

TOWARDS AN ECOLOGICAL APPROACH FOR INTERACTION MANAGEMENT IN ENTREPRENEURSHIP COURSES

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Abstract

Entrepreneurship education has boomed worldwide for the past 20 years, and methods of teaching entrepreneurship have evolved from the classical knowledge transmission model to a conscious education model that links individuals through active learning methods. As the role of teachers in entrepreneurship is moving to a posture of support and accompaniment in the absence of other professional training, this evolution raises the issue of how teachers of entrepreneurship can manage interactions during class. This topic of entrepreneurial education is significantly underinvestigated, as studies on the role and teaching methods of the entrepreneurship educator have only recently emerged. Considering that pedagogical innovations are contributing to this evolution and the multitude of studies realized in the field of entrepreneurship education, we led a systematic literature review (SLR) covering 1059 scientific documents from 1981 to 2022 indexed in Dimensions.ai, Web of Science (WoS), and Scopus to identify the current research trends linked to 10 active learning methods for entrepreneurship. Since it was more helpful and important to consider the entrepreneurship course as an ecosystem to better understand the interactions played within it, we completed the study inspired by ecological and biotic interaction theories that informed a new approach that highlights the importance of teachers developing social intelligence to build learner-centric environments.

Keywords: entrepreneurship education; ecological sciences; teaching entrepreneurship; entrepreneurial ecosystems.

1. Introduction

Entrepreneurial activity influences the economic vitality of the country (Huang et al., 2022). In addition, there is widespread awareness among global institutions to support business growth (Cant, 2018). Knowledge is one of the main topics central to entrepreneurship, and internal knowledge management supports innovation success (Anzenbacher & Wagner, 2020). Along this line, entrepreneurship teachers use methods that are evolving from a model of direct transmission to a model where they offer support, mentoring, and facilitation of access to resources and networks (Neck & Corbett, 2018). These teachers are no longer the privileged holders of knowledge in the classroom, and this new model implies greater individualization in the relationship with learners and more interactions within the classroom and with counterparts during the course. There are many classroom teaching tools linked to building entrepreneurial skills. In this regard, authors such as Avila-Merino (2019) compare the teaching methods based on strategic approaches for training entrepreneurial competencies with practices based on real entrepreneurial examples.

The way in which entrepreneurship teachers manage interactions in their course has not been sufficiently considered in research thus far. As there is a lack of professional training for them (Neck & Corbett, 2018), teachers are not sufficiently prepared for such a challenge. Due to continuous changes in society, the potential management strategies for interactions between the parties involved in the classroom and in entrepreneurship education seems to be underresearched. Thus, the involvement of members of the entrepreneurial education ecosystem in the facilitation and evaluation of courses is considered. This article explores new ways and perspectives of addressing interactions in entrepreneurship education. As ecosystems are biological units establishing interactions between living beings (Tansley, 1935), we decided to use this opportunity to adopt an approach that considers entrepreneurship courses as ecosystems. The concept of entrepreneurship ecosystems has been deeply explored in research (Isenberg, 2011; Spigel, 2017; Velt et al., 2020; Xie et al., 2021). However, this approach allows us to continue the research proposed by the aforementioned academics from a new perspective. Thus, an ecosystemic approach will allow the identification and evaluation of interactions within the classroom and with peers, which can help improve the quality of teaching. Using this rationale, this research follows two main research questions: RQ1: What are the main topics and their links with teaching methods in entrepreneurship? RQ2: How can an ecosystemic approach inspire research on interaction management in an entrepreneurship course?

To fill the gap identified in this article, we used a systematic literature review (SLR) as the primary research method to identify the evolution of existing knowledge on entrepreneurship education and, more precisely, on pedagogical methods. The choice of the SLR method was justified by the aim of obtaining an overview of the knowledge created in this field (Tranfield et al., 2003). The results provide key insights into the pedagogical methods related to entrepreneurship. Therefore, the findings enable us to generate a new analytical approach based on ecological interactions, which complements the studies on entrepreneurship education ecosystems in the literature (Clarck, 2003; Aldrich, 2008; Toutain et al., 2014; Theodoraki & Messegheem, 2017, Toutain & Bornard, 2021).

The remainder of this paper is structured as follows. Section 2 presents the theoretical framework of the literature review. Section 3 presents the methodology. Section 4 presents the results and the new insights related to the analysis. In Section 5, as a discussion, the link between the pedagogical tools of entrepreneurship and biotic interactions and the major contributions of the research are presented.

