

HOW A PRIVATE EDUCATIONAL INSTITUTION IN SOUTH BRAZIL MANAGED TO CREATE A UNIVERSITY INNOVATION AND ENTREPRENEURSHIP ECOSYSTEM

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Abstract

This article aims to describe the dynamic of a university innovation and entrepreneurship ecosystem, as well as the actions developed by a private university in southern Brazil to create it. Through a descriptive qualitative approach, the research strategy consisted of a case study in which data were obtained through six interviews, non-participant observation, and documentary analysis. The results demonstrated that the university managed to reach an innovation and entrepreneurship ecosystem once they reinforced favorable institutional conditions for entrepreneurship and developed a structured department of entrepreneurship education that gives support to future entrepreneurs. Once the theme has not yet been widely explored in the literature, this article aims to contribute both to broaden the debate and to present a case of a South American private university that may serve as a model for other educational institutions that wish to create or reinforce their university innovation and entrepreneurship ecosystems.

Keywords: Innovation. Entrepreneurship. University ecosystems. University entrepreneurial activities.

1 Introduction

Research on entrepreneurial universities has devoted special attention to understanding how university innovation and entrepreneurship ecosystems have been transforming the environment around them while increasing levels of support for the entrepreneurial academic community (Guerrero et al., 2020; Moraes et al., 2020). The universities modify their main teaching, research, and extension activities to emphasize the transfer of generated knowledge (Berggren, 2017), this process culminates with entrepreneurial ecosystems that offer multiple alternatives to boost the main objectives of their actors involved such as government, industry, academia, students, and users (Koslosky et al., 2015; Guerrero et al., 2020; O’Kane et al., 2020).

Thus, there is a tendency for universities to seek cooperative relations between the productive sector while they play a prominent role in the local development in which they are inserted (Koslosky et al., 2015). According to Cai et al. (2020), this movement meant that higher education was more than ever intertwined with the economic, social, and environmental demands of the post-contemporary world. It ended up generating a new research agenda for understanding the new role of universities in innovation ecosystems (Cai et al., 2020; Guerrero et al., 2020; O’Kane et al., 2020). Although there is still little literature dealing with the issue of university innovation and entrepreneurship ecosystems (Koslosky et al., 2015; Link and Sarala, 2019; Moraes et al., 2020; Barros and Paixão, 2021) it is believed that both university and society yearn for new roles in the performance of higher education and its positive consequences for the community (Cai et al., 2020).

To contribute to this debate, this study is based on Cai et al. (2020) concept of innovation ecosystem, which is defined as having co-innovation networks, in which the actors of organizations are concerned with production of knowledge and wealth creation by interacting with each other in the formation of coevolution and interdependent relationships in trans geographic contexts. Also, new ideas and approaches from various internal and external sources are integrated to generate shared values that aims to the transformation of the society.

This study is based on the description and analysis of the case of the innovation ecosystem of PUCPR, which presents itself as the only private university in the state of Paraná to have developed an ecosystem of university innovation and entrepreneurship (Kaniak, 2020). It is believed that immersion in its history, purposes, and entrepreneurial activities can contribute in a practical way to other universities that wish to follow its model, especially in the Brazilian context, that still lacks the development of entrepreneurial universities (Alves et al., 2019). Therefore, the present research aims to describe the dynamic of a university innovation and entrepreneurship ecosystem, as well as the actions developed to create it.

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This article is structured as follows, in addition to the introduction, there is a theoretical reference topic articulating ideas of authors that served as a basis for this work. After the methodological procedures are presented followed by the description of the case, the presentation of the results and analysis and concluding with the final considerations.



2. Theoretical Reference

2.1 University entrepreneurship activities

Universities have a unique potential to stimulate entrepreneurship. According to Baldini et al. (2015), academic entrepreneurship can be understood as the involvement of a university in activities related to the commercialization of research, including formal mechanisms, such as academic spinoffs, patents, industry-university collaborations, and licensing. In addition, there are other kinds of arrangements like consultancy, networking development and activities related to industrial partners. Perkmann and West (2015) report that the academic space has great strength in its human capital, and universities can become the cradle of technological innovations and developments, especially if carried out in partnership with the government and/or companies.

