

Conceptual Framework for Assessment Entrepreneurial Education

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Abstract

Purpose: This paper aims to presents a conceptual framework for entrepreneurial education assessment composed of five levels and thirty sub-dimensions.

Design/Methodology: The framework was instantiated and developed through four case studies with public and private higher education institutions located in Portugal and Brazil.

Findings: The degree of maturity of a higher education institution in entrepreneurial education can be assessed in a similar way to maturity models in software engineering, in which entrepreneurial teaching practices can be organized considering their scope, relevance, and impact on the development of an entrepreneurial ecosystem.

Conclusion: Academic entrepreneurship is part of the strategic plan of the most successful universities in the world. It is fundamental for those universities to develop their third mission and promote an entrepreneurial environment that stimulates academic entrepreneurship. In this sense, the formulated conceptual framework can constitute a fundamental element for higher education institutions to evaluate their degree of maturity in entrepreneurial education.

Limitations: The framework was only evaluated and applied considering four case studies located in two countries. It is necessary to disseminate it for other geographical contexts.

Implications: From a practical perspective, this framework is relevant for higher education institutions to be aware of the practices they can adopt in the promotion of entrepreneurship education and how to bring it to their strategies.

Originality: This study presents an innovative conceptual framework that explicitly focuses on the process of measuring the maturity of a higher education institution in the adoption of entrepreneurial education practices.

Keywords: Entrepreneurship; Entrepreneurial University; Maturity Model; Higher Education; Third Mission

1. Introduction

Entrepreneurship provides a new view of the world based on knowledge and innovation, from the development of creative people and processes that together promote the appearance of new ideas, the assessment of opportunities, the mobilization of re-

sources, the assumption of risks and the implementation of differentiated and successful initiatives. In this sense, Van der Sijde et al. (2008) consider that it is fundamental that higher education institutions (HEI) provide a favorable culture for the acquisition of knowledge and the development of attitudes, capacities, and values that promote the entrepreneurial spirit. Taatila (2010) and Ismail & Zulihar (2015) refer to the importance of developing an entrepreneurial profile that involves competencies like creativity, innovation, responsibility, leadership, group work, resilience, and scientific curiosity in higher education.

In recent years, society has witnessed the emergence of new approaches applicable to the teaching of entrepreneurship and entrepreneurial empowerment, like the Entrepreneurial Pedagogy from Fernando Dolabela used in Brazil (Dolabela, 2004). These new methods and tools complement and extend the approach of teaching innovation and entrepreneurship from the domain of management faculties to other educational institutions and courses, namely for engineering, technology, tourism, among others. This vision is complemented by Hamburg (2015), highlighting that entrepreneurial education (EE) is a transversal contribution to the different disciplines and non-disciplinary areas that are embodied in activities or projects developed in a participatory manner by students.

In the traditional approach to EE, the focus was on the elaboration of relatively formal business plans with great emphasis on the financial component and the analysis of the economic viability of the venture (Rocha & Freitas, 2014; Lopes, 2010). However, this approach is only valid if the industry and markets are relatively predictable and stable. In the current reality of disruptive markets and with the high impact of globalization, we have witnessed the emergence of much more innovation and creativity-driven entrepreneurship. This new entrepreneurial style fosters the emergence of disruptive innovation and new business models that challenge the current rules and propose new products, services, and business models (Osterwalter & Pigneur, 2010; Christensen, 2016).

The teaching of entrepreneurship must be able to follow this reality, both in terms of teaching methodologies and tools, which are translated into knowledge that students can apply in a real context. In pedagogical terms, it is essential not to disregard traditional teaching methods, but greater importance should be attached to less formal and more suitable models for teaching. In this sense, this study intends to propose a conceptual framework for entrepreneurial assessment education. Through this framework, HEIs will be able to assess their maturity in teaching entrepreneurship, and it will help them to promote new pedagogical initiatives and tools to be integrated into their courses. Additionally, this framework aims to be a handy tool for HEIs to get to know good international practices in EE and to serve as a reference point and motivation for the use of emerging entrepreneurship pedagogical tools. Also, it serves as an institutional assessment of entrepreneurial university readiness (Etzkowitz, 2016). The established framework was applied in the context of four higher education institutions (HEI) located in Portugal and Brazil. Two of these institutions are public-funded HEI, while the others belong to the private and polytechnic sectors.

The manuscript is organized as follows: Initially, a literature review on entrepreneurship education and maturity models is performed. Then, the proposed framework and research design are presented. After that, the findings are presented and discussed. Finally, the main conclusions are drawn and some indications for future work are given.

2. Literature Review

Among many definitions of entrepreneurship in the literature, this work assumes the concept of a cultural aspect of human behavior expressed by a specific way of thinking and take action (Dolabela & Filion, 2013). This definition encompasses the idea of

entrepreneurship as competence to be developed/learned and not a gift from the DNA. Based on that vision, it is possible to discuss aspects of EE, from the pedagogical (tools and methods) to the behavioral standpoints (culture). The relevant questions are how entrepreneurs learn, how to develop entrepreneurial competencies, and how to teach these contents. These questions will be explored in the following sections.