2. Theoretical Framework

2.1. Pedagogical innovation and the role of the entrepreneurship teacher

Entrepreneurship education has boomed worldwide (Katz, 2003; Kuratko, 2005, Neck & Greene, 2011; Fayolle, 2018), increasing the number of courses and the heterogeneity of student profiles as described by Letowski (2014), in the same classroom. This diversity generates new learning opportunities but also a wider range of difficulties for learners to access knowledge (Makaya, 2022). Current research supports that entrepreneurship education actively promotes entrepreneurial intention (Piperopoulos & Dimov, 2015). Entrepreneurial activities promote social and economic development by increasing people's income, creating more jobs and stimulating more people in society to explore innovative ideas (Lv et al., 2021). There are several skills that are important for an entrepreneurship education to include, and a practical and experiential learning experience for both teachers and students helps develop pedagogical methods and models adapted to new needs. Entrepreneurs can grow entrepreneurial qualities, such as entrepreneurial knowledge, attitudes, and skills, through education that fosters creativity (Otache, 2019). In addition, authors such as Ala et al. (2022) have shown that in entrepreneurial education, learning

outcomes are expected to relate to creativity, innovation or risk-taking, among others. In that sense, entrepreneurial education has gained popularity in recent years.

Prior studies have established the relevance of understanding entrepreneurial learning through the lens of social constructivism (Anderson & Jack 2008). Entrepreneurial learning is socially constructed from the perspective of learning by doing (Pittaway & Thorpe, 2012). Considering learners involved in an entrepreneurship course as creators of knowledge, Béchard and Grégoire (2005) proposed a competence model taking into account learners' competencies in the interactions they have with their teacher and their environment. Surlemont and Kearney (2009) proposed defining entrepreneurial pedagogy according to different principles, such as responsible, experiential, reflective and collaborative, that are in line with the constructivist and social constructivist perspectives (Gergen, 1999). One of the main sources of theory on social constructivism is Vygotski (1987), who identifies the role that social interaction plays in learning. In a social constructivist educational setting, the responsibility for learning lies with the learner, while the teacher is a facilitator who guides the direction and promotes new patterns of thought. Such a role echoes recent research that underlined the role of mentoring, facilitation and support for entrepreneurship teachers. (Neck & Corbett, 2018).

2.2. Active learning methods

Particular attention to pedagogical innovations can help teachers adapt and create new pedagogical tools themselves (Carrier, 2007, Neck & Greene, 2011). In particular, Neck and Greene (2011) proposed a cognitivist approach valuing the diversity of profiles and motivations to explore a new frontier of entrepreneurship as a method, and suggested a portfolio of educational actions (business creation, serious games, creativity tools, practical reflections) to fit with this method. Active learning methods and theories have a major place in pedagogical innovation when teaching entrepreneurship. The interest in active pedagogies is justified by the nature of the object of teaching and an openness to theories of educational sciences and, in particular, to constructivist and socioconstructivist theories of learning (Fayolle & Verzat, 2009). Thus, different methods should be highlighted, such as serious games that allow teachers to better play their role as facilitators through a better analysis of student activities and better guidance on their business choices (Allegra et al., 2022, Kusdiyanti et al., 2022, Ruiz-Alba et al., 2019). As serious gaming is likely to awaken student interest in the discipline (Thanasi-Boçe, 2020), there is an opportunity for the teacher to deepen their understanding after the game by using other teaching methods (Ahsan & Faletehan, 2021) that are either classical or innovative. Mentoring programs have been

widely considered by authors such as Elliott et al. (2020), who consider them to support student learning in entrepreneurship. Authors such as Russell et al. (2008) have emphasized that business plans bring benefits to participants, with a particular emphasis on the development of entrepreneurial skills. The role of the coach has also been considered in research, such as that proposed by Kutzhanova et al. (2009), to be relevant in entrepreneurship.

2.3. Impact of the learning environment

Many pedagogical methods and tools have been used and tested in entrepreneurship education (Carrier, 2007), with experiential learning being one of the most researched methods (Charrouf & Taha Janan, 2019), which is also linked to interactions between the parties involved. With the intense search for effectiveness in entrepreneurship education, the development of innovative pedagogies has become a challenge (Bhullar & Aggarwal, 2022). Considering novel tools, Fitouri and Zouaoui (2021) discussed the link between entrepreneur learning and entrepreneurial coaching, and St-Jean and Audet (2009) discussed mentoring as a tool to support entrepreneurs. Thus, it has been suggested that an entrepreneurship course is not limited to its classroom, so teachers have to manage interactions within an ecosystem of actors in their courses. Several studies have been carried out on the role and influence of the learning environment (Toutain et al., 2017). Foliard et al. (2018), in their work on the legitimacy of the teacher in entrepreneurship education, identified a set of counterparts with which these teachers interact during their courses: the teachers themselves, the students, the institution, peers, and external stakeholders. Toutain and Bornard (2021) worked on the mediating role of teachers within entrepreneurial educational ecosystems in primary and secondary schools, but how teachers can assume this function within the classroom ecosystem has not been deeply explored.

The ecosystemic approach has been developed in research on entrepreneurship for dozens of years (Theodoraki et al., 2020b), but studies on entrepreneurship educational ecosystems are conducted more from a macro level than a micro level. Considering the entrepreneurship course as an ecosystem may permit a better understanding of the interactions within it and how teachers can manage them. Thus, from a social constructivist perspective, pedagogical innovations, and active learning methods in particular, have contributed to the evolution of the new role for the teacher. Considering how these methods are applied may permit us to better consider the challenge of interaction management faced by the teachers who use them. In addition, using an ecosystemic approach at a micro level may enable a deeper

understanding of such interaction management challenges. In the next section, we propose an SLR on active learning methods in entrepreneurship to answer RQ1.

