

University-level entrepreneurship education: a bibliometric review using Tree of Science

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Abstract

Entrepreneurship education helps students build the skills, abilities, attitudes, and aptitudes they need to start a business. Universities play a key role in educating and transforming people. However, the academic literature in this area is fragmented. This article identifies the main areas in this field throughout its history based on a review of the literature. A scientometric study was conducted based on the results of a document search in Scopus. Using Tree of Science software, the most important documents were classified based on a network of citations. The results reveal three main perspectives: the impact of entrepreneurship education, entrepreneurship education methodologies, and new trends in entrepreneurship education. Researchers can use these results to propose ways to strengthen entrepreneurship education.

Keywords: Entrepreneurship; Education; Bibliometric; University; Review

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1. Introduction

Nowadays people dream of creating a venture, company, or organization to provide an income, autonomy, and independence, while improving their living conditions, contributing to society, and exploiting new opportunities.

Although entrepreneurship has always existed and is inseparable from human history, in recent years this topic has gained special importance due to the need to face the times of change, profound transformation and complex and unexpected situations to which societies are subjected (Torres, 2010, Cervantes & Narvaez, 2020), to address the lags and demands that society requires in terms of employment as a mechanism to combat poverty (Salinas & Osorio, 2012), to stimulate economic growth and boost innovation, in addition to improving social and environmental sustainability, and which is a matter of concern for families, companies and the state (Iwu et al., 2021; Rashid, 2019)

For Jena (2020) entrepreneurship education has played an essential role in the economic prosperity and social stability of many countries and for this reason it is considered a crucial component for progress, since it allows satisfying the needs of the population, the creation of new income, sources of employment, raises productivity, competitiveness and a variety of added economic values. An increasing number of countries around the world are deploying projects that encourage the production and commercialization of knowledge and that address untapped market opportunities (Audretsch & Thurik, 2001). These policies are a priority for governments because of the way they benefit the productive system and improve quality of life indices (Zambrano Carbonell, 2016) to rebuild an equitable society.

Universities around the world are leading agents of transformation. By their very nature, they must contribute to maintaining social, economic, and environmental structures (Rubio et al. 2023) by educating individuals capable of solving real-world problems, addressing global challenges, and discovering and exploring opportunities. Therefore, entrepreneurship education is important. This line of education means shifting away from the traditional paradigm of preparing employees to be entrepreneurs. Instead, universities must take on a dynamic role in the process of educating potential entrepreneurs, who need skills that allow them to exploit opportunities in their surroundings (Bonstein, 2009; Benavides et al., 2010) and universities must also transfer knowledge to strengthen the economy (Osorio & Pereira, 2011, Tracey & Phillips, 2007) in which the agents of change or educational improvement are the students themselves (Sáiz et al., 2023).

Cervantes-Muñoz et al. (2024)

Mult. J. Edu. Soc & Tec. Sci. (2024), 11(1), 1-19. <https://doi.org/10.4995/muse.2024.20688>

Entrepreneurship education has seen significant growth in recent decades and for Kuratko (2005) it is evident by the increase in course offerings in both colleges and universities, which shows the academic legitimacy of entrepreneurship and the challenges that need to be addressed. For Ratten & Usmanij (2021) this field has also flourished as a field of research because of its role in accelerating global economic growth, but it requires a full understanding of the nature and capacity of entrepreneurship education to transform society.

In studies developed by Wardana et al. (2020); Ahmed et al.(2019); Hassan et al. (2020); Nowinski, et al. (2019), among many others, it is exposed that entrepreneurship education positively influences self-efficacy, attitude, intention, initiative or entrepreneurial mindset, so there are great challenges in order to develop entrepreneurship programs and learning methodologies, offer a different way of seeing the world, promoting as cited by Garcia et al. (2022) the generation of new knowledge based on innovation and problem solving for the benefit of society and economic growth.