In the technology transfer process, ideas are generated, expanded by complementary knowledge, and transformed into salable goods in the market, generating innovation and social well-being (Chais et al., 2018; Cunningham et al., 2017; Pertuzé et al., 2010). In Brazil, university innovation agencies or Technological Innovation Centers (NITs) act as an “intermediary” between innovation providers (university scientists) and those who can potentially help commercialize these innovations (companies, entrepreneurs, and venture capitalists) (Sartori, Spinosa and Nogas, 2017). Thus, the transfer of technology from academic institutions has been seen as a strategic condition, both for companies and the technological development of countries to face the challenges of a global economy (Santos et al., 2020; Audretsch et al., 2014; Bengtsson, 2017).

Much of the transfer of technology from the academy to the market comes from the generation of intellectual property by the university. As explained by the USP Innovation Agency (Auspín, 2021), the intellectual property covers two major areas: industrial property (patents, trademarks, industrial design, geographical indications, and protection of cultivars) and copyright (literary and artistic works, programs computer domains, Internet domains, and immaterial culture). For Pereira (2011), the intellectual property comprises the right of an individual or a legal entity to a movable intangible asset.

Another mechanism developed by universities is business incubators. They are organizations created to host and support micro and small companies to enable their initial development or even their creation (Azevedo et al., 2016; Steiner et al., 2013). Engelman and Fracasso (2013) highlight that university incubators are an important tool to accelerate the growth and success of new companies through managerial support, with services and resources. In addition, they must have infrastructure, training, human resources, and advice, offering specialized services to assist tenant companies in their activities. Incubators also aim to facilitate fundraising from development agencies or potential investors to accelerate the performance of companies originated in the university (Neves and Franco, 2019; Suzuki and Okamuro, 2016; Padilla-Meléndez et al., 2020).

Companies incubated within the university are generally called university spinoffs, which consist of companies that have emerged based on knowledge, skills or ideas that the founders (usually students or even teachers) have generated at the university (Heblich and Slavtchev, 2014). According to Pattnaik and Pandey (2016), to be considered a university spinoff, the company needs to bring together four major characteristics: the parent organization, whose innovation is coming out, must be a university or academic institution; the result that derives must be a separate legal entity, not an extension of a controlled body of the university; should explore the knowledge produced based on academic activities and must be geared towards the generation and commercialization of technology, distancing itself from a non-productive organization.

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In addition to the actions mentioned above, more punctually ones are also carried out such as consultancies, lectures, and events with partnerships outside the university, which foster networking and reinforce the entrepreneurship ecosystem. These actions consist of other forms of university-company-society engagement and are activities different from those that are formally registered in the contract or that take place via protocol processes (Fuller and Pickernell, 2018). All these activities support the emergence of ecosystems that foster entrepreneurship and innovation in the university environment.

2.2 University entrepreneurship and innovation ecosystems

According to several authors, there is still a gap in the literature regarding the conceptualization of innovation ecosystems (Koslosky et al., 2015; Barros and Paixão, 2021). Historically Moore (1993) was the first to use the term relating it to the idea of an economic community that, through the foundation of interactive organizations, acts cooperatively. Later, following this conception, Saxenian (1994) referred to regional innovation ecosystems as locations that act by transmitting and absorbing knowledge. Christensen and Rosenbloom (1995) expanded the idea to a commercial nest where each actor contributes with specific components to find a solution to a problem. Powell et al. (1999) added that research universities are very important for successful cluster formation as they contribute to the advancement of science and technology.

Ecosystems exist nationally, regionally and at the community level. Nevertheless from this millennium onwards, it is observed that there is an increasing interest in studying ecosystems especially related to universities (Morris et al., 2017). For Carvalho et al. (2010), universities have a crucial position in promoting ecosystems of innovation due to their collaboration with actors such as the government, business associations, entrepreneurs, NGOs, service providers, and incubators.

