

# Digital entrepreneurship and entrepreneurship education: a review of the literature

Digital  
Entrepreneurship  
education

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## Abstract

**Purpose** – Continuous advances in digital technology and business models digitalization have decisively altered the entrepreneurial landscape redefining the aims and the requirements of entrepreneurial education to suit the new digital reality in entrepreneurship. The purpose of this study is to shed light in a neglected niche in the intersection between digital entrepreneurship (DE) and entrepreneurship education and outline DE education as field of research. Given that the interdisciplinary growth of DE research outpaces instructional designs in terms of required knowledge and skills, it is important to document how entrepreneurship education responds to the ongoing integration of emerging digital technologies with the entrepreneurial process. Moreover, the introduction of a DE education conceptual framework would facilitate the discussion on theoretical and practical implications and promote new conceptualizations in future research, new educational approaches and new curriculum designs.

**Design/methodology/approach** – A concept-driven, semi-structured developmental literature review methodology, based on grounded theory and reinforced with increased systemization, was used for the identification and analysis of peer-reviewed articles. Previous literature reviews were used to define the search keywords. The articles from three databases were carefully selected, based on protocol and strict eligibility criteria. The papers in the final set were classified in four primary dimensions, synthesized from several sub-streams of research. Each sub-stream highlighting a different view of DE education emerged through open, axial and selective coding of articles. The combined perspectives of these dimensions resulted in a new DE conceptual framework.

**Findings** – Thematic interrelation between the studies examined, revealed an ample view of the various schools of thought in the research field, offering also a better understanding on how entrepreneurial education addresses the practical requirements of digital entrepreneurship. A four dimensional conceptual framework produced highlights pedagogy and learning, success factors and barriers, behavioral approach and ecosystems as the current trends of research. Also, directions for future research are proposed.

**Practical implications** – The classification framework proposed can serve as a roadmap for entrepreneurship educators seeking efficient pedagogical practices focused on the transfer of knowledge and training on the new skills required by DE and motivate future researchers aiming to propose novel educational interventions.

**Originality/value** – Although digital entrepreneurship research has gained significant momentum in recent years, little attention is paid to its increased educational requirements. The body of knowledge develops in an uncontrolled and fragmented manner, and the systematic study of the field from an educational perspective was missing. This study offers a representative picture of the topic, highlights current trends of research, synthesizes literature from different disciplinary origins, provides linkages between unconnected streams of research and points out research gaps. Finally, it proposes a conceptual framework to circumscribe DE education as a field of study and serve as a basis to help future research move forward.

**Keywords** Entrepreneurship, Digital entrepreneurship, Entrepreneurship education, Entrepreneurship course, Literature review

**Paper type** Literature review

## Introduction

Entrepreneurship is the driver for personal prosperity, financial and social development, as well as productivity (Gorgievski and Stephan, 2016; Kuratko, 2005; Nabi *et al.*, 2017). Universities adopt an entrepreneurial culture and combine entrepreneurship courses in the curriculum in order to inspire their students (Fernández-Pérez *et al.*, 2019; Hahn *et al.*, 2019) and provide them with creativity skills and entrepreneurial attitudes facilitating opportunity



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exploitation and value creation (Gundry *et al.*, 2014). Entrepreneurial initiatives occur mainly in the form of new business ventures launched either by individual entrepreneurs, or by entrepreneurial teams identifying and pursuing business opportunities. In many cases, these entrepreneurial endeavors take place in the corporate environment and are organized by innovative employees who share the same entrepreneurial spirit with entrepreneurs, also known as intrapreneurs (Antoncic and Hisrich, 2001; Rae and Woodier-Harris, 2013). Both entrepreneurship and intrapreneurship are critical for economic and social development and heavily rely on human capital developed through formal education and training (Antoncic and Hisrich, 2001; Parker, 2011). The entrepreneurs' experience and education is closely related to the success of digital startup (Zaheer *et al.*, 2019b), and a strong educational background increases probabilities of reaching entrepreneurial milestones (Ratzinger *et al.*, 2018). Additionally, there are positive insights linking education with human capital and entrepreneurial outcomes confirmed by meta-analytic research, justifying the heavy investments on entrepreneurship education from governments, universities and private organizations (Martin *et al.*, 2013).

Entrepreneurship education also plays a significant role in providing the required knowledge to enable opportunity identification (Kakouris and Liargovas, 2020; Karimi *et al.*, 2016; Shane and Venkataraman, 2000) and exercises the cognitive mechanisms for opportunity evaluation through the available information (Gielnik *et al.*, 2012; Marvel *et al.*, 2016). The transformation of entrepreneurial processes through the utilization of emerging digital technologies, not only offered competitive advantages to those investing in IT capabilities but also created new opportunities to entrepreneurs through easy access to the global markets (Del Giudice and Straub, 2011; Steining, 2019). Although, information has become more accessible to larger numbers of stakeholders through digital communication technology utilization (Yeganegi *et al.*, 2021), the scene of possible competitors has also widened compared to brick and mortar entrepreneurship. The increased competition, intensified the demand for human capital, in terms of capabilities, and made it a significant driver for digital innovation (Suseno and Abbott, 2021) and entry into digital entrepreneurship (Mir *et al.*, 2023).

Digital Entrepreneurship (DE) conceptually emanates from the use of digital technology as a facilitator, as a mediator, as the product itself and finally as the ubiquitous component of every entrepreneurial attempt (Steining, 2019). Traditional business models have been transformed by digital technology in a considerable manner and other totally new digital ones have been created (von Briel *et al.*, 2018). This relatively new phenomenon has shown accelerated dynamics of evolution in the recent years, showing progress both from theoretical and technological point of view (Elia *et al.*, 2020). DE dominated the entrepreneurial landscape, especially during the restrictions and social distancing of the recent pandemic, due to the acceleration in digital technology adoption, which entrained rapid and groundbreaking changes in the entrepreneurial scheme. As more disruptive digital technologies intrude in business models, a complex combination of innovation, leadership and management skills is required (Sousa and Rocha, 2019), which has serious implications for DE teaching and learning (Ratten and Jones, 2021). Scholars who have closely studied the various facets of DE, realize that the body of knowledge develops rapidly, in a rather uncontrolled and fragmented fashion, and few papers cope with DE educational perspective (Kraus *et al.*, 2019; Zaheer *et al.*, 2019a), leaving a considerable void in the literature regarding the consecutive adoption of disruptive new digital technologies in business and how it should be addressed from an educational viewpoint (Sreenivasan and Suresh, 2023). Despite the rapid developments in entrepreneurship education, the interdisciplinary growth of DE as a field of research, often outpaces instructional designs regarding required knowledge and skills (Birch *et al.*, 2017; Kakouris and Liargovas, 2020; Ratten and Jones, 2021). Additionally, the effect of entrepreneurship education and training tends to be overestimated by mainstream studies, gasping to catch up with the latest developments. An opportunistic rivalry of studies

presenting a plethora of success stories in traditional entrepreneurship, frequently overestimates the impact of entrepreneurship education without sound empirical evidence (Martin *et al.*, 2013; Matlay, 2004). The lack of theoretical frameworks analyzing DE education conceptual dimensions, hinders the evolution of original research pertained to the theoretical and practical implications of the new emerging technologies engaged in DE. Finally, empirical results are not organized in a productive way, raising difficulties in the evaluation and subsequent dissemination of the results in policy and practice. Inability of assessment of the empirical results of educational interventions based on the new emerging technologies would create a non-factual image of the research field, with diverse consequences for practice.

