

# Entrepreneurship Education at University: Towards a Review of Effective Learning Models\*

Katarina Milosavljević, Zoran Rakićević, Jovana Rakićević\*\*

## Abstract

Expanding upon existing reviews on entrepreneurship education, this article provides an overview of effective learning models classified as either generalised, augmented, motivational, or training type. By subjecting a broader set of studies ( $N = 3,291$ ) to bibliometric analysis, followed by a systematic literature review focusing on a smaller subset ( $n = 90$ ), 25 models were identified. Further investigation revealed that 11 of these models were of the generalised type, eight were based on augmented approaches, four focused on training, and two represented the motivational type of entrepreneurship education.

**Keywords:** entrepreneurship education, systematic literature review, learning models, students

**JEL Codes:** I21, I23, L26

## 1. Introduction

Entrepreneurship involves a dynamic progression from an innovative concept to enterprise establishment and its evolution into a business capable of generating substantial value (Yıldırım/Aşkun 2012). While entrepreneurship can take many forms, they all entail willingness to take initiative and accept risks in the pursuit of value creation and economic prosperity (Pantea 2018; Tiberius/Weyland 2023). Rakićević et al. (2022) define entrepreneurship as the capacity to overcome resource limitations to capitalise on opportunities. As the conceptual initiators who possess the creativity and drive to realise an idea in practice, entrepreneurs play a crucial role in this process (Yener/Arslan/Demirtaş 2018). Given these attributes, it is not surprising that entrepreneurship is considered crucial for fostering economic growth and generating employment. Although it starts with an individual, it can be promoted not only by governmental and pro-

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\*\* Katarina Milosavljević, PhD Student of Management and Organization, Faculty of Organizational Sciences, University of Belgrade, Belgrade, Serbia. Email: km20225005@student.fon.bg.ac.rs. Main research interests: Entrepreneurship, Project Management, Strategic Project Management.

Zoran Rakićević, Associate Professor, Department for Production and Services Management, Faculty of Organizational Sciences, University of Belgrade, Belgrade, Serbia. Email: zoran.rakicevic@fon.bg.ac.rs. Main research interests: Entrepreneurship, Management of Small and Medium-sized Enterprises, Production Planning.

Jovana Rakićević, Teaching Assistant, Department for Management of Technology, Innovation, and Sustainable Development, Faculty of Organizational Sciences, University of Belgrade, Belgrade, Serbia. Email: jovana.rakicevic@fon.bg.ac.rs. Main research interests: Technology Management, Technology Entrepreneurship, Entrepreneurship Ecosystem Support.

fessional bodies, but also higher education institutions (HEIs), by cultivating an economy with a strong entrepreneurial focus. HEIs serve as vital hubs of fresh knowledge and consistently replenish the entrepreneurial pool with a dynamic influx of students and researchers.

Entrepreneurship has also attracted considerable research interest, contributing to a debate on whether it is an innate personal characteristic or a disposition and skill set that can be learned (Yener et al. 2018). Those taking the latter perspective advocate for the inclusion of entrepreneurship at all educational levels while promoting lifelong learning and ensuring equitable access to all sociodemographic groups. This approach was adopted by the European Union (EU), leading to the establishment of the Lisbon Strategy for fostering lifelong entrepreneurship education in 2000 (João Rodrigues 2006; Cotoi/Bodoasca/Catana/Cotoi 2011; Čekić-Marković 2015). The goal of this initiative was to transform the EU into the world's most competitive and vibrant knowledge-driven economy. In many EU member states, entrepreneurship content is already integrated into the curriculum across different educational levels. For example, in Slovenia, as a part of the "Entrepreneurship on the Agenda" project funded by the Ministry of Education and Research, primary and secondary school students receive the support needed to start their mini-enterprises, thus contributing to the "Development of Entrepreneurial Culture and Creativity Among Young People" (Lapčević 2017). Similarly, "Junior Achievement" and "K-6" programmes implemented in Estonia allow elementary and high school students to learn about entrepreneurship through play (Lapčević 2017; Hiimäe-Metsar/Raudsaar/Uibu 2021; Loogma/Peterson/Rekkor 2021). Although education has already experienced a considerable shift toward a more interactive and participatory model, focusing specifically on entrepreneurship is a remarkable shift within the educational framework. Inclusion of such subjects in secondary and tertiary education is of particular importance, as students can utilise the knowledge gained to start a business upon graduation (Dorji 2021; Ibrahim/Mohd Razali/Shekh/Zain/Ismail/Ya 2021). While business schools seem the most logical places for learning about entrepreneurship, such education should be offered as a part of other disciplines (Christensen/Arendt/Hjorth 2023), such as art, science, and engineering (Rajchamaha/Prapojanasomboon 2022). Most importantly, entrepreneurship should be taught via a formal and structured programme, enabling students to master the key concepts while developing the much-needed discipline and perseverance.

The growth in entrepreneurship education at universities has also inspired a large number of studies exploring its impact on students' entrepreneurial intentions. For example, Hanandeh et al. (2021) found that this kind of education promotes an entrepreneurial mindset, increasing the likelihood that students will pursue their innovative ideas through start-ups. Ncanywa and Dyantyi (2022) similarly noted that universities might mitigate the growing graduate unemployment

ment by incorporating entrepreneurship education in their curricula. Loboda et al. (2019) concur with this view, adding that this process could be aided by Information and Communication Technology (ICT) tools. Still, the success of such initiatives depends on the appropriate selection of entrepreneurship education models (Boldureanu/Ionescu/Bercu/Bedrule-Grigoruță/Boldureanu 2020), as challenge-based learning (Colombelli/Loccisano/Panelli/Pennisi/Serraino 2022) has been shown to boost students' confidence in their ability to start a business.

Against this backdrop, the aim of the present study is to provide a comprehensive overview of entrepreneurship education. The obtained findings are used to categorise entrepreneurship learning models adopted at HEIs into four pre-defined groups, while identifying those that are most effective in promoting entrepreneurship.

Accordingly, after presenting an introduction and a theoretical background, the research methodology is described in detail. The obtained results are discussed next, and the key conclusions are drawn, complemented by a review of entrepreneurial learning models provided in the Appendix. Finally, study limitations are delineated, along with suggestions for future research directions in this domain.