3. Methodology

Bibliometric analysis is a widely considered method in scientific research (Aljohani et al., 2022; Kraus et al., 2022). In this case, it has been used to analyze the most relevant aspects of pedagogical techniques linked to entrepreneurship, specifically on the main issues discussed above. In particular, in this research, scientific networks were mapped using Biblioshiny (R package) (Aria & Cuccurullo, 2017), which is a widely used method in contemporary bibliometric studies.

3.1. Data

3.1.a Selection of 10 active learning methods

For this study, we first established a list of 10 active learning methods used in entrepreneurship education and characterized the main interactions they involve.

<<Insert Table 1>>

3.2. Systematic literature review

To identify current research trends related to these 10 active learning methods used in teaching entrepreneurship, we conducted a systematic review of the literature. The search term was ST= ("Business Plan Competition" OR "Serious Games" OR "Peer mentoring" OR "Communities of practice" OR "Peer to peer learning" OR "External Mentoring" OR "External coaching" OR "Live Cases" OR "Street Challenges" OR "Co-Development" AND "entrepreneurship") in full text. In addition, when retrieving publications, we considered documents published only in English and with a DOI in a valid format. With these search criteria, 1059 documents were selected from the Web of Science, Dimensions.ai and Scopus databases, from which an SLR analysis was performed as proposed by other authors such as Skare et al. (2022) and Cano-Marin et al. (2023).

3.3. Methods of analysis

First, we extracted metadata and information on the chosen publications from the Web of Science, Dimensions.ai and Scopus databases to obtain descriptive information, such as title, abstract, source title, authors, publication year or citation frequency. Such information enabled us to better characterize the existing work on the chosen active learning methods (Vrontis & Christofi, 2021).

To analyze the topics that are linked to the pedagogical elements used for entrepreneurial training, an analysis of the bigrams that appear in the abstracts of the selected documents was carried out. To identify the terms associated with the teaching methods linked to entrepreneurship, an in-depth analysis of the complete documents was carried out, with reference to the key of most frequently used words and the relationships and trends between them over the years. Finally, a qualitative approach was then used by the authors to manually identify the pedagogical methods most studied in the literature in line with the ecosystem-based approach.

4. Results

4.1 Co-occurrence networks

Based on the relationship between the words in the scientific papers analyzed, it can be seen in Figure 1 that there are four clearly differentiated clusters. The most relevant cluster refers to entrepreneurial education, skills and different methods used, such as blended learning, experiential learning or peer mentoring. Moreover, authors such as Allahar and Sookram (2019) have stated in this regard that entrepreneurial development will require tailored entrepreneurship programs, which allow for tailored education in entrepreneurial skills and characteristics. Such tailored programs are based on the development of an entrepreneurial mindset and may involve the personalization of learning objectives and topics. The evaluation of learning outcomes seems to be an emerging topic within this cluster. The second cluster, represented in blue, is focused around entrepreneurial activity, with nascent entrepreneurs or entrepreneurial skills being some of the most important words. Thus, skills have been related to entrepreneurship by authors such as Chen (1998). In this cluster, one can also see how technology predominates, especially technology transfer. References to business plans as an educational tool are important within this cluster. In the third cluster, represented in green, experience during the process of learning how to create ventures is predominant, for example, with words such as learning experience, pedagogical practice, empirical evidence or inspiring entrepreneurs. The organization of startup competitions is widely explored. Finally, the last cluster, represented in purple, calls for action and should be highlighted, as it is more linked to entrepreneurial intention and the development of

entrepreneurial intentions and mindsets in specific populations, such as secondary school students or women.

<<Insert Figure 1>>

4.2 Topic evolution and trends

It is normal for there to be uncertainty and evolution in topics today due to constant changes and advances in the world. This can affect various fields and disciplines and can make it difficult to predict the future direction of certain topics. In this sense, we observe the evolution of the topics in entrepreneurship in recent times, which allows us to propose a current research agenda. Consequently, it can be observed that special relevance is currently given to training that enables adaptation. It should be noted that at present, there is a clear link between the concepts of entrepreneurship and its practice and study. Topics related to technology and business seemed to have influenced the research more from 2007 to 2015 than in recent times.

Nevertheless, the analysis of trending research topics from 2012 to 2022 (Figure 2) highlights the consideration of digitalization. In particular, virtual and augmented reality are the most current trending topics. The growth of the digital trend is disruptively changing the world (Nyagadza, 2022), so it can be seen in Figure 2 that although there are still elements of a core curriculum, such as business models, that endure over time, digital elements are becoming much more relevant today. However, with digitalization, a clear trend has been observed among the most relevant topics at present. In addition, in a context of digital transformation, the opportunity to identify and assess interactions or engagement becomes key for conscious entrepreneurial education.