Attempting to answer the question of how entrepreneurship education is provided in universities around the world reveals that the academic literature is fragmented and disjointed. For example, studies have examined social entrepreneurship education, conceptualizations from different approaches and theories, the role of entrepreneurs and higher education institutions, education with an entrepreneurial profile, entrepreneurial intention, entrepreneurial spirit, dynamic capabilities, self-efficacy, skills, the impact of entrepreneurship education on business creation, learning experiences from different disciplines, case studies, different perspectives, the reinterpretation of education, innovation, technology transfer, entrepreneurial motivation, teacher training, new businesses, and many others. This broad range of approaches shows that there is many diverse topics that are difficult to group together.

The guiding question for this article is to identify the main themes that have been worked on over time in entrepreneurship education in universities and to determine what the perspectives or trends are, for which a scientometric study is carried out by importing data from scientific articles from the Scopus bibliographic database and applying the Tree of Science (ToS) software that uses graph theory in order to select the most important articles through the network of citations located in all their references, selecting the 50 most important articles to create a simple to understand flow through the allegory of the tree, in which the root corresponds to 10 classic articles, in the trunk would be 10 structural articles and in the branches correspond to 30 articles that show current

perspectives (Robledo et al., 2014) of the subject, which are the impact of entrepreneurship education, methodologies in entrepreneurship education and new trends in entrepreneurship training.

The next section of the article describes the method. It explains how the process was carried out to identify the main articles and which tool was used to do so. Next, the results are presented, revealing the perspectives identified by the analysis. Finally, the conclusions and findings are discussed.

2. Methods

An exploratory study is developed with a descriptive approach that attempts to find patterns of relationship that allow describing situations and events. The design used is non-experimental, since it does not manipulate the variables, but rather observes the events as they occur in their natural context and then analyzes them (Hernández et al., 2020; Hernández & Mendoza, 2018). Likewise, it is cross-sectional since it collects data at a single moment with the objective of describing the facts and analyzing their incidence and interrelation at a given time. Additionally, the study is based on a documentary review of high scientific value.

With respect to the method, the Scopus database is consulted according to established criteria, then the data is exported with complete registry to a BibTeX file format, which is processed in the science tree software and finally the results are consolidated and interpreted, which allow to advance in the conclusions of the investigated topic.

3. Results

To find the scientific articles from the Scopus database, the criteria shown in Table 1 were applied. A Scopus search was used to identify scientific articles. The search criteria appear in Table 1.

Table 1. Search criteria for Scopus search

TITLE	entrepreneurship AND education
AND TITLE-ABS-KEY	university OR universities OR school OR schools OR academics
AND TITLE-ABS-KEY	competence OR capabilities OR capacity OR capability OR proficiency OR skills
PUBLISHED FROM	(All years) TO (Present)

The results were 442 articles, which are exported with all the information in a file in BibTeX format and processed through the Tree Of Science (ToS) software, which allows through an algorithm to apply graph theory, analyzing and filtering articles through their connections, thus allowing a comprehensive approach to the topic through the analysis of leading documents.

The following tree metaphor is then established: for its high input degree and zero output, called roots; for its intermediation degree, called trunk; for its perspectives, called branches (Robledo et al. 2022). The ToS algorithm performs a citation network from the references of the articles and selects the most important papers according to graph indicators such as input degree, for root articles, and intermediate degree for trunk articles. Branch identification is performed with the algorithm of Blondel et al. (2008). ToS has been widely used in different areas of knowledge such as engineering, environmental sciences and management. A detailed explanation of the adoption process of the tool is explained in the work of Eggers et al. 2022.

ToS analyzes the downloaded articles plus their references, analyzing thousands of articles and selecting only the most important within the area of knowledge. In this sense, this article selects the 50 most important ones to create a simple to understand flow through the tree metaphor (Gonzalez-Urango et al. 2024; Marín-Rodríguez et al. 2023). Table 2 shows the selected articles based on these criteria.