## II. Theoretical background

Entrepreneurship education is a dynamic and multifaceted process that aligns with the spirit of innovation and originality. Its primary goal is equipping students with the knowledge and skills needed to pursue a career path of their choice with drive and enthusiasm (Gundry/Ofstein/Kickul 2014). Whether they opt for conventional employment, initiate their entrepreneurial ventures, or pursue advanced studies upon graduation, students should be taught within an environment that is conducive to personal growth and achievement (Krpalek/Krpáľková Krellová/Berková 2018).

As Vivekananth et al. (2023) pointed out, entrepreneurship education at HEIs is vital for empowering the entrepreneurial ecosystem and contributing to job creation and economic growth. Thus, it has to promote an entrepreneurial mindset and propensity for innovation but also address the practicalities of organisational management, financial planning, and other aspects involved in starting and growing a business (Raudsaar/Kaseorg 2016). Most importantly, entrepreneurship education must integrate practical elements rooted in entrepreneurial experiences (Kremel/Wetter-Edman 2019). This entails creating a learning environment where students are immersed in a wide range of entrepreneurial activities, gaining a genuine understanding of the challenges and opportunities that may arise in real-life scenarios (De Carolis/Litzky 2019; Xiaoxing 2020). Such a comprehensive approach bridges the gap between theory and practice, enabling students to navigate the complexities of the entrepreneurial landscape with con-

fidence and competence (Kremel/Wetter-Edman 2019). Although entrepreneurship has traditionally been associated with small business initiation (including visionary spinout companies) and the expansion of small enterprises (Yıldırım/Aşkun 2012), academic institutions are increasingly shifting toward other entrepreneurship types.

The wide variety of forms that entrepreneurship education may take is also reflected in the diversity of studies on this topic. As shown in Table 1, Shabbir et al. (2022) conducted bibliometric analysis using VOSviewer and Scopus database, providing valuable insights into the utility of this approach in enhancing research in this field. Inspired by their work, bibliometric analysis supported by Bibliometrix and the Web of Science database was adopted as a research methodology for the present study. Similarly, drawing upon the typology proposed by Sirelkhatim and Gangi (2015), who categorised entrepreneurship learning into three types—learning about, for, and through entrepreneurship—a type-oriented approach was utilised to provide a detailed overview of various entrepreneurship models and their applications. As a part of their recent qualitative study, Jardim and Sousa (2023) analysed ten influential articles on entrepreneurship education, highlighting its importance for academic success as well as career prospects in the digital era, thus justifying the need for the research presented here.

Given the variety of factors that influence the success of any educational framework, identifying the most effective entrepreneurship education model is challenging, as this necessitates consensus on not only what entrepreneurship education entails but also how its outcomes are measured. Thus, rather than attempting to address this issue, the aim of this study is to provide a holistic overview of the currently utilised entrepreneurship education models. Its novelty lies in the unique approach for scrutinising the existing models and emphasising their practical implications for students.

Table 1 Overview of selected articles with corresponding insights

Type of analysis	Number of examined articles	Key findings	Future research paths	Literature source
Quantitative Bibliometric analysis (bibliographic coupling, keyword co-occurrence, distance-based mapping, clustering, and co-citation analysis)	1,531 articles published between 1950 and 2021	Research trends: Over the past 15 years, research focus has shifted from conventional approaches to entrepreneurship education towards more nuanced and outcome-oriented factors such as intentions, motivation, attitude, and behaviour.  Hot topics: Entrepreneurial intentions emerged as the predominant research topic, closely followed by practice, innovation, and entrepreneurial learning.	Scrutinising entrepreneurial institutions in general (Ruiz-Alba/Guzman-Parra/Vila Oblitas/Morales Mediano 2021) and focusing on undergraduates' entrepreneurial ambitions (Tingting/Jiangfeng/Yinghua 2022).	Shabbir et al. (2022)
Qualitative Systematic literature review (six phases)	129 articles categorised into two groups: 32 considering entrepreneurial learning (EL) and 97 focusing on entrepreneurship education (EE)	EL: Entrepreneurial competencies include creative problem-solving, opportunity recognition and assessment, risk management, value creation, and leveraging social connections. These competencies are developed through learning by doing, learning from failure, case studies, real projects, role-playing, scenarios, and discussions.  EE: Three main EE goals are identified – raising awareness about entrepreneurship, for entrepreneurship (awakening students' intentions to become entrepreneurs in the future), and <i>through</i> entrepreneurship (suggesting learning "with" and "through" real-life entrepreneurship to enable students to experience "being" entrepreneurs).	Analysing the role of EL and EE by comparing online and blended entrepreneurship education (Chen/Ilfenthaler/Yau 2021) and drawing parallels with learning from failure (Lattacher/Wdowiak 2020).	Sirelkhaitim and Gangi (2015)
Qualitative Detailed overview of ten articles published in a selected special issue on entrepreneurship education	Ten articles	Considerations for the future: Adequate entrepreneurship education should equip students for the modern workforce.  Novel learning methodologies: Students consider problem-based learning crucial for their progression through university courses.	Additional detailed analysis of articles considering the impact of EE on the rise of several firms established by students (Breznitz/Zhang 2022).	Jardim and Sousa (2023)

III. Research methodology

The research methodology adopted for this study consists of a bibliometric metadata analysis followed by a systematic literature review.

A. Bibliometric analysis

The Web of Science database was chosen for metadata analysis due to its recognised integrity and reliability (Birkle/Pendlebury/Schnell/Adams 2020; Dabić/Marzi/Vlačić/Daim/Vanhaverbeke 2021). Using the phrase “models of entrepreneurship education for students” and the “All Fields” option, comprehensive searches across all searchable fields with a single query were conducted on August 18<sup>th</sup> 2023, yielding 3,291 articles.

To facilitate the analysis of such a large corpus of papers, Bibliometrix was adopted, as this software incorporates various essential bibliometric analysis methods and is commonly used in quantitative scientometric and bibliometric research (Aria/Cuccurullo 2017). Specifically, the Biblioshiny application was utilised due to its user-friendly interface (Aria/Cuccurullo 2017). The key meta-data pertaining to the analysed 3,291 articles is provided in Figure 1.

