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“Entrepreneurship Education as a Process with the support of a Structural Equation Modelling”

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Entrepreneurship Education as a Process with the support of a Structural Equation Modelling

Introduction

Entrepreneurship has been extensively investigated. Research is anchored in different theories, initially in economics (1870–1940), then in social sciences (1940–70), from the 1970s in management studies, and has now involved a specific research area in its own right (Bruyat and Julien, 2001). The broad attention to the entrepreneurial phenomenon (which makes its literature so rich) owes itself to the awareness that entrepreneurship is an essential lever to cope with a complex economic scenario characterized by increased risk, scant ability to forecast and light geographic boundaries (Hitt and Reed, 2000). It should also be considered that, due to the economic crisis, the importance of entrepreneurship has also increased: the possibility of becoming entrepreneurs has been seen as an alternative to the lack of employment.

Given the prominent role of entrepreneurship in supporting the economy worldwide, it is not surprising, as stated in numerous studies, that entrepreneurship education is becoming increasingly important everywhere in the world, while research in entrepreneurship is growing and getting legitimacy in the scientific communities (Jack and Anderson, 1998; Honig, 2004; Lee and Wong, 2007; Fayolle and Gailly, 2008; Fayolle, 2009). There is a significant and substantial consensus that entrepreneurship is a skill, which can be developed through education (Souitaris et al., 2007; Curley and Formica, 2013). Education should provide an innovative learning environment, thus helping students to develop entrepreneurial competences (European Commission, 2011). At the same time, teachers have to be seen as mentors and supervisors in a cooperative and interdisciplinary learning process characterized by creativity, meaning making and interactivity (Erkkilä, 2000; Lackéus, 2015).

This led to the need for an Entrepreneurial University, caused not only by social and market changes but also by the emergence of a different way to innovate, which makes synergy its vision and, in which “working together” becomes its major tool.

Indeed, the recent communication adopted on the Action Plan Entrepreneurship 2020 (European Commission, 2013) clearly stated that "Universities should become more entrepreneurial". Moreover, against this backdrop, the European Commission, in collaboration with the OECD, has developed a framework for entrepreneurial universities. The framework is designed to help interested universities assess themselves and improve their ability with tailor-made learning modules. This agreement entails developing a framework for entrepreneurial universities that want to undergo self-assessment processes, in order to improve their ability specifically through entrepreneurial training programmes.

Despite the impressive growth of literature in recent years (Katz, 2003; Kuratko, 2005; Neck and Greene, 2011, Fayolle, 2013, Fayolle and Gailly, 2015), defining the focus of entrepreneurship education (EE) still presents major challenges (Fayolle and Gailly, 2008), given the different purposes and the theoretical and methodological approaches that characterize it. Moreover, given the multidisciplinary field of entrepreneurship, the content covered in most entrepreneurship courses is far-reaching (Neck and Green, 2011).

The evaluation of education programmes appears to be a complex issue as well (Ostroff, 1991; Dionne, 1995; Ng and Feldman, 2009), and there are numerous types, objectives and methods of evaluation (Fayolle and Gailly, 2015). Indeed, evaluation of entrepreneurship education cannot be totally disconnected from its pedagogical engineering, both at the design level and at the programme implementation level (Bechard and Gregoire, 2005).

In an attempt to provide a contribution to the studies that aim to boost entrepreneurship education and the entrepreneurial activity of universities, as a member of a broader research group[1] I analysed and tested an experimental lab, the ExperimentaLab, a virtual platform to support entrepreneurial training programmes through a learning process that simulates the progression from idea to start-up, helping students or would-be entrepreneurs acquire entrepreneurial competences and skills, thus increasing their future likelihood of starting up a business. Experimental labs are networks of individuals "federated" from universities, research labs, financial markets and business partners, who become part of an innovative ecosystem by means of a virtual platform, rather than relying only on their own capabilities (Andersson et al., 2010).

In so doing, the ExperimentaLab training process focuses on the third mission of the university, i.e., to promote economic and social development (Etzkowitz and Leydesdorff, 2000; Etzkowitz, 2004), as it seeks to educate would-be entrepreneurs by helping them practise the managerial and entrepreneurial functions of new venture creation. Modern knowledge-based economies urge universities to embrace the third mission and regard themselves as critical factors in the development process: entrepreneurship begins in academia.

To evaluate the educational effectiveness of the virtual platform ExperimentaLab four simulations by role play were conducted, which allowed issues related to such a complex phenomenon to be dealt with.

The research questions addressed in this work are: can the adoption of the ExperimentaLab positively influence the outcome of entrepreneurial training activity (i.e., the acquisition of entrepreneurial competences by students)? If so, what characteristics of the ExperimentaLab influence the outcome of entrepreneurial training? Finally, does the adoption of the ExperimentaLab impact on players' satisfaction?

[1]My PhD research was carried out as part of a broader research conducted at the Department of Economics of the University of Campania Luigi Vanvitelli and at the Department of Management, Economics and Institutions of Federico II, which saw the involvement of a number of researchers: L., Castaldi, V., Iscaro and C., Turi, and prof. L., D'Ambra. The work has been presented at several international conferences and some parts of it have been published in international journals.

The work is organized as follows. The next section presents the literature review, narrowed down from the broad field of entrepreneurship to the niche of entrepreneurial outcomes. First I move from the broader definition of the entrepreneurship phenomenon onto a more specific focus on the entrepreneur. Then I focus on the stream of research covering entrepreneurship education, the entrepreneurial university, entrepreneurial learning and entrepreneurial outcomes, to finally concentrate on the concrete instrument of the theoretical framework developed in this work, highlighting the dimensions thought to positively influence the outcome of entrepreneurial training activity. While the issue of experimental labs represents a niche in the literature still in its embryonic phase, the belief that they can effectively sustain student training (their ability to go from intention to action) has motivated the creation of a real platform, the ExperimentaLab, to be tested by simulation. Thus the following section discusses the process of new venture creation and the setting up the virtual platform called ExperimentaLab. The next section presents the research methodology: the structural equation model and multi-group to evaluate the effectiveness of the ExperimentaLab. Moreover, in the following section I describe the sample used and explore the validity of the questionnaire created to apply the methodology previously explained. The next section discusses the simulations conducted (concluded in May 2016), showing that the ExperimentaLab could be a valid educational tool potentially implementable by entrepreneurial universities. I analyse the results, draw conclusions and discuss some major implications for future research.

1. Literature review

1.1 Entrepreneurs and entrepreneurship

Richard Cantillon (approx. 1680–1734) was the first author to give entrepreneurship a more precise economic meaning. In his *Essai sur la nature du commerce en general* (1755/1999), he outlined the principles of the early (emerging) market economy based on individual property rights and economic interdependency and recognized three classes of economic agents: landowners, entrepreneurs, and hirelings (van Praag, 2005; Hébert and Link, 2006; Hébert, 2009). In this regard, Cantillon created a vision of how a capitalist economy works and gave the entrepreneur a key role, as an arbitrager responsible for all the exchange in the economy, and who, in turn, brings about the equilibrium between supply and demand (Landström and Benner, 2010).

Another writer who should be mentioned is Jean-Baptiste Say (1767–1832), who was himself an industrial entrepreneur as a manager of a textile mill (Hoselitz, 1960). He employed an empirical description of what entrepreneurs actually did and analysed their function independently of the particular social framework, within which they operated (Kalantaridis, 2004). In contrast to Cantillon, Say suggested another definition of entrepreneurship, which emphasized the coordinating role in production and distribution. Thus, the entrepreneur is a coordinator and entrepreneurship consists in combining the factors of production into an organization.

In the mid eighteenth century, production conditions and social relations began to change, and a new way of thinking started to emerge. These changes also affected the intellectual and academic environment.

Marshall (1930) defined the entrepreneurial function in providing innovation and consequently progress. It is important to stress that already in Marshall's formulation not all business people can be considered entrepreneurs. There are in fact business owners who cannot avoid taking risks and other who "follow beaten tracks" (Lynskey and Yonekura, 2002). In order to belong to the first group, superintendence is not enough, but forecasting and leadership are also required (Marshall, 1930). That said, Marshall's entrepreneur is innovative in operative terms, meaning that he innovates for efficiency rather than efficacy, leaving to Schumpeter the possibility of being the first author to identify the role of the entrepreneur in creating changes and disequilibrium in the market, through innovation and proactiveness.

Schumpeter (1934) saw the entrepreneur as the major agent of economic development and defined entrepreneurship as the process, by which the economy as a whole goes forward and develops.

Entrepreneurship research was anchored in different theories, initially in economics (1870–1940), followed by the social sciences (1940–70) and after 1970 in management studies – based primarily on migration patterns – but has now evolved as a specific research area in its own right (Bruyat and Julien, 2001).

Entrepreneurship is complex, chaotic, and lacks any notion of linearity (Neck and Green, 2011). Indeed, there exist many definitions of entrepreneurship, which differ not only because they come from diverse disciplines, but also because they focus on different elements of the phenomenon (i.e., organization, individuals, process, content) (Sciascia and De Vita, 2004). A comprehensive notion is provided by Shane and Venkataraman (2000, p. 218), who defined the field of entrepreneurship "as the scholarly examination of how, by whom, and with what effects opportunities to create future goods and services are discovered, evaluated, and exploited".

Research and studies about entrepreneurship have been growing fast in the past 15 years due to the recognition that entrepreneurship is the engine that drives the economy of most nations, which, in turn, has led to increasing interest in education programmes (Karmarkar et al., 2014).

Nowadays, the broad interest in entrepreneurial phenomenon (which makes its literature so rich) is due to the awareness that entrepreneurship is an essential lever to cope with the new competitive environment (Hitt and Reed, 2000). In such an environment, where uncertainty is the main feature, entrepreneurship represents an important research field as it is connected to the chance of detecting new opportunities sustaining social and economic development. The critical role of entrepreneurship is also evident in the European reference framework where 'Entrepreneurship and a sense of initiative' is one of eight key competences for lifelong learning, which citizens require for their personal fulfilment, social inclusion, active citizenship and employability in a knowledge-based society (European Commission, 2012).

In this regard the European Commission (2013) describes entrepreneurship as a powerful driver of economic growth and job creation: it creates new companies and jobs, opens up new markets, and nurtures new skills and capabilities. For this reason, the Europe 2020 strategy recognises that if Europe has to face the current economic and social challenges, there is a critical requirement for its citizens to become more entrepreneurial across all walks of life - for example, in economic and social innovation, new business creation, employability and active citizenship. Any dynamic economy and society requires people who have the motivation, knowledge and skills to become entrepreneurs. Yet the entrepreneur is a key figure in the emerging stages of business creation.

Thus entrepreneurship education sits at the heart of this new "entrepreneurial ecosystem" (Mason and Brown, 2013) as it shapes young people’s mind-sets, attitudes and skills, and it is an important element for entrepreneurial attitude and intention for upcoming entrepreneurs (Souitaris et al., 2007).

1.2 Entrepreneurship Education

Considering the prominent role of entrepreneurship to support the economy worldwide, it is not surprising, as stated in numerous studies, that entrepreneurship education is becoming increasingly important worldwide, while research into entrepreneurship is growing and acquiring legitimacy in scientific communities (Jack and Anderson, 1998; Honig, 2004; Lee and Wong, 2007; Fayolle and Gailly, 2008; Fayolle, 2009; Fayolle et al., 2014).

Entrepreneurial education includes all activities aiming to foster entrepreneurial mind-sets, attitudes and skills and covering a range of aspects such as idea generation, start-up, growth and innovation (Fayolle, 2009).

Shigeru Fijii pioneered teaching in this field in 1938 at Kobe University in Japan. Courses in small business management began to emerge in the 1940s, and in 1947 Myles Mace introduced the first course in entrepreneurship in the USA at Harvard Business School. Only half a century later this phenomenon had gained a more universal recognition (Alberti et al., 2004). Entrepreneurship courses are taught at nearly every accredited institution belonging to the American Assembly of College Schools of Business (AACSB) at over 1400 post-secondary schools, and enjoy considerable world-wide growth (Honig, 2004).

As discussed by Jack and Anderson (1998), the teaching of entrepreneurship is both a science and an art, where the former relates to the functional skills required for business start-ups (an area which appears to be teachable) while the latter refers to the creative aspects of entrepreneurship, which are not explicitly teachable. Although the focus of most entrepreneurship courses and training lies in the scientific dimension of entrepreneurship, it has been acknowledged that entrepreneurship education should also help ignite the artistic, creative and perceptual aspects of entrepreneurship (Lee and Wong, 2007).

Education should provide an innovative learning environment, thus helping students to develop entrepreneurial competences (European Commission, 2011). Teachers have to be seen as mentors and supervisors in a cooperative and interdisciplinary learning process characterized by creativity, meaning making and interactivity (Erkkilä, 2000; Lackéus, 2015). Educators have the responsibility to develop the discovery, reasoning, and implementation skills of their students so they may excel in highly uncertain environments (Neck and Green, 2011).

Besides the development of an entrepreneurial spirit and taste for entrepreneurship, entrepreneurship education can also contribute to improving the image and highlight the role of entrepreneurs in society (Fayolle and Gailly, 2008). Among the reasons to promote entrepreneurial education, beyond that of economic development and job creation, there is also a less common but increasing emphasis on the effects that entrepreneurial activities can have on students' as well as employees' perceived relevancy, engagement and motivation in both education (Surlemont, 2007) and in working life (Amabile and Kramer, 2011). Finally, the role entrepreneurship can play in taking on important societal challenges (Rae, 2010) has positioned entrepreneurial education as a means of empowering people and organizations to create social value for the public good (Austin et al., 2006; Volkmann et al., 2009).

Generally, entrepreneurship education aims to increase the awareness of entrepreneurship as a career option, and enhances the understanding of the process involved in initiating and managing a new business enterprise (Lee and Wong, 2007). Entrepreneurship education can help students see in new venture creation a possible career option, develop positive and favourable attitudes towards entrepreneurial situations and also offer new career prospects for part or all of one's professional life. The objectives of entrepreneurship education could be classified into three categories: raising awareness, teaching techniques, tools and how to handle situations and supporting project bearers (Fayolle, 2007).

Although the key to successful entrepreneurship education is to find the most effective way to manage the teachable skills and identify the best match between student needs and teaching techniques, there is no universal pedagogical recipe to teach entrepreneurship, and the choice of techniques and methods depends mainly on the objectives, contents and constraints imposed by the institutional context (Arasti et al., 2012).

Fayolle (2013), at a didactical level, analyses the basic questions of entrepreneurship education in terms of: what, how, for whom, why and for what results the entrepreneurship education programme is designed (Jones and Matlay, 2011) (see figure 1). In particular, the question "what" can be analysed at two levels of learning: content and knowledge (Fayolle, 2013). The contents are often based on the most popular textbooks in entrepreneurship and tend to reflect the nature (opportunity-centred) and dynamics of the entrepreneurial process (opportunity identification, evaluation and exploitation) (Shane, 2003). As regards knowledge, pride of place is given to the business planning approach and the functional knowledge supporting the new venture creation process (Honig, 2004). Yet Edelman, Manolova and Bruch (2008) have highlighted the existence of a gap between what we teach in entrepreneurship and what entrepreneurs do (Fayolle, 2013). Researching the "what" question is thus still of considerable importance.

The question "how" can be managed with different methods and approaches. Much of the literature on entrepreneurship education emphasizes the importance of active, experiential learning by doing and "real-world" pedagogies. The main focus is on active pedagogies, but little evidence is provided regarding the match between the methods used and audience specificities, methods and contents and so on. In the same line of thought, few studies have set out to compare the effectiveness and efficiency of different teaching methods used with same-profile students or with the same types of objectives. Hence, it is only possible to list the best practices for entrepreneurship educators: experiential learning rather than transmission of knowledge, the learner's active participation, etc., highlighting that the "how" question also still needs to be researched.

The question “for whom” regards the audiences. Research in EE offers insights into a great variety of audiences: secondary and upper-secondary pupils and students; students engaged in a range of disciplines, from various socio-demographic backgrounds and with different levels of motivation and different aspirations towards entrepreneurship (Fayolle, 2013).

The question “why” describes the objectives for entrepreneurship education programmes that they can be at both the pedagogical and socio-economic. Finally, the question “for which” can be analysed with the evaluation. Little research is available concerning the assessment and measurement of entrepreneurship education programmes and courses. Yet, entrepreneurial outcomes and, more generally, the effectiveness of entrepreneurship education are key issues for both policy-makers and educators (Fayolle, 2013).

This work analyses the impact of the entrepreneurship education programme conducted through the virtual platform ExperimentaLab (“how”) on acquisition of entrepreneurial competences by students (“what”).

Thus this work focuses on the “what” and “how” didactical areas of entrepreneurship education, widely mentioned as those that still lack the necessary attention (Pittaway and Cope, 2007; Solomon, 2007; Fayolle and Gailly, 2008; Samwel Mwasalwiba, 2010).

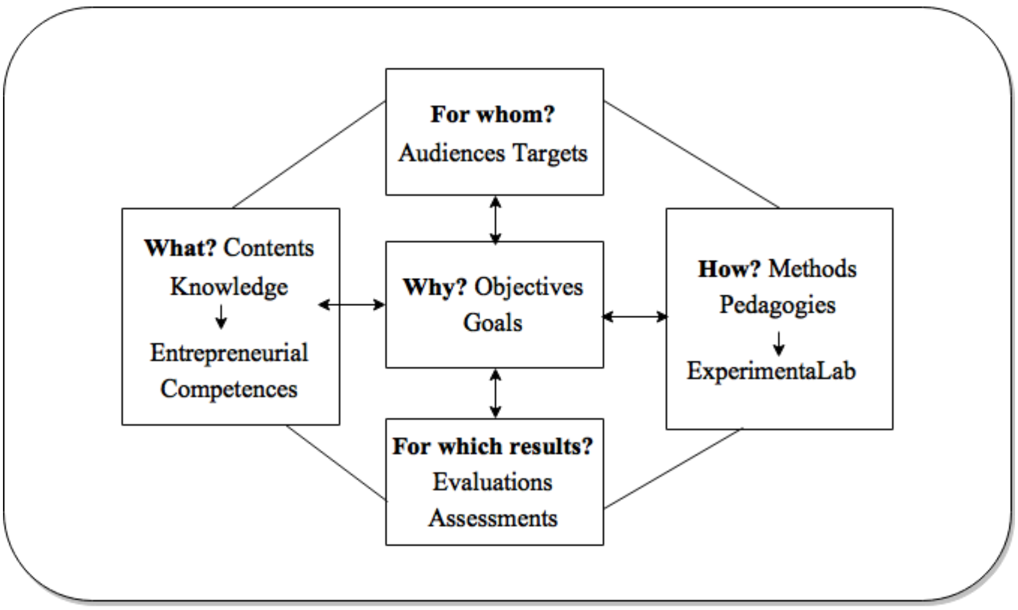

Figure 1. A teaching model in entrepreneurship education (adapted from Fayolle, 2013)

1.3 Entrepreneurial university

The role of universities in providing entrepreneurship education is today much emphasized as a way to stimulate the entrepreneurial mind-sets of young people and promote more entrepreneurial attitudes and behaviours in society. Large investments from both public and private sources are made to organize and carry out entrepreneurship education, and many people are in this respect involved in providing or receiving entrepreneurship education.

A study by Charney and Libecap (2000) established that, from 1950 to 2000, the number of university institutions worldwide offering entrepreneurship training programmes at different levels has increased from one to more than 1500. From a few single entrepreneurship courses offered in the US in the 1980s, the supply has thus grown exponentially in recent decades and entrepreneurship has today become a subject offered more or less at all major universities worldwide (Carrier, 2007).