<<Insert Figure 2>>

The predominance of technology-related topics from 2020 onward should be noted in particular in regard to virtual reality, augmented reality and digital technologies. In that area of technology, authors such as Ratten and Usmanij (2021) or Tay et al. (2022) highlight some digital tools or methods linked to entrepreneurial education. Therefore, the current trend and the digital impulse that have transformed pedagogical methods should be highlighted. In addition, the COVID-19 period was an unprecedented shock to global

education stakeholders, which has influenced this trend. In particular, authors such as Secundo et al. (2021) point out how COVID-19 has led to the redesign of entrepreneurial education models considering digital aspects. Digital learning has boomed, and many innovative strategies have been tested and developed, particularly virtual and augmented reality. For instance, as Yang et al. (2022) and Zulficar et al. (2021) mentioned, virtual simulation games have been a useful and innovative pedagogical method for entrepreneurship courses during the COVID-19 pandemic. Studies on digitalization in entrepreneurship courses have been conducted for ten years, and in recent years, studies have apparently focused more on how to use digitalization for designing, assessing or developing new educational programs in entrepreneurship. The teaching impact of serious games can be enhanced by artificial intelligence, e.g., by providing targeted feedback from teachers to learners (Chen et al., 2022). Thus, the context of digital transformation in entrepreneurship education can foster research on interaction management through the development of innovative tools and works on new teaching models. Hence, digital technologies, particularly artificial intelligence and big data, can support reflections on the personalization of learning.

5. Proposal of an ecosystemic approach

Taking into account the results obtained in the assessment of the trends and links between elements related to pedagogy and entrepreneurship and considering the existing gap between biotic interactions and entrepreneurship since no other research explicitly mentions this link, this section proposes a new approach based on how ecological sciences can enable teachers to better manage interactions.

5.1 Biotic interactions approach: From ecosystems to biotic interactions

The results of the systematic literature review highlight the important role played by different pedagogical methods in classrooms, companies and ecosystems in general in the proposed model for entrepreneurship education. Entrepreneurship has been understood as a process of decision-making through the identification of opportunities (Abatecola et al., 2022). Moreover, biology and ecology often inspired research on entrepreneurship and entrepreneurship education, particularly in regard to entrepreneurial ecosystem topics (Aldrich, 2008; Clarck, 2003; Toutain et al., 2014). Adopting an ecosystemic approach allows the issue of interactions in the classroom to be addressed, considering this space as the ecosystem in which teachers deliver entrepreneurship education and in which relationships are formed among the parties involved in the whole process. Ecological sciences can add

interesting insight into the function of entrepreneurial ecosystems and help understand interactions as vectors of entrepreneurship education.

Entrepreneurial research has adopted a transdisciplinary approach to explore the concept of entrepreneurship ecosystems for years (Isenberg, 2016). Nevertheless, studies seem to mainly consider the “beneficial relationships” generated by entrepreneurship ecosystems (Theodoraki et al., 2022), such as symbiosis or coopetition (Cavallo et al., 2019; Theodoraki et al., 2020a), and avoid negative interactions. Thus, the analysis of interactions in entrepreneurship ecosystems should take into account all types of interactions. Ecological sciences, and biotic interaction theories in particular, may rise to this challenge. Recent studies invite us to refer to the ecological sciences as the sciences that study the relationship between organisms and the environment in which they live (Haeckel, 1866), to lead more accurate research on human interactions (Debourdeau, 2016).

Biotic interactions may permit a deeper understanding of the interactions played in entrepreneurship ecosystems, particularly educational entrepreneurship ecosystems. According to biotic interaction theories (Cheng, 1991, Goudard, 2007), each individual or population can have a positive (facilitation), negative (inhibition) or neutral effect on another individual or population. The interactions of facilitation include the following: a) mutualism, a phenomenon of beneficial association between two living species. This can be optional (protocooperation) or mandatory, in which case it is called symbiosis. B) Cooperation, an association of two living beings where both partners derive benefits from a noncompulsory relationship. C) Commensalism, a direct or indirect interaction between two species from which only one benefits, without harming the other. The interactions of inhibition include the following: a) competition, an indirect or direct interaction of an antagonistic nature; b) predation, an instantaneous direct interaction, of a unilaterally harmful antagonistic nature, between a species identified as a predator and from one to several species identified as prey; c) parasitism, a lasting direct interaction, of a unilaterally harmful to detrimental antagonistic nature, between species identified as parasite(s) and species identified as host(s), on which the "harmful" species will unilaterally depend on a trophic and vital level for all or part of its life; and d) amensalism, a direct or indirect interaction between two species, without impact for one but harmful or detrimental for the other. In addition, the absence of competitive, commensal or mutualist interactions between two species refers to neutral interactions.

Knowing these types of interactions may help build new interaction management models for entrepreneurship teachers and educational programs. At the scale of the entrepreneurship

course, one or more of these interactions are at stake depending on the educational tools and strategies used. For instance, in recent decades, business plan competitions have boomed in entrepreneurship courses, and such methods can foster toxic interactions in entrepreneurship classrooms during the course. Thus, research on educative entrepreneurship ecosystems is mostly developed at a macrolevel, considering entrepreneurial universities, and there is a lack of studies considering the entrepreneurship course as an ecosystem.