For Hayter (2016) the concept of university entrepreneurial ecosystem is associated with the action of university spinoffs and their impact in terms of networking, and providing resources and connections that lead to the success of the ecosystem. Therefore, the role of knowledge intermediaries, which include technology transfer offices (TTOs), incubators, science parks, university funding, angel investors, cooperative research centers, and industry consulting practices are essential.

Another definition is found in Yi & Uyarra (2018) which point to the academic entrepreneurial ecosystem as composed of multidimensional enterprises supporting the development of entrepreneurship through various initiatives related to teaching, research, and dissemination. For these authors, a set of academic entrepreneurial actors (for example, universities, research institutions, companies, venture capitalists) and factors (for example, university leadership, governance and entrepreneurial capacity, markets, support scenario, and so on), must coexist and interact through the entrepreneurial academic process.

Additionally, the concept of Triple Helix is also relevant to this topic. Etzkowitz and Zhou (2017) describes that the Triple Helix constitutes an innovation model in which the university/academy, industry and government, as primary institutional spheres, interact to promote development through innovation and entrepreneurship. Etzkowitz and Leydesdorff (2000) explain that the university has undergone a major transformation in its role for economic and social development. From the 19th century, the university incorporated research into its teaching mission. By the end of the Cold War, it advanced in its function, including economic development, generating new industries and companies.

In view of the relevance of knowledge in society for the generation of wealth, universities gained prominence, equivalent to government and industries, as observed by the regional development demonstrated by Stanford University and Massachusetts Institute of Technology, examples of Entrepreneurial Universities. In this way, university is relevant in playing a creative role in social and economic development, as it manages to understand the needs of citizens, government and industry (Etzkowitz and Zhou, 2017) In this way, university innovation and entrepreneurship

ecosystems rely on the relevant collaboration of entrepreneurial universities, which offer a critical contribution to the factors of production, which leverage social and economic development, while enabling the improvement of human capital, knowledge capital, and entrepreneurship capital (Guerrero et al., 2020; Chais et al., 2018). Additionally, Koslosky et al. (2015) highlight that the innovation ecosystem encompasses the notion that in this environment, businesses will be catalyzed, supported, and sustained, generating value, and impacting society by developing the interaction and flow of information between more diverse actors.

3. Methodological procedures

This research is considered qualitative and descriptive since it aims to explain the social phenomenon with the least possible distance from the natural environment in which takes place (Merriam, 2009). Thus, it was sought to understand the processes described by the agents from their singular interpretation in their social world (Godoi et al., 2006). In addition, it is an interpretative case study that investigates a contemporary phenomenon within its real-life context, to capture and understand the dynamics of an organization in its formal and informal established activities, obtaining a rich description of the phenomenon and developing conceptual categories that illustrate it (Godoi et al., 2006).

This research is qualitative in its assumption once the research participants and the phenomenon were understood from their perspectives (Bauer and Gaskell, 2002). The nature of the research is descriptive, since the researcher did not interfere with the facts, which were recorded, analyzed, classified, and interpreted (Raupp and Beuren, 2003). To maintain the validity of the construct in this research, according to the recommendations of Eisenhardt (1989), the triangulation of multiple sources of evidence (documents, interviews, non-participant observation) was adopted. To guarantee the reliability of the study, Yin's case study protocol (2009) was used, containing the procedures for collection in the research field, the study questions, and proposals, in addition to the guide for the final report. The data collected in the field, as well as memos and documentation, were gathered in a database and classified for analysis according to the guidelines for content analysis by Bardin (2011). The systematization of the analysis took place in the stages of pre-analysis, exploration of the material, and treatment of the data together with the interpretation.