In particular, Katz (2003) reports that in 1994 more than 120,000 students were enrolled on entrepreneurship courses, whereas by the beginning of the new century it was reasonable to believe that the number had increased by 50 per cent in the United States. In Canada, the number of undergraduate entrepreneurship courses increased by 44 per cent between 1979 and 1999, although growth has fallen off considerably from 2000 to 2005 (Menzies, 2005). A similar trend in the development of entrepreneurship courses appears in France (Fayolle, 2003) and even throughout Europe as a whole (Wilson, 2004).

University education has undergone two major revolutions that have changed and enriched its mission: from teaching, to research, and from research to entrepreneurial vocation. According to the literature, the university's "third mission" is to promote economic and social development (Etzkowitz and Leydesdorff, 2000; Etzkowitz, 2004). Modern knowledge-based economies urge universities to embrace the third mission and regard themselves as critical factors in the development process. Indeed, as highlighted by Etzkowitz and Leydersdorff (2000), the future role for the entrepreneurial university is based on alignment of the academic mission based on teaching and research with structure and functions based on real economic development.

Entrepreneurship education can help promote an entrepreneurial and innovative culture by changing mind-sets and providing the necessary skills. This particularly relevant in Europe, where the welfare system has made people scarcely inclined to take risks. This attitude was reinforced in universities, traditionally focused on ensuring that students find secure future jobs. Meanwhile globalisation, the rapid development of technology and the lower cost of travel have completely changed the nature of work. It is no longer enough to train students for a career. Universities must prepare students to work in a dynamic, rapidly changing entrepreneurial and global environment (Wilson, 2008). At the same time, universities have become more entrepreneurial, deploying patenting and licensing, incubators, science parks, university spin-outs, and investing equity in start-ups (Rothaermel et al., 2007). All these factors pave the way for an essential engagement of universities in nowadays economic and social development.

The belief that the university system can practically and effectively promote entrepreneurship was the leitmotif for this research project. With entrepreneurial vocation and strategic vision, the university tries to fill the gap between discovery and application by collaborating with external actors. In fact, university-industry interaction is based on a variety of linkage mechanisms and arms-length relationships (Etzkowitz and Dzisah, 2015). Among others, as pointed out by Rothaermel et al. (2007), universities have been increasing their entrepreneurial activity through various tools, such as patenting and licensing, incubators, science parks and TTOs.

Literature focusing on the entrepreneurial university expanded rapidly (Henrekson and Rosenberg, 2001; Etzkowitz, 2003; Di Gregorio and Shane, 2003; Friedman and Silberman, 2003; Siegel et al., 2003; Rothaermel et al., 2007).

Etzkowitz (2004) describes the evolution of the entrepreneurial university model, starting from the institution of an industrial liaison office, followed by the setting-up of a technology transfer office and, finally, the creation of an incubator. This evolution is influenced by the larger framework, in which relationships take place: the external conditions (the characteristics of the local system of innovation) and the internal conditions (the university environment) both affect the efficiency and hence the evolution of knowledge transfer mechanisms (Etzkowitz, 1988; Powers and McDougall, 2005; Bercovitz and Feldamn, 2006). The evolution of the entrepreneurial university model can be linked to what Chesbrough (2003) terms the shift from a "closed innovation system" to an "open innovation system".

While closed innovation is internal, centralized and somehow "self-referential", open innovation is externally focused, collaborative and based on the recognition of the importance of internal and external knowledge flows. Since knowledge is a fluid mix of insights (Davenport and Prusak, 1998), the wider it flows the higher the chances of generating innovation. Hence, the shift from innovation initiatives that are centred on internal resources to those that are centred on external networks (Nambisan and Sawhney, 2011).

In an attempt to provide a contribution to the studies that aim to boost entrepreneurial education and the entrepreneurial activity of universities, I analysed and tested an experimental lab (the ExperimentaLab), a virtual platform to support entrepreneurial training programmes through a learning process that simulates the progression from idea to start-up, supporting students and would-be entrepreneurs in the acquisition of entrepreneurial competences and skills, thus increasing the future likelihood to start a business.

In so doing, the ExperimentaLab keeps focusing on the third mission of the university, educating would-be entrepreneurs and helping them practise the managerial and entrepreneurial functions of new venture creation. The ExperimentaLab is an entrepreneurship training programme relying mostly on experiential teaching and "learning by doing" methods, as is often the case in entrepreneurship education (Carrier 2007). For universities this means adopting unconventional experience-based teaching and evaluation methods necessary to deliver entrepreneurial competences (Kickul and Fayolle, 2007).

1.4 Entrepreneurial learning

Entrepreneurial learning has emerged as an important area of enquiry in relation to both the academic study of entrepreneurship and the practical development of new entrepreneurs, yet it is an area, which is not well understood (Deakins et al., 2000; Rae, 2005).

As regularly reported over the past years, there is increasing interest in the research field of entrepreneurial learning (Harmeling and Sarasvathy, 2013). Some studies argue that part of the increasing interest in entrepreneurial learning is that the current provision of entrepreneurship education is supplied and does not fully reflect a demand-led approach that values how entrepreneurs learn (Pittaway and Thorpe, 2012). Since entrepreneurship courses were first provided in conventional business education (Kuratko, 2005), much research focused on exploring the programmes already provided (Vesper and Gartner, 1997). Only later did interest emerge in exploring the learner's side that aimed to understand how real-life entrepreneurs learn and acquire entrepreneurial competences (Morris et al., 2013; Sirelkhatim and Gangi, 2015).

Competences have been gaining considerable attention in recent years across diverse fields (Sánchez, 2013). Generally speaking, competency includes knowledge, skills, attitudes and behaviours needed to complete an activity successfully (Morris et al., 2013; Sánchez, 2013; Sirelkhatim and Gangi, 2015). Entrepreneurial competences include, amongst many other things, opportunity recognition, opportunity assessment, risk management, creative problem solving, value creation and building and using networks (Morris et al., 2013). Entrepreneurial learning focuses on exploring how entrepreneurs acquire the previously mentioned entrepreneurial competences (Cope, 2005). Many articles on entrepreneurial learning have drawn on the literature from relevant fields such as individual learning and adult learning (Cope, 2005; Pittaway and Thorpe, 2012).

The concept of entrepreneurial learning has been mainly defined from a perspective of entrepreneurship theory. For instance, Minniti and Bygrave (2001) define entrepreneurship as a learning process, where entrepreneurial learning is described as generated, at least in part, by the reinforcement of the belief in certain actions due to their positive outcomes. Similarly, Politis (2005) describes entrepreneurial learning as a process that facilitates the development of necessary knowledge for being effective in starting up and managing new ventures. His study highlights entrepreneurial learning as an experiential process where enterprising individuals continuously develop their entrepreneurial knowledge throughout their professional lives (Politis 2005). Entrepreneurial learning can also be conceived as a lifelong learning process, where knowledge is continuously shaped and revised as new experience takes place (Sullivan 2000).

From these definitions, it can assume a strong relationship between the entrepreneurial process and learning. Minniti and Baygrave (2001) point out that 'entrepreneurship is a learning process, and a theory of entrepreneurship requires a theory of learning'. However, we still have a limited knowledge and understanding of the interaction between learning and entrepreneurship, and such a process remains one of the most neglected areas of entrepreneurial research, and thus, understanding (Zahra, 2012). Entrepreneurial learning is seen as an extremely complex dynamic phenomenon (Warren, 2004).

It has been observed that education should be brought to life through practical experiential learning models and experience of real-world entrepreneurs (Cupe and Watt, 2000; Rasmussen and Sørheim, 2006; and Fayolle and Gailly, 2008;).

Experiential Learning Theory (ELT) provides a holistic model of the learning process and a multilinear model of adult development, both of which are consistent with what we know about how people learn, grow, and develop. The theory is called "Experiential Learning" to emphasize the central role that experience plays in the learning process, an emphasis that distinguishes ELT from other learning theories. The term "experiential" is used therefore to differentiate ELT both from cognitive learning theories, which tend to emphasize cognition over affect, and behavioural learning theories that deny any role for subjective experience in the learning process (Kolb et al., 2001).

Another reason the theory is called "experiential" is its intellectual origins in the experiential works of Dewey, Lewin, and Piaget. Taken together, Dewey's philosophical pragmatism, Lewin's social psychology, and Piaget's cognitive-developmental genetic epistemology form a unique perspective on experiential learning (Kolb, 1984).

This provides a conceptual foundation for a model of entrepreneurial learning, which accommodates social participation and human action as well as cognition, enabling learning theory to be applied to entrepreneurship (Rae, 2005).

By digging deeper into the practice-oriented experience and looking at its different elements, Fayolle and Gailly (2008) introduce the professional dimension, which equals the practical orientation and comprises three aspects: "hard facts" (knowing what to do), "soft facts" (knowing how to react in a specific situation) and "know-whom" (knowing, which network can be helpful in this process). Generally speaking, the literature suggests that the networking capabilities of the individual entrepreneur influence organizational performance. Gruber-Muecke and Kailer (2015) have found that entrepreneurs must do two things: one is conducting the business efficiently, and the other is networking and creating future opportunities (Zott and Amit, 2007).

It has been observed that entrepreneurship training programmes can influence both entrepreneurial behaviour and orientation (Garavan, and O'Cinneide, 1994). While entrepreneurial orientation is meant as the entrepreneurial processes that answer the question of how new ventures are undertaken, entrepreneurial behaviour can be described as the processes, practices and decision-making activities that lead to entrepreneurship (Lumpkin and Dess, 1996). It is practical entrepreneurial experience and as such can also be gained outside education. Young people should be encouraged to develop entrepreneurial skills through informal and non-formal education like volunteering. Such experiences should also be validated and recognized, in accordance with the recommendation proposed in this area by the European Commission (2013).

Young people, who benefit from entrepreneurial learning both inside and outside universities, develop business knowledge and essential skills and attitudes including creativity, initiative, tenacity, teamwork, understanding of risk and a sense of responsibility. This is the entrepreneurial mind-set that helps entrepreneurs transform ideas into action and also significantly increases employability (European Commission, 2013). Furthermore, partnerships with businesses can ensure that education and training curricula are relevant to the real world.

The discussion in entrepreneurial learning is centred on the idea of gaining entrepreneurial competences through experience that entrepreneurs gain from “learning by doing” (Cope and Watts, 2000), routinized activities (Reuber and Fischer, 1993 in Cope, 2005), contingencies, non-continuous events (Harmeling and Sarasvathy, 2013), failure (Minniti and Bygrave, 2001), and reflecting (Cope, 2005) from experience gained through such life events.

Also, the methods suggested by researchers drawing on how entrepreneurs learn assume that a high proportion of active learning is important to enable problem solving, self-reliance and self-reflection (Klapper and Tegtmeier, 2010). The educational methods suggested by entrepreneurial learning literature are scenarios, role playing and real business experiences (Corbett, 2005), case study discussions and business simulations (Chang and Rieple, 2013), live projects that combine traditional teaching with talks from business people (Heinonen and Poikkijoki, 2006), peer assessment, primary data gathering and reflective accounts (Chang and Rieple, 2013), person-induced business simulation (Klapper and Tegtmeier, 2010), incubators (Vincett and Farlow, 2008), internships to create and implement innovative products for real clients (Wang and Verzat, 2011), and live projects where students collaborate with real business people (Chang and Rieple, 2013).

The focus on studying entrepreneurs as the starting point for designing entrepreneurship education programmes is considered important as it will contribute to provide learner-centred programmes that better engage students rather than teacher-centred ones (Jones, 2010). However, while many studies assert that entrepreneurs differ from non-entrepreneurs, there is no unified description of how they differ (Lee et al., 2005). Also, many researchers refute the question of an entrepreneur as an individual who acts or learns differently. As maintained by Ramoglou (2013): “as there is nothing to be learned from dancers beside they dance, there is nothing unique to be found in individuals who just exercise entrepreneurial action”. Entrepreneurs actually learn similarly to how other adults do (Sirelkhatim and Gangi, 2015).

As Rae (2009) suggests, learning should be relational, authentic, relevant, useful and productively shared. Based on Kolb's (1984) theory, entrepreneurial learning can be regarded as an experiential process, in which entrepreneurs develop knowledge through four distinctive learning abilities: experiencing, reflecting, thinking and acting (Johannisson et al., 1998; Moustaghfir and Sirca, 2010).

Following the same order of ideas, many other scholars have assumed that entrepreneurial learning is a process by which people acquire, assimilate, and organize newly formed knowledge with pre-existing structures, and how learning affects entrepreneurial action (e.g. Warren 2004; Cope 2005; Corbett 2005; 2007).

Learning is the process by which people acquire new knowledge, including skills and specific competences, from experience or by observing others, and assimilate and organize them with prior knowledge in memory to make them retrievable for use in both routine and non-routine action (Holcomb et al. 2009). Learning is also defined as an emergent, sense-making process, in which people develop the ability to act differently, through knowing, doing and understanding why (Mumford 1995). By learning, people construct meaning through experience and create new reality in a context of social interaction (Weick, 1995). Accordingly, entrepreneurial learning is the outcome of dynamic social processes of sense making, which are not only cognitive or behavioural but also affective and holistic (Gibb, 2001; Cope, 2005). It is a dynamic process of awareness, reflection, association and application that involves transforming experience and knowledge into functional learning outcomes (Rae, 2006), where 'process' refers to the logic of explaining the causal relationship between entrepreneurs' previous experiences and the performance of the subsequent venture (Politis, 2005). Entrepreneurial learning is hence complex and interconnected with a somewhat ad hoc approach to formal learning and a heavy reliance on experiential learning (Warren, 2004).

Different factors affect the entrepreneurial learning process. For instance, prior knowledge and heuristics orient entrepreneurs to information cues and act to produce new knowledge, on which entrepreneurs rely to recognize and exploit opportunities (Holcomb et al., 2009). Similarly, the entrepreneur's career experience, in terms of start-up, management and industry-specific experience, is positively related to the development of entrepreneurial knowledge (Politis, 2005) that facilitates decision-making about entrepreneurial opportunities under uncertainty and time pressure (Johannisson et al., 1998; Sarasvathy, 2001). Sarasvathy (2001) refers to two kinds of predominant logic or reasoning as: 1) causal reasoning, which uses techniques of analysis and estimation to explore and exploit existing and latent markets, and 2) effectual reasoning, which calls for synthesis and imagination to create new markets that do not already exist. Rae (2006) found that entrepreneurial learning occurs and can be interpreted by reference to three factors: 1) personal and social emergence of the entrepreneur; 2) contextual learning, which leads to the recognition and enacting of opportunities in specialized situations; and 3) the negotiated enterprise, which includes processes of participation and joint enterprise, changing roles over time, and engagement in networks of external relationships. Building on the first factor, Liang and Dunn (2008) pinpoint the importance of optimism vs. realism, among other entrepreneurial characteristics, to shape entrepreneurs' experience and hence their knowledge.

1.5 Entrepreneurship programmes and Entrepreneurial outcomes

It is widely acknowledged that individuals who chose entrepreneurship as an alternative career are subjected to various "push" and "pull" factors that ultimately determine and shape their chosen entrepreneurial paths (Matlay and Storey, 2003). In this context, Kuratko (2005) claims that entrepreneurship, or at least some pertinent aspects of it, can be taught by business educators and/or training professionals prior to, during and after commencement of entrepreneurial activities. Rae (1997) suggests that "the skills traditionally taught in business schools are essential but not sufficient to make a successful entrepreneur". Given these perspectives, it is not surprising that there is an ongoing and protracted debate on whether universities can really make a significant contribution to the number and quality of entrepreneurial stock that operates in an economy (Matlay, 2006).

Despite the ongoing debate, the number and variety of entrepreneurship programmes on offer has expanded significantly in Europe, Asia, North America, Australia and New Zealand (Vesper and Gartner, 1997). Even in the US, where there is a long and well established tradition of entrepreneurship education (see Brockhaus et al., 2001), there has been an enormous growth in the number of relevant courses offered during the 1990 to 2005 period (Solomon, 2007). As elsewhere in the industrialised world (see Houston and Mulholland, 2003), the diversity and heterogeneity of entrepreneurship education courses across primary, secondary and university levels in the US has been matched by a growing rhetoric that demands even more - and better - programmes (Solomon et al., 2002).

Interestingly, most business schools appear to use a combination of theoretical and practical approaches, often reinforced by detailed analysis of entrepreneurial problems and solutions grounded within "realistic" case and field studies (Timmons, 2003; Peterman and Kennedy, 2003). Honig (2004) found that one of the more popular curricula formats of entrepreneurship education in US involved teaching the practicalities and monitoring of business plans. In all, 78 of the top 100 universities in the US regarded the development of a business plan as the most important feature of their entrepreneurship education provision. Winslow et al. (1999) undertook an analysis of "entrepreneurship" and "small business management" courses provided in business schools. They found both similarities and differences in design, delivery and assessment. For instance, both course types were aimed at a common customer base (students, nascent entrepreneurs, small business owner/managers and the unemployed) and tended to focus on the "enterprise" as an economically feasible and profitable unit (see Zeithaml and Rice, 1987). Similarly, they tended to provide a theoretical and practical coverage of the planning, implementing and operating stages of small enterprises. Indeed, Winslow et al. (1999) claimed that "the conceptual difference is often blurred, in both the academic and real worlds".

In a context characterized by such a high heterogeneity and variety of entrepreneurship programmes, well-defined entrepreneurial learning outcomes are needed, for educators to adopt effective entrepreneurial learning methodologies.

While no consensus has been established on a definitive method for measuring EE outcomes (OECD 2009), any study of entrepreneurship education training programmes must be clear about, which outcomes are being measured and how they are being measured. Drawing upon the available literature and the evaluations of a range of entrepreneurship education training programmes, outcomes vary widely (Matlay, 2008). Furthermore, intended outcomes are not limited to conventional entrepreneurship measures, such as the number of new start-up ventures or their performance. They may also focus on improving skills or changing attitudes, such as encouraging participants to consider entrepreneurship as a career option (Samwel Mwasalwiba 2010).

It is necessary to make a serious attempt to merge theory, practice and actual observation of what entrepreneurs do and how they learn (Harmeling and Sarasvathy, 2013).

Pedagogical research highlights that the evaluation of impact should be a key dimension of any teaching programme and therefore needs to be considered at the programme design step (Fayolle and Gailly, 2008; Nabi et al. 2015). As described by Nabi et al. (2015), the impact of entrepreneurship education programmes on attitudes and behaviour is ambiguous as studies suggest both positive and negative outcomes (Thompson et al., 2010; Fayolle 2013; Martin et al., 2013).

This work evaluates the entrepreneurial outcome of the ExperimentaLab entrepreneurship education programme, which adopts a pedagogical method that goes beyond formal classroom teaching (Souitaris et al., 2007), focuses on exploration, discussion and experimentation (based on students' needs and interests,) and shares the inclusion of an important element of realism, such as real-life problems to be solved (Nabi et al., 2015). This is powerful because, despite the challenges to the learner, the learning is more transferable to the real world (Blenker et al., 2012).

In line with recent literature on entrepreneurial learning (illustrated in previous paragraph), the outcomes of the ExperimentaLab EE programme are represented by the acquisition of entrepreneurial competences by individuals (participants). In the conceptual model in figure 2, explained in the next paragraph, the acquisition of these competences is represented by a construct named “Educational effectiveness”.

1.6 Theoretical Framework

Edelman, Manolova, and Bruch (2008) highlighted the existence of a gap between what is taught in entrepreneurship and what entrepreneurs do. Further, Matlay and Carey (2007) in their review of the literature on entrepreneurship education argued that “conceptual and contextual clarity, empirical rigorousness and comparability of emergent results are of paramount importance to academic attempts at bridging the entrepreneurship education and graduate enterprise chasm in the UK” (Matlay and Carey, 2007). In their view, a common definitional platform could serve as a “first base” from which to negotiate the multitude of meanings, interactions and outcomes attributable to the interface between “entrepreneurship” and “entrepreneurship education”. Definitional divergence, however, should not be perceived as a recent problem or development to affect these two interrelated fields of research. Some early commentators on entrepreneurship, including Cole (1968), Kirzner (1973) and Drucker (1985), highlighted inherent theoretical divergence in this topic and argued in favour of a common definitional model. In contrast, however, Bygrave and Hofer (1991) reached the conclusion that a single entrepreneurship model is unlikely to satisfy the varied requirements of a wide range of stakeholders.