We assume that managing interactions in an entrepreneurship course is a matter of fostering interactions between human agents of the ecosystems and limiting the risks of internal or external conflicts. Thus, the identification of biotic interactions in their courses may enable better teacher management of interactions. For instance, they can identify and/or integrate types of facilitation (mutualism, cooperation or mutualism) to foster interactions in their courses. In addition, by identifying inhibitory tactics, such as predation or parasitism, they can act to limit the risks of conflict. Competition is a special case in course interaction management, as it can have a positive impact (such as coopetition or emulation) or a negative impact on the course (such as conflicts, discouragement or dropouts).

Following this novel approach, different management practices have been identified in the literature considering the interactions that develop through the lens of biotic interactions. For each active learning method selected in the previous section, we identified the category of biotic interactions that would be involved in the process (competition, symbiosis, mutualism, parasitism, commensalism, and/or predation) and the interaction management challenges they may represent for teachers (fostering interactions or limiting internal or external conflicts).

The most relevant results from the previous literature review of pedagogical strategies were then put into this perspective. Thus, the analysis of this literature through the lens of biotic interaction theories led us to propose an interaction management approach in an entrepreneurship course (Table 2).

<<Insert Table 2>>

Examining the studies of good practices of interaction management in entrepreneurship courses through the lens of biotic interaction theories, we identified the entrepreneurship teacher as a key element in the student-centered learning environment, based on innovative

pedagogies and built on values such as openness, trust, listening, integrity, humility or healthy competition (Table 2).

According to the similarities detected in the analysis, teachers must propose adaptable and personalized solutions. In this sense, social intelligence is identified as a variable that significantly influences the ability of the teacher to manage interactions for quality teaching. Thorndike (1920) presented social intelligence as "the ability to understand others and to act appropriately in interpersonal relationships". Riggio (1986) proposed a model of social intelligence based on different skills: emotional efficacy, social efficacy, emotional sensitivity, social sensitivity, emotional control and social control. For Gardner (1996), intelligence is an ability that can be developed, and social intelligence is also one of the "multiple intelligences" in the model he proposed. As demonstrated by Riggio and Reichard (2008), social intelligence can foster effective leadership skills, which can be useful for course management, thus becoming relevant in the optimization and development of training courses.

<Insert Figure 3>

On the other hand, pedagogical follow-up is required in training courses since methodologies are constantly changing and adapting to the changing needs of the environment. In particular, authors such as Botha and Robertson (2014) emphasize the usefulness of a detailed business plan for evaluating opportunities.

This means reinforcing pedagogical engineering skills and the ability to adapt pedagogical solutions to each context. In light of the need for adaptability, the variety of existing pedagogical innovations and methodologies and their link with the environment should be taken into account. In this way, the capacity to adapt pedagogical solutions to each context is reinforced, influencing the quality of teaching and knowledge transfer.

Conclusion

The aforementioned findings allowed us to answer the research questions addressed in the present study. Regarding RQ1, a growing tendency for terms related to education and digital methodologies is observed in recent years, coinciding with the pandemic situation. At the same time, there is an evolution in the terms used to describe the design of training and self-

study key concepts, which allows us to consider the relevance of the personalization of education. Digitalization and gamification appeared as relevant concepts for the development of more research on the field of interaction management in entrepreneurial courses.

In addition, considering the novel approach of this research and in response to RQ2, it is observed that there is a relationship between ecological interactions and those that occur in the teaching processes related to entrepreneurship. By focusing on the interactions in entrepreneurship education through the scope of theories of ecological interactions, we noted the importance of building a learner-centric environment built on positive values which require the entrepreneurship teacher to develop social intelligence. Overall, the results of this study highlight the importance of considering the complex relationships and interactions in the ecosystem when implementing entrepreneurship education initiatives.

Previous research in the field has not fully explored the potential of using the principles of ecology to inform entrepreneurship education. This absence suggests that opportunities may exist for new and innovative approaches in the future. By taking into account a wider range of proposed ecological concepts and principles, teachers can better understand how an entrepreneurial education that takes into account the relationships and interactions within the ecosystem can impact the construction of learner-centered environments.

Limitations

This research is not without limitations. Thus, it should be considered that the link to ecology does not appear in scientific articles that relate entrepreneurial education and the different pedagogical methods selected; therefore, a theoretical approach has been used in this aspect that lays the groundwork for future research and contributions. The interaction management model that we propose is based on a theoretical approach that will have to be contested in practice or through different empirical models that allow further research on this topic. On the other hand, language is also another limitation, since English has mainly been considered in the SLR. Thus, taking into account these characteristics, it is possible to derive future contributions that compare the state of the art in this area of analysis in another language or even in another publication format, thus accessing the scientific relevance of the contributions at a geographic level.