For Yin (2009) the case study investigates a phenomenon in-depth, and the single case study is adequate when analyzing a representative and unique case of a phenomenon. Following this orientation, the choice for this university was due to its model of acting in university entrepreneurship that carries singularities about other private universities. As presented in a thesis defended in the yesteryear by Kaniak (2020), the case of PUCPR can be considered distinct since it represents the only private university in the state of Paraná that has an innovation agency and managed to create an innovation and entrepreneurship ecosystem in few years' time.

Data collection was carried out in the second half of 2019 at the Pontifical Catholic University of Paraná (PUCPR). Six people personally involved in the university's innovation and entrepreneurship ecosystem were interviewed, namely: the director of the innovation agency, the coordinator of the innovation agency, a professor, the entrepreneurial education coordinator, the founder and member of an incubated spinoff at the university and the coordinator of a company that has a partnership contract with the university's technology park. The interviews lasted an average of 40 min and were recorded with the interviewees' authorization and later transcribed. To guarantee the validity, each transcribed interview was submitted to each interviewee for them to review it and/or correct its content. A field diary was used by the researcher to record observations and all the researched documents were kept in a database for further analysis. All the data was organized and stored using the Nvivo software as a tool.

The analytical categories and elements used in the analysis were:

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Table 1 – Analytical Categories and Analysis Elements

Analytical Categories	Analysis Elements
University innovation and entrepreneurship ecosystem (Cai <i>et al.</i> , 2020; Guerrero <i>et al.</i> , 2020)	<ul style="list-style-type: none"> • History of the innovation agency • Infrastructure • Performance model
Entrepreneurial activities developed at the university (Heblich and Slavtchev, 2014; Siegel and Wright, 2015)	<ul style="list-style-type: none"> • Generation of intellectual property • Technology transfer processes • Generation of collaborative partnerships • Business incubation/spinoffs • Lectures and events • Support activities for entrepreneurial education

Source: the authors (2021)

4. Case presentation

The Pontifical Catholic University of Paraná - PUCPR - is part of the Marist Group, created in 1817 by Marcelino Champagnat, in France. The Marist Group operates in the areas of education and concentrates its activities throughout the country. The institution is a private Catholic non-profit university that was created on March 14, 1959, by Archbishop of Curitiba Dom Manuel da Silveira D’Elboux. The foundation brought together seven institutions, among which were the faculties of Philosophy, Law, and Medicine (PUCPR, 2021).

Currently, the university has 9 “Schools of Knowledge” with 50 undergraduate courses, 16 *stricto sensu* Postgraduate programs, 1650 professors, and 280 laboratories. The academic structure of PUCPR on the Curitiba campus is formed by 8 national and 1 international school. The administration of each School is managed by the Academic Council, the School Decanate, the Course Collegiate, and the Course Coordination. In addition to the Curitiba campus, the university currently has 3 other campuses: Londrina, Toledo, and Maringá (PUCPR, 2021).

PUCPR's innovation ecosystem, called Hotmilk, is responsible for generating knowledge, innovation, and technology, through research, with a structure of more than 200 laboratories and 240 researchers. The areas of expertise include research, development, and innovation (R & D + i), open innovation, accelerator, and incubator for the development of spinoffs. In terms of research, development, and innovation, the institution has a portfolio of projects developed in partnership with major institutions and companies such as Bosch, Renault, Volvo, Nokia, the Bill and Melinda Gates Foundation. The incubator/accelerator offers complete structure, mentoring with market professionals, connection with investors and laboratories for the creation of prototypes to support spinoffs in all stages of development. Between 2018 and 2020, 98 new companies were accelerated (Hotmilk, 2021).

Hotmilk is located within the university's Tecnoparque, a group of buildings dedicated to the development and sharing of new technologies in partnership with several companies. It was created in 2014 to foster entrepreneurship and offer an enabling environment for the exchange of knowledge and attracting partnerships and resources (Hotmilk, 2021). The team consists of 18 people, being a director, innovation and entrepreneurship coordinator, a project coordinator, a legal coordinator, some teachers, analysts and commercial brokers.