There is a debate amongst academics and business people about whether entrepreneurship can be taught in the first place (Fayolle and Gailly, 2015). Some perceive entrepreneurship as a talent, with which one is born and cannot be taught; however, this can also be said of other professions, such as engineering or medicine, and nobody will dispute the need to teach students these subjects (Fayolle, 2013).

At the same time as this debate, there is an established recognition about the increasing demand for entrepreneurship education (Jones and Matlay, 2011). Hence (as illustrated in paragraph 1.2), the discussion — as Fayolle (2013) suggested — as an attempt to avoid stagnation, should move from whether or not entrepreneurship education can be taught to focus on the basic questions coming from education science: what, how, for whom, why and for what results is the entrepreneurship education programme designed (Jones and Matlay, 2011).

The shift in this discussion could help to further design entrepreneurship education programmes that are able to contribute to the challenge of codifying entrepreneurial skills like selling, managing people and product development into a teachable curriculum (Aronsson and Birch, 2004). Also, focusing on education science questions could contribute to the design of effective entrepreneurship education programmes that correlate with practices recommended by entrepreneurial learning (Jones, 2010), as well as being able to adapt to the resources and timetable constraints of Higher Education institutions (Vincett and Farlow, 2008).

In this regard, this work joins that part of literature on entrepreneurship education emphasizing the importance of "active", "experiential", "learning by doing" and " real-world" pedagogies, which, as Alain Fayolle (2013) suggests, is not currently well addressed by the entrepreneurship education research.

Looking at the outcomes of entrepreneurship education programmes (see previous section), in this work I analyse the impact of the adoption of the virtual platform ExperimentaLab (guiding the progression from idea to start-up) on the acquisition of entrepreneurial competencies by students/would-be entrepreneurs, which can increase the future likelihood of starting a business.

As already said, in this work I focus on the "what" and "how" of entrepreneurship education as areas mentioned by many researchers as those that have received scant attention in literature (Solomon, 2007; Pittaway and Cope, 2007; Fayolle and Gailly, 2008; Samwel Mwasalwiba, 2010). This research thus aims to contribute to an area — course contents and methods of teaching entrepreneurship (Solomon, 2007) — which needs further in-depth description in order to contribute to efforts to extract best entrepreneurship education programme practices (Jones and Matlay, 2011).

Since the purpose of this work is to investigate whether the designed platform ExperimentaLab can support entrepreneurship education by helping students/would-be entrepreneurs acquire entrepreneurial competencies, students in the sample were asked to fill in a questionnaire to evaluate both the design of the virtual platform and its entrepreneurial outcomes.

As regards the design of the ExperimentaLab, students were asked to assess the following items: 1) platform accessibility and navigation; 2) simplicity and clarity of the procedures; 3) functionality of the adopted Stage and Gate model; 4) support activity.

To identify the variables comprising the above items, I considered 1) the elements that Klabbers (2009) intends as constituting gaming-simulation (i.e. actors, rules and resources); 2) suggestions emerging from the focus group with experts, which allowed to address gaps in the literature (Iscaro et al., 2016); 3) data emerging from a first simulation. Thus, to produce the questionnaire an operational definition was carried out as follows: the item *"platform accessibility and navigation"* is composed of six variables: the ease of access to the platform services, the ease of platform navigation, the comprehensibility of platform language, the clarity of rules, the importance of the forum, and the importance of face to face; *"simplicity and clarity of the procedures"* consists of four variables: the simplicity of the form Idea in Progress guiding the process of idea development in the platform, the clarity of the rules, the clarity of the difference between a stage and a gate, and the clarity of the contents of the adopted (revised version) of the Stage&Gate model; *"functionality of the Stage&Gate model to develop business ideas"* includes variables related to the suitability of the Stage&Gate for the simulation goal and to the functionality of the different stages of the adopted Stage&Gate model; *"support activity"* comprises three variables: the impact of skilled human resources, the importance of a venture sitter, the level of collaboration with other human resources and organizations external to the ExperimentaLab network.

Like recent articles about entrepreneurial learning, this work makes a serious attempt to merge theory, practice and actual observation of what entrepreneurs do and how they learn (Harmeling and Sarasvathy, 2013).

This work aims to investigate the effectiveness of the entrepreneurship education programme supported by the adoption of the virtual platform ExperimentaLab. As regards the impact of the ExperimentaLab in terms of entrepreneurship education, students were asked to assess the item "*educational effectiveness*", indicating the utility of the ExperimentaLab for entrepreneurship education in terms of acquisition of entrepreneurial competencies.

The European Community defines entrepreneurial competencies as "a composition of an entrepreneurial attitude, entrepreneurial skills and knowledge of entrepreneurship" (Antonaci et al., 2014). The *entrepreneurial attitude* implies "learning to become entrepreneurial", i.e. the development of an entrepreneurial mind-set to help the future entrepreneur act and assume the responsibilities required of the role. *Entrepreneurial skills* entail "learning to become an entrepreneur", i.e. the acquisition of the knowledge and useful skills to turn ideas into action. It is possible to distinguish between soft skills (communicative, social, etc.) and hard skills (more technical, such as the ability to draw up a business plan). *Knowledge of entrepreneurship* refers to "learning to understand entrepreneurship", i.e. the understanding of the concept of entrepreneurship itself and others related to it (e.g. identify opportunities, understand the context, in which to live and work, learn issues related to ethical enterprises etc.) (Antonaci et al., 2014).

For the questionnaire I then carried out an operational definition for the item *educational effectiveness* based on the following variables: increase in risk propensity, the growth of the entrepreneurial spirit, the increase in ambition, the increase in failure tolerance, the usefulness of the platform for determining personal goals, self-efficacy, effectiveness of the platform compared to traditional learning methods, the feasibility of the business idea, the propensity to invest in the idea and identification with the role played during the simulation.

The issue of educational effectiveness could also be analysed by means of the theory of effectuation, which states that entrepreneurs will determine goals according to the resources in their possession (Sarasvathy, 2001; Sarasvathy, 2009). Some authors (Honig, 2004; Fisher, 2012; Fayolle, 2013) connect the theme of entrepreneurship education with theory of effectuation. The theory of effectuation (Sarasvathy, 2001) offers alternative views on how entrepreneurs think, make decisions, behave and act entrepreneurially. There are five core principles that define Effectual Logic. These are:

1. The Bird in Hand Principle: Entrepreneurs start with what they have. They will look at who they are, what they know and who they know. Their education, tastes and experience are examples of factors, which are important in this stage. Besides these examples, this is also the stage where entrepreneurs look at their 3F's, better known as friends, family and fools. From this point, they will look at their abilities. Thus an entrepreneur does not start with a given goal, but with the tools he or she has;
2. The Affordable Loss Principle: An entrepreneur does not focus on possible profits, but on the possible losses and how to minimise such losses;
3. The Crazy Quilt Principle: Entrepreneurs cooperate with parties they can trust. These parties can limit the affordable loss by giving pre-commitment;
4. The Lemonade Principle: Entrepreneurs will look at how to leverage contingencies. Surprises are not necessarily seen as something bad, but as opportunities to find new markets;
5. The Pilot-in-the-plane: In this stage, all the previous principles are put together. The future cannot be predicted, but entrepreneurs can control some of the factors, which determine the future.

Sarasvathy (2001) argues that effectuation processes are regarded as more effective when the future is unpredictable. The logic of effectuation is particularly useful in areas where human action is the most important factor shaping the future (Sarasvathy, 2001); for example in a new firm that from inception is aiming at international markets, the environment is hard to predict and the founding entrepreneur is influential in the firm's development.

Though the evaluation of education programmes appears to be a complex question (Ostroff, 1991; Dionne, 1995; Ng and Feldman, 2009), and there are numerous types, objectives, and methods of evaluation (Fayolle and Gailly, 2015), the analysis for this study is based on two of the five principles proposed by Sarasvathy (2001) to evaluate training programmes: 1) The Crazy Quilt Principle by virtue of an increase in group-work ability, and 2) The Lemonade Principle through the increase in creativity and acquisition of useful competencies (which could allow to leverage contingencies).

The entrepreneurial outcome (and educational effectiveness) of EE programmes could also depend on the satisfaction that participants derive from the educational process (Solomon and Matlay, 2008). The satisfaction concept was recently extended to the context of higher education, while several definitions already exist in the services and consumer marketing literature (Gruber et al., 2010). Consumer satisfaction can be defined as pleasurable fulfilment, which means that consumers perceive that "consumption fulfils some need, desire, goal, or so forth and that this fulfilment is pleasurable" (Oliver, 1999). Referring to Oliver and DeSarbo's (1989) definition of satisfaction, Elliott and Shin (2002) describe student satisfaction as "the favourability of a student's subjective evaluation of the various outcomes and experiences associated with education". According to recent research findings, satisfied students may attract new students by engaging in positive word-of-mouth communication (Mavondo et al., 2004; Marzo-Navarro et al., 2005ab; Gruber et al., 2010). Moreover, student satisfaction also has a positive impact on student motivation (Elliott and Shin, 2002). Therefore for the questionnaire I carried out an operational definition of the item *players' satisfaction* based on the following variables: overall player satisfaction, match with expectations, propensity to suggest others to participate in the programme, and level of commitment.

All the above variables, comprising seven different items, were measured on a semantic scale from 1 to 7 (where 1 is the lowest score and 7 the highest). This scale was adopted for the relative ease and immediacy of implementation, albeit aware of the possible mechanisms of distortion potentially triggered in the respondents' answers (e.g. response set).

In conclusion, it can be hypothesised that the designed structure of the *ExperimentaLab* supports the acquisition of entrepreneurial competencies by students/would-be entrepreneurs, thus revealing educational effectiveness, by means of a process that stimulates players' satisfaction (Figure 2).

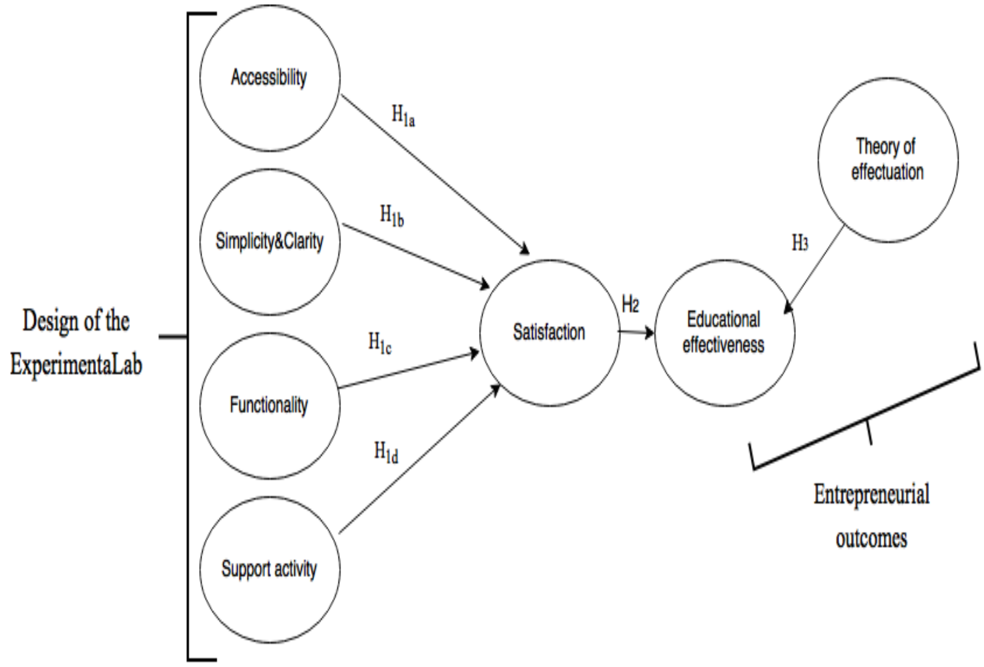

Figure 2. The conceptual model.

In an ever-changing world, there is need to teach methods that stand the test of dramatic changes in content and context (Neck and Greene, 2011), and the virtual platform ExperimentaLab (Iscaro et al., 2015) might be one of these methods.

In this perspective, as illustrated in the conceptual model (Figure 2), I suggest the following research hypotheses:

H_1: The design of the ExperimentaLab impacts positively on player satisfaction.

In particular:

H_{1a}: Platform accessibility and navigation impact positively on player satisfaction;

H_{1b}: Simplicity and clarity of procedures impact positively on player satisfaction;

H_{1c}: Functionality of the Stage&Gate model to develop business ideas impacts positively on player satisfaction;

H_{1d}: Support activity impacts positively on player satisfaction.

H_2: The satisfaction generated to players by the participation to the ExperimentaLab EE programme positively impacts on entrepreneurial outcomes in terms of educational effectiveness of the programme.

H_3: The theory of effectuation can contribute to explain the educational effectiveness of the ExperimentaLab EE programme.

The methods used to study entrepreneurship education have changed over the years. Martin, McNally and Kay (2013) in the article "Examining the formation of human capital in entrepreneurship: A meta-analysis of Entrepreneurship Education outcomes" identified and analysed 42 studies ranging from 1979 to 2011. Yet some contradictory results can be observed, which relate to the lack of methodological rigour and the non-inclusion of moderators in most studies (Fayolle, 2013).

The empirical study illustrated in this work (simulation by role play) was conducted on a sample of university students. At the end of the simulation period, the sample students filled in a questionnaire.

Although aware of the various questionnaires used in the field (Autio et al. 2001; Kirby 2007; Fayolle and Gailly 2015; Ruskovaara et al. 2015; Gruber-Muecke and Kailer 2015), I structured the questionnaire for the simulation run in the ExperimentaLab stimulated by the entrepreneurship education guidelines of the European Union (European Commission, 2012; European Commission 2013), basing on a conceptual model (see figure 2) that outlines seven constructs onto three dimensions: (a) design of the ExperimentaLab, (b) player satisfaction, (c) entrepreneurial outcomes. The dimension (a) describes the structure of the virtual platform (ExperimentaLab), which delineates the entrepreneurship education programme. The structure of the ExperimentaLab consists of four constructs: "platform accessibility and navigation", "simplicity and clarity of the procedures", "functionality of the Stage&Gate model to develop business ideas", and "support activity". The dimension (b) identifies the "players' satisfaction" stemming from the ExperimentaLab EE programme. Finally, the dimension (c) represents the educational outcome of the programme itself that concerns two constructs: “educational effectiveness” and “theory of effectuation”.

2. From Entrepreneurship to the ExperimentaLab

2.1 New venture creation

Entrepreneurship and new business operations are potential sources of economic development and growth in the modern society. On the whole, Schumpeter (1934) considered entrepreneurship as the process, by which the economy as a whole goes forward and develops.

New venture creation is a significant factor in entrepreneurship research as new firms are major job creators and competition facilitators and an important source of innovation and wealth creation (Eftekhari and Bogers, 2015).

The classic expression of entrepreneurship is business start-ups, in other words, innovative ideas that develop into companies (Timmons and Spinelli, 1999). The term ‘start-up’ implies that a new venture potentially creates a new market and inverts the positions of incumbent firms by introducing new products or services. They are assumed to be more innovative than established firms and essential for job generation and economic growth (Reynolds and White, 1997; Shane, 2008; Eftekhari and Bogers, 2015).

Unfortunately, the survival rate of new ventures is not good. Government data, research and business mortality statisticians agree that failure is the rule, not the exception, and that start-ups run a particularly high risk of failure (Timmons and Spinelli, 1999).

As suggested by Eftekhari and Bogers (2015), new venture creation can benefit from purposeful management of knowledge flows across organizational boundaries, i.e. from an “open innovation” approach. Indeed, an important element affecting new venture creation and success is access to external knowledge sources (Eftekhari and Bogers, 2015): the increased costs of R&D and lack of resources are making open innovation a very important issue for researchers and practitioners (Chesbrough, 2003). This evolution has simultaneously contributed to and determined what Chesbrough (2003) terms the shift from a "closed innovation system" to an "open innovation system". Open innovation implies the leverage of external knowledge assets across corporate boundaries as a source of innovation (Eftekhari and Bogers, 2015). While closed innovation is internal, centralized and somehow "self-referential", open innovation is externally focused, collaborative and based on the recognition of the importance of relational capital; it is from knowledge flows and collaboration that entrepreneurial innovation can emerge.

In detail, Chesbrough describes open innovation as consisting of five core components including networking, collaboration, corporate entrepreneurship, proactive intellectual property management, and finally a belief that R&D is crucial to the future of a company (Curley and Formica, 2013). The core philosophy underlying Chesbrough's paradigm for open innovation networking and collaboration is that innovation can be made quicker, easier and more effective by the exchange of ideas (Curley and Formica, 2013).

When considering open innovation, some traditional elements of entrepreneurship research need to be revised. In particular, Gruber and Henkel (2006) suggest that liabilities of newness (McGrath, 1996) and smallness (Mugler, 1995; McGrath, 1996) derived from entrepreneurship theory cannot be applied per se to ventures using open innovation processes. Entrepreneurs in open innovation networks can build businesses on freely shared knowledge assets from Internet-based communities, benefiting from mitigated liabilities of newness and smallness (Gruber and Henkel, 2006). Hence, understanding how to best use the trend towards open and distributed innovation processes to the advantage of new ventures is essential.

In an attempt of answer the previous research questions (see introduction and paragraph 1.6), I participated to the activity of analysis and test the ExperimentaLab, a virtual platform - designed by Valentina Iscaro and Laura Castaldi - based on an open (learning) process that simulates the progression from an idea to a start-up, thus increasing the probability of new venture creation. The designed virtual platform is an experimental lab, i.e. a network of entrepreneurial individuals from universities, research labs, financial markets and industry who -

rather than relying only on their own capabilities - become part of an innovative ecosystem exploiting an open innovation model, to sustain entrepreneurship (Andersson et al., 2010).

2.2 Games and simulations

Games are an alternative for traditional education and training that provides balance between theory and practice (Ruohomaaki 1995; Romanel et al., 2014). Gilgeous and D´Cruz (1996) argue that games provide active participation: instead of hearing concepts and observing how one can do something, games allow people practice by themselves. Games do not replace the traditional approach to teaching, but supplement it (Nassar 2003); they can be used to develop new capabilities or as an additional teaching method (Romanel et al., 2014).

Considering entrepreneurship as a “managerial behaviour, which consistently exploits opportunities to deliver results beyond one’s own capabilities” (Thompson, 1999), it appears that entrepreneurship requires enterprising individuals who can identify and implement new opportunities. Thus entrepreneurship is a skill, learned through experience, and improved with practice. A high quality of education in innovative fields provides a great opportunity for the establishment of new entrepreneurship. Through entrepreneurship education, young people learn organizational skills, including time management, leadership development and interpersonal skills (Stamboulis and Barlas, 2014).

Entrepreneurs continuously accumulate experience by conducting and evaluating experiments in the marketplace. Before their entry into the market process, would-be entrepreneurs can benefit from experimentation labs, which offer a new locus for experimental activity (Curley and Formica, 2013). In these contexts, would-be entrepreneurs start with ideas that they want to turn into a business. By running experiments, business ideas move from an embryonic state to full manifestation in the form of new ventures.

Experiences gained in such labs produce a range of perspectives to help the decision maker limit his or her exposure to risk and uncertainty when it becomes time to carry out experiments in the marketplace (Curley and Formica, 2013). Thus, the experience becomes the centrepiece for entrepreneurial development, from which entrepreneurs will learn.

