete through digital platforms: The roles of digital platform capability, network capability and ambidexterity. *Journal of Business Research* 100: 196–206. [\[CrossRef\]](#)
- Charrón Vías, Marta, and Beatriz Rivera-Cruz. 2020. Fostering innovation and entrepreneurial culture at the business school: A competency-based education framework. *Industry and Higher Education* 34: 160–76. [\[CrossRef\]](#)

- Chou, Chun-Mei, Chien-Hua Shen, Hsi-Chi Hsiao, and Su-Chang Chen. 2010. A study on constructing entrepreneurial competence indicators for business department students of vocational and technical colleges in Taiwan. *World Transactions on Engineering and Technology Education* 8: 316–20.
- Cohen, Susan, and Yael V. Hochberg. 2014. Accelerating Startups: The Seed Accelerator Phenomenon. *SSRN Electronic Journal* 9: 752–53. [\[CrossRef\]](#)
- Costa, Sílvia F., Susana C. Santos, Dominika Wach, and António Caetano. 2018. Recognizing Opportunities across Campus: The Effects of Cognitive Training and Entrepreneurial Passion on the Business Opportunity Prototype. *Journal of Small Business Management* 56: 51–75. [\[CrossRef\]](#)
- Elia, Gianluca, Alessandro Margherita, and Giuseppina Passiante. 2020. Digital entrepreneurship ecosystem: How digital technologies and collective intelligence are reshaping the entrepreneurial process. *Technological Forecasting and Social Change* 150: 119791. [\[CrossRef\]](#)
- Elia, Gianluca, Giustina Secundo, and Giuseppina Passiante. 2017. Pathways towards the entrepreneurial university for creating entrepreneurial engineers: An Italian case. *International Journal of Entrepreneurship and Innovation Management* 21: 27. [\[CrossRef\]](#)
- Etzkowitz, Henry, and Loet Leydesdorff. 2000. The dynamics of innovation: From National Systems and “mode 2” to a Triple Helix of university-industry-government relations. *Research Policy* 29: 109–23. [\[CrossRef\]](#)
- Farhangmehr, Minoo, Paulo Gonçalves, and Maria Sarmento. 2016. Predicting entrepreneurial motivation among university students: The role of entrepreneurship education. *Education and Training* 58: 861–81. [\[CrossRef\]](#)
- Fayolle, Alain, and Benoit Gailly. 2008. From craft to science: Teaching models and learning processes in entrepreneurship education. *Journal of European Industrial Training* 32: 569–93. [\[CrossRef\]](#)
- Fernandes, Josi, Katy Mason, and Ronika Chakrabarti. 2019. Managing to make market agencements: The temporally bound elements of stigma in favelas. *Journal of Business Research* 95: 128–42. [\[CrossRef\]](#)
- Ferreras-Garcia, Raquel, Ana Beatriz Hernández-Lara, and Enric Serradell-López. 2021. Gender and learning results: A study on their relationship in entrepreneurship education and business plans. *Studies in Higher Education* 46: 2355–70. [\[CrossRef\]](#)
- Garcez, Ana, Ricardo Silva, and Mário Franco. 2021. Digital transformation shaping structural pillars for academic entrepreneurship: A framework proposal and research agenda. *Education and Information Technologies* 27: 1159–82. [\[CrossRef\]](#) [\[PubMed\]](#)
- García, Andrés Iborra, Bárbara Álvarez Torres, Pedro Sánchez, Juan Ángel Pastor Franco, and Tanya Suárez. 2016. ICT entrepreneurial ecosystem for engineering education. *International Journal of Engineering Education* 32: 2033–47.