In addition, other entrepreneurial activities are developed jointly with Hotmilk in a building on the campus called “Entrepreneurship HUB”. This nucleus is focused on entrepreneurial education for university students who can learn and practice entrepreneurship from high school to graduate school (Hotmilk, 2021).

5. Results and analysis

In this section, the dynamics of PUCPR university innovation and entrepreneurship ecosystem will be described as well as the entrepreneurial activities that support it, and the analysis of the data obtained will be compared with the literature.

Historically, at the Pontifical Catholic University of Paraná there was a change in the name of the nucleus responsible for managing entrepreneurial activities, which went from ‘PUCPR innovation agency’ to ‘Hotmilk PUCPR innovation ecosystem’, as explained by E1, coordinator of Hotmilk:

Now we are “killing” the PUC agency innovation name and making it: Hotmilk innovation ecosystem. We want to work our brand for the market because a very strong concept has been created that is difficult to explain, we have the innovation park, the innovation agency, Hotmilk, there are many names, one doesn’t need that. We are PUC’s innovation ecosystem (E1).

The coordinator also describes that initially, in 2012, the activities of the PUCPR innovation agency were more focused on the generation of intellectual property and there was no incubator for the spinoffs, an activity that only appeared a few years later. The importance of intellectual protection activities that existed before the formal creation of innovation centers in universities was also pointed out by Castro and Souza (2012) who affirm that the application for patents had already been carried out by countless institutions before the introduction of the Law of Innovation. The Innovation Law, dated 2004, in Brazil, sought to promote partnerships between universities and companies and established the mandatory creation of Technological Innovation Centers in public research centers and high education institutions in the country (Paranhos et al., 2018).

Currently, at PUCPR, the generation of intellectual property takes place within each school of the university through research carried out by teachers and students. Schools are in constant contact with Hotmilk. As explained by E2, professor at the university, schools have their innovation programs:

Within the School of Medicine, which is the school I work at, we have a program called HIPUC. So, this program is about innovation in the health area that involves new technologies (E2).

Each program works by creating inventions that will possibly in turn, be forwarded to patent applications. E3, director of Hotmilk, points to the importance of transferring the technologies developed at the university:

Another challenge for us is to transform more and more research into business, to make the transfer. This is one of our focuses: maximizing the impact of research (E3).

For the aforementioned interviewee, technology transfer processes at universities must go beyond invention and patent application. He even makes a self-criticism about the number of patents generated versus the number of transfers or licenses to the market:

Today, as in any university, we have a zillion patents shelved, which no one buys, but we want to increasingly enhance this (E3).

A similar finding was also made in the study by Dias and Porto (2014), who claim that Brazilian universities tend to place a greater emphasis on the patent application and grant than on licensing, resulting in little value addition, in terms of innovation, for the market. However, although the fact that having more or fewer patents granted should not in itself constitute a factor of performance definition for entrepreneurial universities (Abreu and Grinevich, 2013), it is still an

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important indicator for obtaining good positions in university rankings, which perhaps explains this contrast.

Thus, E3 believes that an effective way to facilitate technology transfer is via spinoffs, as they are smaller and more agile companies and, therefore, tend to explore the commercial application of inventions more quickly. He exemplifies this issue by telling about an entrepreneur that was incubated at Hotmilk:

We have an example of a spinoff here that used one of our inventions commercially (...) In fact, of all the companies that came here, this was the one that expanded the fastest and received the most investments, it belongs to a professor of ours. They grew from 6 people to 49 in 1 year and a half. So, we want to see more examples like this inside here (E3).

The director's consideration is in line with Miranda et al. (2018) who affirm that, currently, universities have focused on the creation of university spinoffs as the main means of transferring technology arising from their activities.