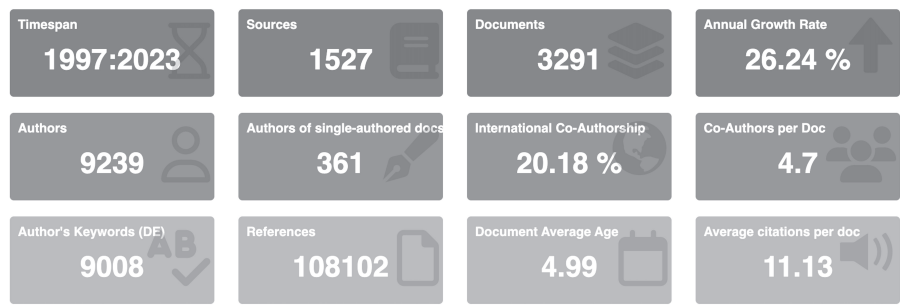
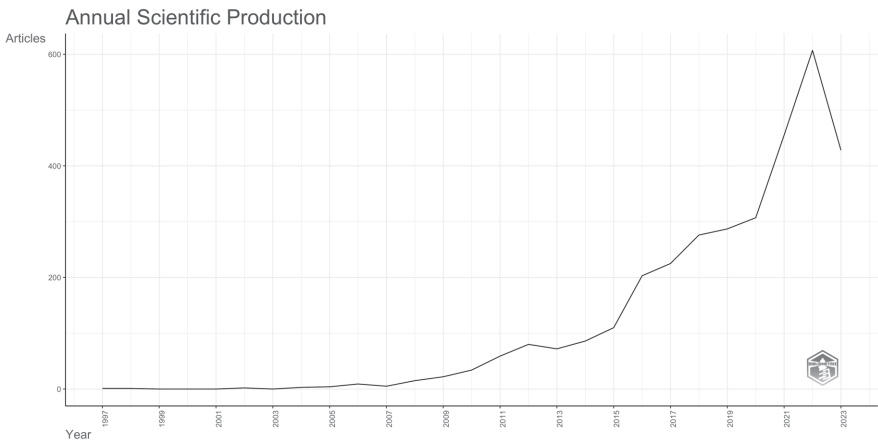


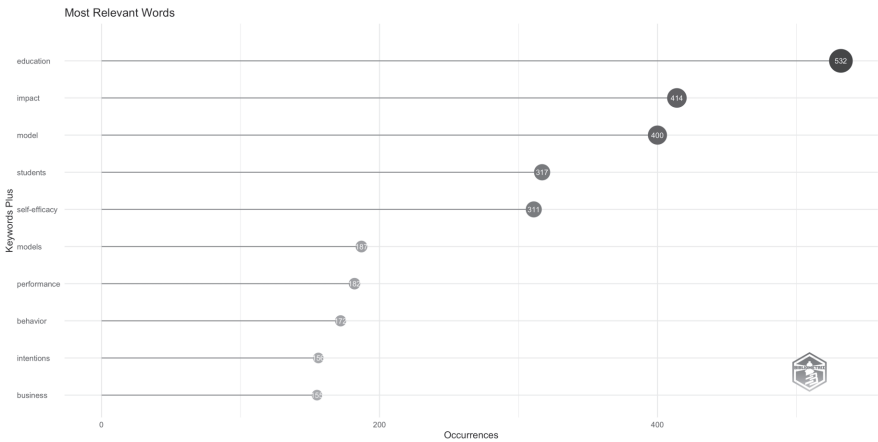
Figure 1 The key characteristics of the articles included in bibliometric metadata analysis

As can be seen from Figure 1, in the 1997–2023 period chosen for the analysis, the number of publications pertaining to entrepreneurship education models increased at an annual rate of 26.24 %. However, significant growth began in 2012 and peaked in 2022 with 607 papers (Figure 2), indicating that this is a rapidly expanding research field.



**Figure 2 Annual scientific production**

As shown in Figure 3, the most frequently used words in these publications are “education” (532 occurrences), “impact” (414), and “model” (400).



**Figure 3 Most frequently featured words**

The collaborative country map depicted in Figure 4 illustrates the participation of different nations in joint entrepreneurship education endeavours driven by the scientific community.

Country Collaboration Map

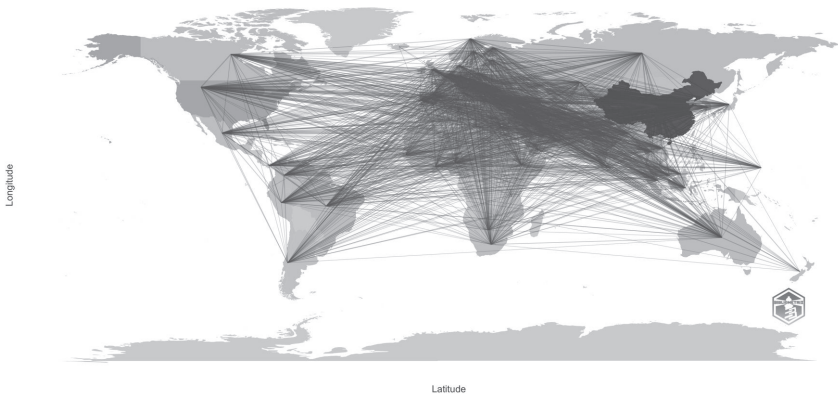


Figure 4 Country collaboration map

Table 2 presents an overview of publications resulting from collaborations between researchers from Central and Eastern European countries.

Table 2 Number of publications resulting from research collaborations involving Central and Eastern European countries

Participating countries	Number of publications
Estonia and Poland	9
Ukraine and Poland	5
Romania and Poland	5
Czech Republic and Romania	5
Czech Republic and Poland	4
Hungary and Romania	4
Hungary and Czech Republic	3
Lithuania and Latvia	2

B. Systematic literature review

The systematic literature review comprised the identification, screening, eligibility, and inclusion phases, as recommended by Xiao and Watson (2019) and depicted in Figure 5.

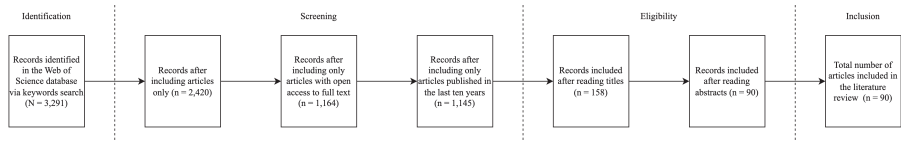


Figure 5 Systematic literature review flow (Xiao/Watson 2019)



During the screening phase, papers featured in conference proceedings, meeting abstracts, book reviews, and similar documents were excluded, thus reducing the initial pool of 3,291 articles to 2,420. Next, by eliminating articles that could not be accessed in full, the sample was reduced further to 1,164. Finally, by restricting the focus on the papers published in the last ten years, 1,145 remained. This set was further narrowed down to 158 by reading the titles and subsequently to 90 by evaluating the abstracts. Only 21 of these articles described one or more entrepreneurship learning models, resulting in 25 models that were subjected to further scrutiny.