- Grivokostopoulou, Foteini, Konstantinos Kovas, and Isidoros Perikos. 2019. Examining the impact of a gamified entrepreneurship education framework in higher education. *Sustainability* 11: 5623. [\[CrossRef\]](#)
- Haase, Heiko, and Arndt Lautenschläger. 2011. The “Teachability Dilemma” of entrepreneurship. *International Entrepreneurship and Management Journal* 7: 145–62. [\[CrossRef\]](#)
- Hägg, Gustav, and Jonas Gabrielsson. 2019. A systematic literature review of the evolution of pedagogy in entrepreneurial education research. *International Journal of Entrepreneurial Behavior & Research* 26: 829–61. [\[CrossRef\]](#)
- Hsieh, Hsiu-Fang, and Sarah E. Shannon. 2005. Three approaches to qualitative content analysis. *Qualitative Health Research* 15: 1277–88. [\[CrossRef\]](#)
- Ilomäki, Liisa, Sami Paavola, Minna Lakkala, and Anna Kantosalo. 2016. Digital competence—An emergent boundary concept for policy and educational research. *Education and Information Technologies* 21: 655–79. [\[CrossRef\]](#)
- Jardim, Jacinto. 2021. Entrepreneurial Skills to Be Successful in the Global and Digital World: Proposal for a Frame of Reference for Entrepreneurial Education. *Education Sciences* 11: 356. [\[CrossRef\]](#)
- Kaminsky, Oleg Ye, Yulia O. Yereshko, Sergii O. Kyrychenko, and Rostislav V. Tulchinskiy. 2021. Training in digital entrepreneurship as a basis for forming the intellectual capital of nation. *Information Technologies and Learning Tools* 81: 210–21. [\[CrossRef\]](#)
- Kazakeviciute, Agne, Renata Urbone, and Monika Petraite. 2016. Curriculum development for technology-based entrepreneurship education: A cross-disciplinary and cross-cultural approach. *Industry and Higher Education* 30: 202–14. [\[CrossRef\]](#)
- Khaouja, Imane, Ghita Mezzour, Kathleen M. Carley, and Ismail Kassou. 2019. Building a soft skill taxonomy from job openings. *Social Network Analysis and Mining* 9: 43. [\[CrossRef\]](#)
- Kozlinska, Inna, Tõnis Mets, and Kärt Rõigas. 2020. Measuring learning outcomes of entrepreneurship education using structural equation modeling. *Administrative Sciences* 10: 58. [\[CrossRef\]](#)
- Kripa, Dorina, Edlira Luci, Klodiana Gorica, and Ermelinda Kordha. 2021. New business education model for entrepreneurial heirs: University of tirana social innovation and internationalization. *Administrative Sciences* 11: 122. [\[CrossRef\]](#)
- Lewandowska, Anna, Mateusz Stopa, and Elżbieta Inglot-Brzęk. 2021. Innovativeness and entrepreneurship: Socioeconomic remarks on regional development in peripheral regions. *Economics and Sociology* 14: 222–35. [\[CrossRef\]](#)
- Liu, Haibin, Sadan Kulturel-Konak, and Abdullah Konak. 2021. A measurement model of entrepreneurship education effectiveness based on methodological triangulation. *Studies in Educational Evaluation* 70: 100987. [\[CrossRef\]](#)
- Lv, Yijun, Yingying Chen, Yimin Sha, Yangjie Huang, and Leilei Huang. 2021. How Entrepreneurship Education at Universities Influences Entrepreneurial Intention: Mediating Effect Based on Entrepreneurial Competence. *Frontiers in Psychology* 12: 2612. [\[CrossRef\]](#)
- Lyytinen, Kalle, Youngjin Yoo, and Richard J. Boland Jr. 2016. Digital product innovation within four classes of innovation networks. *Information Systems Journal* 26: 47–75. [\[CrossRef\]](#)

- Ma, Hongjia, Chunting Lang, Yang Liu, and Yang Gao. 2020. Constructing a Hierarchical Framework for Assessing the Application of Big Data Technology in Entrepreneurship Education. *Frontiers in Psychology* 11: 2338. [\[CrossRef\]](#)
- MacInnis, Deborah J. 2011. A framework for conceptual contributions in marketing. *Journal of Marketing* 75: 136–54. [\[CrossRef\]](#)
- Mancha, Rubén, and G. Shankaranarayanan. 2020. Making a digital innovator: Antecedents of innovativeness with digital technologies. *Information Technology and People* 34: 318–35. [\[CrossRef\]](#)
- Manzon, Elliott. 2017. Creating Student Engagement: The Kickstarter Active Learning Project. *Marketing Education Review* 27: 115–18. [\[CrossRef\]](#)
- Mets, Tõnis, Jack Holbrook, and Siim Läänelaid. 2021. Entrepreneurship education challenges for green transformation. *Administrative Sciences* 11: 15. [\[CrossRef\]](#)