2.1 Entrepreneurship Education

The contents that frequently appear in EE studies are entrepreneurial training, with emphasis on entrepreneurial skills and competencies and entrepreneurial intent (Araujo & Davel, 2018). Rocha & Freitas (2014) argues that the two perspectives are conducting EE practice. The first one focuses on education about entrepreneurship, while the second one is the education to the entrepreneurship. It means that the first is a theoretical approach to the theme, while the latter combines theory with practice with an emphasis on acting. These perspectives encompass most of the approaches.

EE is necessarily a complex process. The literature offers several empirical studies that reveal successful experiences (Varblane & Mets, 2010; Cheng et al., 2009; Hussain & Norashidah, 2015), but other initiatives were not successful (Matlay, 2008; Unachukwu, 2009). This situation reflects the high variety of ideas and efforts that have been made at this level. It also demonstrates the complexity of the process of teaching entrepreneurship. It is not only a question of a content offer but a change in the mindset and behavior of the student. A discussion about EE in primary education or HEIs appear in the literature, and the majority of authors advocate EE in HEIs (Lopes, 2010; Henrique & Cunha, 2008) with a specific methodology, different from the traditional education based only in the transmission of knowledge (Dolabela & Filion, 2013; Lima et al., 2015).

2.1.1 Education about Entrepreneurship

The teaching of entrepreneurship can contribute to opening up multiple perspectives of professional activity to students. At the same time, it allows the development of necessary technical skills related to innovation, organizational management, human resources management, financing, among others (Graevenitz et al., 2010; Branch, 2017). Additionally, Fayolle & Gailly (2015) refer to the importance of EE to be carried out through the design of entrepreneurial attitudes and skills. Consequently, Linton & Klinton (2019) argues that the concern of universities should be to prepare students to teach them to think, analyze, and act autonomously and independently.

Entrepreneurship courses are essential to ensure that entrepreneurial skills are adequately transmitted at the right time. This training is vital to enable students to manage the difficulties and problems that entrepreneurs face, and also to acquire knowledge and useful information about the process of launching and managing a start-up. Entrepreneurs don't need to have a tertiary education to create a start-up. Still, necessarily all entrepreneurs will require knowledge in the areas of management, finance, strategy, marketing, leadership, and communication (Bilic et al., 2011). In this sense, universities can assume a crucial role in stimulating students to entrepreneurship and in training new entrepreneurs. Volkmann et al. (2009) emphasize the importance of formal school systems and informal systems in learning entrepreneurship. They recommend the existence of compulsory and elective courses, the involvement of several disciplines and the presence of lifelong learning after university.

The learning paradigm in higher education has progressively changed. HEIs are typically geared towards preparing students for the labor market. At the same time, the teaching of academic entrepreneurship should complement this vision and allow students to have the knowledge and, eventually, the experience that will facilitate the creation and exploration of new ventures. In this sense, Raposo & Paço (2011) argue that the teaching of entrepreneurship should not be confused with the teaching of management techniques. Although this technical component is essential, Juvová et al.

(2017) consider that it is above all crucial to promoting a different culture and mentality in terms of creativity, the openness of spirit, resilience, and willingness to take risks and self-confidence.

Teachers and professors play a fundamental role in the application of entrepreneurial pedagogy because they are the guide and transmitter of knowledge. At the same time, they must also be responsible for cooperating in the design of teaching and learning strategies. Thus, the teacher contributes to the creation of values with the entrepreneur. On the other hand, Fejes et al. (2019) advocate that by fostering the entrepreneurial spirit of the students and involving the community in the entrepreneurial process, teachers also broaden their entrepreneurial capacities by learning from the work carried out by the students.

The study conducted by Charney & Libecap (2000) reveals some of the main advantages of entrepreneurship curricula, namely the students: (i) are more likely to start a new business; (ii) have the possibility of obtaining 27% more annual income; (iii) tend to be more satisfied on average in their jobs than individuals with advanced training in management (e.g., MBAs); (iv) are involved in the processes of developing new products and R&D activities; and (v) work in great numbers of high-tech companies. Grecu & Denes (2017) complement this vision and add two new benefits: (i) ability to recognize commercial opportunities and act on them; and (ii) increase students' self-esteem. Finally, Nieuwenhuizen et al. (2016) present a high-level vision of the learning outcomes of an entrepreneurship program that must be based on two dimensions, namely the empowerment of students and the transformation of the institution and community in which they serve.

Structuring an EE program can be carried out in several ways. It is essential to look at the most common strategies that can be found in entrepreneurship courses. According to Redford (2006), the primary strategies include the preparation of business plans, open discussions in classrooms, case studies, individual and group research projects, and testimonies of entrepreneurs who have created their own business. Lima et al. (2015) have pointed out that methodologies aimed at starting a business, predominantly based on business plans, should be directed to individuals with a high level of entrepreneurial intent already verified. These entrepreneurs, in general, have also identified a viable business opportunity, so that they can carry out the right steps to start your venture. These approach does not develop personal abilities, either creativity or innovation (Araujo & Davel, 2018).

Andrade & Torkomian (2001) suggest the division into a set of steps that first of all involve understanding the internal and cultural aspects of the teaching institution, the macro design of the program, the curriculum structuring, and the didactic structuring. These elements should be properly articulated with the teacher's community and students. In that way, Amaral et al. (2018) proposes a model in of EE in five stages: (i) isolated activities stimulated by the teachers or demanded by the students; (ii) specific activities that cover the fundamental concepts of entrepreneurship (e.g., business plan, strategic positioning, financial analysis); (iii) set of specific disciplines in which there is an articulation between the various taught contents; (iv) entrepreneurial culture across multiple disciplines of an undergraduate program; and (v) entrepreneurship center in which there is integration with the entrepreneurship community (e.g., business incubators, start-up companies). The first four stages reveal an increasing maturity of HEI to execute EE. The fifth stage brings the practical aspect of learning by doing, which led to the idea of education to entrepreneurship.