The aim of this study is to capture the literature landscape in the intersection between digital entrepreneurship and entrepreneurship education, and circumscribe DE education as field of research. The study intends to examine papers from different disciplines, specifically addressing DE education and training, in order to document current research trends dealing with the practical and theoretical implications of disruptive new digital technologies incorporated in entrepreneurship, and point out challenges and future research directions. The research questions serving the aims of the study are:

- RQ1. What are the current trends in digital entrepreneurship education research?
- RQ2. Which are the most prolific journals?
- RQ3. Which are the most prolific authors?
- RQ4. How has the number of publications evolved over time?
- RQ5. What are the promising avenues for future research?

A semi-structured literature review was chosen as the most suitable tool for this kind of research. A literature review would (1) present the state of the art in entrepreneurship education research regarding DE education, (2) identify trending research directions through conceptual classification of articles, (3) bridge fragmented areas of research, (4) highlight research gaps and (5) create a research agenda (Snyder, 2019). A literature review among other useful information may reflect the development of the research field through time using the number of papers published per year on the subject, and report on journals specializing on the issue with the highest number of published peer-reviewed articles in tandem with the methodologies and units of analysis used. For the purpose of the study, both conceptual and empirical papers will be sought, concerning DE educational approaches or interventions for the development of DE opportunity awareness (education on DE), for the implementation of business idea into a digital business venture (education for DE) and finally, for the experiential acquisition of DE knowledge and skills (education through DE) (Secundo *et al.*, 2021).

The structure of the paper is as follows. The next section provides the reader with essential definitions of terms, followed by the required theoretical background, based on previous literature reviews. Next, the deployment of the methodology is described. The results section, presents statistical information about the sample, before the concept-centric analysis of the articles is conducted. The concepts highlighted in the literature, are synthesized in the concept analysis section, presenting the state of the art on DE education research. The conclusion section follows with the recognized research gaps, limitations and proposals for future research.

## Definitions

### *Digital technology*

Emerging digital technologies, such as artificial intelligence (AI), immersive technologies, mobile and cloud computing, social media, internet of things and data analytics, which are

nowadays intertwined into digital platforms, have substantially altered the entrepreneurial processes, offering ubiquitous access to infrastructures and services, create opportunities for disruptive innovation artifacts (Nambisan, 2017; Sousa and Rocha, 2019). Digital technologies blurring the physical barriers between actors increase their ability to constantly interact with and through these platforms and have access to enormous amounts of information. The inventive combination of information from multiple sources in digital environments in an ubiquitous manner, raises opportunity awareness, facilitates decision making and offers new ways to deal with uncertainty inherent in entrepreneurship (Giuggioli and Pellegrini, 2022; Obschonka and Audretsch, 2020; Ratten, 2013). Hence, the potential for value creation is maximized through digitalization and business model innovation (Zott and Amit, 2017).

### *Digitalization*

According to (Caputo *et al.*, 2021), digitalization is “the integration of multiple technologies into aspects of daily social life”. The use of digital technologies creates business model innovation, by decreasing its reliance on physical interaction and moving business processes into digital space, which produces new opportunities for revenue and value creation (Kraus *et al.*, 2019). Digitalization is primarily fueled by the advances made in emerging digital technologies such as cloud computing, AI, immersive technologies and the internet of Things. This transformation though usually involves fundamental changes in the socio-cultural context, since digital technology influences different aspects of human experience with the digital business, either as a customer, employee or business manager (Stolterman and Fors, 2004). Digitalization requires broader research perspectives on the implications of digital technologies on entrepreneurship in general from cognitive, social and institutional perspectives (Nambisan, 2017), and new explanatory theories examining DE from a digitalization perspective are needed (Ratten and Usmanij, 2021). Additionally, digitalization is a key factor for the transfer of knowledge obtained through formal and informal education and practice, from the individual to the university and DE ecosystem and back (Toniolo *et al.*, 2020). The role of educators is therefore becoming more complex, since it requires not only to reshape entrepreneurship courses according to the required new digital competencies, but also to coach students and entrepreneurs on the utilization of emerging digital technologies (Lamine *et al.*, 2021).

### *Digital entrepreneurship*

Digital Entrepreneurship refers to the human orchestrated efforts for turning business ideas into real products or services, as well as the development of the required processes for this accomplishment, using digital technology as an input (Giones and Brem, 2017). It also refers to the transfer of assets, services or parts of the business in the digital domain (Kraus *et al.*, 2019), shifting the traditional way of doing business and exploiting of business opportunities through leveraging digital technologies (Rippa and Secundo, 2019; Younis *et al.*, 2020).

## **Research background**

The findings from a number of significant literature reviews, and special issue editorials on DE shown in Table 1, are briefly presented, to provide background information on the ongoing DE research and highlight research streams and gaps.

The new possibilities offered by emerging digital technologies, create opportunities for entrepreneurs and help them handle uncertainty and risk. This was carried out by the progressive shift from the traditional fixed connections between actors, processes and outcomes, to flexible ones due to digitalization. The necessity to investigate the impact of digital technology on classic theoretical entrepreneurship concepts, and discuss the

Author(s) Year	Title Methodology/Period/Number of papers	Period No. of papers	Journal
Nambisan, S. 2017	Digital entrepreneurship: toward a digital technology perspective of entrepreneurship	n.a.	Entrepreneurship Theory and Practice
Kraus, S; Palmer, C; Kailer, N; Kallinger, FL; Spitzer, J 2019	Digital entrepreneurship A research agenda on new business models for the twenty-first century Evidence-informed literature review (Tranfield <i>et al.</i> , 2003), Quality control (Bouncken <i>et al.</i> , 2015)	n.a. 2007–2018 35	International Journal of Entrepreneurial Behavior and Research
Steininger D.M. 2019	Linking information systems and entrepreneurship: a review and agenda for IT-associated and digital entrepreneurship research Systematic Literature Review, (Webster and Watson, 2002)	1990–2017 292	Information Systems Journal
Rippa P., Secundo G. 2019	Digital academic entrepreneurship: the potential of digital technologies on academic entrepreneurship	n.a.	Technological Forecasting and Social Change
Zaheer H., Breyer Y., Dumay J 2019	Digital entrepreneurship: an interdisciplinary structured literature review and research agenda Evidence-informed literature review, (Tranfield <i>et al.</i> , 2003)	n.a. 2000–2019 133	Technological Forecasting and Social Change
Satalkina, L. and Steiner, G 2020	Digital entrepreneurship and its role in innovation systems: a systematic literature review as a basis for future research avenues for sustainable transitions PRISMA Method, (Moher <i>et al.</i> , 2009)	2014–2018 113	Sustainability (Switzerland)
Secundo G., Rippa P., Cerchione R 2020	Digital Academic Entrepreneurship: a structured literature review and avenue for a research agenda Structured literature review, (Massaro <i>et al.</i> , 2016; Petticrew and Roberts, 2006; Tranfield <i>et al.</i> , 2003)	2005–2018 59	Technological Forecasting and Social Change
Sahut J.-M., Iandoli L., Teulon F. 2021	The age of digital entrepreneurship Special Issue	2015–2018 47	Small Business Economics
Kollmann T. 2022	Eras of Digital Entrepreneurship Scoping literature review, (Templier and Pare, 2015)	1990–2020 1,354	Business and Information Systems Engineering

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**Table 1.**  
Previous literature reviews

implications for practice was realized, as well as the need to develop well matched methodologies for studying these phenomena (Nambisan, 2017).

Opportunities, challenges and success factors regarding digital business models became the centre of research interest, while other research directions were identified, including the stages of the digital entrepreneurship process, from idea conception to the actual digital enterprise startup; digital platform strategies, for networking and growth; digital

ecosystems, offering information sharing and collaboration to different actors; and social digital entrepreneurship concerning the use of digital technology for the social welfare. The void in DE education research is highlighted, given that new skills are required, to tackle with the constant introduction of cutting-edge technologies in DE (Kraus *et al.*, 2019).