- Miles, Morgan P., Huibert de Vries, Geoff Harrison, Martin Bliemel, Saskia De Klerk, and Chick J. Kasouf. 2017. Accelerators as authentic training experiences for nascent entrepreneurs. *Education and Training* 59: 811–24. [\[CrossRef\]](#)
- Monllor, Javier, and Aracely Soto-Simeone. 2019. The impact that exposure to digital fabrication technology has on student entrepreneurial intentions. *International Journal of Entrepreneurial Behaviour and Research* 26: 1505–23. [\[CrossRef\]](#)
- Muafi, Muafi, Wirman Syafri, Hadi Prabowo, and Sofyan Ashari Nur. 2021. Digital Entrepreneurship in Indonesia: A Human Capital Perspective. *Journal of Asian Finance, Economics and Business* 8: 351–59. [\[CrossRef\]](#)
- Nambisan, Satish, and Robert A. Baron. 2013. Entrepreneurship in innovation ecosystems: Entrepreneurs' self-regulatory processes and their implications for new venture success. *Entrepreneurship: Theory and Practice* 37: 1071–97. [\[CrossRef\]](#)
- Nambisan, Satish, Kalle Lyytinen, Ann Majchrzak, and Michael Song. 2017. Digital Innovation Management: Reinventing Innovation Management Research. *MIS Quarterly* 41: 223–38. [\[CrossRef\]](#)
- Nambisan, Satish, Mike Wright, and Maryann Feldman. 2019. The digital transformation of innovation and entrepreneurship: Progress, challenges and key themes. *Research Policy* 48: 103773. [\[CrossRef\]](#)
- Nambisan, Satish. 2017. Digital Entrepreneurship: Toward a Digital Technology Perspective of Entrepreneurship. *Entrepreneurship Theory and Practice* 41: 1029–55. [\[CrossRef\]](#)
- Ndou, Valentina, Giustina Secundo, Giovanni Schiuma, and Giuseppina Passiante. 2018. Insights for shaping Entrepreneurship Education: Evidence from the European Entrepreneurship centers. *Sustainability (Switzerland)* 10: 4323. [\[CrossRef\]](#)
- Oppong, Gladys Yaa Saah, Saumya Singh, and Fedric Kujur. 2020. Potential of digital technologies in academic entrepreneurship—A study. *International Journal of Entrepreneurial Behaviour and Research* 26: 1449–76. [\[CrossRef\]](#)
- Petersson McIntyre, Magdalena. 2020. Agencing femininity: Digital Mrs. Consumer in intra-action. *Journal of Cultural Economy* 13: 54–72. [\[CrossRef\]](#)
- Pittaway, Luke, and Jason Cope. 2007. Entrepreneurship Education—A Systematic Review of the Evidence. *International Small Business Journal* 25: 479–510. [\[CrossRef\]](#)
- Ratten, Vanessa, and Petrus Usmanij. 2021. Entrepreneurship education: Time for a change in research direction? *International Journal of Management Education* 19: 100367. [\[CrossRef\]](#)
- Rayna, Thierry, and Ludmila Striukova. 2021. Fostering skills for the 21st century: The role of Fab labs and makerspaces. *Technological Forecasting and Social Change* 164: 120391. [\[CrossRef\]](#)
- Rico, Heidy, Florentino Rico, Mario de la Puente, Carlos De Oro, and Elkyn Lugo. 2022. SBL Effectiveness in Teaching Entrepreneurship Skills to Young Immigrant Mothers Head of Household in Colombia: An Experimental Study. *Social Sciences* 11: 148. [\[CrossRef\]](#)
- Ries, Eric. 2011. *The Lean Startup: How Today's Entrepreneurs Use Continuous Innovation to Create Radi-Cally Successful Businesses*. New York: Crown Publishing, ISSN 978-0-307-88791-7.
- Rippa, Pierluigi, and Giustina Secundo. 2019. Digital academic entrepreneurship: The potential of digital technologies on academic entrepreneurship. *Technological Forecasting and Social Change* 146: 900–11. [\[CrossRef\]](#)
- Rippa, Pierluigi, Giovanni Landi, Silvia Cosimato, Lorenzo Turriziani, and Mohamed Gheith. 2022. Embedding entrepreneurship in doctoral students: The impact of a T-shaped educational approach. *European Journal of Innovation Management* 25: 249–70. [\[CrossRef\]](#)
- Rodríguez-López, Ángel, and Jaime E. Souto. 2019. Empowering entrepreneurial education using undergraduate dissertations in business management and entrepreneurship: A five-year study (2012–2016). *Education and Training* 61: 255–71. [\[CrossRef\]](#)
- Schaefer, Ricardo, and Italo Fernando Minello. 2016. Educação Empreendedora: Premissas, objetivos e metodologias. *Revista Pensamento Contemporâneo Em Administração* 10: 60. [\[CrossRef\]](#)
- Schumpeter, Joseph A. 1942. *Capitalism, Socialism and Democracy*. New York: Harper & Row.