Learning from experience and implementing the experimental results are two essential steps that would-be entrepreneurs should consider to reduce the level of risk intrinsic in new ventures focused on innovation. Experimental results indicate what policies can be developed to reduce the start-up time significantly. The less the time needed to complete the launch of a new venture, the lower the start-up costs, the less up-front capital required and the higher the probability of the venture actually getting started (Curley and Formica, 2013).

In this vein, a way to support the development of entrepreneurial competencies in would-be entrepreneurs could be the adoption of serious games. In general terms, "serious games" (SGs) can be applied to a broad spectrum of application areas, e.g. military, government, educational, corporate and healthcare. A brief survey of the literature reveals that there seem to be as many definitions available as there are actors involved, but most agree on a core meaning that serious games are (digital) games used for purposes other than mere entertainment (Susi et al., 2007). As stated by Ben Sawyer, co-founder of the Serious Games Initiative, the serious games market was at $20 million, and digital gaming was a $10 billion per year industry (van Eck, 2006).

According to Corti (2006) game-based learning "is all about leveraging the power of computer games to captivate and engage end-users for a specific purpose, such as to develop new knowledge and skills". Further, serious games allow learners to experience situations that are impossible in the real world for reasons of safety, cost, time, etc., but they are also claimed to have positive impacts on the players' development of a number of different skills.

In light of this situation, entrepreneurial education could strongly benefit from an effective use of serious games, an emerging paradigm in technology-enhanced learning (TEL). Indeed technology can enhance learning, and can be used to tighten or slacken the bonds between perceiving, learning, knowing and action (Goodyear and Retalis, 2010). TEL design is a job for teams of people, rather than for lone individuals; TEL design is hard, takes time and needs experience, but

TEL design experience can be shared (Goodyear and Retalis, 2010). TEL is proving an attractive term because it is open to a very broad range of interpretations. As described by Goodyear and Retalis (2010) it is to cover all those circumstances where technology plays a significant role in making learning more effective, efficient or enjoyable.

Serious games can motivate learners and show the concrete relevance and application of topics and skills that may be difficult to explain in words (this is particularly true for entrepreneurship and soft skills). Moreover, they offer players the capacity to try alternatives and experience the consequences. They also provide immediate feedback, which is efficient for procedural learning and assessment. Furthermore, they place learners in an active role, stimulating them to think critically and lend themselves to collective and social use.

Serious games are processes based on simulations. Simulations use mathematical or physical models to reproduce the conditions of a situation or process. Business simulators situate players in a virtual situation, in which they have to make decisions. Simulations push them not only to think, but also to understand how the real business world works, what they should keep in mind and how their decisions affect the performance of a firm. The simulation process is an interactive learning method, in which the goal is to learn business by doing business in a risk-free environment.

Wolfe and Bruton (1994) carried out an extensive literature review to identify, which of a variety of computer-based business games were most likely to be useful in entrepreneurship courses. They found that only three simulations were of interest to university-level entrepreneurship training.

The first of these is the Entrepreneurial Simulation Program (Penderghast, 1988). In the simulation, participants start and operate a retail shoe store for a period of 12 months. All the teams receive the same starting capital. At the end of the period, the store is sold and its value is used to determine the participants' performance. The second simulation, entitled Entrepreneur: A Simulation (Smith and Golden, 1987), requires the teams to buy and operate a retail clothing store. They are asked to make certain quarterly decisions and implement changes to improve the firm's performance. The third and last simulation is Starting a Small

Business: A Simulation Game (Gupta and Hamman, 1974). Here, participants are given a starting capital of $100 000 to create a small firm producing a type of popcorn with high sales potential. In support of these games, Wolfe and Bruton (1994) described them as requiring a certain amount of creativity on the part of students, who can test their risk-taking capacities in the small business environment that most entrepreneurs experience. On the negative side, however, the games are designed to develop a limited range of entrepreneurial skills, and tend to merely scratch the surface of the aspects they cover. As a result, the authors felt teachers wishing to use these simulations should also provide some compensatory activities to fill in the gaps (Carrier, 2007). According to Thavikulwat (1995), The Business Enterprise Simulator (Davis and Parker, 1994) and Venture Forth (Willmer, 1986), two additional entrepreneurship simulations, were also of interest to entrepreneurship educators even though they were not considered by Wolfe and Bruton. Thavikulwat particularly recommended a third package, called Deal, a computerized business gaming simulation designed to test the concept of gaming on the markets (resources, products, money and interpersonal relationships) in a multi-industry setting. According to Thavikulwat, Deal, unlike other simulations, provided stimulating challenges, objectively assessed the results achieved by participants, and was easy to use while remaining extremely flexible.

It has also been observed that active participation by students in simulations may help them to become aware of some of the more emotional aspects related, for example, to entrepreneurial failure (Petranek and Corey, 1992). Multimedia simulations, including the Harvard simulation entitled Launching a High-risk Business (Sahlman and Roberts, 1999), can be used to raise student awareness of the more emotional aspects of entrepreneurship, such as the ability to deal with failure and transform it into a learning opportunity (Honig, 2004). The need for new entrepreneurs to learn to manage their emotions in situations of failure was also broadly addressed by Shepherd (2004), who proposed several possible educational approaches for this purpose, including simulations.

As mentioned above, the overall goal of this project is to explore whether the ExperimentaLab may be an effective tool to support students/would-be entrepreneurs in the acquisition of entrepreneurial competences. It adopts gaming-simulation as a method. The ExperimentaLab works based on a paradigm able to react to a modern uncertain context, leaving the presumption to go from business idea to business model, to proceed by trial and error in an environment, in which no failure is a failure, but rather a valuable lesson to reshape the starting idea by investigating unknown processes. It entails testing the business idea by an "iterative" process, which, thanks to the different backgrounds of participants, is able to evaluate the idea prototype, test it, analyse the feedback and inspect it.

Aspiring entrepreneurs, before entering the market, could exploit the ExperimentaLab to "test" their ideas and reduce the risk associated with the uncertain entry in the market of a new innovative idea. The lab works by evaluating the full spectrum of ideas, monitoring and reviewing their basic assumptions and forecasting the performance-gain underlying these assumptions.

This study combines literature on learning, simulation design, and research methods to formulate a methodology to assess the educational validity of a virtual platform supporting entrepreneurship education. It is possible to represent the research path as illustrated in the following figure 3.

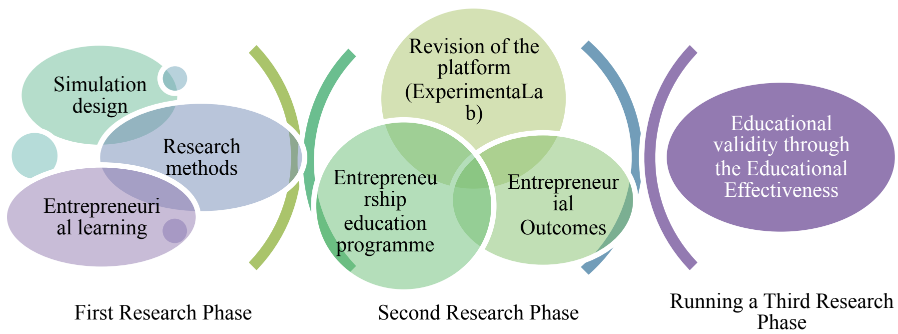

Figure 3. Research phases

Starting from the literature review on simulation design, entrepreneurial learning, entrepreneurship education programme, entrepreneurial outcomes and method research, I try to assess the educational validity of a virtual platform supporting entrepreneurship education (figure 3). The latent variable of this research is represented by the educational effectiveness.

2.3 The ExperimentaLab

Experimental labs are networks of individuals "federated" from universities, research labs, financial markets and business partners, who become part of *an innovative ecosystem* by means of a virtual platform, rather than relying only on their capabilities (Andersson et al., 2010). Aspiring entrepreneurs can obtain important support via experimental labs to proceed from an intuition to a product/service ready for market and investors.

Experimental labs create a dynamic environment that links, in a new and unexpected way, aspiring entrepreneurs, academics, researchers, experts and practitioners. The daily work of a laboratory is building upon each other's ideas; it is sharing to improve. Each member achieves a result thanks to other members' suggestion. Experimental labs offer the possibility to perform an iterative process of analysis, in an evolutionary way between mentoring and coaching. "Try" rather than analyse is a culture encouraged by labs; experience is a way, for entrepreneurs, to find their own path thanks to the network (Curley and Formica, 2013).

From a cognitive perspective, experimental labs can represent a lever for knowledge creation and exploitation (Iscaro and Castaldi, 2014). Experimental labs are based on the job of virtual teams that analyse, process and test the business ideas into a shared virtual space. In this vein the concept of ba may be evoked as a shared space (physical, virtual or purely mental), in which not only relationships but also knowledge comes from common experience, whether direct or indirect (Nonaka et al., 2000).

In an attempt to contribute to the activity of universities favouring entrepreneurship, and led by the belief that potentially implementable results have to be achieved, this research sheds light on the adoption, by entrepreneurial universities, of a new tool, the *ExperimentaLab,* in order to provide students with an entrepreneurial training programme and a strong network to simulate the progression from an idea to a real start-up. As a tool for entrepreneurial training, the ExperimentaLab aims to improve individual competences to start a new venture (Matricano, 2014).

The need for an Entrepreneurial University is caused not only by social and market changes but also by the emergence of a different way to innovate, which makes synergy its vision and uses "the working together" as its main tool. In this context, the ExperimentaLab could be a way to make universities entrepreneurial; indeed, it is a community of personnel who interact with each other and with the external environment to support entrepreneurship and generate innovation.

Based on the assumption that the value of experimental labs depends on their members' cognitive assets and that knowledge is a peculiar resource, which does not behave in the same way as physical assets, the research sets out to analyse the issue of experimental labs through the implementation of the virtual platform ExperimentaLab, where entrepreneurial competencies can be actively developed through simulation by role play. This is in line with the observation that entrepreneurial education requires practice: in a changing world, there is a need to teach methods that stand the test of dramatic changes in content and context (Neck and Greene, 2011).

This experiential model is designed to help students learn to tolerate risk, learn from failure, increase self-efficacy and develop some other entrepreneurial skills required to motivate and lead entrepreneurial individuals and teams through unknown territory.

2.4 Focus group and first platform design

Before the first design of ExperimentaLab (by Valentina Iscaro and Laura Castaldi), it was necessary to organise a focus group with experts in order to dispel some doubts mainly arising from the embryonic stage of the literature on experimental labs (Castaldi and Iscaro, 2015). The focus group involved five participants who were selected on the basis of relevant research criteria as they were experts in those areas and therefore able to deal with the themes needed to explore[2]. The five participants were faculty members of the University of Campania Luigi Vanvitelli, with expertise in entrepreneurship and firm start-ups, knowledge dynamics and management of innovation processes, finance and investment analysis, business economics and management. The focus group took place in a meeting room at the Department of Economics of the University of Campania Luigi Vanvitelli and lasted approximately 70 minutes. Thus, the development of the virtual platform was carried out only after dealing with the following three unaddressed issues: 1) concrete creation and organisation of teams by cognitive area, 2) value appropriation and regulation of relations, 3) virtual network fragility (Iscaro et al., 2015). Thus, based on a literature review and on the results of the focus group, the final design of the ExperimentaLab was built on the following structuring elements: *actors/roles, rules* and *resources* (Klabbers, 2009), able to allow cooperation and knowledge flows among participants, at the same time bordering the fragility related to a virtual community.

The lab was built on three *actors/roles*: aspiring entrepreneur, venture sitter, human resources. Anyone can be an *aspiring entrepreneur* with a good idea but this is doomed to be forgotten without the necessary support: thanks to the experimental lab aspiring entrepreneurs become part of an innovative ecosystem rather than relying only on their own resources. With a supposed background in entrepreneurship and/or management, the *venture sitter* (Matricano and Pietrobon, 2010) is a role somewhere between a mentor and a coach. The venture sitter helps the aspiring entrepreneur choose the most suitable human resources and define timing and goals, also providing them with indications to advance and assess the outputs from the human resources. In the ExperimentaLab, thanks to *human resources*, the aspiring entrepreneurs can access competences, skills and experience not possessed, in order to explore, analyse and define their ideas.

[2] As stated by Blumer (1969), a limited number of individuals - well-informed, acute observers - gathering to discuss is more useful than a representative sample.

Rules and *resources* that make the daily exchange of knowledge and experience possible in the designed platform are:

- *mechanisms of externalization and sharing* (messaging, forums, videoconferences, meetings), through which all members of the ExperimentaLab can easily share their own intellectual capital;
- a *non-disclosure agreement* with the aspiring entrepreneur. This rule guarantees the non-disclosure of aspiring entrepreneurs' ideas by all members of the ExperimentaLab;
- the rule of *"work-for-equity"* to remunerate participants. As all agents involved assume the risk of enterprise, they do not overload the financial situation of the rising firm and follow the principle of "the success of one is the success of all": all together bet on the idea. This principle stimulates members' effort and reduces the fragility of virtual networks;
- a revised version of the *Stage&Gate model* (Cooper, 1994; Cooper et al., 2002) as a process for the development of business ideas.

In the everyday work of the ExperimentaLab, the starting point is an aspiring entrepreneur who *"entrusts"* his/her idea to the community of the lab. Ideally, the platform administrator (university) through an internal team of experts in entrepreneurship and innovation, analyses all the ideas submitted in order to select the most valid, those that actually will be "processed" in the lab. This is followed by a match between aspiring entrepreneurs and venture sitters. After these preliminary steps the real work begins. Together, the aspiring entrepreneur and venture sitter identify the different cognitive areas required to develop the business idea (e.g., marketing, legal, information technology, chemistry, graphics, digital, etc.) and the human resources required for each. Once human resources have agreed to participate in the project, they access the model *idea in progress*, based on a revised version of the Stage&Gate model (Cooper, 1994; Cooper et al., 2002). The stages are where the work is done; the gates are checkpoints that guarantee a satisfactory quality. The platform is based on four stages: scoping, building a business case, development, elevator pitch. Between the stages there are gates, checkpoints for quality control. Between the stages there are gates, checkpoints for quality control. They are confrontation moments with the general aim of assessing the real attractiveness and feasibility of the project based on a *go/no go* decision logic.

3. Statistical Methodology: Structural Equation Modelling

3.1 Structural Equation Modelling

The founding fathers of Structural Equation Modelling (SEM), from Sewall Wright (1921, 1934) and the early econometricians (Haavelmo, 1943), to Blalock (1964) and Duncan (1975) have all considered SEM a mathematical tool for drawing causal conclusions from a combination of observational data and theoretical assumptions.

Wright gave the key definition of a path coefficient. He raised the question of measuring the causal connections between variables and posed the question of measuring the direct impact and the indirect impact through path coefficients. Wright pioneered one of the first methods using a graphical model (path coefficients), which is still widely used in the social sciences, and also in other fields.

The method of path coefficients was suggested a number of years ago (Wright, 1921) as a flexible means of relating the correlation coefficients between variables in a multiple system to the functional relations among them. The method has been applied in quite a variety of cases. The object of investigation is a system of variable quantities, arranged in a typically sequential order representative of some chosen point of view toward the functional relations (Wright, 1934).

As a tool, SEM was elaborated at the beginning of 1970s, and rapidly gained considerable popularity. Such models are the reinterpretation, arrangement and, above all, generalization of those that, in the 1970s, were called casual models and that, in the first half of the same decade, encountered considerable popularity thanks to the technique of path analysis.

By using SEM, it is possible to analyse, simultaneously, both the relations of dependence between the LVs (i.e., structural models), and the links between the LVs and their indicators, that is, between the corresponding manifest variables, MVs (i.e., measurement models).

LISREL (Jöreskog and Sörbom, 1989ab; Byrne, Barbara, 2001) or Covariance Structural Analysis (CSA) lies at the basis of such models. LISREL was initially the name of a software program and used to estimate the structural parameters of factorial analysis by adopting the maximum likelihood method. For many years, the maximum likelihood method (SEM-ML) was the only estimation method for SEM. Today, different estimation techniques can be used for the estimation of SEM.

Indeed, in 1975 Wold developed a soft modelling approach, making it different from the hard modelling approach of LISREL, in order to analyse the relationships among different blocks of observed variables on the same statistical units.

The method, known as PLS for SEM (SEM-PLS) or as PLS-path modelling (PLS-PM), is distribution-free, and was developed as a flexible technique aimed at the casual predictive analysis in the presence of high complexity and scant theoretical information.

Following the seminal work of Jöreskog (1978), a number of models for linear structural relations have been developed (Bentler et al., 1980; Lohmoller, 1989). Commercial statistical packages include LISREL "Linear Structural Relationship" (Jöreskog and Sörbom, 1989, 1996), EQS (Bentler, 1985), CALIS (Hartmann, 1992), MPLUS (Muthén and Muthén, 1998), RAMONA (Browne, Mels, and Cowan, 1994), SEPATH (Steiger, 1995) and AMOS (Arbuckle, 1997).

A new technique for the estimation of structural equation models was recently introduced. In 2003 Al Nasser suggested extending knowledge of information theory to the SEM context by means of a new approach called generalized maximum entropy (SEM-GME). This new method is still present in the PLS-approach since no distribution hypothesis is required.

Structural models as applied in the social sciences only began appearing in the 1970s (Bollen 1989; Jöreskog 1978), with their increasing application paralleling the availability of software (Jöreskog and Sörbom 1996), all of which executed CB-SEM (Hair et al., 2015). While Herman Wold — who was also the academic advisor of Karl Jöreskog, one of the LISREL CB-SEM software package developers — originated variance-based SEM in the 1970s (Wold 1973a, 1975), software packages executing PLS-SEM were developed much later (e.g., SmartPLS; Ringle et al., 2005). Jöreskog and Wold (1982) viewed CB-SEM and PLS-SEM as complementary rather than competitive statistical methods. More specifically, Wold (1982) recognized CB-SEM's potential for the social sciences but was concerned about the informational and distributional requirements that he regarded as unrealistic for empirical research. He also believed that estimation and description were emphasized too much and prediction too little (Dijkstra 2010). It is important to point out that alongside PLS-SEM, another PLS culture has arisen from Wold's original works — PLS regression. This approach generalizes and combines features from principal component analysis and multiple regression, but generally does not allow for the evaluation of complex cause–effect relationships between latent constructs (for a notable exception, see Arteaga et al., 2010). Natural science disciplines, such as chemometrics, generally use PLS regression (e.g., Wold et al., 2001), but PLS-SEM is the approach that has become established in marketing and business research (e.g., Henseler et al., 2009).

For this reason, the constructs of SEM can be estimated with independent regression equations, such as the PLS-Path Modelling approach, or through more involved approaches such as those employed in LISREL. In the PLS (partial least squares) approach, where there are less probabilistic hypotheses, data are modelled by a succession of simple or multiple regressions without any identification problem. Wold (1975) presented the main principles of PLS for principal component analysis that were extended to situations with more than one block of variables. Wold's other presentations of partial least squares path modelling (PLS-PM) appeared in the same year (Wold 1975). Later, Wold (1980) provided a discussion on the theory and application of PLS for path models in econometrics. The specific stages of the algorithm are well described in Wold (1982a, 1985), with extensive reviews on the PLS approach to structural equation models with further developments presented in Chin (1998) and Tenenhaus et al. (2005).

In LISREL, on the other hand, the estimation is made by maximum likelihood and is based on the hypothesis of multinormality and allows the variance–covariance matrix to be modelled.