Theoretical and Practical Implications

With our study, we propose to understand differently the dynamics operating in an entrepreneurship course by considering the course as an ecosystem, which focuses mainly on interactions. This allows for a different approach since most studies on entrepreneurial educational ecosystems examine the macro level. Our research contributes to theoretical development within the field of entrepreneurship education through the introduction of theories related to social intelligence and leadership to the role of entrepreneurship teachers. In addition, entrepreneurial education and innovative pedagogical methods are considered to help develop strategies that favor the relationship between teachers and students and therefore facilitate the learning process. In this sense, our study is a proposal to consider the topic of interactions in an entrepreneurship course differently. Accordingly, the study may help entrepreneurship teachers adapt to the evolution of their role by offering them concrete strategies and tools to manage interactions in a better and more current way. It may inspire decision-makers and educational institutions to develop impactful training programs for entrepreneurship teachers. As there is a lack of training for entrepreneurship teachers, our study may inspire new training models based on the development of social intelligence and leadership skills. Such programs may reinforce the quality of entrepreneurship courses and the adaptation of the teacher to the social constructivist paradigm.

Future research lines

Researchers may draw inspiration from the directions we propose to lead deeper inquiries into transdisciplinary studies on the way that ecological sciences can provide an accurate understanding of entrepreneurship ecosystems and educational entrepreneurship ecosystems in particular. In addition, considering the scarcity of research on the subject of interaction management in entrepreneurship courses, a call for research is made.

- There needs to be more studies on how digital technologies and specifically digitalization can enable the personalization of entrepreneurial learning and reinforce the quality of entrepreneurial courses. Such research may focus on digitalization as a business intelligence tool assisting teachers in the decisions they have to make to manage interactions during lessons. Thus, studies should focus on how digitalization enables a better analysis and assessment of the interactions at play during the course and on the outcome of entrepreneurship courses. Research can also be launched on the effect of interactions in a course on student engagement and satisfaction.

- More research is needed from a practical perspective in training management, including research based on the impact of serious gaming in entrepreneurship courses. Qualitative research may be conducted on interaction and gamification to identify more realistic design practices and animations of gamified entrepreneurial courses;
- Research needs to consider entrepreneurship courses as ecosystems. To this end, qualitative studies are suggested to analyze internal and external interactions and student awareness. On the other hand, research on social intelligence in entrepreneurship education seems relevant in terms of the needs for adaptation to the environment and to continuous changes. At the same time, the link between pedagogical methods and biological interactions may differ in different countries, so analyzing and comparing these links at the international level will be fundamental to further deepen the topic.

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Tables and Figures

Method	Interactions	References
Business plan competition	<ul style="list-style-type: none"> - Between learners of the same team. - Between different teams - Between learners and teachers - Between learners and counterparts 	Mc Kenzie & Sansone, 2019 ; Watson et al., 2017; Watson et al. 2015 ; Russel et al., 2008 ; Gailly, 2006
Communities of practice	<ul style="list-style-type: none"> - Between entrepreneurs - Potential presence of facilitators 	Toutain et al., 2017, Léger-Jarniou, 2012
Codevelopment	<ul style="list-style-type: none"> - Between learners - Teachers are facilitators 	Ballon, & Veyer, 2020; Payette & Champagne, 1997
External coaching	<ul style="list-style-type: none"> - Between coaches and learners - Teachers are facilitators 	Fitouri & Zouaoui, 2021
External mentoring	<ul style="list-style-type: none"> - Between mentors and mentees - Teachers are facilitators 	McKevitt & Marshall, 2015; St Jean & Audet, 2009
Live cases	<ul style="list-style-type: none"> - Between learners - Between learners and entrepreneurs - Between learners and teachers - Between teachers and entrepreneurs 	Ilonen & Hytti 2022 ; Neubert et al., 2020 ; Carrier, 2007
Peer mentoring	<ul style="list-style-type: none"> - Between mentors and mentees - Between teachers and mentors - Between teachers and mentees 	Voldsund & Bragelien, 2022; Kubberrod & Fosstenlokken, 2018,
Peer-to-peer learning	<ul style="list-style-type: none"> - Between entrepreneurs 	Foliard, 2021 Xu et al., 2021

	- Potential presence of facilitators	
Serious games	<ul style="list-style-type: none"> - Between learners and teachers - Between learners - Role of digital technologies (virtual reality, artificial intelligence, big data...) in interactions. 	Ala & al., 2022; Bhullar & Aggarwal, 2022
Street challenges	<ul style="list-style-type: none"> - Between learners and entrepreneurs - Between learners and prospective clients - Between teachers and entrepreneurs 	Mc Ardle & de Konning, 2022