- Seal, Kala C., Linda A. Leon, Zbigniew H. Przasnyski, and Greg Lontok. 2020. Delivering business analytics competencies and skills: A supply side assessment. *Interfaces* 50: 239–54. [\[CrossRef\]](#)
- Secundo, Giustina, Gioconda Mele, Giuliano Sansone, and Emilio Paolucci. 2020a. Entrepreneurship Education Centres in universities: Evidence and insights from Italian "Contamination Lab" cases. *International Journal of Entrepreneurial Behaviour and Research* 26: 1311–33. [\[CrossRef\]](#)
- Secundo, Giustina, Mele Gioconda, Pasquale Del Vecchio, Elia Gianluca, Alessandro Margherita, and Ndou Valentina. 2021. Threat or opportunity? A case study of digital-enabled redesign of entrepreneurship education in the COVID-19 emergency. *Technological Forecasting and Social Change* 166: 120565. [\[CrossRef\]](#) [\[PubMed\]](#)

- Secundo, Giustina, Pierluigi Rippa, and Michele Meoli. 2020b. Digital transformation in entrepreneurship education centres: Preliminary evidence from the Italian Contamination Labs network. *International Journal of Entrepreneurial Behavior & Research* 26: 1589–605. [\[CrossRef\]](#)
- Secundo, Giustina, Pierluigi Rippa, and Roberto Cerchione. 2020c. Digital Academic Entrepreneurship: A structured literature review and avenue for a research agenda. *Technological Forecasting and Social Change* 157: 120118. [\[CrossRef\]](#)
- Sirelkhatim, Fatima, and Yagoub Gangi. 2015. Entrepreneurship education: A systematic literature review of curricula contents and teaching methods. *Cogent Business and Management* 2: 1052034. [\[CrossRef\]](#)
- Snyder, Hannah. 2019. Literature review as a research methodology: An overview and guidelines. *Journal of Business Research* 104: 333–39. [\[CrossRef\]](#)
- Song, Abraham K. 2019. The Digital Entrepreneurial Ecosystem—A critique and reconfiguration. *Small Business Economics* 53: 569–90. [\[CrossRef\]](#)
- Souitaris, Vangelis, Stefania Zerbinati, and Andreas Al-Laham. 2007. Do entrepreneurship programmes raise entrepreneurial intention of science and engineering students? The effect of learning, inspiration and resources. *Journal of Business Venturing* 22: 566–91. [\[CrossRef\]](#)
- Sundqvist-Andberg, Henna, and Maria Åkerman. 2021. Sustainability governance and contested plastic food packaging—An integrative review. *Journal of Cleaner Production* 306: 127111. [\[CrossRef\]](#)
- Teece, David J. 2014. The foundations of enterprise performance: Dynamic and ordinary capabilities in an (economic) theory of firms. *Academy of Management Perspectives* 28: 328–52. [\[CrossRef\]](#)
- Teece, David J. 2018. Business models and dynamic capabilities. *Long Range Planning* 51: 40–49. [\[CrossRef\]](#)
- Toniolo, Korinzia, Eleonora Masiero, Maurizio Massaro, and Carlo Bagnoli. 2020. A grounded theory study for digital academic entrepreneurship. *International Journal of Entrepreneurial Behavior & Research* 26: 1567–87. [\[CrossRef\]](#)
- Torraco, Richard J. 2005. Writing Integrative Literature Reviews: Guidelines and Examples. *Human Resource Development Review* 4: 356–67. [\[CrossRef\]](#)
- Vorbach, Stefan, Elisabeth Maria Poandl, and Ines Korajman. 2019. Digital entrepreneurship education: The role of MOOCs. *International Journal of Engineering Pedagogy* 9: 99–111. [\[CrossRef\]](#)
- Wang, Shu-Mei, Hsiu-Ping Yueh, and Pei-Chang Wen. 2019. How the New Type of Entrepreneurship Education Complements the Traditional One in Developing Entrepreneurial Competencies and Intention. *Frontiers in Psychology* 10: 2048. [\[CrossRef\]](#)
- Wu, Yenchun Jim, Chih-Hung Yuan, and Chia-I. Pan. 2018. Entrepreneurship education: An experimental study with information and communication technology. *Sustainability* 10: 691. [\[CrossRef\]](#)
- Yang, Shu, Romi Kher, and Thomas S. Lyons. 2018. Where Do Accelerators Fit in the Venture Creation Pipeline? Different Values Brought by Different Types of Accelerators. *Entrepreneurship Research Journal* 8: 1–13. [\[CrossRef\]](#)
- Yashin, Alexander, Alexey Klyuev, and Anna Bagirova. 2018. Designing entrepreneurial education in Russia: Hard and soft skills. *Ekonomski Vjesnik: Review of Contemporary Entrepreneurship, Business, and Economic Issues* 31: 261–74.
- Yoo, Youngjin, Ola Henfridsson, and Kalle Lyytinen. 2010. The new organizing logic of digital innovation: An agenda for information systems research. *Information Systems Research* 21: 724–35. [\[CrossRef\]](#)
- Žur, Agnieszka. 2020. Two heads are better than one—Entrepreneurial continuous learning through massive open online courses. *Education Sciences* 10: 62. [\[CrossRef\]](#)