Guided by the classification adopted by Hasan et al. (2017), Panfilova et al. (2019), and Boldureanu et al. (2020), the following types of entrepreneurship education were identified: generalised, motivational, augmented, and training. According to Hasan et al. (2017), generalised entrepreneurship education aims to provide the theoretical knowledge students can rely upon as they transition into real-life opportunities. On the other hand, motivational entrepreneurship education focuses on promoting the self-determination and self-confidence needed to create and lead an enterprise (Hasan et al. 2017). The aim of augmented entrepreneurship education is to simulate business practices, allowing students to develop and maintain sophisticated entrepreneurial skills (Hasan et al. 2017; Panfilova et al. 2019; Boldureanu et al. 2020). While a similar approach is taken by the training-based models based on real projects, they are typically implemented within academic institutions, whereas augmented education may be provided by other stakeholders with expertise in business or a specific industry sector (Hasan et al. 2017; Panfilova et al. 2019; Boldureanu et al. 2020). Table A (presented in the Appendix) provides an overview of the 25 models described in the 21 reviewed articles, categorised into one of the aforementioned types of entrepreneurship education. Where available, the number of study participants is included, along with the study programmes into which the models are incorporated and the key findings.

#### IV. Discussion and conclusion

As can be seen from Table A presented in the Appendix, 11 of the described models belong to the generalised type of entrepreneurship education, while eight pertain to the augmented, four to the training, and two to the motivational category. However, two of the generalised models pivot towards the practical application of holistic entrepreneurship learning. One of these models suggests replacing the traditional undergraduate thesis with start-up programme management (Liu/Galichkina/Kurilova/Vlasova 2021), while the other proposes online learning that connects universities, government, and industry (Tóth-Pajor/Bedő/Csapi 2023).

Analyses further revealed that the emphasis on innovation is the key focal point of both generalised and augmented models. Whether promoted through

studio-based projects, game theory applications, simulations, or virtual reality experiences, innovation stands out as a consistent objective of education aimed at fostering entrepreneurial skills. Several models are developed from a global perspective, exemplified by initiatives like the Network of multidisciplinary ideation and business model generation (NETMIB) incubation platform. This international orientation prioritises collaboration among universities from different parts of the world with the goal of addressing the common socioeconomic challenges on a global scale (Tóth-Pajor et al. 2023). Moreover, most augmented models emphasise the benefits of integrating technology such as virtual reality, computer-assisted instruction (CAI), and gamification into the curriculum to enrich the learning experience and create a dynamic and engaging educational environment for students. Oe and Tanaka (2023) also advocate for the inclusion of business-oriented activities, such as SWOT (Strengths, Weaknesses, Opportunities, and Threats) analysis, to complement materials based on the social learning theory.

Training models expose students to various ways of founding and organising start-ups, helping them learn the practical aspects of establishing and running entrepreneurial ventures. There are numerous examples of such initiatives, including LearnFab—a company run by students who are in charge of managerial and operational activities—which led to the creation of six start-ups (Fischer/Rosilius/Schmitt/Bräutigam 2021). Gruendungsgarage, another start-up accelerator programme, has brought 130 new jobs to the economy (Glinik 2019). Motivational models are particularly effective in enhancing student motivation as they often include gamified entrepreneurship courses and promote engagement of alumni entrepreneurs in start-up initiatives.

Some of the models described in the reviewed articles are geared toward specific learning outcomes. For instance, the NETMIB incubation platform aims to elevate participants' self-esteem, whereas the CAI model is designed to enhance entrepreneurial interest, skills, and knowledge among musical talents. The level of learning process interactivity also varies, whereby models such as the hackathon and the Virtual Reality-Interactive Learning Model (VR-ILM)-based Smart Space focus on hands-on, interactive experiences, while others often rely on a more conventional lecture-based approach.

Evidence of the significant impact of specific entrepreneurship models on students' skills and intentions supports theories correlating entrepreneurship education and entrepreneurial success. The innovative practices featured in these models also align with the theories advocating experimental and interactive learning methods. Their practical application in different fields of study—including business, economics, engineering, technology, medicine, agriculture, journalism, art, and other domains—highlights the versatility of entrepreneurship education. Many of these models also emphasise the importance of the learning experience. For

example, VR-ILM-based Smart Space incorporating virtual reality and computer-supported systems was shown to increase employment in the real estate services sector by 43 % (Pan 2022), while the CAI model increased students’ entrepreneurial interest, skills, and knowledge by 55.62 %, 57.32 %, and 72.12 %, respectively (Cao 2022). Some models include policymakers among the influential factors, as their decisions determine whether entrepreneurship education will be offered as a part of the curriculum and at which levels. They are also responsible for encouraging practical learning experiences like live case studies and hackathons. A brief overview of the aforementioned implications is given in Table 3.

**Table 3 Theoretical, practical, and policy implications of the study findings**

Theoretical implications	Practical implications	Policy implications
Entrepreneurship education types (generalised, augmented, motivational, and training) provide a diverse theoretical framework for analysing educational outcomes.	Different models are applied across diverse fields (business, engineering, medicine, and others), highlighting their versatility.	Policymakers are encouraged to integrate entrepreneurship education at all levels, focusing on practical experiences like case studies and hackathons.
Applied models significantly impact students’ skills and intentions, supporting the theoretically postulated correlation between education and success.	Learning is enhanced through virtual reality and computer-supported systems.	NETMIB incubator platform exemplifies global collaboration in entrepreneurship education and problem-solving initiatives.
Innovative practices align with theories promoting experimental and interactive learning.	VR-ILM-based Smart Space increased employment by 43 % (Pan 2022) and the CAI model enhanced participants’ skills/knowledge by over 55 % (Cao 2022).	

**V. Limitations and future directions**

The limitations of this study primarily stem from the research methodology and the restrictions imposed on the publication language when conducting database searches. First, as only the Web of Science database—which is one of many relevant databases available—was consulted, this narrowed the research scope. Additionally, a single keyword combination was chosen to obtain a broad range of articles, but other sources could have been potentially uncovered if other combinations were explored.