Table 1: Selection of 10 active learning methods in entrepreneurship education

	Pedagogical tools	Interaction management challenges	Key success factors
Mutualism	Peer mentoring <i>Voldsund & Bragelien, 2022; Kubberod & Fosstenlokken, 2018</i>	Foster interactions	Good relationship Commitment and motivation Trust Regularity of contacts Values and ethics Listening Attributes to mentor Structured academic program
	Peer-to-peer learning <i>Foliard 2021; Xu et al., 2021</i>	Foster interactions	Variety of speakers, pedagogical organization
	External Mentoring McKevitt & Marshall, 2015; <i>St Jean & Audet (2009)</i>	Foster interactions	Efficient mentoring system, listening abilities, quality of the match
	Communities of practice <i>Toutain et al., 2017 ;</i>	Foster interactions	Listening and, network-oriented abilities

	<i>Léger-Jarniou, 2012</i>		
Cooperation	Co-Development <i>Payette & Champagne, 1997</i>	Foster interactions	Knowledge of codevelopment techniques, trust, openness
	Street Challenges <i>Mc Ardle & de Konning, 2022</i>	Foster interactions	Good sense of observation and opportunity detection, ability to build faithful connections
	Business Plan Competition <i>Russel et al., 2008</i>	Foster interactions	Cooperation between team members or with counterparts (like mentors, coaches, prospective clients...)
Commensalism	External coaching <i>Fitouri & Zouaoui, 2021</i>	Foster interactions	Organization enhancing learning benefits
	Live cases, testimonials <i>Ilonen & Hytti 2022; Neubert et al., 2020; Carrier, 2007</i>	Foster interactions	Pedagogical engineering, listening and understanding the needs of learners, network-oriented
Competition	Business Plan Competition <i>Szymanska, 2020 ; Mc Kenzie & Sansone, 2019 ; Watson et al., 2017 ; Watson et al., 2015 ; Botha & Robertson, 2014 ; Gailly, 2006</i>	Foster interactions	Network-oriented, promotion of healthy competition, foster cooperation between team members and counterparties, supportive learning environment based on dialogue, goodwill and confidence
	Serious Games <i>Kusdiyanti et al., 2022; Chen et al., 2022; Allegra et al., 2022; Ahsan & Faletahan, 2021; Thanasi-Boçe, 2020; Chaarouf & Yousra, 2019; Ruiz-Alba et al., 2019; Carrier 2007</i>	Foster interactions	Learner-centric, knowledge of experiential learning
Predation	Business Plan Competition <i>Avila-Merino, 2019; Cant, 2018</i>	Limit internal and external conflicts	Promotion of healthy competition, respect, continuous feedback, recognition for all learners, follow-up.

Parasitism	Business Plan Competition <i>Pittaway & Edwards</i> <i>2012</i>	Limit internal and external conflicts	Peer assessment
Amensalism	All pedagogical tools	Limit internal and external conflicts	Learner-centric, listening, care, self- confidence

Table 2. Association of terms based on interaction management in entrepreneurship courses