On the other hand, E2, an interviewed professor, points to the difficulties that Brazilian universities face concerning the transfer of technology to established companies, due to cultural factors:

What is a big difference between Brazil and Silicon Valley, for example, is that I think that the companies here are very distant. If you invite a company to participate in an innovation project, they like the idea, they think it's wonderful, they even participate in the event, attend the lectures, send speakers ... but for them to invest money in the development of the project, then ask for the licensing of technology, no, they don't have this culture (E2).

Cultural barriers that interpose in the technology transfer processes in Brazil have also been pointed out in previous studies (Dias and Porto, 2014; Gonçalves and Tomaél, 2015; Volles et al., 2017). For these authors, the most cited aspects are: lack of a culture focused on socioeconomic entrepreneurship (Volles et al., 2017); companies withdraw from the partnership because of the high costs of research and the length of the process (Gonçalves and Tomaél, 2015); lack of an institutional university policy adequate to its role as an innovative agent (Dias and Porto, 2014).

Singh et al. (2020) also found, in a study related to the challenges faced by TTOs or NITs in Southern Brazil, that the main difficulty faced was linked to cultural aspects such as the lack of a culture that excels in the interaction between university-company and deficiencies in communication and dialogue with the market. However, differently from the results pointed out by the referred authors, in the specific case of PUCPR, analyzing the documents related to the strategies used to publicize their services to companies, it was observed that PUCPR innovation agency invests a lot in communication, having included a professional specialized in the field on the team. Perhaps this fact helps in the institution's proximity to the market. Another argument is that PUCPR being a private institution by its nature, may have greater agility in decision-making and communication issues if compared to the public high education institutions in the country.

Regarding the generation of collaborative partnerships, more specifically, all interviewees stressed that the university seeks to foster relationships that bring benefits to all involved. E1 explains that many companies initially approach only for the interest in attracting talent among students:

Many companies want to get close to us due to the issue of qualified labor, they want to find professionals for them among our students (E1).

It was exactly the case that started the partnership formed between PUCPR and a well-known company in the health services area. The company aimed to attract young people with talent and experience in spinoffs. E1 says that many partnerships start like this, with a company in search of talents, but then the partnership solidifies and encompasses other interests:

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Many opportunities come to us, and the catalyst is the companies' need for qualified labor (...) With this company, it was like that, and afterwards we suggested a cooperation term and started an open innovation program with them (E1).

The strategy punctuated by the interviewee is aligned with others found in the literature. In addition to the main objectives of the partnerships, there is a range of mechanisms that generate other kinds of collaboration, interaction, and cooperation and expand the initial objectives in other forms of benefits for institutions (Guerrero et al., 2014; Guerrero, et al., 2020; O'Kane et al., 2020). Still, according to Kruss and Visser (2017), the factors that lead a company to collaborate with the university are multiple. However, the authors argue that more innovative companies tend to be more interested in establishing collaborations of this nature, which precisely explains the intention of university's partner that was interviewed for this study.

For O'Kane et al. (2020) universities that favor the transfer of their knowledge to companies not only receive an increase in their reputation but also end up increasing the attractiveness and satisfaction among academics. In the program developed in partnership between PUCPR and the health services company, the objective was to select spinoffs to solve the company main problems. The spinoffs with the best ideas went through a period of immersion with mentors who were company's specialists. In the end, the best projects, from the best spinoffs, had the opportunity to be contracted by the company to implant the projects. E4, the company coordinator, explains in more detail how the process happened:

The spinoffs selected in the project received space on the Hotmilk accelerator to test, validate and improve their proposal for products and services, and further development. In the end, the three best solutions were awarded, and we made room for them to test their proposals here within our company (E4).

Hotmilk coordinator adds that he and his team have been making an effort to disseminate this type of partnership that he calls "corporate open innovation programs":

We are consolidating this type of programs (corporate open innovation). The idea is to take this agile work methodology, spinoff mentality, and this culture of innovation into large corporations that partners with us. Today we are doing a pilot program with this company, but we want to consolidate this model in a near future (...) I think this is something that we do well and brings a great benefit to those involved (E1).