To correctly apply LISREL CB-SEM and PLS-SEM, researchers must understand the purposes, for which each approach was developed and apply them accordingly (Hair et al., 2015). Structural equation models with good measurement properties generally achieve comparable results with either approach, especially when the CB-SEM's model specifications have been correctly set up (Reinartz et al., 2009). Moreover, both approaches should still consider issues such as the appropriate use and interpretation of formative versus reflective measures (Diamantopoulos et al., 2008). These situations are often those in which the measurement properties are questionable and the results may diverge, thus requiring the researcher to make a reasoned judgment as to which approach is most appropriate (Hair et al., 2015).

On the basis of studies carried out by Chin, Gaston Sanchez (2009) and Crisci (2012), it is possible to illustrate the main differences between the models mentioned above (see figure 4) and generalized maximum entropy[3] for a complete overview (see table 1) of this topic.

GME estimation method has been widely used for the estimation of general linear models. The GME estimator is based on the classic Maximum Entropy Principle (MEP) of Jaynes (1957a,b), which uses Shannon's entropy measure (Shannon, 1948) to recover the unknown probability distribution in the case of ill-posed problems (Ciavolino and Al-Nasser, 2009; Ciavolino et al., 2015).

The GME method represents a semi-parametric estimation method for the SEM (Al-Nasser, 2003; Ciavolino and Carpita, 2015). The GME for the SEM can be seen as an extension of the GME application for the simultaneous equations system (Zellner, 1962) already developed by Golan et al. (1996).

[3] The generalized maximum entropy (GME, Golan, Judge and Miller, 1996; Ciavolino et al., 2015).

The GME approach for the SEM considers, as for the general linear models, the re-parametrisation of the unknown parameters and the disturbance terms as a convex combination of expected value of a discrete random variable. Given the re-parametrisation and the re-formulation, the GME system can be expressed as a nonlinear programming problem subject to constraints. The coefficients and the error terms are estimated by recovering the probability distribution of the discrete random variables set.

Table 1. The main differences between *LISREL*, *PLS path modelling and generalized maximum entropy*

	Lisrel	***PLS path modelling***	***GME***
Object	***Parameter-oriented***: Objective is to reproduce the covariance matrix of the MVs by means of model parameters.	***Description-Prediction oriented***: Obtain the scores of latent variables for predictive purposes without using the model to explain the covariation of all the indicators.	***Estimation precision-prediction oriented:*** *maximize the "objective function =* ***Shannon's entropy function",*** *emphasizing both estimation precision and prediction.*
Approach	***Covariance-based***: The residual covariances are minimized for optimal parameter accuracy.	***Variance-based***: Aims at explaining variances of dependent variables (observed and unobserved) in regression sense (i.e. residual variances are minimized to enhance optimal predictive power).	***Theoretical information-based***: Under Jaynes' maximum entropy (uncertainty) principle, out of all those distributions consistent with the data evidence we choose the one that maximizes the entropy function

			and thus maximizes the missing information, in order to get models based on real data.
Optimality	If the hypothesized model is correct in the sense of explaining the covariations of all indicators, CSA provides optimal estimates of the parameters (i.e. it offers statistical precision in the context of stringent assumptions).	PLS trades parameter efficiency for prediction accuracy, simplicity and fewer assumptions.	GME provides the estimation in the case of negative freedom degrees; -uses all the information in the data; - is robust to the underlying data generation process and to the limited-incomplete nature of economic data; - performs well relative to competing estimators under a squared error measure performance.
Type of fitting algorithm	Simultaneous estimation of parameters by minimizing discrepancies between observed and predicted Covariance/correlation matrix. **Full information method.**	Multi-stage iterative procedure using OLS. Subset of parameters estimated separately **A limited information method**.	The estimation of the parameters is obtained by the maximization of the Shannon's entropy function subject to consistency and normalization constraints. **Full information method.**
Conception	Used more as an auxiliary tool for theory testing.	Used more as a decision making tool, with emphasis on parsimonious prediction.	Used as a tool to solve problems called ill-conditioned, where the lack of information and / or specific data

			about the problem in hand requires the recruitment of general assumptions as possible with respect to the parameters of the system under study.
LV scores	Indeterminate. Indirect estimation computed with the whole set of MVs.	LVs explicitly estimated as linear combination of their indicators.	Each LV is re-parameterized as a convex combination of a discrete random variable.
Relationship between the LVs and MVs	Typically only with reflective indicators	Reflective and formative indicators.	Reflective and formative indicators.
Treatment of measurement residuals	Combines specific variance and measurement error into a single estimate.	Separates out irrelevant variance from the structural portion of the model.	The variance/covariance matrix $\Psi, \theta_{\varepsilon}, \theta_{\delta,}$ are re-parameterisation as a expected value of a discrete random variable.
Manifest variables	Continuous and interval scaling	Continuous, interval scaling, categorical.	Continuous, interval scaling, categorical.
Assumed distributions	Multivariate normal if estimation through Maximum Likelihood.	No distribution assumptions.	Semi-parametric.
Sample size	High >200 unit.	Medium 40<unit< 200.	Low 10<unit<40.

Model correctness	To the extent that the theoretical model is correct it is able to explain the covariations of all indicators.	To the extent that the theoretical model is correct it is determined partly from the power of the relations of path between the LVs.	To the extent that the theoretical model is correct it is determined by the chance to obtain a set of consistent relations based on data.
Consistency of estimators	Consistent, given correctness of model and appropriateness of assumptions.	Bias estimators tend to manifest in higher loading coefficients and low path coefficients. The bias is reduced when both the size and the number of indicators for the LVs increase. (***consistency at large***).	Consistent and asymptotically normal under four mild conditions: 1. The error support spans a uniform and symmetrical around zero; 2. The parameter support space contains the true realization of the unknown parameters; 3. The errors are independently and identically distributed; 4. The design matrix is of full rank (Golan 2003:5).
Missing value	Maximum Likelihood Method (E.M. Algorithm[4])	NIPALS algorithm.	Imputation methods (list wise deletion)
Evaluation model	Evaluation model by means of hypothesis testing: ***Chi-square:*** the H_0 hypothesis is:	- R^2 for dependent LVs; - GoF (*Amato et al. 2004*) - resampling (jack knifing and bootstrapping) to examine the stability of estimation.	- Normalized index of entropy that quantified the level of information generated from the model on the basis of the

[4] see Meng and Rubin, 1991.

			collected data. - Pseudo R^2.
Free software	OpenMx, R package sem	PLSGraph, SmartPLS, R package plspm	Matlab package, Fortran, Gams.
Software	AMOS(SPSS),LISREL, EQS, Mplus, SEPath.	XLSTAT-PLSPM, SPAD-PLS	
Applicability	• The phenomena analysed are clear; • Low complexity of the model; • Presumes the use of reflective indicators; • Usually stringent assumptions about distribution, independence, large sample size; • Treatment of hierarchical data, multi-group; Comparison of models, which come from different populations with a single objective function.	• Relatively new phenomena or mutant; • Relatively complex model with a large number of indicators and / or latent variables; • Epistemological need to model the relationship between LVs and indicators in different ways (formative and reflective); • Hypothesis normality, independence and the sample size is not met; • Multi-group.	• Complex model with incomplete data and small sample size; • Use both reflective and formative indicators; • It is easier to impose non–linear constraints; • Does not require distributional hypothesis; • Multi-group, hierarchical data; • Ability to insert a

		priori information on the model.

Looking at table 1, for analysis of the research questions mentioned above, I used the PLS approach. The reasons were the following: it is variance-based, i.e. strongly prevision oriented, whose aim is to obtain the scores of the latent variables for predicted purposes without using the model to explain the covariation of all the indicators. According to Chin (1998), the estimates of the parameters are obtained by using the ability to minimize the residual variances of all dependent variables (both latent and observed). Besides, the PLS does not require items, which follow a multivariate normal distribution and adopts both formative and reflective indicators and works on medium samples properly.

Partial least squares (PLS) path modelling (PM) can be used to study data presented in the form of q-th blocks made P_q of variables observed on the same subjects. In PLS path modelling, it is usually assumed that each block of variables can be summarised by a single latent variable and that linear relations exist between latent variables.

PLS-PM follows some established steps. In the first stage, the latent construct scores are estimated via a procedure made up of simple and/or multiple regressions that take the relation of the structural model (typically referred to as the inner model), which shows the relationships (paths) between the latent constructs. PLS-SEM only permits recursive relationships in the structural model (i.e., no causal loops). Therefore, the structural paths between the latent constructs can only head in a single direction. In the structural model, I distinguish between exogenous and endogenous constructs. The term exogenous is used to describe latent constructs that do not have any structural path relationships pointing at them. Thus, the term endogenous describes latent target constructs in the structural model that are explained by other constructs via structural model relationships.

The second stage of the structural equation model comprises the measurement model, also referred to as outer models in the PLS-SEM context. Measurement models include the unidirectional predictive relationships between each latent construct and its associated observed indicators (Figure 4). Multiple relations are not permitted; therefore indicator variables are associated with only a single latent construct. PLS-SEM can handle both formative and reflective measurement models. Reflective indicators are seen as functions of the latent construct, and changes in the latent construct are reflected in changes in the indicator (manifest) variables. Reflective indicators are represented as single-headed arrows pointing from the latent construct outward to the indicator variables; the associated coefficients for these relationships are called outer loadings in PLS-SEM. In contrast, formative indicators are assumed to cause a latent construct, and changes in the indicators determine changes in the value of the latent construct (Diamantopoulos et al., 2008). Formative indicators are represented by single-headed arrows pointing toward the latent construct inward from the indicator variables; the associated coefficients for these formative relationships are called outer weights in PLS-SEM. Researchers using PLS-SEM often refer to reflective measurement models (i.e., scales) as Mode A, and formative measurement models (i.e., indices) are labelled Mode B (e.g., Rigdon et al., 2010).

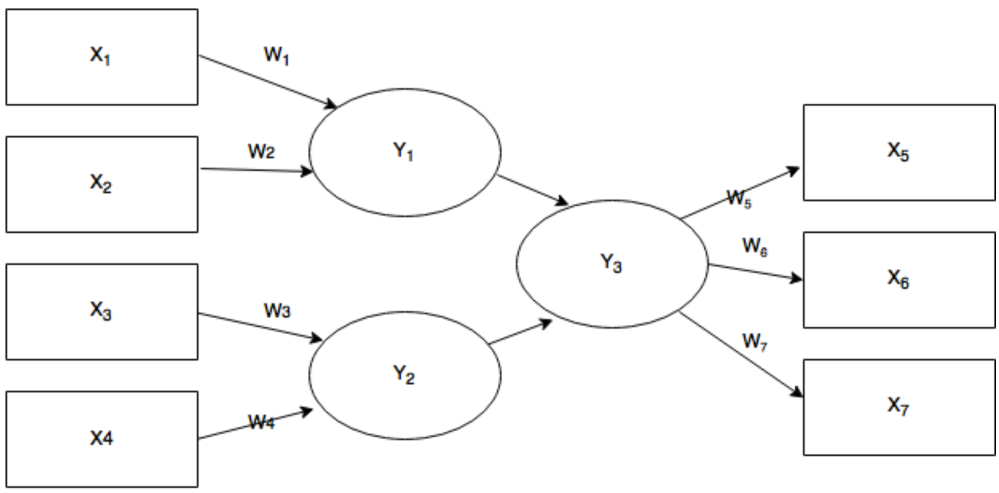

Figure 4. Path model example by Hair et al. (2015)

As shown in Figure 4: X_1-X_7 represent the manifest variables' scores; Y_1-Y_3 explain the latent construct scores; W_1-W_7 constitute the relationship between indicator variables and latent constructs scores. The measurement of the constructs can only occur indirectly through observable variables affected by measurement errors. More precisely, a measure is an observed score, or numerical data, gathered through questionnaires, interviews, observations, or other instruments and considered a similar empirical construct (De Vellis and Robert, 1991; Edwards and Bagozzi, 2000). A measure, therefore, does not refer to the instrument of data collection but to the action of collection and to the score generated from these procedures.

Each one-dimensional construct is represented by a circle with different arrows that depart from it to form a block of indicators. The direction of causality is from the construct toward the indicators with the hypothesis that varying the latent construct, there are changes also in the indicators. These measures are called reflexive or indicators (Fornell and Bookstein, 1982). The measures are reflective of the basic theory of the classical tests (Lord and Novick, 1968), the estimation of reliability (Nunnally, 1978), and factor analysis (Kim and Muller, 1978), each of which is a measuring function of a latent variable, plus the error term. The error term represents the fraction of the latent variable, which is not explained by the manifest variables. The latent variable is measured through the manifest variables that are the items of the questionnaire.

The measurement model formulation depends on the direction of the relationships between the latent variables and the corresponding manifest variables (Fornell and Bookstein 1982). Different types of measurement models are available: the reflective model (or outwardly directed model), the formative model (or inwardly directed model) and the MIMIC model (a mixture of the two previous models) (Vinzi et al. 2010). In a reflective model, the block of manifest variables related to a latent variable is assumed to measure a unique underlying concept. Each manifest variable reflects the corresponding latent variable and plays the role of an endogenous variable in the block specific measurement model. In the reflective measurement model, indicators linked to the same latent variable should co-vary: changes in one indicator imply changes in the others.

Moreover, internal consistency has to be checked, i.e., each block is assumed to be homogeneous and unidimensional (Amato et al. 2004). The decision to operationalize formative and/or reflective indicators should be based on theoretical considerations.

The basic PLS-SEM algorithm (Lohmöller 1989) follows a two-stage approach. In the first stage, the latent constructs' scores are estimated via a four-step process as shown in Table 1. The second stage calculates the final estimates of the outer weights and loadings as well as the structural model's path coefficients. The path modelling procedure is called partial because the iterative PLS-SEM algorithm estimates the coefficients for the partial ordinary least squares regression models in the measurement models and the structural model. More specifically, when a formative measurement model is assumed, a multiple regression model is estimated with the latent construct as the dependent variable and the assigned indicators as independent variables (computation of outer weights). In contrast, when a reflective measurement model is assumed, the regression model includes single regressions with each indicator individually being the dependent variable, whereas the latent construct is always the independent variable (computation of outer loadings). When the structural model relationships are calculated, each endogenous latent construct represents the dependent variable with its latent construct antecedents as independent variables in a partial regression model. All partial regression models are estimated by the iterative procedures of the PLS-SEM algorithm.

To test the hypotheses, structural equation modelling (SEM) (Bollen 1989; Tenenhaus et al. 2005) was used. SEM is a technique that combines factorial analysis procedures (Bryant and Yarnold 1995), which are mainly used to obtain an estimate of the latent variables and evaluate the relationship among the latent variables that establish the dimensions of the construct. Formally, I assume p_q variables, where q= (1…..,Q) number of blocks and where p_q = (1,…,P_q) number of variables of the q-th block linked to the Q dimension observed on n players (i = 1,…,n). The resulting data x_{ip_q} are collected in a partitioned data matrix X:

$$X = \{X_1, \dots, X_{q,} \dots, X_Q\}$$

where X_q is the generic q-th block made of P_q variables. The variables of the q-th block are called manifest variables and are assumed to be centred. Unless stated explicitly, they are assumed to be standardized.

Each block of variables X_q is considered to constitute the observable expression of a latent variable ξ_q with mean zero and variance one. There are two ways to connect the manifest variable P_q in block q to its latent variable ξ_q: the formative and reflexive ways. They are described in great detail by Fornell and Bookstein (1982). In the reflexive way, the latent variable ξ_q gives rise to each manifest variable X_{pq}

$$X_{p_q} = \lambda_{p_q}\xi_q + \varepsilon_{p_q} \tag{1}$$

where ε_{pq} is a zero mean random term not correlated with the latent variable ξ_q. The manifest variables Xp_q are reflective of the unobserved latent variable ξ_q (j = 1,…,Q). In the formative way, the manifest variables X_{pq} give rise to the latent variable ξ_q

$$\xi_q = \sum_{p=1}^{Pq} w_{pq} X_{pq} + \delta_q \tag{2}$$

where w_{pq} are the coefficients of regression linking each manifest variable to the corresponding latent variable; δ_q is a zero mean random term not correlated with the manifest variable x_{pq} . The manifest variables X_{pq} produce the unobserved latent variables ξ_q(q = 1,…,Q). Structural relations are also assumed to exist between the latent variables defined by linear equations of the form

$$\xi_j = \sum_{q=1}^{Q} \beta_{wj}\, \xi_q + \zeta_j \tag{3}$$

where ξ_j (j = 1,…,J) is the generic endogenous latent variable, β_{mj} is the generic path coefficient interrelating the m-th latent variable to the j-th endogenous, and ζ_j is the error in the inner relation (i.e., the disturbance term in the prediction of the j-th endogenous latent variable from its explanatory latent variables). Q is the number of latent variables, which affects the generic endogenous variable. ζ_j is a zero mean random term not correlated with the explanatory latent variables $\xi_{j'}$ appearing in Eq. (3).

In the SEM literature, each block of variables X_{p_q} represents the observable expression of a latent variable ξ_j. Several orthogonal latent variables are necessary to describe each block. Equation (1) can be modified to include s orthogonal latent variables per block:

$$X_{p_q} = \lambda_{p_q1}\xi_{q1} + \cdots + \lambda_{p_qs}\xi_{qs} + \varepsilon_{qs} \qquad (4)$$

The relationships among the latent variables are represented by path coefficients. The method of path coefficients is a flexible means of relating the correlation coefficients between variables in a multiple system to the functional relationships among them. This method is claimed by Wright (1921) to provide a measure of the influence of each cause upon the effect. This influence is graphically represented by the path diagram. The notion of the path diagram was developed by Wright (1921, 1934) to provide a convenient representation of those relationship systems that conform to the above assumptions (see chapter 1).

In this essay, each one-dimensional construct is represented by a circle with a series of arrows that lead to a block of indicators. The direction of causality is from the construct towards the indicators with the hypothesis that variations in the latent construct result in changes in the indicators. These measures are called ‘‘reflexive’’ or indicators ‘‘effect’’ (Fornell and Bookstein 1982). The measures are reflective of the basic theory of classical tests (Lord and Novick, 1968), estimation of reliability (Nunnally 1978), and factor analysis (Kim and Muller 1978), each of which measures a function of a latent variable, plus the error term. The error term represents the fraction of the latent variable that is not explained by the manifest variables. The next step of this research aims to propose an estimate of multi-group path analysis to investigate the educational entrepreneurship effects stemming from the relationship with the structure of the virtual platform (ExperimentaLab), and educational effectiveness, thus drawing implications for the entrepreneurship education process.

3.2 Multi-group PLS analysis

Multi-group structural equation models allow you to examine models simultaneously across multiple samples. In the SEM methodological literature, general statistical tests dealing with hypotheses about potential group differences are commonly referred to as tests of model invariance (Marcoulides and Heck, 1993).

The analysis basically takes place through the study of the invariance (Meredith, 1993), which proceeds sequentially through a series of steps, each of which introduces additional constraints with respect to the initial model. In the absence of constraints between groups each group can be analysed separately, while in presence of constraints between groups the data of all groups must be analysed simultaneously. The basic requirement for a model of multiple groups is that populations are clearly defined and the samples are independent (e.g., males and females). By means of multi-group models, any assumptions concerning the invariance can be examined, considering as extreme assumptions, those in which (Crisci and D'Ambra, 2012):

• all parameters are not invariant (there are no constraints on parameters);
• all parameters are invariant (all parameters are constrained).

Researchers often examine and discuss just the difference in the size of the estimates of the paths of two or more sets of the data (Thompson et al., 1995).

When estimating the meaning of the differences of the paths of a particular model for two or more sets of data, a t-test based on the standard errors is obtained by means of a re-sampling procedure like bootstrap. Yet problems may arise if the assumption of a normal population or of a similar group sample size is not met. An alternative approach, i.e. a permutation or randomization procedure

(Chin, 2003; Esposito Vinzi et al., 2010), is available, in which a subset of all the possible data permutations between the sample groups is constructed.