The role of information technology (IT) and information systems became central to the development of DE business models. Steininger (2019) highlighted four major roles for IT; IT as an infrastructure based facilitator used for business processes support, IT as a mediator offering the IT-based network customer relation support, IT as an outcome/product of the business model and IT as ubiquity as a combination of all the previous. An analysis framework proposed by Sahut *et al.* (2021) focused on information processing, and the important role of digital information in value creation. Four streams of research were identified, regarding digital business models, digitalization of entrepreneurial processes, digital platforms and entrepreneurial ecosystems.

The increased availability of digital technology created potential for academic entrepreneurship development. A research agenda was proposed on the basis of participating actors, digital artifacts, democratization and inclusiveness in DE (Rippa and Secundo, 2019). However, the “dearth” in literature regarding dynamic frameworks which might assist scholars and practitioners to better understand the complex DE phenomenon highlighted the absence of entrepreneurship education research in the context of digital technology (Zaheer *et al.*, 2019a). The individual entrepreneur, the entrepreneurial process and the entrepreneurial ecosystem are the elemental scopes of innovation systems research. The crucial role for entrepreneurship education was highlighted by the required knowledge and skills, as well as the ability of the individual digital entrepreneur to acquire new knowledge (Satalkina and Steiner, 2020a, b). Secundo *et al.*, (2020a), examine the effects of digital technology on the emerging forms of academic entrepreneurship and identify four primary research areas. Firstly, digital technology for entrepreneurship education, especially in terms of experiential learning which shows significant growth mainly due to the safe educational environments offered by emerging digital technology, secondly, the “maker space movement” for academic entrepreneurship highlighting the role of fabrication labs and maker spaces in practical entrepreneurial knowledge acquisition, and thirdly, digital technology for entrepreneurial opportunity discovery and innovation. The university plays a fundamental role on providing the required human capital resources, such as entrepreneurial knowledge and skills for opportunity management and collaboration, as well as knowledge spillovers leading to the development of DE ecosystems.

The previous literature reviews have different aims and scopes and as a result they present different views of DE. However, it is evident that the educational dimension of DE is generally neglected and it is only partially addressed under the prism of academic DE. As DE is moving in its expansion Era (Kollmann *et al.*, 2022), with increasing complexity due to the contingencies created by emerging digital technologies, typical entrepreneurship education strives to follow the evolution of the field in a fragmented manner. Entrepreneurship education has a fundamental role, firstly in knowledge acquisition and planning during the entrepreneurial process and secondly in the dissemination of new knowledge in the entrepreneurial ecosystem (Satalkina and Steiner, 2020a). Since DE shows an increased momentum of development, the timely examination of the DE education status could provide insights for designing appropriate educational interventions for its future needs.

## Methodology

The concept-driven literature review methodology used for the implementation of this study, initially proposed by Webster and Watson (2002), has been frequently used in previous Information Systems and Management research (Kunz and Sonnenholzner, 2023;

Steininger, 2019). A semi-structured developmental methodology research design was chosen, reinforced with elements of Grounded Theory (Wolfswinkel *et al.*, 2013) and review systemization (Kraus *et al.*, 2020), aiming to provide trustworthy and reliable results, rather than eliminating biases at all costs (Kunisch *et al.*, 2023). This type of literature review is the most appropriate for emerging topics, in order to make preliminary conceptualizations, combine perspectives and produce new conceptual frameworks in a developmental fashion (Snyder, 2019; Templier and Paré, 2015). The immaturity of DE education as a research field, justifies the adoption of such an exploratory approach, with intentionally blurred disciplinary boundaries, in order to capture the inherent fragmentation of the existing research. However, the research protocol, ensures the ability to replicate the study and maintains rigor while it attempts to cover both depth and breadth of the literature (Kraus *et al.*, 2022). Therefore, contrary to methodologies derived from life sciences, the research design is not so tightly planned, and offers researchers the freedom to make conceptual explorations and develop ideas (Snyder, 2019; Tranfield *et al.*, 2003).

The first phase of the methodology, concerns the identification of articles. A search for existing literature reviews was conducted, to serve as a basis for the selection of appropriate databases and keywords for the main search of articles. In order to capture papers missed by the main search, backward and forward searches were employed recursively until no new concepts resulted from the analysis. A backward search spots prior papers missed, by scanning through the references of the selected papers in the first step, whereas, a forward search identifies articles citing key papers produced in previous steps, so as to ensure that the latest studies were included in the sample. In the second phase, the papers gathered during the identification, were screened for duplicates and a set of predefined eligibility criteria were used to eliminate irrelevant articles. Papers relevant to the scope and aims of the current study were picked, for full text processing through scanning the titles, keywords and abstracts. Eligible papers were classified according to their content, using a concept centric approach.

#### *Article identification process*

The aim of the identification process was to capture as many papers related to digital entrepreneurship education, as possible. There was no particular time period restriction; however the search was focused on the fields of business, management, economics, social sciences, computer science, information systems, engineering and education. Since the purpose of the review was to explore the breadth of the literature but cover the depth also, only peer-reviewed papers written in English were included (Templier and Paré, 2015). Although DE is an emerging topic of research, book chapters and conference papers were excluded from the sample, as they pertain to research in progress and do not always maintain strict quality standards and formality of journal articles (Kraus *et al.*, 2020; Kunisch *et al.*, 2023; Levy and Ellis, 2006). Eligible articles had to qualify predefined journal quality criteria for inclusion (Cram *et al.*, 2020; Kraus *et al.*, 2020; Kunisch *et al.*, 2023; Zaheer *et al.*, 2019a). The quality criteria required for the journal to have an impact factor, or to be included in the Chartered Association of Business Schools list of journals. For the highly cited articles which did not meet the previous standards, at least a Q3 Scimago journal ranking was required.

The main search for peer-reviewed papers was conducted in three databases, Scopus, Science Direct and Web of Science. Multiple searches were executed, using search terms, such as “digital business”, “digital entre\*”, “digital startup”, “digital innovation”, “internet entre\*”, “online entre\*”, “cyber entre\*”, “e-entre\*”, “net entre\*”, in combination with the term “educ\*”. These search terms, resulted from previous literature reviews, cross-reading of some high quality articles and discussions within the authors’ team (Kraus *et al.*, 2020; Tranfield *et al.*, 2003). The words “digital”, “online”, “cyber” and “net, as well as the prefix “e–”, were

occasionally used interchangeably in the literature, so they were all used in consecutive searches. Asterisks were used to ensure the inclusion of different words with the same etymological root, such as “entrepreneur”, “entrepreneurial” or “entrepreneurship”, “education”, “educational”, “educator”, etc. Different forms of the same word found in the literature, such as “startup” and “start-up”, were also included (Wolfswinkel *et al.*, 2013). Boolean operators were employed, to combine the search terms in a purposeful way. An example Boolean compound expression used in one of the searches was: “digital entre\*” AND “educ\*”. This combination would return articles including combinations of the different forms of the search terms in the title, the abstract or author keywords. An example article returned by this search was the article of Shurville and Rospigliosi (2009).