It is also important to note that the chosen query encompassed “All Fields”, which can sometimes result in less precise outcomes due to searching across all metadata. The inclusion of open access papers published in languages familiar to the authors further reduced the range of articles available for review.

These limitations, however, also offer opportunities for future research in this field, as exploring a larger number of databases and using new keyword combinations would facilitate a more comprehensive analysis. The obtained findings

can also be supplemented by qualitative studies involving expert interviews or focus group discussions with relevant stakeholders.

## References

- Aria, M./Cuccurullo, C. (2017): Bibliometrix: An R-tool for comprehensive science mapping analysis, in: *Journal of Informetrics*, 11, 4, 959–975.
- binti Ibrahim, I. I./bin Mohd Razali, M. F./binti Shekh, R./Zain, M. N. B. M. N./binti Ismail, I./binti Ya, S. (2021): The essential of entrepreneurship inclination in higher learning institution (HLI), in: *International Journal of Academic Research in Business and Social Sciences*, 1, 7, 1677–1686.
- Birkle, C./Pendlebury, D. A./Schnell, J./Adams, J. (2020): Web of Science as a data source for research on scientific and scholarly activity, in: *Quantitative Science Studies*, 1, 1, 363–376.
- Boldureanu, G./Ionescu, A. M./Bercu, A. M./Bedrule-Grigoruță, M. V./Boldureanu, D. (2020): Entrepreneurship education through successful entrepreneurial models in higher education institutions, in: *Sustainability*, 12, 3, 1267.
- Breznitz, S. M./Zhang, Q. (2022): Entrepreneurship education and firm creation, in: *Regional Studies*, 56, 6, 940–955.
- Cao, H. (2022): Entrepreneurship education-infiltrated computer-aided instruction system for college Music Majors using convolutional neural network, in: *Frontiers in Psychology*, 13, 900195.
- Čekić-Marković, J. (2015): Entrepreneurial Education: Comparative overview of educational policies, models and practices, in: *Social Inclusion and Poverty Reduction Team, Government of the Republic of Serbia*.
- Chen, C. (2022): Research on Structuring a “Student-Centered” Training Model of Innovative and Entrepreneurial Graduates in Colleges and Universities, in: *Scientific Programming*, 2022, 1, 9003869.
- Chen, L./Ifenthaler, D./Yau, J. Y. K. (2021): Online and blended entrepreneurship education: a systematic review of applied educational technologies, in: *Entrepreneurship Education*, 4, 2, 191–232.
- Christensen, B. T./Arendt, K. M./Hjorth, D. (2023): How learning spaces matter in entrepreneurship education: introducing the concept of topopraxis, in: *Entrepreneurship & Regional Development*, 35, 3–4, 317–336.
- Colombelli, A./Loccisano, S./Panelli, A./Pennisi, O. A. M./Serraino, F. (2022): Entrepreneurship education: the effects of challenge-based learning on the entrepreneurial mindset of university students, in: *Administrative Sciences*, 12, 1, 10.
- Cotoi, E./Bodoasca, T./Catana, L./Cotoi, I. (2011): Entrepreneurship European development strategy in the field of education, in: *Procedia-Social and Behavioral Sciences*, 15, 3490–3494.
- Dabić, M./Marzi, G./Vlačić, B./Daim, T. U./Vanhaverbeke, W. (2021): 40 years of excellence: an overview of Technovation and a roadmap for future research, in: *Technovation*, 106, 102303.
- De Carolis, D. M./Litzky, B. E. (2019): Unleashing the potential of university entrepreneurship education: A mandate for a broader perspective, in: *New England Journal of Entrepreneurship*, 22, 1, 58–66.

- Dorji, T. (2021): Content Analysis of Entrepreneurship Education in Primary and Secondary School Textbooks, in: *Research in Educational Policy and Management*, 3, 1, 42–59.
- Fischer, S./Rosilius, M./Schmitt, J./Bräutigam, V. (2021): A brief review of our agile teaching formats in entrepreneurship education, in: *Sustainability*, 14, 1, 251.
- Glinik, M. (2019): Gruendungsgarage: A Best-Practice Example of an Academic Start-up Accelerator, in: *International Journal of Engineering Pedagogy*, 9, 3, 33–43.
- Gundry, L. K./Ofstein, L. F./Kickul, J. R. (2014): Seeing around corners: How creativity skills in entrepreneurship education influence innovation in business, in: *The International Journal of Management Education*, 12, 3, 529–538.
- Hanandeh, R./Alnajdawi, S. M. A./Almansour, A./Elrehail, H. (2021): The impact of entrepreneurship education on innovative start-up intention: the mediating role of entrepreneurial mind-sets, in: *World Journal of Entrepreneurship, Management and Sustainable Development*, 17, 4, 856–871.
- Hasan, S. M./Khan, E. A./Nabi, M. N. U. (2017): Entrepreneurial education at university level and entrepreneurship development, in: *Education + Training*, 59, 7–8, 888–906.
- Hasche, N./Linton, G. (2021): University–industry collaboration: constructing a business model lab for student venture creation, in: *International Journal of Entrepreneurial Behavior & Research*, 27, 5, 1241–1263.
- He, Z./Liu, Y./Wang, X./Li, R./Lv, N. (2023): Gamified Entrepreneurship Courses Motivate College Students' Satisfaction: An Integrated Flow Framework, in: *SAGE Open*, 13, 2, 21582440231177029.
- Hiimäe-Metsar, K./Raudsaar, M./Uibu, K. (2021): Development of entrepreneurial literacy in upper secondary school with Junior Achievement tasks, in: *Eesti Haridusteaduste Ajakiri, Estonian Journal of Education*, 9, 2, 184–211.
- Huang, Y./Bu, Y./Liu, L./Xu, D./Xu, Z./Zhao, G. (2022): Relationship between entrepreneurship education curriculum and agricultural students' satisfaction in China, in: *Frontiers in Psychology*, 13, 884565.
- Jackson, A./Henry, S./Jackman, K. M./Jones, L./Kamangar, F./Koissi, N./Hohmann, C. F. (2023): A Student-Centered, Entrepreneurship Development (ASCEND) Undergraduate Summer Research Program: Foundational Training for Health Research, in: *CBE—Life Sciences Education*, 22, 1, ar13.
- Jardim, J./Sousa, M. J. (2023): Research and Trends in Entrepreneurship Education, in: *Education Sciences*, 13, 7, 673.
- João Rodrigues, M. (2006): The Lisbon Strategy after the mid-term review: implications for innovation and life-long learning, in: *Corporate Governance: The International Journal of Business in Society*, 6, 4, 349–357.
- Klucznik-Törő, A. (2021): The new progression model of entrepreneurial education – guideline for the development of an entrepreneurial university with a sustainability approach, in: *Sustainability*, 13, 20, 11243.
- Kremel, A./Wetter-Edman, K. (2019): Implementing design thinking as didactic method in entrepreneurship education. The importance of through, in: *The Design Journal*, 22, 1, 163–175.
- Krpalek, P./Krpálková Krellová, K./Berková, K. (2018): Entrepreneurship in relation to contemporary concepts of education, in: *Marketing and Management of Innovations*, 2, 11–22.