Randomization or permutation procedures are the preferred tests of significance for non-normal data. These techniques are considered distribution-free tests in that they require no parametric assumptions. Randomization tests should not be viewed as alternatives to parametric statistical tests. Rather, they should be considered as tests for that particular empirical form to be examined.

In this perspective, I utilized the randomization procedure to examine our sample with non-normal data. The procedure for a permutation test based on random assignment, as described by Edgington (1987) and Good (2000), and subsequently illustrated by Chin and Dibbern (2010), is carried out in the following way:

1. A test statistic is computed for data;
2. The data are permuted (divided or re-arranged) repeatedly in a way consistent with the random assignment procedure. With two or more samples, all observations are combined into a single large sample before being rearranged. The test statistic is computed for each of the resulting data permutations;
3. The proportion of the permutations of the data in the set of reference with the values of the test statistic ≥ (or, for some statistic tests, ≤) the value of the results obtained experimentally is the *P-value*, which is the minimal level of significance, at which the null hypothesis can be rejected.

When the basis for the permutation of the data is random attribution, the permutation test is often referred to as "Randomization-test". This previous definition is broad enough to include procedures called randomization tests that depend on both random samples and randomization. The modern concept of randomization is, however, a permutation test, which is just based on randomization, where the way, in which the sample was chosen is unimportant. As Edgington (1987) underlines, a permutation test based on randomization "is valid for any type of sample, regardless of the way the sample is chosen". The null and alternative hypothesis to be tested to compare the PLS parameter (path coefficient) estimations between two independent groups G1 $(m_1, m_2, \dots, m_l)$ and

G2 $(m_1, m_2, \dots, m_k)$, where m represents the number of components and sample size of n1 and n2 respectively. The hypothesis are as follows: H_0: path coefficients are not significantly different; H_1: path coefficients are significantly different (Crisci and D'Ambra, 2012).

Recent data suggest that there are significant interactive effects by gender in the field of the entrepreneurship (Zhang et al., 2014; Reynolds et al., 2002; Wilson et al., 2007).

Many factors undoubtedly contribute to the disparity between men and women in entrepreneurial career interests and behaviour. One factor in particular, entrepreneurial self-efficacy, or the self-confidence that one has the necessary skills to succeed in creating a business, has been demonstrated to play a key role in determining the level of interest in pursuing an entrepreneurial career. Interestingly, the effects appear to differ by gender. For example, Kickul, Wilson and Marlino (2007) found that entrepreneurial self-efficacy had a stronger effect on entrepreneurial career interest for teenage girls than for boys. For teenage girls, it appears that their perceptions that they have the abilities or skills to succeed as entrepreneurs are simply more important in considering future career options than for boys. These findings are consistent with previous research on adults that indicates that women are more likely than men to limit their ultimate career choices because of their lack of confidence in their abilities (Bandura, 1992), and that women in particular shun entrepreneurial endeavours because they think they lack the required skills (Chen et al., 1998).

As described by Wilson, Kickul and Marlino (2007), explore the interplay between gender is key to improving the study in entrepreneurship activities.

4. Statistical validity and reliability of the questionnaire and choice of rating

In this research, the structured equation model (SEM) and group comparison (PLS-PM) have been adopted as a methodological approach, along with the use of a questionnaire, as the data collection method.

In order to achieve the aforementioned purposes (see theoretical framework paragraph), at the end of the simulation the students who took part in the platform filled in a questionnaire, which was divided into eight different items made up of variables measured on a semantic scale from 1 to 7 (where 1 is the lowest score and 7 the highest). This scale was adopted for the relative ease and immediacy of implementation, but took possible distortion mechanisms potentially triggered by the respondents' answers (e.g. response set) into account. The questionnaire was organized into seven constructs: "Accessibility", "Simplicity & Clarity", "Functionality", "Support activity", "Utility", "Educational Effectiveness", and "Satisfaction".

STATA analytical software was employed to analyse the collected data. The questionnaire reliability test verifies the consistency of the findings and internal reliability of the scales of measurement (multi-item scales). The test was conducted using Cronbach's Alpha Reliability Measure. The internally consistent scales that are acceptable for questionnaire design occur when Cronbach's Alpha (α) is above 0.70 (Nunnally, 1978). Therefore, the questionnaire sectional reliability tests used for data collection figure in the entrepreneurship education program presented in the table 3. The overviews of Cronbach's Alpha (α) for all scales are above the recommended Cronbach's alpha (α) minimum value of 0.60, therefore, internally consistent scales were assumed.

Nunnally (1978) established the α level at 0.70 or higher for the reliability coefficient

$$\alpha_q = \frac{\sum_{p \neq p'} cor(x_{pq}, x_{p'q})}{P_q + \sum_{p \neq p'} cor(x_{pq}, x_{p'q})} X \frac{P_q}{P_q - 1} \tag{5}$$

where p is the number of manifest variables in q-th block.

Moreover, reliability was measured through composite reliability called Dillon-Goldstein's rho (DG) as proposed by Chin (1998). DG is defined as:

$$\rho_q = \frac{\left(\sum_{p=1}^{P_q} \lambda_{pq}\right)^2}{\left(\sum_{p=1}^{P_q} \lambda_{pq}\right)^2 + \sum_{p=1}^{P_q}(1 - \lambda^2{}_{pq})} \tag{6}$$

Chin (1998) established that DG should be higher than 0.70. DG is a better reliability measure than Cronbach's alpha (α) in SEM because it is based on loadings rather than the correlations between the observed variables (Demo et al. 2012).

Consequently, Rasch analysis was used to test the validity and the reliability of each scale included in the questionnaire. Rasch analysis is a statistical approach to measure human performance, attitudes and perceptions. It is named after its inventor, the Danish mathematician Georg Rasch. He published his theory in 1960 and died in 1980. Rasch analysis was conceived as a psychometric tool for use in social sciences, and in the last 10 years it has become increasingly applied in rehabilitation research.

Thanks to the Rasch model, it is possible to transform the supplied responses in continuous measures for both the items and the students.

The basic assumption of the Rasch model (RM) is that the reply given from n-th item to S-th student depends on two parameters: the first item parameter (σ_S), measures the difficulty of the item, while the second, called the person parameter (β_n), reflects a student's ability.

Literature offers a number of alternative procedures for estimating parameters, including Joint maximum likelihood, Conditional maximum likelihood (CML) and Marginal maximum likelihood (MML). Under appropriate assumptions these solutions are asymptotically equivalent, consistent and multivariate normal (Camminatiello et al., 2010).

When the items are polytomous with a different number of categories that do not have the same distance, the most correct IRT version is the Partial Credit Model (PCM) proposed by Wright and Masters (1982).

Again in literature, there are different tools to evaluate the model's goodness of fit to observed data. One of the most widely used is based on the residuals analysis for each individual (or item). The interpretation of standardised residuals is simple but too analytic because it refers to each individual or item (see tables 2.1, 2.2 and 2.3).

To obtain concise information, the outfit or Unweighted Mean Square statistic equal to 1 is estimated. In any event, values greater than 2 are bad for the measurement. It can be demonstrated that outfit statistics are sensitive to great differences between β e δ; to balance this characteristic it is possible to weigh the squared residuals with the variance, obtaining another synthetic statistics defined as INFIT (or Weighted Mean Square statistic). The INFIT statistic is sensitive to unexpected behaviour that affects responses to items in line with person ability levels, while the outfit measurement is externally sensitive, so it is useful to calculate both these statistics.

The results of the Rasch analysis show item reliability equal to 0.93 and a person reliability equal to 0.75, so the test has excellent reproducibility proprieties. The INFIT and OUTFIT statistics for most items do not present values outside the range [0.6, 1.4], so there is a good fit between data and model for all the items used (Tables 2.1, 2.2, and 2.3).

Table 2.1 INPUT: 127 PERSONS 3 ITEMS MEASURED: 127 PERSONS 3 ITEMS 19 CATS 3.65.0 (simplicity & clarity)

Category label score	Observed count %	Observed Average	Sample expect	INFIT MNSQ	OUTFIT MNSQ	Structure calibration
1 1	1 1	-3.63	-5.39	2.08	2.11	none
2 2	5 4	-3.25	-3.14	1.99	2.35	-5.70
3 3	6 5	-1.36	-1.21	.60	.60	-1.81
4 4	12 10	-0.58	-.29	.42	.36	-1.12
5 5	37 31	1.83	1.48	1.30	1.40	-.29
6 6	49 41	3.35	3.53	1.24	1.22	2.61
7 7	18 20	5.46	5.33	.87	.85	6.29

OBSERVED AVERAGE is mean of measures in category. It is not a parameter estimate.

Table 2.2 INPUT: 127 PERSONS 5 ITEMS MEASURED: 127 PERSONS 5 ITEMS 30 CATS 3.65.0 (effectiveness)

Category label score	Observed count %	Observed Average	Sample expect	INFIT MNSQ	OUTFIT MNSQ	Structure calibration
2 2	2 2	-.33	-.60	1.34	1.18	none
3 3	4 3	-.31	-.36	1.05	1.08	-1.17
4 4	7 6	-1.02	.01	1.17	1.27	-.75
5 5	21 17	.23	.63	.50	.39	-.80
6 6	59 48	1.54	1.51	.61	.58	.02
7 7	30 24	2.78	2.56	.77	.86	2.70

OBSERVED AVERAGE is mean of measures in category. It is not a parameter estimate.

Table 2.3 INPUT: 127 PERSONS 6 ITEMS MEASURED: 127 PERSONS 6 ITEMS 39 CATS 3.65.0 (accessibility)

Category label score	Observed count %	Observed Average	Sample expect	INFIT MNSQ	OUTFIT MNSQ	Structure calibration
2 2	5 4	-1.34	-.70	.26	.41	none
3 3	14 11	.05	-.15	1.15	1.06	-2.01
4 4	13 11	.16	.44	.26	.20	-.34
5 5	39 32	1.13	1.04	.75	.65	-.92
6 6	31 25	1.89	1.80	1.11	.94	1.07
7 7	20 16	2.78	2.88	1.42	1.22	2.20

OBSERVED AVERAGE is mean of measures in category. It is not a parameter estimate.

As mentioned beforehand regarding reading performance, it would be appropriate to remove or replace the items that present the INFIT and OUTFIT statistics outside the range [0.6, 1.4], because they could distort the obtained measures. However, it was preferred not to make these changes in order to remain faithful to the calibrated test, and stakeholders can focus on the contents of such items to address educational proposals regarding the more problematic disciplinary aspects.

The goodness of fit can be graphically evaluated through the Item analysis: Characteristic Curves (ICC) and Category Probability Curves (CPC). The ICC of i-th item represents the probability of achieving a given score for the item, depending on the parameter value β. The misfit of s-th item is observed when one or more points $\hat{p}_{nsx}$ are not on the ICC of the item, where $\hat{p}_{nsx}$ is the probability that individual n chooses the category x to item s, as specified by the Rasch model, with estimated parameters. The CPC allows for the probability of choosing each of the possible categories according to the difference between subject ability, average difficulty of the item, and category thresholds. The thresholds correspond to the measures, to which the adjacent categories are equally probable. Compared to the ICC, the ordinate represents the expected score for the item, and is obtained by accumulating the product of the estimated probability for each response for each ability level in abscissa, and the corresponding raw score. To improve the goodness of fit of a model, one can eliminate all badly fitting items (and/or individuals) through an iterative procedure. Often the set of excluded items helps to measure a separate dimension. However, in extreme cases, it may not be possible to identify any set of items consistent with the hypothesis of the Rasch model: this can be caused by a badly calibrated questionnaire or a mixture of individuals apparently belonging to the same population, but in reality related to different populations.

The latter case can be a symptom of a different item function corresponding to distinct groups of individuals: this phenomenon is called Differential Item Functioning or DIF. More precisely, an item is considered biased when, with respect to a certain level of ability, the probability of choosing a certain category of response differs systematically between subgroups of individuals (eg., between males and females). If the presence of DIF is statistically significant, it will be necessary to identify homogeneous groups of individuals that present a good fit. In literature there are several DIF diagnostics (Glas and Verhelst, 1995), but those most used and implemented (Wu et al., 1998) in more commonly used software are based on a residual analysis of those subgroups that are identified by one or more aggregation variables. In order to compare the abilities of individuals and the difficulties of the items, one can use the person-item map, a simultaneous graphical representation of both individuals and items. It allows assessment of more difficult items and of individual capability.

In order to verify that the thresholds are ordered and that there is a suitable distance between them, the CPCs have been shown. So as not to bore the reader, figures 5 and 6 show only the CPCs of the items that allow different answers that have a score ranging from 1 to 7. It is easy to check that the category 1 curve of probability first meets the category 2 curve of probability, followed by category 3, and so on, for each instance.

```
P      -+------+------+------+------+------+------+------+------+-
R  1.0 +                                                         +
O      |                                                        7|
B      |                                                      77 |
A      |                                                     7   |
B   .8 +1                                                  77    +
I      | 1       22222                        66666       7      |
L      | 1      2     2                      6     6      7      |
I      |  1    2       2           55555    6       6    7       |
T   .6 +   1  2        2          5     5  6         6  7        +
Y      |    12          2        5      5  6          67         |
    .5 +    *            2       5       56           67         +
O      |    21           2      5        65           76         |
F   .4 +   2  1           *3  4*        6  5         7  6        +
       |  2   1          32 34 544      6  5        7    6       |
R      |  2    1        3  2435   4    6    5       7    6       |
E      | 2      1      3   *  *    4  6      5     7      6      |
S   .2 +2        1    3   4 25 3    46        5   7        66    +
P      |          1 33   4  52  3   64         5 7           6   |
O      |           *1   4   5 2  3 6  4        7*5            66 |
N      |       3333  1**  55   2*6*3   444  777   555           6|
S   .0 +*********************************************************+
E      -+------+------+------+------+------+------+------+------+-
       -7     -5     -3     -1      1      3      5      7      9
        PERSON [MINUS] ITEM MEASURE
```

Figure 5. CATEGORY PROBABILITIES: MODES - Structure measures at intersections (simplicity & clarity)

```
P      -+-------+-------+-------+-------+-------+-------+-------+-
R  1.0 +                                                         +
O      |                                                         |
B      |3                                666666                 7|
A      | 33                            66      66             77 |
B   .8 +   3                           6          66          7   +
I      |    3                         6             6        7    |
L      |     3                       6               6      7     |
I      |      3                     6                 6    7      |
T   .6 +      3                    6                   6  7       +
Y      |       3  44444    5555  6                    6 7        |
    .5 +        34     4  5    56                      *         +
O      |        43      45      *                     7 6        |
F   .4 +       4 3      54     6 5                    7  6       +
       |      4   3    5  4   6   5                  7    6      |
R      |     4     3  5    4 6     5                7      6     |
E      |    4       35     4 6      5              7        6    |
S   .2 +   4        53      *        55           7          6   +
P      | 44        5  3    6 44        5        77            66 |
O      |4        55    3 66    4        55    77                6|
N      |      555     66*33     444       ****5                  |
S   .0 +**************77777**************************************+
E      -+-------+-------+-------+-------+-------+-------+-------+-
       -6      -4      -2       0       2       4       6       8
        PERSON [MINUS] ITEM MEASURE
```

Figure 6. CATEGORY PROBABILITIES: MODES - Structure measures at intersections (functionality)

These results show the need to unify the first scale numbers. As it does not produce alterations to the theoretical model, resizing the scale for the measurement of some items is proposed for future research.

5. Simulation: statistic analysis, results and conclusions

5.1 Simulations and sample

Entrepreneurship education (EE) is currently one of the fastest growing fields of education globally (Solomon, 2007). This is an indication of the importance of entrepreneurship for the economy of any society. There is a tacit assumption that links providing EE and promised economic growth, generating employment opportunity, and enhancing economic development at large. This assumption has been widely explored and some evidence has been found to support it (Ligthelm, 2007; Mojica et al., 2010; Pacheco et al., 2010).

In behavioural sciences, researchers are often interested in studying theoretical constructs that cannot be directly observed. These abstract phenomena are termed latent variables, and because latent variables are not directly observed, it follows that they cannot be directly measured. As such, the unobserved variable is linked to one that is observable, thereby making measurement possible.

The measurement of constructs can only occur indirectly through observable variables affected by measurement errors. More precisely, a measure is an observed score, or numerical data, gathered through questionnaires, interviews, observations, or other instruments and is considered a similar empirical construct (De Vellis and Robert, 1991; Edwards and Bagozzi, 2000).

The research focuses on the educational impact of the ExperimentaLab EE programme by involving students of different master degree courses in role-play simulations guided by the virtual platform. These were conducted, partly in a laboratory at the Department of Economics of the University of Campania “Luigi Vanvitelli” (each student using a computer), and partly in external environments where the students could connect to the platform. The platform was open for the entire duration of the simulations to allow students to log in and work in the virtual environment at any time.

A first simulation was run in 2014, showing that the ExperimentaLab could be effective at processing an idea and make it potentially ready for market and investors and thus a valid educational tool potentially implementable by an entrepreneurial university (Iscaro et al., 2015).

The simulation involved 31 students (17 male and 14 female) from a master's degree course in Market-Enterprise Relations at the Department of Economics, University of Campania Luigi Vanvitelli. Students were divided into three groups to compare three different approaches to work in the ExperimentaLab, given the same starting conditions. Furthermore, in order to validate the ExperimentaLab process, four control groups were used that processed different business ideas but pursued the same aim: to make them potentially ready for market and investors. The students in the control groups were on a master's degree course in Business Planning at the University of Campania Luigi Vanvitelli and were at the same stage in their university career as the students in the sample. They worked without the platform support, enabling comparison between the final outcomes of the platform students and those of the control groups. The simulation produced the following results from the two groups:

1) students engaged in the role play - their overall evaluation was strongly positive, with all the scores well over the threshold. Players evaluated the ExperimentaLab as effective to structure everyday work and suitable to achieve the purpose of processing an idea and making it potentially ready for the market and investors;

2) a committee constituted by experts from different fields: professors/tutors and instructors in the game, an expert in research methodology, an expert in innovative processes and finance, PhD students of the programme in Entrepreneurship and Innovation of the University of Campania Luigi Vanvitelli who acted as potential customers - the comparison between experts' assessments showed that the overall evaluation (deriving from the average score each group achieved in each item) was always higher for groups in the sample compared to the control ones. Principal component analysis was used to analyse data. The

results from principal component analysis suggested that the effectiveness of the business idea processed in the ExperimentaLab depends on the platform design. By effectiveness of the business idea I mean its attractiveness for potential customers and the likelihood of finding investors and being launched on the market, while the ExperimentaLab design is defined by the structure of the roles (the suitability of the three roles and their respective functions to work in the ExperimentaLab) and the daily work processes (the ExperimentaLab as it was conceived in its everyday functioning – Stage&Gate model, interaction tools, etc.).

The proposition addressed, therefore, was that the ExperimentaLab design positively influences the effectiveness of the business idea processed within it (figure 7).

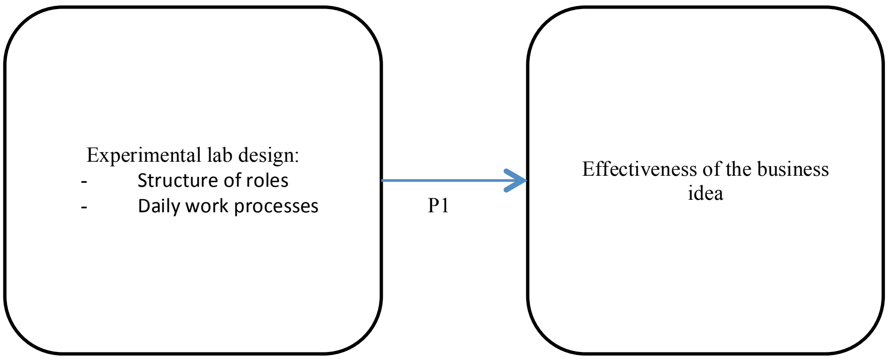

Figure 7. First simulation: theoretical framework.