Regarding the incubation of companies, PUCPR has a spinoff incubator/accelerator that started in 2014. The director explains that today the incubation and acceleration of spinoffs is one of the main activities they perform:

We were able to create good programs and bring spinoffs, understand the stages of maturity of the spinoffs, and which methodology we need to give to support them and how to foster the networking of these companies into the ecosystem (...) another feature we have, is that the spinoffs can be a resident here, in the campus or outside, we have both of them (E3).

According to Noronha et al. (2014), there are two classifications for university spinoffs. Resident companies are those that occupy the infrastructure of the incubator or the university, developing their activities internally. Non-resident companies do not occupy physical space but receive the same advantages as residents in terms of managerial, financial, and technical support. In addition, the author points out that incubated companies often go through three incubation stages: pre-incubation, incubation, and post-incubation. Within this concept, the PUCPR incubator encompasses both types of incubation (residents and non-residents) and owns projects aiming at forming companies in the three mentioned incubation stages.

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In addition, to support the management and provision of infrastructure, the coordinator interviewed points out that PUCPR main differential is to bridge the gap between spinoffs and investment funds. He states that the main objective of the contract between the university and the spinoffs is to facilitate their approach with investors, as explained by E1:

The purpose of the contract with us (university) is for us to be agents for attracting investments for them (spinoffs). They are in here, we are looking for investment funds. When the spinoff is at the correct maturity stage we connect them to funds or angel investors and if they establish a contract, the university keep a part of it (E1).

PUCPR's strategy of bringing incubated spinoffs closer to investors is widely defended by several authors. Many postulate that the universities should prioritize access to investments as an essential factor for the growth of the spinoff (Wright, 2006; Suzuki and Okamuro, 2017; Neves and Franco, 2019). Hotmilk promotes this model and according to E1 the incomes from the successful agreements between spinoffs and investment funds are very lucrative. The university gets a percentage of the value of the agreement and invest in other startups at the initial stage, forming a virtuous cycle which ends up being a good deal for the three parties.

In addition to these eventual payments, the university also receives a monthly amount paid by the spinoffs to use the space and other benefits received. For interviewee E5, founder of one of the spinoffs interviewed, the monthly amount paid to the university is considered a good investment once it gives him the networking that he needs to boost the company:

We started the spinoff in the incubation program, went through the levels and now we are in the Hotmilk acceleration program, which has a monthly cost but it is worth it for network (...) With their help I was able to talk to the director of Ifood, for example, he is the man who merged Itaú with Unibanco. So, these guys have experience, have a different world view of business, which I would not have access otherwise. So I think the connections that Hotmilk provides are excellent for us (E5).

The importance of the connections and networking enabled by universities is wide debated in the literature. Many of them highlights that the contact with researchers and experienced professionals to exchange knowledge, learning, and social capital is an important differential to university spinoff companies (Heblich and Slavtchev, 2014; Hayter and Cahoy, 2016; Eveleens et al., 2017). In this case, in addition to the networking approach with other entrepreneurs provided by the university, E1 adds that PUCPR also provides mentoring to its incubated business with professionals from the market and not only with academical professors. They also bring them for workshops and brainstorm sessions to be in contact with the students and the incubates entrepreneurs.

Abreu and Grinevich (2013), affirm that bringing speakers from companies and facilitating their dialogue with academics generates, above all, prestige and influence to their universities and ends up attracting a greater number of strategic partnerships. In addition, Galán-Muros et al. (2017) argue that giving industry lectures at the university generates a series of advantages for students' learning and approaching new partners.

At PUCPR, a good number of the spinoffs incubated at the university started their ideas in entrepreneurial education programs that are aimed at developing entrepreneurship in students. The coordinator of the Entrepreneurship Hub, E6, highlights the importance of this work. He believes that the entrepreneurial vision must be awakened from the beginning of school life, because even if the student do not become an entrepreneur, he might be a future professional or manager of a company that will have a greater openness to boost entrepreneurship.