Table 2. Main articles after applying Tree of Science to Scopus data

Roots	Trunk	Branch 1 Impact	Branch 2 Methodologies	Branch 3 Trends
Ajzén (1991)	Jack & Anderson (1999)	Oosterbeek, Praag & Ijsselstein (2008)	Vesper & Gartner (1997)	Siegel & Phan (2005)
Gorman, Hanlon & King (1997)	Heinonen & Poikkijoki (2006)	Huber Lr. (2014)	Kourilsky & Esfandiari (1997)	Rasmussen & Sørheim (2006)
Shane & Venkataraman (2000)	Blenker, Dreisler, Faergemann & Kjeldsen (2008)	Stamboulis & Barlas (2014)	Jack & Anderson (1999)	Mustar (2009)
Krueger, Reilly & Carsrud (2000)	Lautenschläger & Haase (2011)	Premand, Brodmann, Almeida, Grun Von Jolk, & Barouni (2016)	Heinonen & Poikkijoki (2006)	Moroz, Hindle & Anderson (2010)
Katz (2003)	Seikkula, Satu vuori, Ruskovaara & Hannula (2015)	Ndou, Secundo, Schiuma & Passiante (2018)	Tessema (2012)	Mojab, Zaefarian & Dazian (2011)
Kuratko (2005)	Lackéus & William (2015)	Portuguez, Ross & Gómez (2019)	Gedeon (2014)	Ulvenblad, Berggren, & Winborg (2013)

Roots	Trunk	Branch 1 Impact	Branch 2 Methodologies	Branch 3 Trends
Fayolle, Gailly & Lassas (2006)	Johannisson (2016)	Wang, Yueh & Wen (2019)	Abou- (2016) Warda	Lans, Blok & Wesselink, (2014),
Pittaway & Cope (2007)	Hamzah, Yahya, Sarip & Adnan, (2016)	Pisoni (2019)	Huq & Gilbert (2017)	Akhmetshin, Mueller, Chikunov, Fedchenko & Pronskaya (2019)
Souitaris, Zerbinati & Al-Laham. (2007)	Huang-Saad & Celis (2017)	Vodă & Florea (2019)	Warhuus, Tanggaard, Robinson & Ernø (2017)	Sansone, Battaglia, Landoni & Paolucci (2021)
Fayolle & Gailly (2008)	Jones, Pickernell, Connolly & Netana (2017)	Hahn, Minola, Bosio & Cassia (2020)	Niccum Wolf & Trowbridge (2017)	Bolzani, Munari, Rasmussen & Toschi, (2021)

3.1. Roots

When the topic of entrepreneurship is addressed, the issue of entrepreneurship implicitly arises and Kuratko (2005) mentions the importance of encouraging or promulgating entrepreneurship, which he defines as that force or intention that motivates the emergence of new enterprises and continuous innovation, whose teaching and learning have been prioritised by business schools and universities, with a notable growth in curricula and programmes. However, he mentions that there is no clear framework or specific theory and suggests that new methods and paradigms be studied to help achieve effective results.

Along these lines, Souitaris, Zerbinati, Al-Laham, Pittaway, and Cope (2007) showed that entrepreneurship programs can increase inspiration, entrepreneurial intention, and entrepreneurial attitudes. This idea recalls the theory of planned behavior proposed by Ajzen (1991). According to this theory, any activity requires some level of planning and may be preceded by the intention to adopt such a behavior. Intentions and their models are the best individual predictors of any planned behavior, including entrepreneurship (Krueger, Reilly, & Carsrud, 2000).

As explained by Fayolle & Gailly (2008), there are many methodologies and teaching processes in entrepreneurship. However, it is important to rethink entrepreneurship education using a variety of teaching methods and learning processes. It is also important to reflect on entrepreneurship education from an ontological, pedagogical, and didactic point of view. Entrepreneurship education

should be built on a general framework (Fayolle et al., 2006) that evaluates entrepreneurial intentions over time. Entrepreneurship education should be rethought from a new perspective instead of that of just creating businesses. This new perspective should culminate in greater awareness, an entrepreneurial mindset, learning to innovate, and the realization of new ideas.

Finally, Gorman, Hanlon, and King (1997) and Katz (2003) have provided chronologies of education and entrepreneurial spirit, finding that these elements form a valuable academic discipline with a growing number of publications, especially in the United States. Therefore, the main challenge is to continue creating a systematic body of knowledge on entrepreneurship education, which focuses not only on creating entrepreneurial ventures but also on taking opportunities within these ventures (Shane & Venkataraman, 2007).