After the first simulation, it was possible to carry out a revision of the platform to improve its operation, together with a revision of the research methodology and the students' questionnaire. This was done through identification of the coefficient matrix and Cronbach's Alpha test (Cronbach, 1951), in order to solve the limitations arising during the first simulation and empirical analysis and in relation to the number of analysed variables. Other simulations (concluded in May 2016) were then run in an attempt to overcome previous limitations, better test the platform and investigate the phenomenon.

In total, in the following simulations, 127 students (69 male and 58 female) involved in four master degree courses at the Department of Economics of the

University of Campania Luigi Vanvitelli (Market-Enterprise Relations, Business Planning, Innovation management, and Entrepreneurship and development strategies) played the role of aspiring entrepreneurs. Academically, 74% had an average university score in all exams of between 27-30 - given a max score of 30 per exam - 12% lay between 23-26 and 14% fell between 18–23. They were almost equally distributed in terms of previous work experience: 52% were completely devoid of experience while 48% had had some work experience.

It is a sample of convenience, which, as the name suggests, chooses the units according to a criterion of convenience as it selects the units that are immediately available. It is also called accidental sample or opportunistic. Among the most frequent convenience samples it is possible to remember those constructed from the common passers-by or with the frequenters of the department store, or even the pre-built. In extensive research conducted in universities are the new freshmen who represent the sample, because they are the most readily available subjects.

The sample is a reflection of the student population at the Department of Economics of the University of Campania Luigi Vanvitelli (the last 3 years), regarding gender, age and average score in all exams the student population. For this reason, it is possible to call the sample as a sample of convenience.

Students spontaneously formed groups after a business idea competition, during which some of them presented their entrepreneurial ideas. Each group consisted of students playing the role of aspiring entrepreneurs, while mentors (i.e. course professors and university/affiliated tutors) played the roles of venture sitters and human resources.

The overall aim was to evaluate the effectiveness of the ExperimentaLab in helping students to analyse and develop their business ideas through a process supporting the acquisition of entrepreneurial competences.

Data generated by the simulations were analysed through a structural equation model (SEM). SEM is a statistical methodology that takes a hypothesis testing approach to the multivariate analysis of a structural theory bearing on some phenomenon (Byrne, 2001). The goodness-of-fit of the models was evaluated using the chi-square (χ^2) statistic.

5.2 Results and Analysis

The first purpose of this study is to investigate whether the hypothesized work structure of the ExperimentaLab and related cognitive dynamics may support university entrepreneurial education and entrepreneurial activity.

In order to achieve this aim, at the end of the simulation the students involved in the platform filled in a questionnaire, which was structured into seven different items made up of variables measured on a semantic scale from 1 to 7 (where 1 meant the lowest score and 7 the highest). For the operational definition see paragraph 1.6.

To analyse the existence of significant relationships between latent hypothesized constructs, it is appropriate to briefly calculate descriptive statistics regarding the mean, the variance and the non-normal distribution of the data (table 3), just before applying the PLS SEM analysis. The Shapiro-Wilks test is based on the comparison between the normal distribution and data quantiles. The standardized Skewness test determines the lack of symmetry in the data, while the standardized Kurtosis test shows whether the distribution shape is either flatter or more accentuated than for a normal distribution.

Table 3. Kurtosis/Skewness/Shapiro Wilk (W) tests for Normality

Variable	**Mean**	**Variance**	**W**	**Pr (Skewness)**	**Pr (Kurtosis)**
Ease of access to the platform services	5.196	1.905	0.979	0.073	0.327
Easy of platform navigation	5.086	1.825	0.981	0.087	0.262
Comprehensibility of platform language	5.267	2.022	0.950	0.009	0.679
Clarity of rules	5.708	1.462	0.963	0.031	0.135
Importance of the forum	5.692	1.865	0.848	0.000	0.006
Importance of face to face	6.385	1.080	0.744	0.000	0.000
Simplicity of the Idea in progress form	5.314	1.598	0.951	0.005	0.301
Clarity of the form rules	5.385	1.492	0.975	0.059	0.979
Clarity of difference between a stage and a gate	5.204	1.767	0.974	0.185	0.366
Clarity of the Stage & Gate contents	5.456	1.599	0.952	0.019	0.846
Suitability of the Stage & Gate for the simulation goal	5.606	.859	0.977	0.041	0.898
Functionality of S&G to build a business	5.842	.927	0.924	0.004	0.115

case					
Functionality of S&G development	5.629	1.012	0.947	0.003	0.087
Functionality of S&G scoping	5.622	1.316	0.947	0.009	0.333
Difficulty of S&G mode	4.905	2.022	0.977	0.066	0.452
Impact of skilled human resources	6.086	.968	0.794	0.000	0.000
Importance of a venture sitter	6.165	.694	0.946	0.006	0.966
Level of collaboration with other human resource	5.740	1.463	0.847	0.000	0.006
Level of collaboration with other organizations	4.055	2.735	0.957	0.066	0.261
Growth of the entrepreneurial spirit	6.007	1.103	0.919	0.000	0.313
Usefulness of the platform for the determination of personal goals	6.102	1.187	0.815	0.000	0.004
Increase of creativity	6.291	1.160	0.752	0.000	0.000
Increase of ambition	6.204	.910	0.824	0.000	0.010
Increase of failure tolerance	5.448	1.487	0.986	0.357	0.198
Increase of risk propensity	5.236	1.658	0.947	0.005	0.553
Cognitive enrichment	6.165	1.043	0.781	0.000	0.000
Increase of work in group ability	6.196	1.540	0.735	0.000	0.002
Support for learning theoretical notions	5.984	1.571	0.789	0.000	0.003
Feasibility of business idea	5.834	1.170	0.914	0.000	0.117
Propensity to invest in the idea	5.440	1.708	0.874	0.000	0.013
Acquisition of useful competences	6.110	.908	0.828	0.000	0.000
Identification with the role played	5.803	.905	0.972	0.071	0.212
Self-efficacy	5.889	.892	0.958	0.061	0.779
Effectiveness of the platform compared to traditional learning methods	6.070	1.431	0.768	0.000	0.001
Overall satisfaction	6.133	1.021	0.837	0.000	0.001
Match with expectations	4.031	3.919	0.969	0.769	0.000
Propensity to suggest others to participate	6.188	1.313	0.787	0.000	0.005
Level of commitment	6.133	1.021	0.912	0.001	0.502

As shown in table 3, the Skewness and Kurtosis values demonstrate a deviation from normal distribution, indeed the p-value for this test is < 0.01, thus I reject the hypothesis that the examined variables follow a normal distribution with a confidence level of 99%. Moreover, the Skewness and Kurtosis values demonstrate a deviation from a normal distribution and consequently the non-normality of the multivariate distribution of the p considered variables. In addition, a value of Shapiro-Wilk close to the value 1 allows us to reject the null hypothesis and accept the alternative hypothesis that corresponds to the non-normal distribution data.

The STATA analytical software was employed to compute the data collected.

Starting from the correlation matrix I analysed the correlation of the variables of the student questionnaires. The results showed a high correlation among the variables of each semantic area, on which the questionnaire was articulated. Based upon these results, identification of the reliability tests was carried out to solve the limitations arising during the first empirical analysis and related to the small number of cases in relation to the number of variables analysed (see table 4) using R-Gui. Consequently, this analysis is based on the relationships between the manifest variables (indicators) and the hypothesized latent variables (constructs). The structural equation model proposed, involves 33 manifest variables onto 7 latent variables

The reliability test of the questionnaire serves to verify the consistency of the findings and internal reliability of the scales of measurement (multi-item scales). The test was conducted using Cronbach's Alpha Reliability Measure. The internally consistent scales acceptable for a questionnaire design is when the Cronbach's Alpha (α) is above 0.70 (Nunnally, 1978).

Another test utilised for the reliability was the Dillon-Goldstein's rho (DG) as proposed by Chin (1998). Chin (1998) established that DG should be higher than 0.70. DG is a better reliability measurement than Cronbach's alpha (α) in SEM because it is based on the loadings rather than the correlations between the observed variables (Demo et al. 2012). Moreover, Nunnally (1978) established the α level at 0.70 or higher for the reliability coefficient. Therefore, the sectional reliability tests of the questionnaires used for data collection in the entrepreneurship education program are presented in the table 4.

Table 4 shows that α reliability requisite of 0.70 or higher was achieved for almost all constructs. The support activity and the satisfaction construct have a value of 0.521 and 0.527, yet this result is not worrying because the DG value exceeds 0.70. Indeed, the DG reliability requisite of 0.70 or higher was achieved for all constructs, with satisfactory DG values between 0.769 and 0.925 recorded. Internally consistent scales are therefore assumed.

Table 4. Reliability tests.

	Mode	MVs	C.alpha	DG.rho
Accessibility	Reflective	6	0.855	0.894
Simplicity&clarity	Reflective	4	0.892	0.925
Functionality	Reflective	4	0.872	0.913
Support activity	Reflective	3	0.521	0.769
Theory	Reflective	3	0.781	0.873
Satisfaction	Reflective	3	0.527	0.917
Effectiveness	Reflective	10	0.742	0.829

The other model establishes the relationship between the block of the manifest variables and their corresponding latent variables (Outer Model). Based on the values of the communality, some variables have been eliminated for having a low value. There are: the level of collaboration with medium large companies, the higher expectations and increase of risk propensity. Although other variables have a low community value, I decided to include them because they are significant in the explanation of the model.

The MVs are linked to the LVs in a "reflective" way. In other words, the MVs are considered reflections or manifestations of the LVs. For these LVs, in correspondence with their respective MVs, I read the std. loadings that are standardized regression coefficients (a simple linear regression).

In the outer model, the value of the loading and the weights (table 5), are positive for each variable, and the correlation between the latent variables and manifest variables are quite high.

The developed model is the following (table 5).

Table 5. Outer Model.

Accessibility	**Weight**	**Loading**	**Communality**	**Redundancy**
ease.of.access.to.the.platform.services.x4	0.198	0.797	0.635	0.000
easy.of.platform.navigation.x5	0.240	0.804	0.646	0.000
comprehensibility.of.platform.language.x6	0.243	0.880	0.774	0.000
clarity.of.rules.x7	0.235	0.801	0.642	0.000
importance.of.the.forum.x8	0.192	0.702	0.492	0.000
importance.of.face.to.face.x9	0.193	0.582	0.338	0.000

Simplicity&Clarity				
simplicity.of.the.Idea.in.progress.form.x10	0.266	0.847	0.718	0.000
clarity.of.the.form.rules.x11	0.295	0.893	0.797	0.000
clarity.of.difference.between.a.stage.and.a.gate.x12	0.272	0.830	0.689	0.000
clarity.of.the.Stage.Gate.contents.x13	0.316	0.907	0.822	0.000
Functionality				
suitability.of.the.Stage.Gate.for.the.simulation.goal.x14	0.302	0.904	0.817	0.000
functionality.of.the.S.G.build.a.business.case.x16	0.332	0.902	0.813	0.000
functionality.of.the.S.G.development.x17	0.298	0.878	0.772	0.000
functionality.of.the.S.G.scoping.x18	0.234	0.710	0.504	0.000
Support activity				
impact.of.skilled.human.resource.x20	0.403	0.765	0.585	0.000
importance.of.venture.sitter.x21	0.515	0.737	0.544	0.000
level.of.collaboration.with.other.Human.Resource.x22	0.468	0.668	0.446	0.000
Theory of effectuation				
increase.of.creativity.x26	0.422	0.856	0.732	0.000
increase.of.work.in.group.ability.x31	0.317	0.758	0.575	0.000
acquisition.of.useful.competences.x36	0.452	0.881	0.777	0.000
Satisfaction				
Overall.satisfaction.y1	0.410	0.916	0.839	0.425
would.you.suggest.to.partecipateto.this.program..y3	0.372	0.885	0.783	0.397
level.of.commitment.y4	0.343	0.860	0.739	0.375
Effectiveness				
Feasibility.of.business.idea.x33	0.346	0.784	0.614	0.399
propensity.to.invest.in.the.idea.x34	0.270	0.729	0.531	0.345
identification.with.the.role.played.x37	0.198	0.613	0.375	0.244
self.efficacy.x38	0.233	0.661	0.437	0.284
effectiveness.of.the.platform.compared.to.traditional.learning.methods.x39	0.368	0.696	0.484	0.314
Growth.of.the.entrepreneurial.spirit.x24	0.246	0.808	0.653	0.000
usefulness.of.the.platform.for.the.determination.of.personal.goals..x25	0.260	0.856	0.732	0.000
increase.of.ambition.x27	0.230	0.838	0.703	0.000
increase.of.failure.tollerance.x28	0.144	0.489	0.239	0.000
support.for.learning.theorical.notions.x32	0.209	0.729	0.532	0.000

On the contrary, the inner model (see table 6), considers the relationships between latent variables (LVs), which are assumed to be linearly interconnected according to a causal-effect relationship model.

The present study aims at verifying, from an explorative and non-confirmative view point, the existence of positive and significant relationships between the following LVs:

1. Accessibility and Satisfaction
2. Simplicity & Clarity and Satisfaction
3. Functionality and Satisfaction
4. Support Activity and Satisfaction
5. Satisfaction and Educational effectiveness
6. Theory of effectuation and Educational effectiveness

The LVs - Accessibility, Simplicity & Clarity, Functionality, Support activity, and Theory of effectuation - are exogenous LVs, i.e. they are variables, which are never predicted and behave only as predictors, while Satisfaction and Educational effectiveness are endogenous LVs (i.e. dependent).

In correspondence with the endogenous LVs, I read the coefficient of determination R^2. For each regression in the structural model I have an R^2 that is interpreted similarly to any multiple regression analysis. R^2 indicates the amount of variance in the endogenous latent variable explained by its independent latent variables. In particular the R^2 for the LV "Satisfaction" is 0,507, while the R^2 for the latent variable "Educational effectiveness" is 0,649.

Table 6. Summary inner model.

Latent variable	R2	Block_Communality	Mean_Redundancy	AVE
Accessibility	0.000	0.588	0.000	0.588
Simplicity&clarity	0.000	0.756	0.000	0.756
Functionality	0.000	0.726	0.000	0.726
Support Activity	0.000	0.525	0.000	0.525
Theory of effectuation	0.000	0.694	0.000	0.694
Satisfaction	0.507	0.787	0.399	0.787
Educational effectiveness	0.649	0.488	0.317	0.488

5.2.1 Convergence and Discriminant Validity

The convergent validity represents common variance between the indicators and their construct, and this means that a set of indicators measure the same underlying construct (Henseler et al. 2009). Fornell and Larcker (1981) recommend using the average variance extracted (AVE) as a criterion. The higher the AVE value, the more representative the indicators are of the construct, into which they load. In general, this value should be above .50 (Fornell and Larcker, 1981). As shown in table 6, the AVE for each construct was satisfactory.

Fornell and Larcker (1981) suggest that the square root of AVE in each latent variable can be used to establish discriminant validity if this value is larger than other correlation values among the latent variables. To do this, a table is created, in which the square root of AVE is calculated and written in bold on the diagonal of table 7; in this table the "Latent Variable Correlation" is placed in the lower left of the triangle.

For example, in the Simplicity & Clarity latent variable, AVE is found to be 0.756 - hence its square root becomes 0.8694. This number is larger than the correlation values in the column of Simplicity & Clarity and also larger than those in the row of Simplicity & Clarity. Similar observation is also made for all other latent variables, indicating that in the most cases the discriminant validity is well established.

Table 7: Fornell-Larcker Criterion Analysis for Checking Discriminant Validity

	Accessibility	Simplicity&Clarity	Functionality	Support Activity	Theory	Utility	Satisfaction	Effectiveness
Accessibility.	0.767							
Simplicity& Clarity	0.712	0.869						
Functionality.	0.637	0.743	0.852					
Support Activity	0.424	0.300	0.479	0.725				
Theory of effectuation	0.507	0.440	0.582	0.525	0.833			
Satisfaction	0.630	0.567	0.615	0.491	0.684	0.729	0.887	
Educational effectiveness	0.520	0.440	0.577	0.476	0.683	0.774	0.715	0.699

The goodness of fit (GOF) of a statistical model describes how well it integrates with a set of observations. GOF indices summarize the discrepancy between the observed values and those expected in the SEM.

In classical SEM applications, multivariate models for continuous data (often involving latent variables) are estimated from some summary statistics, typically means and covariances or correlations (Maydeu-Olivares and Garcia-Forero 2010).

The GOF is a global criterion proposed by Tenenhaus et al. (2004) to account for the model performance in both the measurement and the structural model, and thus provide a single measure for the overall prediction performance of the model (Amato et al. 2004). This index is bounded between 0 and 1 and is a descriptive index, i.e., there is no inference-based threshold to judge the statistical significance of their value (Vinzi et al. 2010). In this paper, the GOF value is equal to 0.59.

5.2.2 Parameter estimation and validation by re-sampling methods

To estimate the model parameter, I used the R-package module. To calculate the inner estimates of the latent variables, I used the path-weighting Scheme. The non-parametric bootstrap procedure can be used in PLS-PM to provide confidence intervals for all parameter estimations, building the basis for statistical inference. Bootstrap samples are created by randomly drawing cases with replacement from the original sample.

The bootstrap results are useful for assessing the significance of the inner and outer model parameters, and in particular, it is essential to check whether or not the constructed interval with the percentile bootstrap contains a zero.

For the Outer Model, the signs of the loadings and the weights are the same for each variable. As it is possible to see in table 8, for the loadings, they all have positive and significant values.

Table 8. Loading.

Variables	**Original**	**Mean.Boot**	**Std. Error**	**perc. 025**	**perc. 975**
acc-ease.of.access.to.the.platform.services.x4	0.797	0.787	0.051	0.685	0.865

acc-easy.of.platform.navigation.x5	0.804	0.796	0.049	0.680	0.874
acc-comprehensibility.of.platform.language.x6	0.880	0.874	0.022	0.833	0.914
acc-clarity.of.rules.x7	0.801	0.796	0.048	0.707	0.868
acc-importance.of.the.forum.x8	0.702	0.709	0.059	0.578	0.805
acc-importance.of.face.to.face.x9	0.582	0.593	0.072	0.459	0.713
simpl-simplicity.of.the.Idea.in.progress.form.x10	0.847	0.845	0.036	0.774	0.901
simpl-clarity.of.the.form.rules.x11	0.893	0.893	0.020	0.852	0.928
simpl-clarity.of.difference.between.a.stage.and.a.gate.x12	0.830	0.833	0.035	0.760	0.889
simpl-clarity.of.the.Stage.Gate.contents.x13	0.907	0.909	0.016	0.873	0.936
func-suitability.of.the.Stage.Gate.for.the.simulation.goal.x14	0.904	0.904	0.017	0.871	0.935
func-functionality.of.the.S.G.build.a.business.case.x16	0.902	0.900	0.018	0.860	0.927
func-functionality.of.the.S.G.development.x17	0.878	0.881	0.033	0.812	0.930
func-functionality.of.the.S.G.scoping.x18	0.710	0.709	0.092	0.515	0.858
supp-impact.of.skilled.human.resource.x20	0.765	0.736	0.096	0.511	0.866
supp-importance.of.venture.sitter.x21	0.737	0.726	0.087	0.510	0.835
supp-level.of.collaboration.with.other.Human.Resource.x22	0.668	0.662	0.095	0.467	0.875
theory-increase.of.creativity.x26	0.856	0.852	0.047	0.738	0.921
theory-increase.of.work.in.group.ability.x31	0.758	0.752	0.097	0.513	0.875
theory-acquisition.of.useful.competences.x36	0.881	0.883	0.026	0.821	0.929
sat-Overall.satisfaction.y1	0.916	0.916	0.013	0.894	0.941
sat-would.you.suggest.to.partecipateto.this.program..y3	0.885	0.882	0.035	0.807	0.938
sat-level.of.commitment.y4	0.860	0.855	0.044	0.745	0.914
eff-Feasibility.of.business.idea.x33	0.784	0.781	0.049	0.671	0.852
eff-propensity.to.invest.in.the.idea.x34	0.729	0.734	0.057	0.623	0.828
eff-identification.with.the.role.played.x37	0.613	0.601	0.105	0.345	0.772
eff-self.efficacy.x38	0.661	0.656	0.072	0.475	0.766
eff-effectiveness.of.the.platform.compared.to.traditional.learning.methods.x39	0.696	0.698	0.060	0.587	0.801
eff-Growth.of.the.entrepreneurial.spirit.x24	0.808	0.809	0.039	0.719	0.866
eff-usefulness.of.the.platform.for.the.determination.of.personal.goals..x25	0.856	0.856	0.037	0.790	0.927
eff-increase.of.ambition.x27	0.838	0.838	0.041	0.743	0.905
eff-increase.of.failure.tollerance.x28	0.489	0.479	0.091	0.305	0.641
eff-support.for.learning.theorical.notions.x32	0.729	0.733	0.066	0.553	0.819

As regards the significance of the path coefficients, table 9 shows that all the links are significant, except for the impact of Theory of effectuation on Educational effectiveness. In this case, the path coefficients have an interval with negative and positive values.