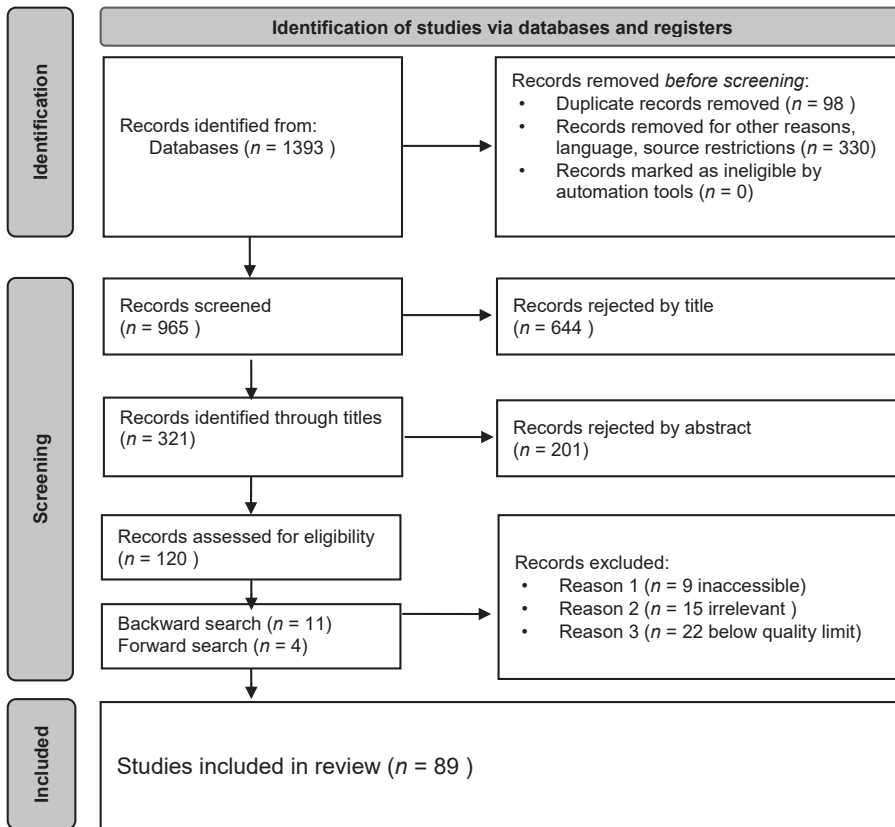
Overall, 1,393 articles resulted using the same search terms in all databases and after applying the aforementioned limitations of language and publication source only 1,063 remained. 965 articles were left for screening after the deletion of 98 duplicates. To reduce personal bias, the screening procedure was executed independently by each of the authors using special literature review software (Ouzzani *et al.*, 2016), and final decisions for exclusion were made after discussion of disputes (Wolfswinkel *et al.*, 2013). A total of 321 relevant articles were identified scanning through the titles and author keywords for education related terms including but not limited to “education”, “university”, “academia”, “student”, “teaching”, “competencies”, “knowledge”, “skill” and “learning”. After, abstract reading, ensuring the relevance to the research problem and the proper use of search terms in each article, 120 articles were kept for further processing (Templier and Paré, 2015). Basic criteria for inclusion of an article in the sample were the article to discuss DE related issues from an educational viewpoint, for example teaching, learning, pedagogy, knowledge and skills, competencies and human capital in general, entrepreneurial intentions, academic entrepreneurship, entrepreneurship courses, incubation, digital learning platforms etc. Typical reasons for exclusion were: dealing with digital transformation in education, business models, regulations, market orientation, intellectual capital management, technology transfer, digital applications, venture capital etc, or articles where education had a secondary role. An example of exclusion after abstract reading, was an article examining the design of e-learning in entrepreneurship courses, in an institutional manner with no DE-specific educational implications. Another example of exclusion was a literature review discussing the perception of barriers towards DE, where education was used only as a control variable with no further implications. A number of 9 inaccessible articles and 22 articles failing to comply with eligibility criteria were removed. Another 15 articles were rejected after full text reading, since they were pertained to internet education, e-learning, barriers to ICT use, MOOCs in education etc. The 74 articles remaining for full text reading were supplemented by 4 eligible articles resulting from forward search and 11 more coming from backward search. The final 89 papers for review are shown in Table A1 in Appendix. The number of articles resulting in each step of the selection process is illustrated in Figure 1.

When the same articles resulted from all databases and no new concepts came up from the analysis of articles, it was concluded that the critical mass of relevant literature had been collected and the search was considered “complete” or “saturated” (Webster and Watson, 2002; Wolfswinkel *et al.*, 2013).

## Results

### *Number of papers per year*

The number of articles published each year is shown in Figure 2, as a means to provide answer to Question 4 on how has the field evolved in number of publications. From 2001 to 2017, the research interest in digital entrepreneurship education is still in its “infancy” (Kraus *et al.*, 2019), with an average production of  $M_{(2001-2017)} = 1.67$  articles per year, most of them



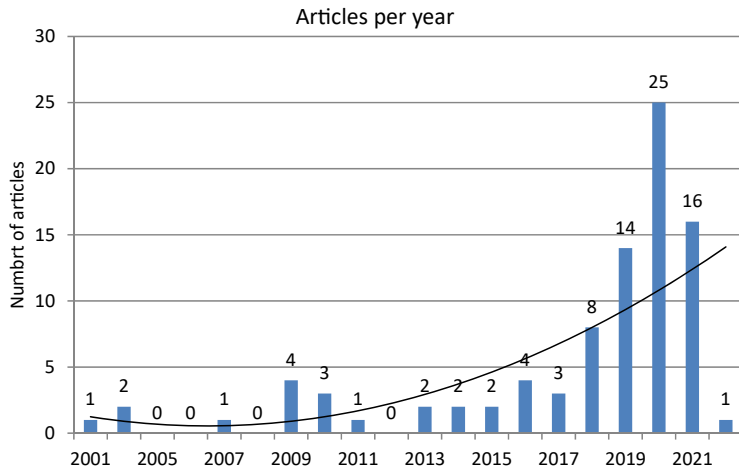
Source(s): Adapted from Page *et al.*, (2021)

Figure 1.  
Article selection  
process

published in journals in the fields of Information Systems and Education sciences. Research production shows a steep rise between 2017 and 2019, which coincides with the publication of the first literature reviews on DE. This shows an increased research interest in DE education, with  $M_{(2018-2021)} = 15.8$  articles per year, as the field's important role in the development of DE research and practice has been recognized. As a result, many relevant articles have been published since then, in high quality journals from the fields of Entrepreneurship, Management and Psychology.

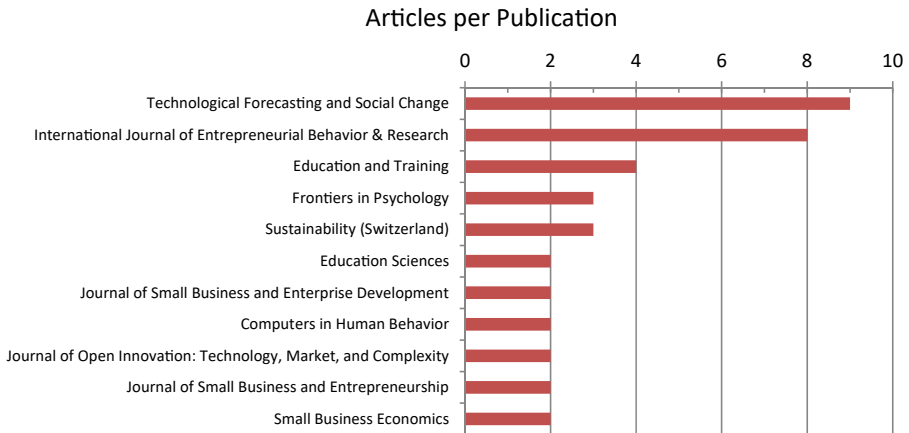
### Prolific journals

To answer Question 2 regarding the most prolific journals, the number of papers per journal is shown in Figure 3. *Technological Forecasting and Social Change* is the most prolific journal, with 9 articles published between 2019 and 2021. *International Journal of Entrepreneurial Behavior and Research* follows with 7 of the 8 articles published between 2018 and 2022 and one of the earliest articles published in 2004. In the third place comes *Education and Training*, with 4 of the 5 articles published from 2018 to 2021 and one article published in 2009. *Frontiers in Psychology* and *Sustainability* have published 3 articles each in 2020.