3.2. Trunk

The articles that shape the theory of entrepreneurship education form the trunk of the Tree of Science. Heinonen and Poikkijoki (2006) addressed the issue of entrepreneurial spirit (as in the previous discussion) by reviewing the teaching techniques used in entrepreneurship education. They found that knowledge, experience, and action are important elements of entrepreneurship programs. Along the same lines, Hamzah et al. (2016) reported that entrepreneurial spirit is one of the soft skills needed by university graduates to ensure entrepreneurial survival. They found that this skill can be taught through a compulsory course on all programs based on less theory and more real-life experiences to ensure an impact at different levels.

In the discussion of course curricula, Huang-Saad and Celis (2017) explained that entrepreneurship programs leverage curricular and co-curricular contents, offering students different ways of developing their entrepreneurial capabilities, which act as a gateway to entrepreneurial spirit outside the classroom. However, it is important to be mindful of influential people, as well as students' careers, when developing programs to attract a diverse student base.

Regarding qualifications, Johannisson (2016) and Lackéus and William (2015) have reported that academic study provides students with basic competencies to learn entrepreneurship by allowing them to cross university boundaries. However, teaching processes based on practical learning must be enhanced. It is important to recognize not only the cognitive capabilities of students but also their affective and conative capabilities to close the gap between entrepreneurship education and technology transfer within the university environment. In turn, Lautenschläger and Haase (2011)

noted that entrepreneurship education should promote idea generation, innovation, opportunity detection, and problem-solving skills. It should therefore focus more on promoting business-oriented soft skills than on teaching how to start a business.

Blenker et al. (2008) studied entrepreneurship education by examining changes. They found that the university context requires major changes in didactics and pedagogy through new learning methodologies, evaluation processes, and educational frameworks that involve motivational aspects, competencies, and innovation skills. Jack and Anderson (1999) noted that, in view of the growing number of faculties that teach business courses, art and science must also be developed. In other words, students must learn to be innovative, reflective, and creative to satisfy the need for business novelty, but they also need to be competent and multifunctional managers.

Regarding the impact of entrepreneurship education, Jones et al. (2017) reported that programs provide value in businesses creation and support throughout people's careers. However, there is a need to evaluate practices and measure effectiveness in terms of achieving sustainable business creation. To conclude, Seikkula et al. (2015) found that entrepreneurship education is also applicable to teachers. Through problem-based learning as well as practical and experiential descriptions of situations, teachers can encourage students to take responsibility and be self-managed.

3.3. Branch

The perspectives on entrepreneurship education form the branch of the Tree of Science. These perspectives are the most substantial ones within the structure of the network. Specifically, there are three such approaches: impact, methodologies, and trends. These approaches are shown in Figure 1.

3.3.1. The impact of entrepreneurship education

The first approach relates to the impact of entrepreneurship education. It refers to cases that have been studied by many authors regarding the application and effects of entrepreneurship education programs for students. The evidence in this regard is contradictory.

Regarding entrepreneurial spirit, Vodă and Florea (2019) studied young university students to identify the development of entrepreneurial spirit from a cognitive approach. They showed that the need to achieve and entrepreneurship education are key determinants in business creation. They also

observed that men tend to be more inclined than women to become entrepreneurs. Similarly, Stamboulis and Barlas (2014) studied the impact of entrepreneurial spirit on entrepreneurial activity especially regarding organizational skills, time management, leadership development, and interpersonal skills, as well barriers to achieving these skills. They observed a positive effect after attending entrepreneurship classes, as reflected by extrinsic barriers, intrinsic barriers, and success factor rates.



Figure 1. Approaches to entrepreneurship education as branch of the Tree of Science

Regarding the curriculum, Hahn et al. (2020) studied the impact of elective and compulsory university-level entrepreneurship education. They also examined the impact on students who have entrepreneurial families. They found that both types of entrepreneurship education help improve skills and that compulsory education depends on students' perceptions of parents' performance as entrepreneurs.