Another reference work in this area, in which the various stages of maturity of an entrepreneurship program are schematically presented, was proposed by Morris & Kuratko (2014). They presented a five competencies framework for 21st-century entrepreneurship program design composed of: (i) concept of the program; (ii) convictions about the program purpose in which student convictions are measured; (iii) competencies around which the program is designed; (iv) connection for extending the

program using internal and external connections; and (v) character of those involved in the program (e.g., profile of leadership, reporting structure). The model initially developed by Morris & Kuratko (2014) was applied by Nieuwenhuizen et al. (2016) to conclude that highly ranked universities and business schools globally tend to offer EE with little to no specialization at the undergraduate level. At the same time, entrepreneurship programs are often specialized and highly interdisciplinary at the postgraduate level. Although these models are relevant in the process of identifying the various stages of entrepreneurship, none of them establish a structure composed by sub-levels or develops a maturity model that allows HEI institutions to assess their level of maturity in the implementation of entrepreneurship programs.

2.1.2 Entrepreneurship to the Entrepreneurship

The challenge in EE is to prepare students for the real world demands of a business launching. Martin & Iucu (2014) advocate that EE is a transversal education for life, is action-centered, integrates multidisciplinary, and is contextualized and created by students. Experiential learning has been a critical element. According to Ismail et al. (2018), to have proper functioning of an entrepreneurship discipline, there must be a close relationship between the teachers and the entrepreneurs because they can complement and help each other. It is important to mention the emergence of new businesses in the areas of knowledge and services have contributed to the increased interest and development of education programs for entrepreneurship (Boyles, 2012).

Lewrick et al. (2010) add other approaches, such as virtual start-up competitions, real business plan competitions, debate and knowledge exchange with entrepreneurs, business workshops, and work experience and internship in start-up companies to the EE process. Furthermore, serious games can be used to improve the learning process while providing an immersive experience for students, which consequently will increase their motivation for entrepreneurship activities. These approaches show an effort to cross the bridge among theory and practice creating a protected environment (laboratory) to learn how to do.

Rae (2005) proposes a triadic model of a conceptual framework of entrepreneurial learning, which includes three dimensions (i.e., personal and social emergence, contextual learning and negotiated enterprise) and eleven sub-themes (e.g., identity as practice, learning through immersion within the industry, engagement in networks of external relationships, tension between current and future identity, opportunity recognition through cultural participation, practical theories of entrepreneurial action, changing roles over time, negotiated practices, participation and joint enterprise, narrative construction identity, and role of family). Tomczyk et al. (2016) state that an entrepreneurship education program in HEI should be based on three pillars: (i) blend of theory and practice; (ii) emphasis on strategic analysis and business plan development; and (iii) mentoring and coaching.

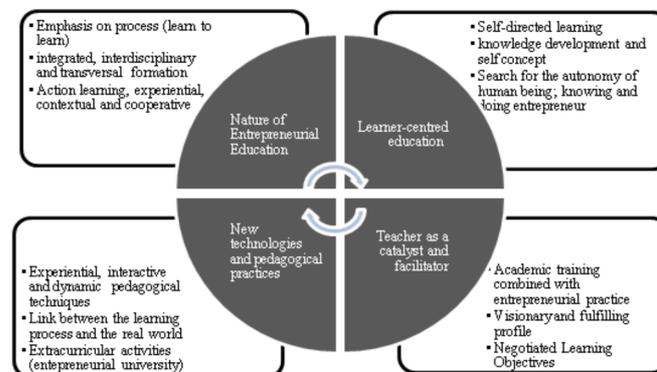
Lopes (2010) investigating references for EE brings a series of action-oriented learning proposals: experiential learning; learning by action; contextual learning (a process of constructing meaning from social interaction and experience); and problem-solving and cooperative learning (working in heterogeneous groups by exercising leadership, communication, team cohesion, among others). This transformation requires a new teacher capable of balancing the transmission of theoretical content and facilitating the learning process, through advice and guidance of practical activities proposed to students (Henrique and Cunha, 2008). At the EE, the teachers become leaders, counselors, or mentors. The questions related to the competencies of teachers have to be discussed. The challenge is to rethink the exercise of the profession and create new forms of teaching with a focus on experience (Araujo & Davel, 2018).

Lima et al. (2014) list suggestions and contributions that encompass methodological aspects:

- Share stories of failure to understand better the fact that making mistakes is natural in entrepreneurship and, in some ways, even desirable as a way of learning.
- Use the media as a means of learning with real cases but complementing them with the fundamental concepts that explain the success stories (or failure) presented in the cases.
- Entrepreneurship should not be a course, but competence to be developed transversally throughout the entire program.
- The university itself needs to be more entrepreneurial, proactive, and innovative. An entrepreneurial culture favors the training of entrepreneurs.
- Students should have more contact with real entrepreneurs, interact with them to learn the practice, whether in the form of mentoring programs, case studies, lectures, internships, or others.
- Offer students the possibility of solving real problems. Seek interaction with companies to develop case studies where students can apply what they learn in the classroom.
- Create conditions for students to develop their business ideas in protected environments, such as co-working labs, where they can experiment, make mistakes, and learn from practice.
- An incentive for teachers to spend time outside the classroom to act as coaches of students who are undertaking.
- Participation in extracurricular activities, such as business and innovation competitions, student associations, junior companies, social projects, and events that will bring the student closer to the entrepreneurial universe.