**Figure 2.**  
Number of papers  
per year

**Source(s):** Created by authors



**Figure 3.**  
Distribution of articles  
per journal

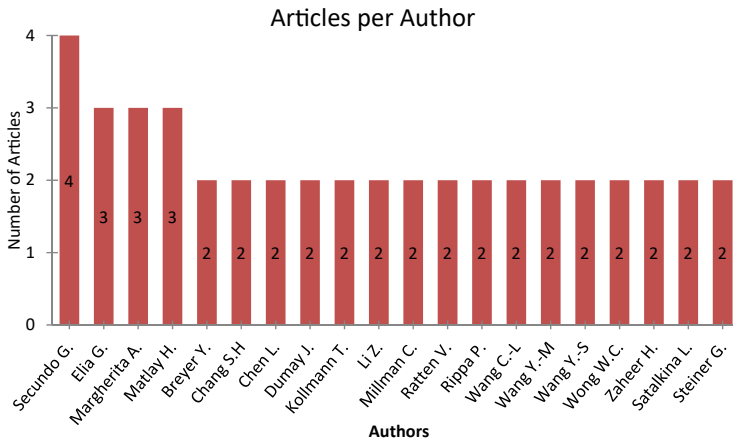
**Source(s):** Created by authors

### *Prolific authors*

To offer an answer to Question 3, the most productive authors based on article publication, are presented in [Figure 4](#). *Secundo G, Elia G, Margherita A. and Matlay H.* appear to be more prolific authors in the field, by the time this study was conducted, who have published at least 3 papers each. They are followed by many authors with 2 papers each. *Secundo G. and Rippa P., Elia G. and Margherita A., Zaheer H., Breyer Y. and Dumay J., Chang S.H and Wang C.L* are the most frequently collaborating teams in co-authoring articles. Co-authorships and collaborations reveal the spread of the papers in different disciplines.

### *Research methods*

Thirty nine papers (43.8%) have used quantitative approaches, in the form of questionnaires, for data collection. Twelve papers (13.5%) have used qualitative methods such as interviews



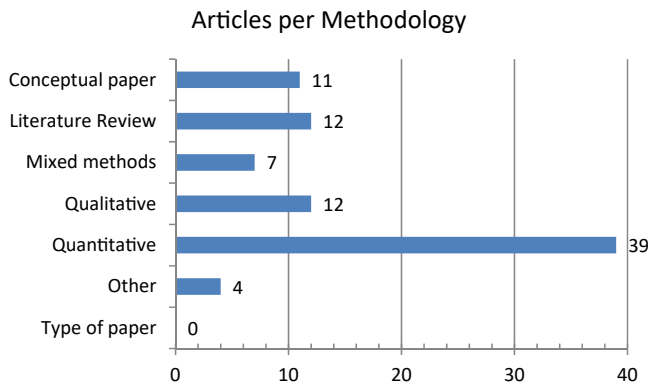
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Figure 4.  
Main authors

or open ended questions, whereas only seven papers (7.8%) used mixed approaches (questionnaires and interviews). Researchers have mainly focused on students in order to collect data, since students are considered an eligible data collection source for entrepreneurial research. The case studies refer to innovative educational interventions, use of digital learning platforms and educational offerings for experiential learning. Figure 5 presents the number of papers per methodology.

### Analysis of concepts

The aim of the analysis and classification of papers was to highlight the different properties of a phenomenon found in the literature, which define its nature. These properties were carefully allocated in distinct categories based on their conceptual similarities. This kind of conceptual analysis is prerequisite for an effective synthesis and integration of concepts



Source(s): Created by authors

Figure 5.  
Papers per  
methodology

because it provides linkages between previously disconnected studies (Kraus *et al.*, 2020), sheds light on the phenomenon and advances conceptual understanding (Kunisch *et al.*, 2023).

#### *Paper analysis and classification*

Eighty nine (89) papers were analyzed based on the different patterns of terms and methodologies used in the examined papers, resulting in several sub-streams of research, which were then categorized into four main conceptual dimensions. The analysis followed the recommendations of Wolfswinkel *et al.* (2013), on highlighting findings relevant to the research questions and taking notes (“excerpts”) on each article during text reading. The “excerpts” produced at the end of this “open coding” procedure were distilled in eloquent insights of surfacing concepts, organized in topics. Next, during “axial coding”, the interrelations between topics were sought, as evidenced by patterns of findings in the examined papers, in order to identify the representative sub-streams of research. Finally, the main conceptual dimensions resulted from the observed interrelations between sub-streams of research, through a “selective coding” procedure. The main dimensions identified are: (1) Pedagogy and learning, educational approaches and learning environments in the; (2) Success factors and barriers, including enabling factors and constrains; (3) Behavioral approach, examining individuals’ intentions towards DE, self-efficacy and other concepts; and (4) Ecosystems approach, including teams, networks and individual human capital. Table 2 presents the DE education conceptual framework, integrating main conceptual dimensions and corresponding sub-streams of research, alongside the key topics accredited to each sub-stream. The conceptual framework provides an answer to Question 1, regarding current trends in digital entrepreneurship education research, by synthesizing the research findings. Additionally, it links previously unconnected streams of research and highlights under-studied areas where more research is needed (Kunisch *et al.*, 2023; Snyder, 2019).

#### *Pedagogy and learning*

The oldest and overabundant stream of research is that of pedagogy and learning, showing that the academic community early recognized the need for addressing DE educational requirements.

*ICT dominance in business.* Early papers describe how disruptive digital technology change creates a new knowledge economy based on digital mindset and computational thinking. These papers ascertain that ICT dominance in business environment requires relevant changes in entrepreneurship education courses. Scholars begin to identify the new qualities students need to develop through entrepreneurship education in order to cope with the requirements of DE.

At first, entrepreneurship education focuses on business plan and typical venture creation and does not offer training on opportunity recognition and business idea exploration with the aid of information technology (Carrier *et al.*, 2004). The obvious need for alignment between business and technology is reflected in the duality of proposed frameworks for business transformation and organizational success, through the incorporation of ICT in business education (Dhar and Sundararajan, 2007). The impact of the new knowledge economy and prevailing of ICT requires higher order thinking skills, which could be developed through emerging training technologies, in order for students to be competent in the new global environment (Clarke and Clarke, 2009; Tarabasz *et al.*, 2018). Increased computational thinking is related with better learning outcomes for technology entrepreneurship students (Kang and Lee, 2020). As groundbreaking technological change alters the physiology of business, the need for students and faculty members to embrace a digital mindset becomes more eminent. However, academic research on entrepreneurship education is not on the edge of the evolutions due to disruptive nature of technology change. Experience gained in MBA

Main conceptual dimensions	Sub-streams	Topics
Pedagogy and learning	ICT dominance in business	Business idea exploration with IT New knowledge economy Digital mindset/computational thinking Disruptive technology change Adaptation of entrepreneurship courses
	Learning approaches	Experiential learning Project based learning University incubators Internships Maker spaces
	Digital Learning Environments	MOOCs Game simulations
Success factors and barriers	Enabling factors	Resources Strategy Business model
	Constrains	Required action Administrative constrains
Behavioral approach	Personality	Self-esteem Self-efficacy Positive thinking Bounded rationality
	Motivational factors	Innovativeness Social support/Gender Leadership Entrepreneurial knowledge/skills Competency
Ecosystems dimension	DE Ecosystems	Entrepreneurial pipeline Collective intelligence entities Information networks
	Teams and networking	Informal collaboration networks E-business teams Social networks
	Human Capital	Education Entrepreneurial Knowledge/skills Competency frameworks