Brodmann et al.(2016) studied the outcomes of business plan training and mentoring for university students one year after graduation. They found that, although certain business skills and personality aspects improved and graduates' aspirations increased, overall employment rates

remained unchanged. Similarly, Portuguez et al. (2019) conducted a case study of a master's-level graduate program to prepare students to start a business. They showed that the active teaching methods of meta-innovation, think and do, participation in interdisciplinary collaborative projects, and expert teacher support enabled the management of new technology-based ventures with the application of entrepreneurial skills by students in their surroundings.

Wang et al. (2019) analyzed the impact of the creativity and entrepreneurship program at a specific university. They observed favorable results in strengthening management and entrepreneurial intention competencies. Therefore, a complementary framework to integrate the entrepreneurship program with business and management courses is recommended to facilitate students' entrepreneurial learning and increase their intention to become future entrepreneurs.

Regarding the structure of universities, Ndou et al. (2018) studied entrepreneurship hubs by analyzing their curricular and extracurricular programs. They identified similarities in the target-audience process model, learning objectives, entrepreneurship contents, learning techniques, and stakeholder participation. They also observed similarities in their phases of inspiration, commitment, exploitation, and maintenance.

Regarding the impact of methodological strategies, Pisoni (2019) analyzed the strategies for introducing blended learning in a network of universities. The analysis showed the effectiveness of learning activities and their integration with online information in teaching and learning processes. This approach has a positive impact on student participation and enhances innovation- and entrepreneurship-oriented soft skills.

Only two instances of contradictory studies were found. First, Oosterbeek et al. (2008) studied the results of an entrepreneurship education program using instrumental variables. They focused on the framework of differences in university students in terms of skill development and motivation. They found little impact on students' self-assessed entrepreneurial skills. This finding may be related to students' realistic view of what it takes to become an entrepreneur or start a business and the need for interpersonal connections. Second, Huber et al. (2014) evaluated the impact on last-year primary school students' ability to build key non-cognitive skills for entrepreneurship. They observed a strong positive effect on non-cognitive entrepreneurial skills. This finding contradicts previous studies in adolescent university student populations and implies that learning is usually more effective at an early age.

3.3.2. Entrepreneurship education methodologies

The second approach refers to methodologies in entrepreneurship education. It refers to research on the structure of entrepreneurship programs and the pedagogical strategies used.

Vesper and Gartner (1997) studied courses within entrepreneurship programs to identify problems in specifications according to professors. The idea was to propose a structure based on leadership training, information and analysis, strategic and operational planning, management and development of human resources, educational management, and business processes. These aspects are part of the Malcolm Baldrige National Quality Award (MBNQA) to measure progress in entrepreneurship education.

In terms of building entrepreneurial spirit, Jack and Anderson (1999) highlighted a need to train students in management skills, innovation, and creativity. This strategy could take the form described by Heinonen and Poikkijoki (2006), through experiential learning that combines knowledge, experience, and action to encourage learners to apply their skills and entrepreneurial behavior by broadening their horizons.

Along these lines, Huq and Gilbert (2017) found that the promotion of creative thinking, innovation in delivering learning outcomes, role-play, humor, constructivism, justice, and equity achieve outstanding learning outcomes in entrepreneurship programs. Teacher training and the inclusion of entrepreneurship education in all disciplines are important factors (Tessema, 2012; Niccum & Trowbridge, 2017). Another important aspect is increasingly working to introduce innovations in the curriculum regarding assessment and learning methods (Kourilsky & Esfandiari, 1997). These innovations should target active team- and opportunity-based learning (Warhuus, Tanggaard, Robinson, & Ernø, 2017). The reason is that such an approach can have a substantial impact on the acquisition of concepts, business skills, and meaningful learning experiences.

To conclude, it is important to establish a normative framework for the design of entrepreneurship programs. This framework should define the goals, content, teaching techniques, and assessment of student transformation (Gedeon, 2014). It should also lead to the creation of innovation and entrepreneurship hubs (Abou-Warda, 2016). The aim is to achieve a more practical, experimental, competitive, and innovative entrepreneurial environment.

3.3.3. New trends in entrepreneurship education

The third and final approach refers to new trends in entrepreneurship education. It corresponds to new practices or perspectives to strengthen entrepreneurship education and make it sustainable over time.