Besides this, they emphasize other situations in which EE occurs, outside classrooms, such as business incubators and technology parks, junior companies, entrepreneurial cells, entrepreneurship clubs and entrepreneurship centers, events, business plan competitions, and entrepreneurial practices. About these practices, it is included teaching partnerships with entrepreneurs in environments such as productive arrangements, cooperatives, small associations of producers and third sector organizations (Lopes, 2010; Guarany, 2006). Entrepreneurship, thus fostered and developed in the various dimensions of the university, leads us to the concept of the entrepreneurial university (Guerrero & Urbano, 2012; Silva et al., 2018). Guarany (2006) argues that this university proposal is transformative because it has as its objective, besides teaching, research, and extension, economic development. Figure 1 shows the differences between the research university and the entrepreneurial university (based on Schaefer & Minello, 2016).

Figure 1. Research university vs. entrepreneurial university



2.1.3 Evolution across the World

The origins and dissemination of EE in HEIs shown that teaching the art of entrepreneurship is relatively recent. In 1947, Harvard Business School created the first course on small business management. Five years later, Peter Drucker began teaching entrepreneurship and innovation at New York University. In 1956, the International Council for Small Business (ICSB) was created, an association focused on research on the subject. In 1978, Babson College of Boston, one of the most renowned entrepreneurs training centers, established the Academy of Distinguished Entrepreneurs, a model for other awards (such as Entrepreneur of the Year Awards from Ernst & Young). In the last forty years, there has been a dizzying growth of EE in HEIs.

In Portugal, entrepreneurship education is recent in higher education curricula, having emerged more broadly since 2004 (Ribeiro et al., 2016). However, the first registration of this type of training was implemented by the Catholic University in 1992 (Redford, 2006). The interest of EE in Portugal arises essentially from a reaction to market needs and the entrepreneurial background of some higher education teachers. Redford (2006) emphasizes that the pedagogy of EE is firmly based on the creation of business plans and theoretical classes, stressing that the use of technology and simulation environments is still little explored. Rodrigues & Barreto (2016) highlight the teaching of entrepreneurship is mainly incorporated in specific undergraduate courses (e.g., management) during one semester. They advocate that this subject is not addressed during all undergraduate courses semesters and does not equally reach students of all courses.

In Brazil, the first offer of a course in the area was in 1981 at Getúlio Vargas Foundation (FGV). Since then, the demand and supply of EE have continued to grow significantly. The Global University Entrepreneurial Spirit Students' Survey Report (GUESSS) noted that the provision of disciplines on the preparation of a business plan as well as high demand for them is frequent (Lima et al., 2014). In 2013, there were 800,144 enrollments in the undergraduate programs in Administration, about 11% of the 7,305,977 enrollments in HEIs in Brazil (Oliveira et al., 2015). Around 30% of programs have at least one course about the topic, which is more than the international sample (Lima et al., 2014).

There are several models of EE. One involves the provision of disciplines by a unit such as the Entrepreneurship Center (CE), PUC-Rio case. Another consists of the content offered in several disciplines (transversal), the case of SENAC-SP. Finally, there are models that current beyond the structure of several courses, like a profusion of competitions aimed at stimulating the entrepreneurial mindset and the formation of startups. For example, SEBRAE carries out the Entrepreneurial University Challenge. It highlights the critical role also played by scientific meetings, such as EGEPE, conducted by the National Association of Studies in Entrepreneurship and Small Business Management (ANEGEPE), and by the Entrepreneurial Education Round (REE), organized by Endeavor Brasil and SEBRAE (Lima et al., 2014).

Recent advances in Brazil can be cited, such as the creation of the first Department of Entrepreneurship and Management at the Federal Fluminense University in 2013 (Lopes, 2017). In 2014, the USP School of Economics and Administration (FEA) began classes in his masters' degree in Entrepreneurship, with two areas of study: internal entrepreneurship and the creation or development of new businesses (Lima et al., 2014).

2.2. Maturity models

Maturity models allow organizations to measure their performance in a particular discipline. The structure of models is based on successive levels towards continuous process improvement. The number of levels may vary according to the detailing of the model adopted. As well as the objective of each level. According to Wendler (2012), maturity models offer a simple but effective benchmark to assess the ability of pro-

cesses to achieve the organizations' objectives, locate improvement opportunities (e.g., productivity, cost reduction) and monitor the actions of continuous improvement of organizational processes.

Maturity models can be implemented using a top-down or bottom-up approaches. In the top-down approach, the maturity levels are previously established and the elements that constitute each level are placed to reflect an evolution of the degree of maturity of organizations. In the bottom-up approach, the characteristics of each component are first determined and, from this initial stage, the dimensions that give rise to the maturity levels are constituted. According to Mettler (2011), the bottom-up approach allows a more comprehensive coverage of all the different steps necessary for organizations to evolve at the maturity level.