**Table 2.**  
Main conceptual  
dimensions and sub-  
streams of research

**Source(s):** Created by authors

courses offering special topics on disruptive technology, suggests that cutting edge entrepreneurship education should move in the intersection of these technologies with management education (Allen, 2020). Further research is needed in the cross section of digital entrepreneurship and entrepreneurship education, in order to address the challenges of incorporating new technologies in educational settings (Ratten and Usmanij, 2021). Deeper analysis of the continuous range of digitalization phenomena between pure digital and pure traditional entrepreneurship with qualitative methodologies, such as multi-method insider action research, would capture unpredicted events taking place during the phases of innovation development and produce “actionable knowledge” for appropriate entrepreneurship educational interventions (Nzembayie *et al.*, 2019). AI-enabled models of the entrepreneurial process showcasing the financial and economic benefits from AI usage in entrepreneurship portrayed the significant role of education in opportunity recognition, decision making and enhanced performance (Giuggioli and Pellegrini, 2022). Finally, while the fundamental changes of the university business model, due to new digital technologies, in terms of value creation, value proposition and value capture, already entail promptly adaptations (Rof *et al.*, 2020), the necessary reforms and diversification of entrepreneurship

education were further impelled by the circumstances of the recent pandemic (Lamine *et al.*, 2021).

*Learning approaches.* The complexity of business models and technological interdependencies, which raised serious difficulties of internet business models conceptualization for students yielded in examination of the various learning approaches used in entrepreneurship courses and proposition of appropriate adaptations to serve the needs of DE (Millman *et al.*, 2009). Experiential learning through internet based student business simulations helps students move beyond business idea development and gain skills and networking competencies, when involved with different functions of an online firm operation (Daly, 2001). Project based learning offers undergraduate students the chance to evaluate digital adoption and identify enabling factors and inhibitors, exercise skills and understand the importance of IT in opportunity exploitation (Pereira *et al.*, 2020). DE courses using blended self-managed action learning, offered student entrepreneurs flexibility, engagement and independent learning (Shurville and Rospigliosi, 2009). These courses also increase students' entrepreneurial skills and attract non-traditional higher education students (Jones and Lau, 2010), while online action learning has a positive impact on students' entrepreneurial self-efficacy and online business implementation intention (van der Westhuizen and Goyayi, 2020). Design thinking has very promising results on secondary education students' entrepreneurial skills, such as innovation, collaboration and co-creation (Androustos and Brinia, 2019). Finally, self-directed learning becomes a significant competency for modern entrepreneurs, allowing them to adapt to the rapidly changing technological environment. Self-directed learning competency combined with experiential learning is critical for self-regulation and re-orientation of the entrepreneur based on actual problems and opportunities (Morris and König, 2021).

Digital based learning helps students develop creativity, collaboration, communication, critical thinking and technical skills, in order to cope with the rapid technological changes (Rohm *et al.*, 2021). Blended approaches and Co-design based learning workshops on the other hand, can reduce course complexity, foster the sense of community, improve networking and accelerate team formation. Prototyping can also take advantage of online assistance offered by mentors from the intimate entrepreneurial ecosystem. However, typical entrepreneurial education processes used in standard entrepreneurship programs, such as, storytelling, pitching and business planning should be redesigned for DE (Laptev and Shaytan, 2022; Secundo *et al.*, 2021).

Elements of technology, business and environment in appropriate proportions of knowledge and experience can create successful Internet startups (Zhang, 2014). Experience obtained through authentic situations, such as student clubs, workshops, incubators, internships and maker spaces is an important driver for students' entrepreneurial self-efficacy (Monllor and Soto-Simeone, 2020) and helps them develop the required mindset in terms of traits, skills and competencies, especially in the field of digital technology (Chang *et al.*, 2018b; Le Dinh *et al.*, 2018; Secundo *et al.*, 2020b).

*Digital learning environments.* The use of internet platforms in innovation courses has always been a requisite (Sun, 2020) for cultivating new sets of skills charted on the 21st century skills framework, which are required for the successful combination of digital and physical world (Rayna and Striukova, 2021). However, skills related to newer technologies, such as AI and augmented reality technologies, which were only recently used to improve digital interaction in universities' simulated business environments, urged by the social distancing restrictions during the COVID pandemic, need to be explored (Ratten, 2020).

The use of MOOCs in technology entrepreneurship courses offers a personalized approach and increases problem solving and multitasking capabilities of learners (Cirulli *et al.*, 2016), while, common experiences and expectations shared between participant students, create business opportunities through knowledge spillovers (Zur, 2020). Digital collaboration,

digital workplace and digital awareness are the key DE competencies developed through the usage of MOOCs (Thanachawengsakul and Wannapiroon, 2021). However, there are still challenges to be addressed. The functions of digital learning platforms, that support academic entrepreneurship through knowledge exchange between university and business need to be defined (Linzone *et al.*, 2020), efficient ways to transfer hands on experience online need to be sought (Huebscher and Lendner, 2010; Vorbach *et al.*, 2019), and influential factors regarding implementation and effectiveness must be further examined (Carenys and Moya, 2016; Wang and Chiou, 2020).

#### *Success factors and barriers*

Entrepreneurship education has a positive impact on students' motivation towards digital academic entrepreneurship, which can help them overcome administrative constraints hindering the development of sustainable student startups (Muafi *et al.*, 2021). Entrepreneurship education can offer experience, knowledge and social capital, which are considered key success factors, especially during the early stages of DE ventures (Zaheer *et al.*, 2019b). Entrepreneurship education is tightly related to human capital resources, however, focusing on the formation of entrepreneurial teams, rather than the individual, would benefit later success (Ladeira *et al.*, 2019). The entrepreneur's personality is considered a significant success factor for team formation and social capital development. A decisive personality, open to experience and striving for achievement, provides the required intrinsic and extrinsic motivation for DE (Yeh *et al.*, 2020), which can be improved through a solid background of entrepreneurship education and training (Chae and Goh, 2020; Shimoli *et al.*, 2020).

#### *Behavioral approach*

A behavioral approach aims to highlight motivational factors supporting the development of students' intentions towards DE.

*Personality and motivation.* A significant moderation of positive thinking was found on the effect of cyber-entrepreneurial self-efficacy on DE intention of non-IT students (Chang *et al.*, 2020), while significant relation was also found between bounded rationality and students' intentions towards e-commerce (Ashraf *et al.*, 2021). Motivation is a good predictor of individuals' entrepreneurial intention, which is fueled by certain Big-Five personality constructs. An extroverted personality acts as a driver for extrinsic motivation, while openness to experience has a positive influence on intrinsic motives towards DE (Yeh *et al.*, 2020). Extrinsic motivation was highlighted as a driver for business students DE intentions, whereas intrinsic motivation predicted the DE intentions of both IT and non-IT students (Wang *et al.*, 2016). Scholars suggest that desirable personality traits can be encouraged by entrepreneurship education (Chae and Goh, 2020).

*Social support and gender.* The significant relation found between extrinsic motivation through social support on DE intention for female students in Saudi Arabia could be further underpinned with suitable educational interventions (Alzamel *et al.*, 2020), while, education can promote DE intentions of unemployed women in India (Mand *et al.*, 2018). Gender was also positively associated with male IT students' intention to start an internet business (Millman *et al.*, 2010). Finally, education can encourage social exposure gained through experience in digital organizations, while also supporting the development of gendered pro-social behavior among students, which were significantly related with students' social DE intentions (Ghatak *et al.*, 2020).