- Lapčević, Z. D. (2017): Entrepreneurship in the subject of technical and informatical education teaching, in: Veljović, A. Proceedings of the second national conference with international participation entitled "Information Technologies, Education and Entrepreneurship 2017 – ITOP17" Technical Faculty Čačak, University of Kragujevac, 475–484, 978–86–7776–211–7.
- Lattacher, W./Wdowiak, M. A. (2020): Entrepreneurial learning from failure. A systematic review, in: *International Journal of Entrepreneurial Behavior & Research*, 26, 5, 1093–1131.
- Lee, Y./Lee, Y. H. (2020): University start-ups: The relationship between faculty start-ups and student start-ups, in: *Sustainability*, 12, 21, 9015.
- Liu, Z. J./Galichkina, M./Kurilova, A./Vlasova, S. (2021): "Start-Up" in E-Learning Mode as a Basic Project of the Final Year of Entrepreneurship Education, in: *International Journal of Emerging Technologies in Learning (iJET)*, 16, 4, 82–94.
- Loboda, V./Ostrovskiy, I./Katerniyak, I. (2019): Developing Entrepreneurial Mindset in University Undergraduates, in: *E-Methodology*, 5, 5, 114–131.
- Long, Z./Zhao, G./Wang, J./Zhang, M./Zhou, S./Zhang, L./Huang, Z. (2021): Research on the Drivers of Entrepreneurship Education Performance of Medical Students in the Digital Age, in: *Frontiers of Psychology*, 12, 733301.
- Loogma, K./Peterson, B./Rekkor, S. (2021): The implementation of entrepreneurship education in Estonian vocational education, in: *Eesti Haridusteaduste Ajakiri, Estonian Journal of Education*, 9, 1, 88–116.
- Ncanywa, T./Dyanti, N. (2022): The Role of Entrepreneurship Education in Higher Education Institutions, in: *E-Journal of Humanities, Arts and Social Sciences* 3, 11, 75–89.
- Oe, H./Tanaka, C. (2023): Qualitative Evaluation of Scaffolded Teaching Materials in Business Analysis Classes: How to Support the Learning Process of Young Entrepreneurs, in: *Education Sciences*, 13, 3, 311.
- Pan, Y. (2022): Designing Smart Space Services by Virtual Reality-Interactive Learning Model on College Entrepreneurship Education, in: *Frontiers in Psychology*, 13, 913277.
- Panfilova, E. E./Demkina, O. V./Galichkina, M. A./Istomina, A. I./Latysheva, V. V./Teymurova, V. E. (2019): Learning models based on a real project in entrepreneurial education, in: *Journal of Entrepreneurship Education*, 22, 2, 1–12.
- Pantea, M. C. (2018): Employment-to-Entrepreneurship Interface in the Context of Tech Innovation: A Qualitative Analysis in Romania, in: *JEEMS Journal of East European Management Studies*, 23, 1, 128–146.
- Rajchamaha, K./Prapojanasomboon, J. (2022): Influence of role models on the entrepreneurial skills of science and technology undergraduates, in: *Education + Training*, 64, 7, 981–995.
- Rakićević, Z./Rakićević, J./Anđelković Labrović, J./Ljamić-Ivanović, B. (2022): How Entrepreneurial Education and Environment Affect Entrepreneurial Readiness of STEM and Business Students? A Longitudinal Study, in: *Engineering Economics*, 33, 4, 414–432.
- Raudsaar, M./Kaseorg, M. (2016): Development of Entrepreneurship Education in Estonian Universities: Case of University of Tartu, in: *European Proceedings of Social and Behavioural Sciences*, 828–837.
- Ruiz-Alba, J. L./Guzman-Parra, V. F./Vila Oblitas, J. R./Morales Mediano, J. (2021): Entrepreneurial intentions: a bibliometric analysis, in: *Journal of Small Business and Enterprise Development*, 28, 1, 121–133.

- Shabbir, M./Batoool, F./Mahmood, A. (2022): Trends in entrepreneurship education: a systematic literature review, in: *Higher Education, Skills and Work-Based Learning*, 12, 6, 1040–1056.
- Sirelkhatim, F./Gangi, Y. (2015): Entrepreneurship education: A systematic literature review of curricula contents and teaching methods, in: *Cogent Business & Management*, 2, 1, 1052034.
- Sörensson, A./Bogren, M. (2020): Organizing an entrepreneurial learning programme: The role of people, process and place, in: *Industry and Higher Education*, 34, 1, 13–23.
- Szymanska, I./Sesti, T./Motley, H./Puia, G. (2020): The effects of hackathons on the entrepreneurial skillset and perceived self-efficacy as factors shaping entrepreneurial intentions, in: *Administrative Sciences*, 10, 3, 73.
- Tiberius, V./Weyland, M. (2023): Entrepreneurship education or entrepreneurship education? A bibliometric analysis, in: *Journal of Further and Higher Education*, 47, 1, 134–149.
- Tingting, G./Jiangfeng, Y./Yinghua, Y. (2022): A bibliometric analysis of college students' entrepreneurial intention from 2000 to 2020: Research trends and hotspots, in: *Frontiers in Psychology*, 13, 865629.
- Tóth-Pajor, Á./Bedő, Z./Csapi, V. (2023): Digitalization in entrepreneurship education and its effect on entrepreneurial capacity building, in: *Cogent Business & Management*, 10, 2, 2210891.
- Vivekananth, S./Indiran, L./Kohar, U. H. A. (2023): The Influence of Entrepreneurship Education on University Students' Entrepreneurship Self-Efficacy and Entrepreneurial Intention, in: *Journal of Technical Education and Training*, 15, 4, 129–142.
- Xiao, Y./Watson, M. (2019): Guidance on conducting a systematic literature review, in: *Journal of Planning Education and Research*, 39, 1, 93–112.
- Xiaoxing, Q. (2020): Research on Innovation and Entrepreneurship Education, in: *Higher Education Research*, 9, 2, 209–213.
- Yang, Q./Zhang, Y./Lin, Y. (2022): Study on the Influence Mechanism of Virtual Simulation Game Learning Experience on Student Engagement and Entrepreneurial Skill Development, in: *Frontiers in Psychology*, 12, 772157.
- Yener, S./Arslan, A./Demirtaş, Ö. (2018): The mediating role of temperament and character on the relationship between mindfulness and entrepreneurial personality, in: *Journal of East European Management Studies*, 23, 3, 404–425.
- Yıldırım, N./Aşkun, O. B. (2012): Entrepreneurship Intentions of Public Universities in Turkey: Going Beyond Education and Research, in: *Procedia – Social and Behavioral Sciences*, 58, 953–963.
- Zeng, M./Zheng, Y./Tian, Y./Jebbouri, A. (2022): Rural E-Commerce Entrepreneurship Education in Higher Education Institutions: Model Construction via Empirical Analysis, in: *Sustainability*, 14, 17, 10854.
- Zhu, H./Wang, Q. (2022): The development dilemma and path choice of innovation and entrepreneurship education based on game theory, in: *Advances in Multimedia*, 2022, 1, 2232253.