The maturity models can be applied to several areas, such as information technology (e.g., Capability Maturity Model Integration, Service Integration Maturity Model, ITIL Maturity Model), Business Process Management (e.g., Business Process Maturity Model, Change Management Maturity Model) or Learning (e.g., Mobile Learning Maturity Model, E-learning Maturity Model, Learning Business Maturity Model). It is particularly important to understand in more detail how some of the leading models are constructed to identify common approaches and good practices. In this sense, the Capability Maturity Model (CMMI) was chosen due to its steadfast adherence to the engineering field software and for serving as a basis for the construction of other maturity models, especially in the area of education and learning. The three models identified in the learning field were also chosen.

CMMI was proposed by the Software Engineering Institute of Carnegie Mellon University and offered a reference model that contains practices that allow assessing the maturity of software development companies. Companies can incorporate the CMMI through its continuous representation or by stages. In the ongoing representation, maturity is evaluated by processes separately, allowing organizations to have several processes at different levels. Serrano et al. (2013) consider that continuous representation is indicated for organizations that want to focus on a specific and critical process for the company and improve it to bring immediate benefits to organizations. On the other hand, in the representation by stages, maturity is measured considering the set of processes established for each level. Therefore, all the processes of this level must be reached. So, the organization is a specific level of maturity. The CMMI considers five levels of capability and performance (Blokdyk, 2018): (i) initial, in which processes are unpredictable and poorly controlled; (ii) managed, considers that the processes are specific to each project and the company is often reactive; (iii) defined, when the processes are common to the organization making it proactive; (iv) quantitatively managed, in which the processes are measured and controlled; and (v) optimizing, in which there is a focus on continuous process improvement.

The Mobile Learning Maturity Model (MLMM), the E-learning Maturity Model (eMM), and the Business Learning Maturity Model (LBMM) use CMMI as the base model. With appropriate modifications the CMMI model can be adapted to measure the maturity of HEI in different areas such as m-learning, lifelong learning, or professional development. Table 1 provides a comparative overview of those models. MLMM and eMM are very similar, and both are composed of five levels, plus level 0. Level 0 of MLMM considers limited mobile presence, while eMM defines it as not performed at the university. The LBMM is somewhat more distinct from previous models and aims to help to learn businesses to assess their maturity in five domains (i.e., leadership, strategy, capacity, portfolio, and marketing).

The HEInnovate initiative promoted by the European Commission, DG Education and Culture, and the OECD LEED Forum is also worth highlighting. This initiative seeks both to be a guiding framework for the entrepreneurial and innovative HEIs and offers the self-assessment tool that can be exploited by HEIs to assess the degree of development of their entrepreneurial activities in eight dimensions: (i) leadership

CONCEPTUAL FRAMEWORK FOR ASSESSMENT ENTREPRENEURIAL EDUCATION

and governance; (ii) organizational capacity funding people and incentives; (iii) entrepreneurial teaching and learning; (iv) preparing and supporting entrepreneurs; (v) digital transformation and capacity; (vi) knowledge exchange and collaboration; (vii) the internationalized institution; and (viii) measuring impact. HEInnovate approach is not limited to the assessment of entrepreneurial education but encompasses several complementary and broader perspectives. In the specific case of entrepreneurial teaching and learning, it is emphasized that HEIs should provide various formal and informal learning opportunities. The entrepreneurial learning outcomes should be incorporated and validated to guide the design and implementation of entrepreneurship study programs, and the results of entrepreneurship research should be integrated into the provision of EE (HEInnovate, 2018).

Table 1. Comparative overview of learning maturity models

Level	MLMM Alrasheedi & Capretz (2013)	eMM Marshall & Mitchell (2004)	LBMM Steele (2016)
0	Limited mobile presence	Not performed (not done at all)	N/A
1	Preliminary (Institutions have a pilot program. The process is reactive and experimental)	Initial (ad-hoc processes)	Static (learning and education business is largely static)
2	Establishment (investment in m-learning technologies, but organizations don't have mechanisms to evaluate their systems)	Planned (clear and measurable objectives)	Reactive (learning and education business is largely reactive according to business needs)
3	Defined (quality of mobile learning systems is measured)	Defined (defined process for development and support of e-learning)	Proactive (business has evolved to be more proactive in serving the market)
4	Structured (m-learning is characterized by optimization and innovation)	Managed (ensuring the quality of both the e-learning resources and student learning outcomes)	Innovative (organizations at this stage are also innovative in discovering learning needs)
5	Continuous improvement (m-learning strategy is constantly evaluated, improved and optimized)	Optimizing (continual improvement in all aspects of the e-learning process)	N/A

3. Proposed Framework

The proposed framework is structured on five levels plus a level 0, which indicates that the organization does not adopt EE. This categorization model is based on the learning maturity models (i.e., MLMM, eMM, LBMM) and CMMI adopted in the software engineering field. Table 2 presents each level and the authors who support each sub-dimensions. The model is gradual, in the way that an HEI to be at a higher level must comply with all the respective sub-dimensions from the level below, as advocated in the learning maturity models and CMMI.