*Self-efficacy.* Personal self-perceptual factors, such as self-esteem, self-efficacy and creativity largely determine DE intentions (Batool *et al.*, 2015). Many personal traits, namely, entrepreneurial orientation, entrepreneurial self-efficacy, and digital literacy were found

positively related to digital innovativeness (Mancha and Shankaranarayanan, 2021). Similarly, IT knowledge, IT adoption and entrepreneurial tendency (Zenebe *et al.*, 2018), computer self-efficacy and personal innovativeness in IT (Chen, 2013, 2014; Wang *et al.*, 2020) and cyber-entrepreneurial self-efficacy were significant predictors of DE intentions and goal commitment, especially for students with no entrepreneurial role models (Chang *et al.*, 2018b). Finally, educational support regarding entrepreneurship and ICT were significant predictors of technology entrepreneurship intention (Youssef *et al.*, 2021).

*Entrepreneurial knowledge and skills.* Entrepreneurial skills in terms of technical knowledge, opportunity identification and managerial skill, were positively related to DE intention (Siriattakul and Jermstittiparsert, 2019). Significant indirect effects of entrepreneurial knowledge through entrepreneurial attitude and perceived behavioral control imply that DE education should focus on entrepreneurial competency specific to digital business (Yaghoubi Farani *et al.*, 2017). Therefore, assessments of students' achievements on different business plan typologies, focusing on specific entrepreneurial skills and competencies, could be considered indicators of entrepreneurial students and substitute self-reported measures (Ferrerias-Garcia *et al.*, 2019).

#### *Ecosystems approach*

This stream of research examines the different sets of actors involved in DE, e.g. individuals, teams as the determinants of the entrepreneurial ecosystem (Satalkina and Steiner, 2020b).

*DE ecosystems.* Entrepreneurship education should develop new learning approaches to encourage creativity, stimulate business model innovation through new business ideas based on the internet and other emerging technologies. The theories of entrepreneurial pipeline and entrepreneurial ecosystems could provide the theoretical underpinnings for this transition (Birch *et al.*, 2017). The level of early stage technology entrepreneurship in an ecosystem is significantly moderated by the availability of information. Intellectual property rights regulations should reserve information availability for educational purposes (Yeganegi *et al.*, 2021). In general, the flows and interdependencies between who, why, how and what into a context independent theoretical framework of DE ecosystems, connecting the community and systems approaches into a collective intelligence entity approach (Elia *et al.*, 2020), in combination with a conceptual framework of progressively implemented factors intertwined with the entrepreneurial process on the micro and macro levels (Toniolo *et al.*, 2020), depending on the maturity of ventures, could aid advances in future research in the ecosystem direction (Galanakis and Giourka, 2017).

*Teams and networking.* Teams and social networking and even informal collaboration networks are more important for DE than entrepreneurial knowledge and previous IT knowledge (Scuotto and Morellato, 2013). IT competencies required in e-business, on the other hand are valuable and irreplaceable for the formation and longevity of entrepreneurial teams (Kollmann *et al.*, 2008). Digital entrepreneurs, compared to traditional entrepreneurs, are more sociable, competitive and vibrant on social media, which has a positive effect on networking (Chae and Goh, 2020). However, face-to-face contacts and positive dispositional affectivity are also required for further development of digital entrepreneurs' networking (Pérez-Fernández *et al.*, 2020).

*Human capital.* Human capital refers to the economic value of a worker's experience and skills and includes assets like education, training, intelligence, skills, health and other things employers value such as loyalty and punctuality (Kenton, 2023). Human capital theory suggests that individuals or teams who benefit of knowledge, experience and other competencies can achieve better performance outcomes. This suggestion is confirmed by the positive relation of entrepreneurship education with entrepreneurial outcomes and performance (Martin *et al.*, 2013). In this line of thought, entrepreneurship courses, help

students develop human capital, including teamwork and skills of interpersonal relations (Beranek and Beránek, 2015). The level of formal education (general, business and technical) not only underpins decisions to start a digital business, but has also a significant impact on attracting external funding (Ratzinger *et al.*, 2018). However, new entrepreneurial competencies, associated with leadership, management and innovation are needed, due to the integration of emerging digital technologies in digital platforms, which Entrepreneurship Education needs to continuously adapt to (Sousa and Rocha, 2019; Tarabasz *et al.*, 2018; Toniolo *et al.*, 2020). Classification frameworks proposed for the numerous competencies needed in each stage of DE venture creation, would assist educators aiming to implement competency driven DE education (Prendes-Espinosa *et al.*, 2021). Furthermore, the development of a meta-competence framework is proposed to broaden scholarly understanding of new entrepreneurial competencies, aid entrepreneurship course designs and competency assessment, leading in successful digital ventures (Reis *et al.*, 2021). Except finance and social capital, the role of human capital, becomes critical, especially for ambitious DE ventures, since technological knowledge and resource investments required are escalated as the complexity of DE mode increases, raising barriers to entry for actors and especially for the disadvantaged (Martinez Dy, 2022). Finally, scholars already discuss the required entrepreneurial training required for the utilization of AI as an enabler technology in DE, in addition to the possibilities for innovative teaching and learning techniques based on AI technology. Nevertheless, research papers in the sample do not delve into the consequences of the more specialized AI technologies, such as generative AI and the new opportunities offered to digital entrepreneurs for customer support, decision making and product optimization. AI can offer valuable aid to digital entrepreneurs so as to increase conversion rates and revenue. DE education has the responsibility to inform them on the benefits of this new technology, but also prepare them for conceivable ethical issues emerging from AI driven entrepreneurship (Giuglioli and Pellegrini, 2022; Obschonka and Audretsch, 2020).

### Conclusions and research agenda

Literature reviews examining the relationship between entrepreneurial education and digital entrepreneurship are missing. With an exception to the work of Secundo *et al.* (2020a, b), who mentioned the anticipated educational requirements for DE, other studies avoided to discuss the educational consequences of DE development. As a result there is lack in theoretical frameworks embracing the different conceptual dimensions of DE education research, in order to sustain research novelty. Moreover, the discussion of the theoretical and practical implications of the empirical results is not organized in a productive way, raising difficulties in the evaluation of their effectiveness. The aim of this paper was to explore the landscape in the intersection between digital entrepreneurship and entrepreneurship education, offer an extensive view of the literature and define DE education as distinct field of research. The theoretical contribution of this research is that the void in the literature has been identified, regarding the study of the adaptation required in entrepreneurship education due to the continual introduction of emerging new technologies in entrepreneurship scheme and several facets of the topic have been unveiled through the analysis and classification of the reviewed literature. The conceptual framework proposed can offer assistance to future researchers who wish to deepen our understanding in specific research areas or want to combine sub-streams of research in an interdisciplinary manner, producing new fertile conceptualizations. The practical contribution is that the current attempts of entrepreneurship pedagogy taking place mainly in academic settings have been charted and the proposed framework can serve as a roadmap for entrepreneurship educators and course designers.

Among the four primary streams of research highlighted, pedagogy and learning was the most ample one, which exhibited a great variety of pedagogical approaches and learning

environments utilized in DE courses. A great effort was devoted by academics to provide answers on how should entrepreneurship education continuously adapt and diversify following the rapid technological disruption and what pedagogical settings should be appropriate for the effective transfer of appropriate knowledge and experience to learners (Tarabasz *et al.*, 2018). However, the answer to this question seems to require a continuous circle of holistic meta-research (Matlay, 2004) following the perpetual introduction of newer and newer digital technologies and their consequences for the individual, the university and the ecosystem (Toniolo *et al.*, 2020).

In conclusion the analysis of the papers in this LR resulted in great multitude and interchangeability of terms in the literature, which shows a fruitful diversity (Matlay, 2004). However, this might also signify underlying conceptual debates and absence of pedagogical focus, as a result of the confirmed fragmentation of the literature in diverse streams of research. Conceptual papers are limited compared to the vast amount of quantitative and qualitative empirical papers, which confirms that scientific research in the field is difficult to follow the rapid development and adoption of digital technologies by the industry. Consequently, it is not only urgent for entrepreneurship education to specialize, diversify and develop expertise in cutting edge technologies with potential in DE practice, but it is also urgent for scholars to provide deeper and broader theoretical foundations of DE pedagogy and training.