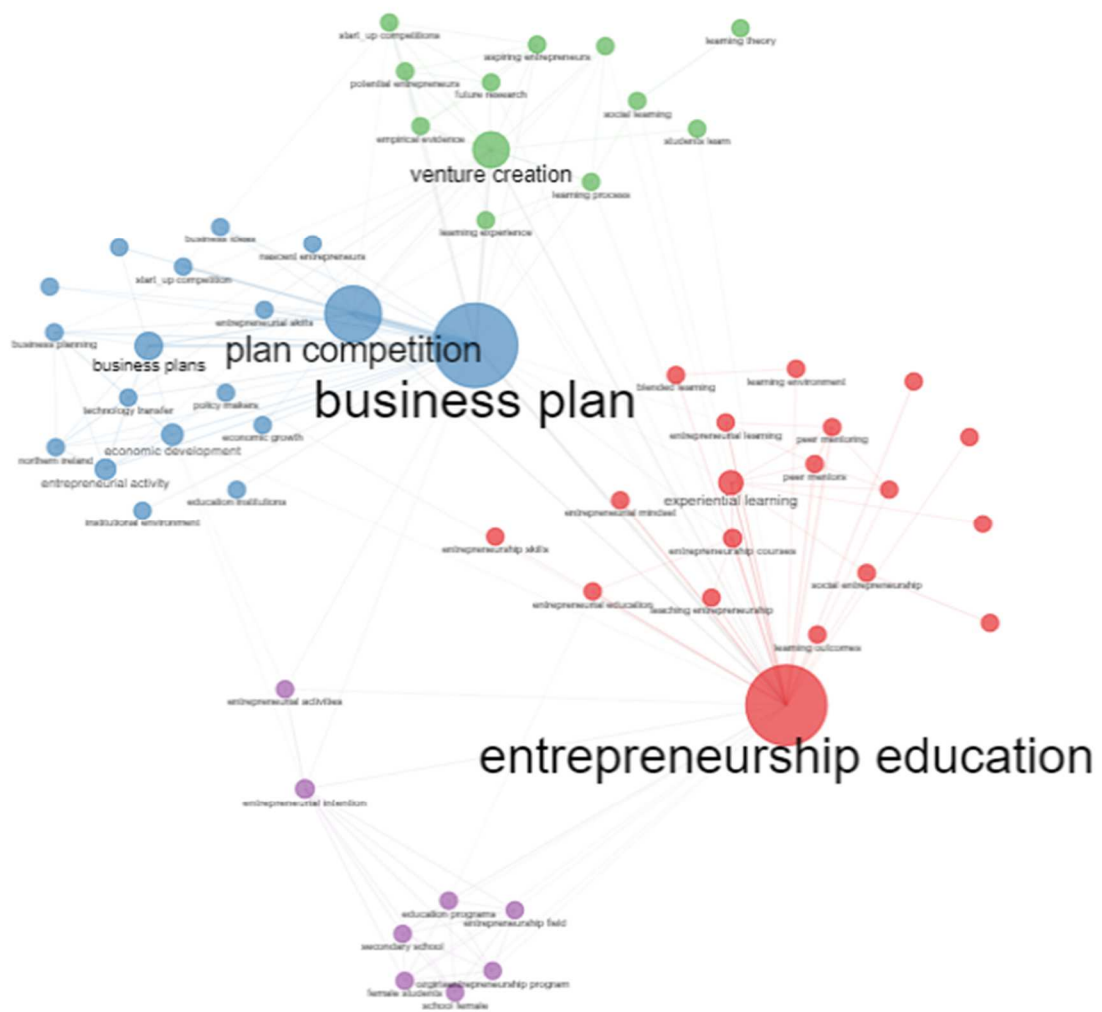


Figure 1. Co-occurrence networks from bigrams from abstracts

Trend Topics

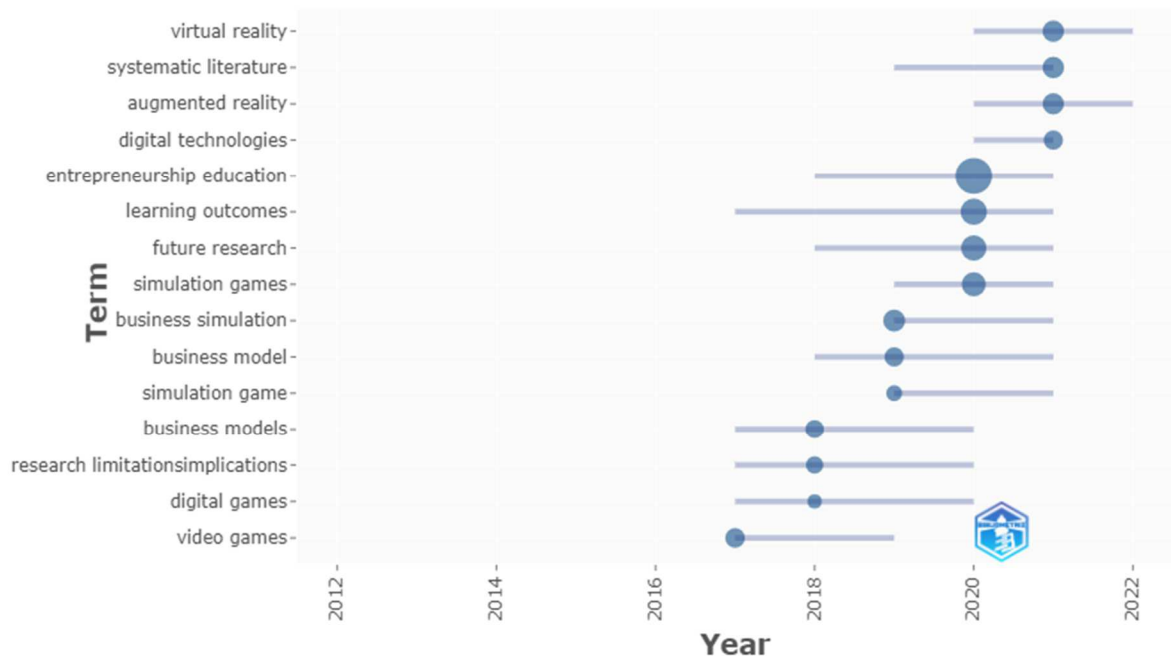


Figure 2. Trend Topic 2012-2022

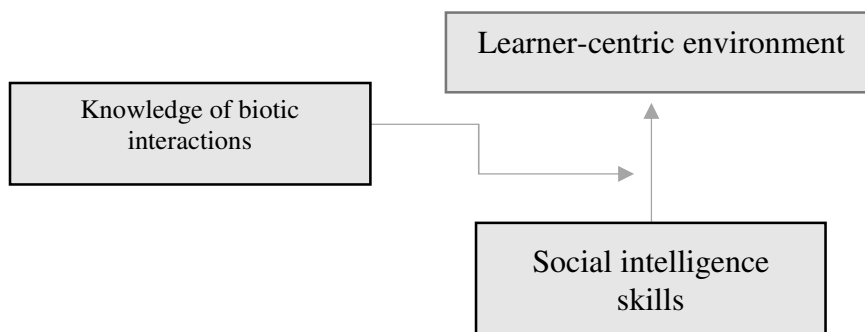


Figure 3: Model of teacher skill development for interaction management in an entrepreneurship course



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