Table 2. Structure of the framework

Level	Dimension	Sub-dimension	Authors
0	Not performed	N/A	Marshall & Mitchell (2004) Alrasheedi & Capretz (2013)
1	Preliminary	Process of launching a start-up, job market, market trends, and business management principles	Amaral et al. (2018) Dabic et al. (2016)
2	Disseminated	Specific discipline (required or elective), creation of business plans, opportunity awareness, market analysis and segmentation, strategic positioning, financial analysis, and intellectual property and law	Andrade & Torkomian (2001) Amaral et al. (2018) Tomczyk et al. (2016) Rae (2005) Mahaffey et al. (2009) Hyclak & Barakat (2010)
3	Defined	Involvement of several disciplines, formation in leadership and creative thinking, development of research, collaborative working, and events and workshops	Volkman et al. (2009) Morris & Kuratko (2014) Robinson & Stubberud (2014) Papagiannis (2018)
4	Structured	Entrepreneurial culture, development of specific themes, strategic thinking, contextual learning, and entrepreneurial mentors	Amaral et al. (2018) Jelenc & Pisapia (2016) Lotulung (2018)
5	Optimized	Integration with the business community (e.g., business incubators, junior businesses, venture labs), involvement of entrepreneurial alumni community, integration of different levels of education (e.g., undergraduate, graduate, doctorates), projects and internships with start-ups, learning by doing, business ideas competitions, management growth and uncertainty, extensive use of digital tools, and entrepreneurship lifelong program	Rae (2005) Pittaway et al. (2019) Jain (2016) Nabi et al. (2017) Neck & Corbett (2018) Volkman et al. (2009) Almeida & Buzády (2019)

4. Research Design

This work is an applied research based on literature review and case studies. The adopted methodology is structured in three stages. In the preliminary stage, performed in 2019, the aim is to explore entrepreneurship programs, namely by looking at the challenges of teaching entrepreneurship, the adopted strategies and technologies, and the structures of an entrepreneurial education program. This stage was written based on documents review and interviews with selected members of the faculty body and staff of each institution. The unstructured interviews allowed the respondent to explore the various entrepreneurship initiatives that each HEI offers, allowing the researcher to perceive the impact of these initiatives deeply. Furthermore, this approach allowed us to increase the interaction between the interviewee and the researcher, and to explore the level of maturity in which each HEI is positioning (Queirós et al., 2017). Moreover, according to Creswell (2014), this approach offers increased validity, as the various issues raised can be clarified and explored in depth. Table 3 presents the profile and position of the interviewed people.

Table 3. Participants in this study

Identifica- tion	Profile	Position
HEI1	Faculty body; Engineering	Associate professor
HEI2	Academic staff	Manager of TTO
HEI3	Faculty body; Business Manage- ment	Associate professor
HEI4	Administrative staff	Manager of TTO

Still, at this stage, it is essential to analyze several maturity models applied in the area of teaching and learning that may give us relevant indications for our study. Next, the conceptual stage proposes an innovative conceptual framework for entrepreneurial education assessment. This framework organizes the various practices of entrepreneurship education at maturity levels. Finally, the fieldwork stage intends to apply the proposed framework to numerous HEI. The obtained results turn possible to comparatively assess the degree of maturity of these organizations in the development of EE and to identify a set of good practices that can be disseminated to other HEI.

The proposed framework was instantiated using a qualitative methodology through case studies. For this purpose, four case studies of HEI from two countries (i.e., Brazil and Portugal) were considered. HEI1 is one of the largest public universities in Portugal, with more than 30,000 students and 1,600 employees. HEI2 is a private polytechnic institute in Portugal recognized for offering high practical and professional impact training with more than 500 students and 70 employees. HEI3 is one of the largest public university institutions in Brazil, with more than 50,000 students and 3,500 members in the faculty body. HEI4 is a private and Catholic Brazilian HEI with more than 20,000 students and 1,200 employees.

5. Results

5.1 Case study I – HEI1

Entrepreneurship is a visible theme in numerous initiatives activities and infrastructure provided by the educational institution, which has the fundamental objective of stimulating the entrepreneurial capacity of students, students, researchers, teachers, and alumni community. In 2005, the Master in Innovation and Technological Entrepreneurship (MIET) was launched, which seeks to stimulate the integrated training of managers and entrepreneurs through hands-on teaching that fosters the development of innovative businesses. This master's degree has aroused a keen interest from the community and has allowed the exchange between students from Brazil and Portugal. MIET is organized in four semesters. In the first three semesters, concepts of entrepreneurship, product and services development, accounting and financial management, technology commercialization, innovation management, business law, etc. are introduced; in the last semester, students can develop a dissertation, project, or an internship.

It is worth mentioning some initiatives that turned possible to disseminate the theme of entrepreneurship to the community. CE_dUP was created by the students and is a pioneer organization in Portugal, whose main objective is to inspire the community of entrepreneurs. It was an initiative created by the students and for the students. Other relevant initiatives are the iUP25K and BIP, which are generically business idea competitions and immersion programs in which the aim is to develop a business based on technologies developed in academia and reward the best projects born in academia. Finally, the week of promotion of innovation and entrepreneurship (SPIE) is already a reference in the field of promotion of innovation and entrepreneurship in the city of Porto. Every year, conferences, informal conversations, workshops, and other initiatives are organized, in which there is extensive participation of the community. Therefore, the strategy to promote entrepreneurship is not aimed exclusively at students, but the institution believes that there should be broad participation and involvement of all university players. The institution also provides a space dedicated to the incubation of start-ups, through a set of structures and specialized services, developed to meet the everyday needs of business start-ups.