Table 9. Bootstrap validation for path coefficients

			Original	**Mean. Boot**	**Std.Error**	**perc.025**	**perc.975**
Accessibility	->	Satisfaction	0.316	0.306	0.153	0.050	0.604
Simplicity & Clarity	->	Satisfaction	0.104	0.118	0.121	0.064	0.371
Functionality	->	Satisfaction	0.234	0.225	0.105	0.018	0.432
Support activity	->	Satisfaction	0.213	0.226	0.067	0.116	0.347
Theory	->	Effectiveness	0.052	0.081	0.099	-0.066	0.261
Satisfaction	->	Effectiveness	0.313	0.300	0.093	0.118	0.465

The specification of the Inner model with the indication of the bootstrap results is shown in figure 8:

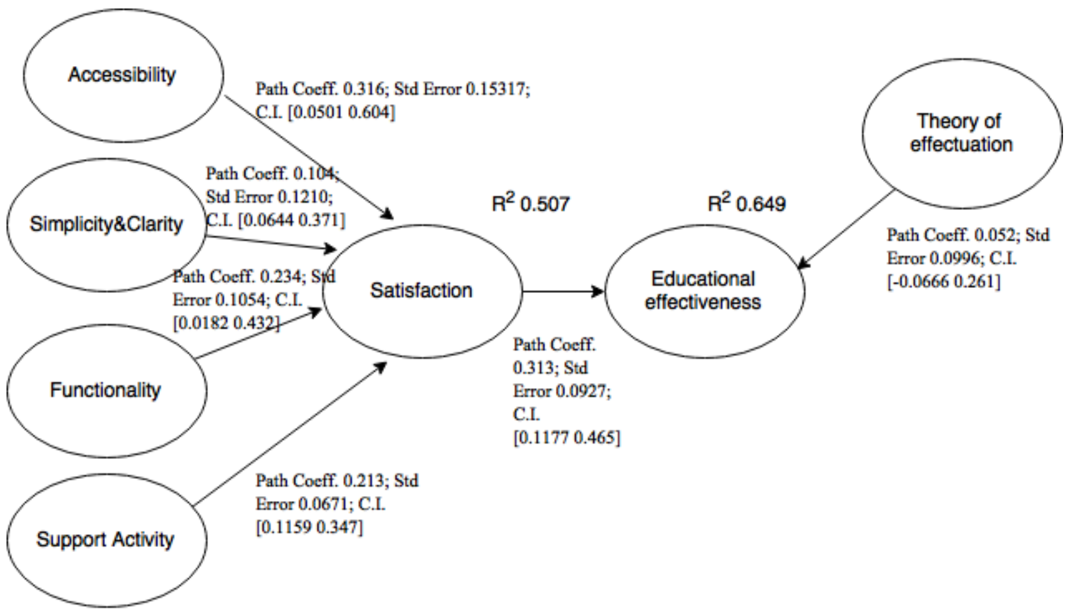

Figure 8. The path diagram for the evaluation of the entrepreneurial education generated by the adoption of the ExperimentaLab; Path Coeff. Path Coefficients, Std Error Standard Error, C.I. Confidence Interval.

To analyse the significance of the reflexive indicator coefficients, the bootstrapping procedure, confirming the aforementioned significance, was applied. Path coefficients, standard errors and confidence intervals, all demonstrated this significance where the confidence intervals do not include zero values. The results (path coefficients, standard errors and confidence intervals) are shown in the path diagram (Figure 8).

Considering the research hypotheses mentioned in paragraph 1.6, I affirm that:

- The "Platform accessibility and navigation" impact positively and significant on "player satisfaction";
- The “Simplicity & Clarity” of procedures impact positively and significant on "player satisfaction";
- “Functionality” of the Stage&Gate model to develop business ideas impacts positively and significant on "player satisfaction";
- “Support activity” impacts positively on "player Satisfaction”;
- The dimension "Satisfaction" is positively correlated with "Educational effectiveness", showing that the designed features and everyday dynamics of the ExperimentaLab virtual platform positively influence educational effectiveness, thanks to participant satisfaction.

Thus, H1a, H1b, H1c, H1d and H2, are confirmed, while there is evidence support H3.

To evaluate the structural model, I used the R^2 measure together with the significance of the path coefficients. Because a prediction-oriented PLS-SEM approach aims to describe the variance of latent variables, the key target construct R^2 level should be high. Deciding what constitutes a high R^2 level depends, however, on the specific research discipline. For this reason, I analysed the conceptual model with R^2, the value of which, as shown by the path diagram (figure 8) confirms the significance of the model, recording very satisfactory values of between .63 and .74.

5.2.3 Group Comparison

Recent studies suggest that we know considerably more about the direct relationship between entrepreneurship education and intention in general than about the moderating role of gender (Nabi et al., 2015). In this regard, an estimate of multi-group path analysis to verify whether significant differences exist between the two groups in terms of path coefficients is proposed, to examine whether there is a difference between female and male students.

Thus, I propose a group comparison. The aim of this methodology is to verify whether significant differences exist between the two groups in terms of path coefficient.

The method used to test such differences is the Permutation test (Good, 2000; Chin and Dibbern, 2010), which is a randomisation test that provides a non-parameter option.

The null and alternative hypothesis to be tested in order to compare the PLS parameter (path coefficients), making estimations between the two independent groups G1 $(m_1, m_2, \dots, m_l)$ and G1 $(m_1, m_2, ., m_k)$, are:

H0: path coefficients are not significantly different;

H1: path coefficients are significantly different.

Given that I have student gender information, I may want to examine whether there is a difference between females and males. To do that, the next step is to calculate PLS Path Models separately for female and male students.

There are numerically different path coefficients between the models. In particular, the link between the theory of effectuation and educational effectiveness for female students is positive and significant (Coeff= 0,4788 and the confidence intervals do not include zero values) while for male students this link is not significant (-0,089 and the confidence intervals do not include zero values).

But the important question is how different the path coefficients really are.

A group analysis was performed in order to get a verdict.

Table 10 shows the obtained results for the group comparison. The first column shows the global path coefficients, the second column the path coefficients for Group1 (female), and the third column the path coefficients for Group2 (male).

The fourth column contains the absolute difference of path coefficient between the two groups. In contrast, the fifth column has the permutation test p-value. In particular, the significantly different path coefficients (p-value of the permutation test < 0.05) are those in bold.

Table 10. Group Comparison in PLS-PM.

	global	**group.female**	**group.male**	**diff.abs**	**p.value**	**sig.05**
Acc->Sat	0.316	0.029	0.482	0.453	0.139	no
Simpl->Sat	0.104	0.309	0.008	0.301	0.238	no
Func->Sat	0.234	0.175	0.201	0.026	0.881	no
Supp->Sat	0.213	0.361	0.174	0.187	0.228	no
Theory->Eff	**0.052**	**0.479**	**-0.089**	**0.568**	**0.019**	**yes**
Sat->Eff	0.313	-0.027	0.372	0.399	0.059	no

As shown in table 9, all the links are significant, except for the impact of the “theory of effectuation” on “educational effectiveness”. When the multi-group PLS was analysed, there was a difference between Table 9 and Table 10, as a positive significance of the "theory of effectuation" item from the female group was evidenced. This shows that the female group demonstrates a greater ability to work in teams, a greater creativity, and a greater acquisition of useful competencies. This result is very interesting given the literature on entrepreneurial outcomes.

The relationships highlighted through the Structural Equation Model allow a cause-effect relationship among items to be hypothesised. In particular it appears that the structure of the ExperimentaLab – i.e. accessibility, simplicity & clarity of procedures, functionality of the adopted S&G model, support activity of the involved network of actors - making knowledge flows possible - may foster participants’ satisfaction, thus positively impacting on the acquisition of entrepreneurial competencies by students, and demonstrating the educational effectiveness of the simulation training experience by means of the ExperimentaLab (our latent variable).

5.3 Conclusions and implications

There is a growing interest in entrepreneurship education expressed by politicians, higher education institutions, universities and students. Entrepreneurship education actively contributes both to the development of student "entrepreneurs" and to the entrepreneurial activity of universities, although the findings are not entirely conclusive. Like some recent articles about entrepreneurial learning, this work makes a serious attempt to merge theory, practice and actual observation of what entrepreneurs do and how they learn (Harmeling and Sarasvathy, 2013).

As mentioned at the beginning of this work, the goal is to provide a contribution to the studies that aim to boost entrepreneurship education and the entrepreneurial activity of universities. As it has been seen, the proposals in the entrepreneurship education literature over the past years are varied, although most of the tools and techniques have not necessarily been empirically investigated for their impact on student learning. The volume and variety of approaches might, at first glance, appear to suggest that significant strides have been made in entrepreneurship education. However, as highlighted by Fayolle (2013), for the future of entrepreneurship education, at least two major evolutions are required. First, the need of robust theoretical and conceptual foundations, drawing from the fields of entrepreneurship and education to support entrepreneurship programmes and courses. Second, the need to reflect upon our practices, and take a more critical stance, breaking away from the far too common "taken for granted" position.

Similarly, the latest developments on the need to open students' minds to fundamental skills such as the identification, discovery or creation of opportunities, also suggests a need to think about the content of entrepreneurship education. For example, Kirby (2004) argues that there needs to be a shift in the emphasis from educating 'about' entrepreneurship to educating 'for' it. Better still, he suggests that entrepreneurship education should stop concentrating on small business creation or management and start concentrating on creativity and change.

In this work I focus on the “what” and “how” of entrepreneurship education as areas mentioned by many researchers as those that have received scant attention in literature (Pittaway and Cope, 2007; Solomon, 2007; Fayolle and Gailly, 2008; Samwel Mwasalwiba, 2010). This research thus aims to contribute to an area — course contents and methods of teaching entrepreneurship (Solomon, 2007) — which needs further in-depth description in order to contribute to efforts to extract best entrepreneurship education programme practices (Jones and Matlay, 2011). Moreover, this work joins that part of literature on entrepreneurship education emphasizing the importance of “active”, “experiential”, “learning by doing” and “ real-world” pedagogies, which, as Alain Fayolle (2013) suggests, is not currently well addressed by the entrepreneurship education research. Obviously, I hope that the less traditional educational processes presented in this work will be appreciated by those who think that it is still necessary to work hard on entrepreneurship education programmes.

It is important to note that there is also a need to increase the number of publications that allow authors to explain how to use new teaching strategies (Fayolle, 2007).

For example, many of the computer simulations presented previously (see 2.2 game and simulation) are still designed to teach purely analytical skills or small business management skills. In the more recent literature, however, some stimulating proposals have emerged concerning the question of basically entrepreneurial competencies.

This new emphasis on competencies should not be to the detriment of knowledge. As Fiet (2000) pointed out, it is a question of changing the perspective from which to think students learn theories, rather than eliminating those theories completely from courses.

This work aims to investigate the effectiveness of the entrepreneurship education programme supported by the adoption of the virtual platform ExperimentaLab. As regards the impact of the ExperimentaLab in terms of entrepreneurship education, students were asked to assess the item “educational effectiveness”, indicating the utility of the ExperimentaLab for entrepreneurship education in terms of acquisition of entrepreneurial competencies.

The study illustrated in previous chapters was conducted on a sample of 127 students following four master degree courses at the Department of Economics of the University of Campania Luigi Vanvitelli, who played the role of aspiring entrepreneurs. Students spontaneously formed groups after a business idea competition, during which some of them presented their business ideas. Each group was composed of students playing the role of aspiring entrepreneurs, while mentors (i.e. course professors and university/affiliated tutors) played the roles of venture sitters and human resources. Structural Equation Modelling was used to analyse the impact of the ExperimentaLab in terms of entrepreneurship education effectiveness, meant as the acquisition of entrepreneurial competencies in a practise-oriented simulation environment, and Rasch analysis was used to ascertain validity and reliability of the questionnaire compiled.

Although several researchers investigated the field of entrepreneurship education, a few studies have been conducted on the subfield of teaching methods.

Effectiveness of entrepreneurship education is largely related to the teacher's skills and his (or her) knowledge of using different teaching method, specifically the methods of teaching entrepreneurship.

This study describes an Entrepreneurship Education (EE) program and aims at testing the program’s effectiveness. The findings suggest that various characteristics of the ‘ExperimentaLab’ are correlated with its educational effectiveness. The results are based on a questionnaire administered to students whose perceptions of their learning outcomes are related to their perceptions of platform characteristics. Moreover, this work shows very detailed first-hand insights into the program and participants’ feedback from a survey on which to can base further inquiries.

In the attempt to contribute to the activity of universities favouring entrepreneurship, and led by the belief that potentially implementable results must be achieved, this research sheds light on the adoption of a new tool by entrepreneurial universities, the ExperimentaLab, in order to provide students with an entrepreneurial training program, along with a robust network to simulate the progression from an idea to a real start-up.

This work evaluates the entrepreneurial outcome of the ExperimentaLab entrepreneurship education programme, which adopts a pedagogical method that goes beyond formal classroom teaching (Souitaris et al., 2007), focuses on exploration, discussion and experimentation (based on students' needs and interests) and shares the inclusion of an important element of realism, such as real-life problems to be solved (Nabi et al., 2015). This is powerful because, despite the challenges to the learner, the learning is more transferable to the real world (Blenker et al., 2012). Accordingly, it suggests an action-based pedagogy that causes students to become active players in the learning process, and proposes a set of activities and experiments to help achieve this. It makes an original proposal, namely, to involve students in the development of learning activities.

Moreover, this study adds to the emerging open innovation literature, in which research in the context of entrepreneurship has been scarce (Chesbrough and Bogers, 2014; Eftekhari and Bogers, 2015).

I focus on the relationship between open innovation and entrepreneurship exploring the functioning of a virtual open process of idea development for new venture creation. It has been observed that innovation has experienced two closely interconnected major revolutions: the first from closed to open innovation, the second from open to “innovation 2.0” which, as defined by the EU Open Innovation and Strategy Policy Group (OISPG, 2011), considers collaboration and networking as a way to maximize the innovation base of organizations, the knowledge and creative capital at their disposal. Innovation 2.0 is based on sharing in order to innovate, through the exploitation of ideas and knowledge flows, thus improving the innovation base of each organization involved in the value network; it makes synergy its vision and, to realize “working together” as a tool, it builds virtual platforms to generate shared value. In this synergistic vision, the university is a major actor, becoming an ecosystem (Curley and Formica, 2012b).

Till the moment not many works study the relationship between open innovation and entrepreneurship, and they mainly focus on the issue of firm performance and survival. Some studies investigate the positive impact of open innovation on new venture success (Eftekhari and Bogers, 2015), however the impact of open innovation on the likelihood to start-up has not been proposed yet. I try to address this research gap by investigating how open innovation, when well-structured in a platform, can facilitate the likelihood to start a new venture.

Entrepreneurs seize identified opportunities and develop initial business ideas through unique resources, in particular leveraging external sources of knowledge through collaboration (Baron, 2006). Collaboration helps would-be entrepreneurs to pursue innovativeness through the sharing of ideas, knowledge, expertise and opportunities with various partners in its value network (Bogers and West, 2012; Nambisan and Baron, 2013; Gruber et al., 2013).

The ExperimentaLab configuration facilitates co-ordination and knowledge sharing thus influencing behaviour and impacting on the decision to start a business. This way my aim is to broaden the scope of research about both open innovation and entrepreneurship, mixing them together. Nonetheless, I am aware of the fact that this is only a first, minor step on the road to gaining a better understanding of the issue of new venture creation through open innovation processes.

The research proposes a new tool for the entrepreneurship education, suggesting the specific features and everyday dynamics a virtual platform should have in order to be effective in the learning process, thus enhancing entrepreneurship. It is important for the process to be well and clearly structured, to allow the sharing of knowledge without putting at risk value extraction for would-be entrepreneurs and other network (Lab) members. Indeed, there is a narrow path between knowledge exchange, which is essential for innovation generation, and protection of intellectual property, which is important to remain competitiveness (Schulz, 2014).

Looking towards the future, the ExperimentaLab, through the creation of a network of experts able to support aspiring entrepreneurs in Academia, may foster the entrepreneurial activity of university, thus supporting its third mission, educating would-be entrepreneurs and helping them practise the managerial and entrepreneurial functions of new venture creation. The ExperimentaLab is an entrepreneurship training programme relying mostly on experiential teaching and "learning by doing" methods, as is often the case in entrepreneurship education (Carrier, 2007). For universities this means adopting unconventional experience-based teaching and evaluation methods necessary to deliver entrepreneurial competences (Kickul and Fayolle, 2007).

Based on the RM analysis results, as a future perspective, it could be useful to re-evaluate the item scale used for certain items in the proposed theoretical model.

I would also like to broaden my theoretical model by adding an analysis of the relationship between entrepreneurship education and entrepreneurial intent as there is a strong link between the two issue as highlighted in the literature (Liñán, 2004).

As highlighted by some authors (see 1.6 Theoretical framework), there is a wide theoretical divergence in topics within entrepreneurship courses, and entrepreneurship education. It could be interesting to analyse this divergence as extension for future research. This creates an atmosphere of discussion and debate.

Finally, I would like to use the Meta-Analysis of academic institutions in three different stages regarding the development of the university as an entrepreneur (Etzkowitz, 2004; Riviezzo et al., 2015).

In the long-term, if the platform is to be concretely implemented as a tool in the entrepreneurial university, thus obtaining labour and capital, it will be possible to utilize Stochastic Frontier Analysis to evaluate the efficiency of the ExperimentaLab in helping aspiring entrepreneurs to turn their ideas into successful start-ups.

The number of observations represents one of the constraining limitations of this research. For this reason, running new simulations to enlarge the number of observations could represent an extension for future research.

In the future, Structural Equation Modelling (SEM) and some of the various estimation methods mostly adopted could be used, (see 3.1 Structural Equation Modelling) such as the Maximum Likelihood (ML), the Partial Least Squares

(PLS) and the Generalized Maximum Entropy (GME), to illustrate their main differences and similarities.

At the end of this work, my main wish is that the less traditional educational strategies presented here will be of interest and use to teachers who wish to enrich the spectrum and range of their teaching tools, and perhaps will even encourage some to adjust or create new tools in entrepreneurship education.

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