VII. Appendix

Table A An overview of analysed entrepreneurship education models

EE type	Short model description	Number of participants	Key findings	Field(s) of study	Literature source
Generalised	Programme A is based on studio work, focusing on business creation and management driven by innovation and organisational adjustments. Mandatory courses are held in purposely designed business studios on campus.	80	In team-based entrepreneurship education, a conceptual model of topo-praxis types is constructed based on the spatial aspects of social interactions.	Business	Christensen et al. (2023)
Generalised	Programme B is identical to Programme A described above but with a 50:50 student ratio in terms of background (business versus art).	50		Business and Art	Christensen et al. (2023)
Generalised	Integrated model – Education about, for, and through entrepreneurship.	Not specified	The authors advocate for the incorporation of sustainability components in new progression models for university entrepreneurship education.	Universal	Klucznik-Tóró (2021)
Generalised	The Network of multidisciplinary ideation and business model generation (NETMIB) incubation platform is a diverse and global online environment that combines incubation programmes offered by higher education institutions (HEIs) in different countries. Guided by the Triple Helix model, the primary goal of this initiative is facilitating collaboration among the public, private, and governmental sectors in order to support individuals in launching new ventures, ultimately contributing to socioeconomic growth. NETMIB also addresses current socioeconomic challenges by encouraging students to generate relevant business ideas.	291	At the end of the study, members of the online incubation platform reported improvements in self-esteem relative to the levels at registration.	Universal	Tóth-Pajor et al. (2023)



EE type	Short model description	Number of participants	Key findings	Field(s) of study	Literature source
Generalised	Game theory is applied to analyse and enhance innovation and entrepreneurship education (IEE) in colleges and universities, as well as to elucidate the dynamics among government, universities, and students engaged in the IEE process. One model explains the external interactions between universities and students and the internal dynamics among students. Another model explores the strategies employed by various stakeholders to maximise their benefits and the resulting impacts on these stakeholders.	Not specified	The key innovation and entrepreneurship education challenges are identified, including inadequate management systems, insufficient resources, curriculum design issues, suboptimal talent development, unqualified educators, and cognitive dislocation.  Recommendations include improving teaching conditions and providing government support for IEE.	Universal	Zhu and Wang (2022)
Generalised	Since the first use of simulation games in education in 1957, this approach has been widely used, with a notable upsurge in its acceptance in the last four decades. This trend coincided with the growing popularity of personal computers (PCs), allowing computer simulation games to be incorporated into management courses.	177	Game elements such as 'goal and feedback' and 'selectivity' did not impact student engagement but positively affected entrepreneurial skill development.	Business	Yang et al. (2022)
Generalised	Foley's model – focusing on process, people, and place – is applied to entrepreneurial learning. These three categories converge into an innovative process that results in a creative profile, leading to specific outcomes.	Not specified	While people are recognised as the central factor in entrepreneurial learning, certain adjustments to the model are needed to optimise it for students.	Universal	Sörensson and Bogren (2020)
Generalised	Model focusing on the steps involved in implementing start-up projects as an alternative to traditional graduation thesis. This approach promotes better comprehension of the taught material, preparing students for running online and offline businesses.	Not specified	The authors propose a final-year entrepreneurship education model based on e-learning, consisting of three key components: students as idea generators, mentors as essential support, and online channels as primary information sources.	Economics, Management, Engineering, Journalism, and others	Liu et al. (2021)
Generalised	As a new approach to higher education in China, student-centred innovation and entrepreneurship education model emphasises student development and learning effects. It also addresses issues like content integration, convergence, and teacher quality.	Not specified	This student-centred educational model requires a shift in teaching and evaluation methods to focus on student learning.	Universal	Chen (2022)
Generalised	A student-centred evaluation model for rural e-commerce entrepreneurship education at universities integrated with professional education.	Not specified	Educational support and feedback effectiveness indicators received relatively high scores, while lower scores were associated with indicators related to learning input and educational process.	Universal	Zeng et al. (2022)