5.2 Case study II – HEI2

The teaching of entrepreneurship is carried out in the context of the various undergraduate programs offered by HEI. Programs such as the BSc. in Management and the BSc. in Computer Engineering provide a mandatory subject included in the 3rd academic year, in which the themes of technological innovation and entrepreneurship are addressed. In this course, students organized into multidisciplinary teams are challenged to create an innovative business for the information technology sector. This curricular unit has a practical emphasis on the presence of entrepreneurs, simulation of a pitch elevator, and the adoption of serious games (Buzady & Almeida, 2019). However, entrepreneurship is not addressed in all programs because the structure and content are the responsibility of the coordinator. The professional's profile, mostly the experience as an entrepreneur, is a conditional factor in dealing with this content.

The small size of the institution (e.g., it has less than 350 students per year) allows great proximity between students and teachers, which is an unequivocal strength of the institution recognized by the Agency for Higher Education Accreditation (A3ES). Similarly, the very proximity between students of various courses promotes the appearance of multidisciplinary teams, which is a crucial feature for business survival in the market (DiResta et al., 2015; Evans, 2018).

The entrepreneurship office is a formal initiative launched only at the beginning of 2016. This office has functioned as a point of receipt of information from abroad and allows the internal dissemination of competitions for business ideas, financing opportunities, among others. The office has also organized presentations by entrepreneurs common to the various courses offered by the institution. By this means,

the institution aims to ensure that all students have minimal contact with the theme of entrepreneurship.

5.3 Case study III – HEI3

The experience with entrepreneurial activities started at this Brazilian public university in 1997. This first cycle involves the creation of a private foundation (to manage non-public resources), a business technology incubator, and a technology transfer office (TTO), named Office for Commercialization and Transfer (ETCO). The TTO was formalized in 2000 due to the requirements of government regulation and external partners like Petrobras. However, the success of these initiatives is not evident. Several patents were filed and granted, but no license agreement was done.

A second cycle started in 2009, with the creation of several research groups and the restructuration of Rectory's initiatives under an Innovation Agency, named AGIR. AGIR does the role of the Nucleus of Technology Innovation, as required by the Brazilian Innovation Law. In the last ten years, several activities, as dissemination of entrepreneurial culture, the discussion about the creation of a technology park, and the formalization of innovation policy for the institution, were carried out.

In parallel, the research groups led an uncountable amount of initiatives. One group created the minor in Entrepreneurship and Innovation (in 2009), the Department of Entrepreneurship and Management at the School of Administration and Accounting was established in 2013 (Silva, Mancebo & Mariano, 2017). This group, in partnership with other researchers, is working to approve a Master in Entrepreneurship and Innovation with CAPES (CAPES is the coordination of high-level education which accredits and evaluate all Brazilian master and doctoral programs). One of the keys initiatives was the creation of the Triple Helix Research Group – THERG-Brazil in 2008. Based on the School of Human and Social Sciences (ICHS), this group dialogues with many internal and external actors and the international movement of TH. The head of this group was Dean of ICHS and supported the creation of a Masters degree in Administration in 2013, with a research line about innovation and entrepreneurship. This internal transformation also supported the election of the last two pro-rectors of graduate programs, research, and innovation as a Rectors in the way of put innovation in the strategy of the university.

As a result of these initiatives, several undergraduate courses have disciplines with the content. AGIR, in a partnership with the Department of Entrepreneurship, is offering courses of patent writing to the faculty body. From a portfolio of 130 patents and software, 12 license agreements were signed. The field of social innovation is being explored with the creation of a catalog with technologies open to society. Also, AGIR operates initiatives funded by government programs to promote university-business collaboration. One action is the PIBITI's program (grants for undergraduate students develop innovation projects). Other is DAI grants (funds for Doctoral students do thesis based on real business problems in collaboration with industry).

5.4 Case study IV – HEI4

Since 1999, several actions were developed by the studied institution, a private university of confessional character, in the south of Brazil. Among them the creation in 2006 by the top-level management of an Entrepreneurship and Innovation Network (INOVAPUC Network), aiming to support entrepreneurship and innovation and to articulate the university units. This framework established institutional policies and supporting structures, including changes to the entity's by laws (Ferreira, Soria & Closs, 2012). The results are evident from success stories, such as the first commercial 3D printer in Brazil, positioning the ecosystem as the one of the best entrepreneurial university experiences in the country. Among the various support structures that make up the network are:

Agency of Technology Management (AGT) - Established in 1999, it is the unit responsible for managing the relations with business and government concerning R&D projects. Its role is to capture society's demands and develop responses. The action involves identifying partners, answer for calls, negotiating partnership terms, and administering technology transfer agreements.

Technology Transfer Office (ETT) - Created to protect intellectual property and promote the transfer of research results to the productive sector. This office aims to establish and operates the institutional policy of intellectual property and TT.

Center for Support the Scientific and Technological Development (IDEIA) - IDEIA is a research support unit that has laboratory infrastructure and physical space for hosting research projects. IDEA acts as a project incubator and prototype development. One of the areas is Free Zone, a fab-lab.

Scientific and Technological Park (TECNOPUC) - Created in 2003, it acts as manager of the University's relations with companies and entities located in its space. With 50,000 m² of built area and 170 organizations installed, including HP and DELL labs, the park has been three times named as the best technology park in Brazil by AN-PROTEC.