#### *Future research agenda*

In order to answer Question 5, seeking promising avenues for future research, we take the findings of this review as a starting point.

Regarding pedagogy and learning, the study of self-directed learning approaches (Morris and König, 2021) and MOOCs which can practically offer active entrepreneurs a flexible way of learning, while, hands on experience techniques would enhance the complex skills developed in collaboration spaces (Rayna and Striukova, 2021) and offer valuable insights on the way prospect digital entrepreneurs learn and progress. A design thinking-based pedagogy in combination to the use of new emerging technologies in university entrepreneurship courses is also an interesting proposal which should be further examined for the development of entrepreneurial skills (Androutsos and Brinia, 2019; Youssef *et al.*, 2021). The use AI and immersive technologies in entrepreneurship education settings, concerning the introduction new AI technologies in the curriculum of entrepreneurship courses, as well as the application of new teaching approaches for the required AI related skills is another promising research direction (Giuggioli and Pellegrini, 2022).

Further research is required on the development, empirical application and assessment of proposed theoretical frameworks such as the “entrepreneurial path” (Galanakis and Giourka, 2017) and the Traction framework (Zaheer *et al.*, 2019b), which explore start-up success factors from the perspectives of expert’s and founder’s, respectively.

From a human capital perspective, competency driven DE education frameworks (Prendes-Espinosa *et al.*, 2021) and meta-competence frameworks development, are prominent topics, which would offer a better understanding on the role of opportunity identification competencies, and provide a link between entrepreneurship course delivered competencies and business performance (Reis *et al.*, 2021). In this regard, both traditional research methodologies, as well as new event-driven methodologies, e.g. the multi-method insider action research, would shed more light on skills required for entrepreneurial practical design and implementation (Nzembayie *et al.*, 2019). A practical benefit from a competency driven education approach would be the increased robustness of DE intentions research through the use of tangible competencies instead of self-reported measures (Ferrerias-Garcia *et al.*, 2019), and the superior assessment of incubation and acceleration processes (Reis *et al.*, 2021).

Entrepreneurial ecosystems is another promising direction for future research, which was the most meager stream of research in number of articles. The collective intelligence entity ecosystem conceptualization (Elia *et al.*, 2020) opens the discussion for synthesizing individual DE education related studies into a context independent theoretical framework. Such a synthesis of different levels of analysis into an ecosystem continuum would encompass personal, social and contextual parameters used in the various frameworks in DE literature, including gender perspective which is underrepresented area of research.

### Limitations

This research is not without limitations. The findings presented here may be limited due to the number of databases and selection criteria. Although, the search terms were carefully selected and were combined in different ways in the compound Boolean expressions used in multiple searches, there is a possibility that other articles relevant to the topic were missed. Additionally, although, in order to mitigate bias, the decisions for article inclusion-exclusion in the dataset were made on an agreement basis between research team members, it is still possible that researchers from other disciplines or different backgrounds might have made different judgments (Kraus *et al.*, 2020). Another source of possible bias is the decisions made during coding and synthesis processes, which could be also influenced by the human factor (Kunisch *et al.*, 2023). Additionally, empirical articles mostly referred to university students from technical departments. Empirical articles using data from employees, managers or students of other disciplines were limited. Future researchers should use non-student samples in order to examine the DE educational needs of employees, managers and nascent entrepreneurs. Empirical studies using theoretical models proposed in the papers studied here are encouraged. Finally, as the role of entrepreneurship education is to develop students' motivation towards entrepreneurial behavior, more research studying the outcomes of DE courses in terms of motivation and opportunity awareness would be welcomed.

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**Further Reading**

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**Appendix**

Main dimensions	Sub-streams	Articles
Pedagogy and learning dimension	ICT dominance in business (16)	Allen (2020), Carrier <i>et al.</i> (2004), Clarke and Clarke (2009), Dhar and Sundararajan (2007), Del Giudice and Straub (2011), Giuggioli and Pellegrini (2022), Kang and Lee (2020), Kollmann <i>et al.</i> (2022), Lamine <i>et al.</i> (2021), Matlay (2004), Nambisan (2017), Nzembayie <i>et al.</i> (2019), Ratten and Usmanij (2021), Rof <i>et al.</i> (2020), Steininger (2019), Zaheer <i>et al.</i> (2019a)
	Learning approaches (16)	Androutsos and Brinia, (2019), Chang <i>et al.</i> (2018a), Daly (2001), Le Dinh <i>et al.</i> (2018), Jones and Lau (2010), Laptev and Shaytan (2022), Millman <i>et al.</i> (2009), Monllor and Soto-Simeone (2020), Morris and König (2021), Pereira <i>et al.</i> (2020), Rohm <i>et al.</i> (2021), Secundo <i>et al.</i> (2021), Secundo <i>et al.</i> (2021), Shurville and Rospigliosi (2009), van der Westhuizen and Goyayi (2020), Zhang (2014)
	Digital Learning Environments (11)	Carenys and Moya (2016), Cirulli <i>et al.</i> (2016), Huebscher and Lendner (2010), Linzalone <i>et al.</i> (2020), Ratten (2020), Rayna and Striukova (2021), Sun (2020), Thanachawengsakul and Wannapiroon (2021), Vorbach <i>et al.</i> (2019), Wang and Chiou (2020), Zür (2020)
Success factors and barriers dimension	Enabling factors (5)	Chae and Goh (2020), Kraus <i>et al.</i> (2019), Ladeira <i>et al.</i> (2019), Shimoli <i>et al.</i> (2020), Zaheer <i>et al.</i> (2019b)
	Constrains (1)	Muafi <i>et al.</i> (2021)
Behavioral dimension	Personality (4)	Ashraf <i>et al.</i> (2021), Chang <i>et al.</i> (2020), Wang <i>et al.</i> (2016), Yeh <i>et al.</i> (2020)
	Motivational factors (15)	Alzamel <i>et al.</i> (2020), Batool <i>et al.</i> (2015), Chang <i>et al.</i> (2018b), Chen (2013, 2014), Ferreras-Garcia <i>et al.</i> (2019), Ghatak <i>et al.</i> (2020), Mancha and Shankaranarayanan (2021), Mand <i>et al.</i> (2018), Millman <i>et al.</i> (2010), Siriattakul and Jermittiparsert (2019), Wang <i>et al.</i> (2020), Yaghoubi Farani <i>et al.</i> (2017), Youssef <i>et al.</i> (2021), Zenebe <i>et al.</i> (2018)
Ecosystems dimension	DE Ecosystems (9)	Birch <i>et al.</i> (2017), Elia <i>et al.</i> (2020), Galanakis and Giourka (2017), Sahut <i>et al.</i> (2021), Satalkina and Steiner (2020a, b), Secundo <i>et al.</i> , (2020), Toniolo <i>et al.</i> (2020), Yeganegi <i>et al.</i> (2021)
	Teams and networking (4)	Chae and Goh (2020), Kollmann <i>et al.</i> (2008), Pérez-Fernández <i>et al.</i> (2020), Scutto and Morellato (2013)
	Human Capital (10)	Beranek and Beránek (2015), Martínez Dy (2022), Obschonka and Audretsch (2020), Prendes-Espinosa <i>et al.</i> (2021), Ratzinger <i>et al.</i> (2018), Rayna and Striukova (2021), Reis <i>et al.</i> (2021), Rippa and Secundo (2019), Sousa and Rocha (2019), Tarabasz <i>et al.</i> (2018)

**Table A1.**  
Final set of articles in the sample by dimension and sub-stream

**Source(s):** Created by authors

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