From a methodological perspective, Rasmussen and Sørheim (2006) cited a need to shift from the traditional individualistic, classroom-based approach in entrepreneurship education to action-based learning, which is more practical and more rooted in a group and network environment. In a complementary study, Mustar (2009) explained that an experiential learning approach should be used in a real environment by combining lectures, interviews, the development of business plans, the analysis of start-ups and incubators, teamwork, and project-based learning.

It is also important to reassess the structure of learning outcomes and competencies. These outcomes should be clear, distinctive, and based on the methodological design of entrepreneurship program curricula (Mojab et al., 2011; Lans et al., 2014). The reason is that the task-based approach that is still applied does not address the multidimensional problems of the business world (Solomon & Tarabishy, 2005; Mulder et al., 2009) in an interdisciplinary context (Ulvenblad et al., 2013).

The issue of sustainability also plays a fundamental role in entrepreneurship education. The university context should strive for science and technology education (Bolzani et al., 2021). Technology transfer from a strategic perspective that links institutional incentives, organizational practices, and teacher, student, and graduate training leads to greater interaction with entrepreneurs (Siegel & Phan, 2005) and encourages the development of academic spin-offs based on practical learning (Sansone et al., 2021), as well as spin-outs that enable the development of entrepreneurial capabilities within an increasingly important university system (Moroz, Hindle, & Anderson, 2010).

Finally, Akhmetshin et al. (2019) concluded that it is important to explore different physical infrastructure scenarios in university campuses. These scenarios include modern technical facilities, interactive boards, and innovative technology-based methods. This approach shows the importance of reinterpreting education in multiple contexts.

4. Conclusions

This study proposed to identify which are the main topics that have been working over time in entrepreneurship education in universities and to determine which are the perspectives or trends,

given that although it is true that the topic has been developing for several decades, the academic literature was dispersed and fragmented.

To achieve this, a scientometric study was developed through a search of information from Scopus documents using defined selection criteria, which were processed through the Science Tree tool that uses graph theory to select leading documents through its citation network, showing them through a tree organization, in which there are 10 articles located in the root that are considered as the support of the theory, 10 articles located in the trunk that give structure to the topic and 30 articles located in the branches that are part of the different perspectives.

According to the methodology used, it is established that in the root, the authors have addressed the subject of spirit, the theory of planned behavior and, of course, intentionality, mentality and entrepreneurial attitude. In the trunk it is found that the authors expose aspects on the methodology and teaching techniques to develop entrepreneurship, in which topics such as soft skills, entrepreneurship programs, development of competencies, teaching techniques applicable not only to students but also to teachers are mentioned.

The branches of the tree show three main approaches: 1) Impact of entrepreneurship education whose authors mostly agree that in there are positive and significant results when evaluating entrepreneurship education evidencing that it contributes to the development of skills and competencies for the development of entrepreneurship and entrepreneurial intention; 2) Methodologies in entrepreneurship education in which it is made clear that it is urgent to break the traditional structures of education in classrooms and individualistic approaches, by scenarios in real environments, with experiential learning, based on action; 3) the development of new trends in entrepreneurship education, in which the authors state that it is necessary to achieve an articulation between entrepreneurship education and sustainable entrepreneurship, continue working on practical learning, innovative methodologies, develop technology training, planning and design of entrepreneurship programs based on competencies, learning outcomes, promotion and leverage of spin-offs, spin-outs and finally address issues of physical and technological scenarios in university campuses.

As limitations to the research, it is established that the analysis carried out is based on a search in Scopus, so it is proposed as a complement in future studies to consult other databases with the same criteria in order to confirm the existing trends or find others.

Finally, it is concluded that although it is true that this research shows that to date there are 3 trends, it is important that academic actors can contribute with future research on topics not yet explored such as articulation with the objectives of sustainable development, transdisciplinary research, experiential learning, articulation between business, state, universities and civil society, training with a global perspective, shared value, professional networks, business mentoring and coaching, disruptive and strategic thinking, among others, in order to achieve training in sustainable and sustainable entrepreneurship.

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Cervantes-Muñoz et al. (2024)

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