RAIAR - Established in 2003, it is a multi-sector technology-based incubator to house startup companies and results of applied research and embryonic ventures from established companies. University's students and faculty staff can create startups with RAIAR support. The incubator has a management support service that assists companies in the areas of business management, including marketing, communication, and product marketing.

Laboratory Specialized on Electro-electronics, Calibration, and Testing (LABELO) - LABELO operates directly in the area of technological services. It is specialized in calibrations and tests, focused on the field of scientific and industrial metrology, accredited in the national competence bodies.

Innovation Center (CI) - Linked to the engineering faculty, CI is the result of a partnership with Microsoft, aiming to accelerate the use of new technologies. CI acts directly in the training of high school and undergraduate students, seeking the creation of new innovative companies in the area of Information Technology.

Laboratory of Interdisciplinary Entrepreneurship and Innovation (IDEAR) - Created as an entrepreneurial nucleus in 2007, it develops relative dissemination actions in the academic community. IDEAR organizes lectures and events related to the theme, training programs, identification, and skills development for the entrepreneur. It also promotes the Entrepreneurial Tournament contest, to awaken and stimulate the entrepreneurial spirit of undergraduate and graduate students. Several teams participating in the Tournament later settled at RAIAR.

6. Discussion

HEI1 is at maturity level 4 (structured). There are already some dimensions of level 5 (optimized), but they are not fully developed. The contact in the classroom with the theme of entrepreneurship is formally made only in the master's degrees. Furthermore, projects involving start-ups primarily arise in the context of research activities carried out by HEIs and associated research centers. In this sense, the direct contact of students with start-ups throughout their learning process does not always happen. Additionally, the connection with simulated environments of the management process and growth of a start-up are also not included in the learning process.

HEI2 stands at level 2 (disseminated). Some gaps and constraints have been identified for this HEI to position itself at the next level, respectively: (i) the teaching of entrepreneurship involves several courses, but the articulation between the contents taught among them is unclear, i.e., there may be an overlap of concepts and others that are not addressed; (ii) not all undergraduate programs offer an entrepreneurship disci-

pline because the decision process is not defined at the organizational level; and (iii) there are no specific leadership and creative thinking trainings, nor are these contents addressed in the curricular units that comprise each course. These deficiencies are minimized in the context of entrepreneurship course, and in an informal way within each working group.

HEI3 is at maturity level 2 (disseminated). It is possible to identify aspects of higher levels (involvement of several disciplines; events and workshops; integration with the business community). However, due to the large size of the university, the knowledge areas are on different levels. Some fields, as Management and Engineering schools, have more contact with entrepreneurial content and practice and can offer projects and services to the industry. The development of a technology park and more collaborative projects can produce cases of well-succeeded ventures and enable a change of culture and subsequent upgrade to level 4. However, the lead time to realize projects is complicated due to bureaucracy. Another aspect is the cultural and ideological beliefs of part of the faculty body understanding entrepreneurial activities as part of a privatization process of the public university.

HEI4 is at maturity level 5 (optimized). The integration with the business community is powerful. The maturity of the incubator process and the impact of well-succeeded experiences in the technology park spread an entrepreneurial culture. The entrepreneurial practice reaches all levels of education. In 2018, the university, in partnership with other local universities, industry, and government actors, launched the initiative “Pacto Alegre” to develop a substantial digital transformation in the whole city of Porto Alegre. As a private but non-profit institution, the level of barriers imposed by the Brazilian legal framework to make partnerships and agreements are lower. On the other hand, the level of public funding is also lower than in a public university. However, they can use the lands and buildings to guarantee infrastructure funding. Moreover, cultural and ideological constraints are lower than in a public institution.

7. Conclusions

The traditional initial teaching and research functions of HEI have given rise to a third function based on a progressive approach to the market and a link to society through the transfer of their knowledge. These new functions are the evident result of all the transformations and pressures that have been brought about by globalization and political, economic, and social factors. As a result, HEIs are increasingly evaluated by their third mission.

Currently, academic entrepreneurship is part of the strategic plan of several universities. In this way, universities seek to develop their third mission and promote an entrepreneurial environment that stimulates academic entrepreneurship. In this sense, fostering entrepreneurship among students has become a relevant topic for HEIs. In fact, EE among young people can contribute to the acquisition of skills and the development of essential attitudes for the development of a new business.

This study presents both theoretical and practical contributions. Conceptually, the study presents an innovative conceptual framework for entrepreneurial education assessment consisting of five levels and thirty sub-dimensions. This framework was defined, taking into account the reference models in the field of learning maturity models and software engineering like CMMI. From a practical perspective, this framework is relevant for HEIs to be aware of the practices they can adopt in the promotion of EE and to enable them to position themselves in this field and to have a greater perception of their degree of maturity in the practices adopted in EE.

The main limitation of this study lies in the use of four case studies, which, despite having a multi-country perspective, do not allow for an exhaustive consideration of all the good practices in entrepreneurship education that can be found in the

international context. Nevertheless, the proposed conceptual model is sufficiently comprehensive and can be extended by universities to define their degree of maturity. As future work, it is intended to extend the framework to takes into account the state of development of each entrepreneurial practice and its outcomes. Furthermore, it is essential to disseminate this framework to various HEIs and help them in the process of measuring the degree of maturity in entrepreneurship education.

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