EE <sup>1</sup> type	Short model description	Number of participants	Key findings	Field(s) of study	Literature source
Generalised	Model based on the social learning theory (which postulates that learning is enhanced through sharing and reflection) developed using a semi-structured questionnaire and scaffolding materials in entrepreneurship education.	24	Scaffolding materials helped participants understand conceptual models, thus stimulating deeper content understanding and more dynamic class discussions. Accordingly, social learning theory is suggested as a useful framework for entrepreneurship education.	Universal	Oe and Tanaka (2023)
Augmented	Virtual Reality-Interactive Learning Model (VR-ILM) implemented as a Smart Space serves as a multi-user interactive learning environment that promotes the development of unique cognitive skills. The risk of anxiety and self-consciousness associated with limited interaction opportunities is reduced through immersive learning experiences, engaging entrepreneurial activities, and meaningful socialisation within the virtual environment. Students can revisit course content as well as engage in real-time interactions with teachers.	Not specified	The programme has significantly impacted employment in various industries, generating 43% additional jobs in the real estate services sector.	Mining and Technology	Pan (2022)
Augmented	Computer-Assisted Instruction (CAI) model incorporating IEE was proposed to enhance the quality and efficacy of music education by fostering creativity among music talents. In addition to adopting a multidisciplinary approach to fostering relationships among educators, students, and teaching methods, CAI relies on multimedia and technology, making learning more engaging and interactive.	Not specified	The proposed CAI model increased students' entrepreneurial interest, skills, and knowledge by 55.62 %, 57.32 %, and 72.12 %, respectively.	Music	Cao (2022)
Augmented	Hackathon is proposed as a new entrepreneurship education model. At the beginning of the workshop, each team receives a packet containing the assignment, simulation materials, and an agenda for the day. Students are then introduced to the Business Model Canvas (BMC), a strategic template for business model development. Pre- and post-workshop surveys focusing on entrepreneurial knowledge and self-efficacy are used to assess program success, while emphasising creativity and teamwork when judging the proposed start-up models.	Not specified	Learning outcomes from the hackathon were not influenced by class standing, prior entrepreneurial knowledge, or gender. However, hackathon participants experienced significant increases in entrepreneurial self-efficacy compared to the baseline as well as their peers taught in traditional class settings.	Accounting, Economics, Management, and Marketing	Szymanska et al. (2020)

EE <sup>1</sup> type	Short model description	Number of participants	Key findings	Field(s) of study	Literature source
Augmented	Danish-based model focusing on processes that generate value through entrepreneurship and innovation.	Not specified	The authors highlight the importance of incorporating sustainability components in new progression models for university entrepreneurship education.	Universal	Klucznik-Tóć (2021)
Augmented	A 3P (presage–process–product) college learning model incorporating students' individual characteristics, learning experience, and learning methods (considered a process variable), as well as performance and gains (as the outcome variable). The interaction among the three Ps forms a dynamic system.	177	Teamwork experience and general self-efficacy positively impacted student engagement and entrepreneurial skill development.	Universal	Yang et al. (2022)
Augmented	A business model lab allowing students to test new venture ideas and business models in the electric utility industry. The four participating companies expected to incorporate new models into their businesses by learning from students and gaining valuable insights into future customer preferences.	Not specified	The authors recognised various types of tensions due to the inherent difficulties in managing student venture creation within a co-curricular setting.	Universal	Hasche and Linton (2021)
Augmented	An innovative approach to involving African and minoritised students in the scientific workforce, using a Summer Research Institute (SRI) as an entry point into a multiyear National Institutes of Health Building Infrastructure Leading to Diversity (NIH BUILD)-funded research training programme.	Not specified	The authors noted increases in students' science self-efficacy and science identity after participation in the SRI training programme.	Science, Technology, Engineering, and Mathematics (STEM) and Social Behavioural Science	Jackson et al. (2023)
Augmented	Entrepreneurship practice with on- and off-campus mentors.	24,677	Factors such as entrepreneurship courses, faculty involvement, competition, practice opportunities, and policy drive the entrepreneurship education performance of medical students.	Medicine	Long et al. (2021)
	Entrepreneurship practice supported by a dedicated start-up fund.				
	An integrated entrepreneurship practice service offered by the school.				
	An independent college students' pioneer park for entrepreneurship practice.				
	Dedicated off-campus practice base for entrepreneurship practice.				
	High degree of integration of practical entrepreneurship projects with professional studies.				

EE type	Short model description	Number of participants	Key findings	Field(s) of study	Literature source
Training	A limited liability company “learnFab” formed and managed by students in the first phase of model implementation was subsequently subjected to case study analysis. Students worked in groups with 7–12 members, while allowing others to join. The second phase entailed creating a curriculum for the general elective subject.	7–12	The educational project led to the creation of six student start-ups. All participants reported increased professional, cooperation, and personal competencies due to the involvement in project activities.	Business and Engineering	Fischer et al. (2021)
Training	British-based model involving start-up process simulation.	Not specified	The study findings underscore the value of incorporating sustainability components in new progression models for university entrepreneurship education.	Universal	Klucznik-Tóró (2021)
Training	Model based on the premise that start-ups are conducive to organisational growth, technological development, product innovation, and expansion into new markets. In the academic context, faculty-led start-ups are utilised to commercialise technologies developed within universities as an alternative to patents and technology transfers. Conversely student-founded start-ups emerge due to the practical application of entrepreneurship education in identifying and capitalising on new opportunities.	Not specified	Faculty labour costs and government research funds influence the success of faculty-led start-ups.  University-affiliated start-ups have the potential to generate financial returns for research and development investments. By establishing collaborative partnerships with industries, these start-ups also play a crucial role in job creation and thus contribute to the economic growth of local communities.	Medicine and Engineering	Lee and Lee (2020)
Training	The “Gruendungsgarage” entrepreneurship initiative was established by the University of Graz (KfU) and the Graz University of Technology (TUG) faculty as an interdisciplinary and inter-university elective course. Initially, students worked on their real business concepts while receiving guidance from university experts and experienced industry professionals. Due to its popularity and continuous refinement, Gruendungsgarage evolved into a full-fledged academic start-up accelerator programme.	205	The Gruendungsgarage has been effective in encouraging diversity among start-up entrepreneurs. It currently serves as a successful global model that enables students and academic staff to rapidly transform their business ideas into marketable products or services. After taking part in the programme, numerous teams launched businesses, many of which are still in existence. To date, the programme has also generated over 130 jobs.	Technology	Glinik (2019)
Motivational	Model based on the engagement of alumni members from the industry in the entrepreneurship education.	1,223	Both faculty and students recognised the knowledge transfer by the industry specialists as instrumental in the programme’s success.	Agricultural	Huang et al. (2022)

EE <sup>1</sup> type	Short model description	Number of participants	Key findings	Field(s) of study	Literature source
Motivational	Model based on gamified entrepreneurship courses with the aim of enhancing the effectiveness of college-level entrepreneurship teaching via interactive and immersive learning experiences.	205	The course satisfaction is influenced by the degree of alignment between course content and participants' competencies, autonomy, and relatedness needs, in line with the self-determination theory (SDT).	Technology	He et al. (2023)

<sup>1</sup> Entrepreneurship Education.