The actions carried out by the Entrepreneurship Hub are divided into three categories: awareness, training, and execution, as explained by the aforementioned coordinator E6:

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The first category is awareness-raising, which consists of lectures and workshops. The second is training, such as disciplines, longer courses, training projects. The third is our main execution program: Spinoff Garage, which lasts 1 semester, and PIBEP, which lasts 2 semesters. This is the time for the students get their hands dirty (...) After that, if the student really wants to enterprise, he can go to the Hotmilk accelerator and be incubated and accelerated (E6).

PUCPR's approach is in line with the ones defended by several authors who point out that universities and schools should implement entrepreneurial education programs and offer entrepreneurship courses at different educational levels and for different target participants (Abou-Warda, 2016; Kakouris and Georgiadis, 2016; Paiva et al, 2019; Hashimoto and Fonseca Jr., 2018). Similar to PUCPR case, Nyadu-Addo and Mensah (2018) and Kummitha and Majumdar (2015) also described entrepreneurial education programs that work the entrepreneurship issue among students and end up allowing the companies' incubation at the university, usually for best projects selected in the programs.

In addition, PUCPR strives to develop practical activities in its training, such as workshops and technical visits. Workshops take place within the partner companies and bring students closer to their reality. E6 mentioned the program called Spinoff Garage in which students are trained in their first mini companies. In this program, they can test their ideas, improve their performance, and ask questions to experts. "We try our best to make the students participating in the program experience which is like creating a company in practice" reports E6. These actions are in line with what describe Hashimoto and Fonseca Jr. (2018) that point out that educational institutions should be concerned with the instruction of students beyond the concepts of entrepreneurship, seeking experiences and learning inside and outside the classroom, in order to increase the chances of success of the future entrepreneur.

And it is precisely this practical approach that ends up creating some difficulties according to the same interviewed. E6 points out that the courses and programs developed by the Entrepreneurship Hub have a more practical focus which often clashes with the mentality of some teachers who have a more theoretical focus. Nevertheless, a practical approach in pedagogical activities for entrepreneurship is defended by countless authors as being the most effective (Abou-Warda, 2016; Kakouris and Georgiadis, 2016; Fayolle, 2010; Hasan, Khan and Nabi, 2017; Miller and Acs, 2017). These authors highlight the importance of experiential entrepreneurial activities with students as being more encouraging and impressing for their formation.

In order to carry out a comparative analysis, even if summarized, a successful case study of entrepreneurial ecosystems developed by a university was found, the Lancaster University case. Pugh et al. (2019) bring examples of programs developed over 20 years to support the entrepreneurial ecosystem in the North West of England. There were three successful projects highlighted:

- a) Program for small businesses - developed in partnership with other organizations and universities in the region, promoting individual and peer learning;
- b) Incubation for startups - supported by several universities, to offer support such as accommodation, training, mentoring and financing, as well as training for network learning;
- c) Program for regional learning - to generate jobs and economic growth outside the big centers. It was developed by the University of Lancaster, in partnership with governmental organizations and 42 universities, 19 Chambers of Commerce and 17 Local Business Partnerships, as well a wider network of public and private partners, which offered a range of business support. A relevant aspect of the program was to develop an approach that would allow activities to be tailored specifically to the local context and the needs of local businesses. Moreover, by bringing different actors into a common environment, with the university as a neutral intermediary, the program provided a collective 'voice' for the formulation of policies.

This is the case of a university that has progressively and comprehensively developed initiatives for entrepreneurial learning. It provided a space for individual and collective learning, bringing interaction and reflection on the daily practices of entrepreneurs. It also promoted learning from and with others to facilitate overcoming challenges and sustained business growth. When comparing with PUCPR case, insights emerge. Both cases provided spaces for exchanging knowledge to improve ideas and businesses. However, Lancaster University developed programs for small businesses and partnerships with the government and other universities. These points can bring observations for PUCPR and the Brazilian context. For small businesses, the Brazilian Micro and Small Business Support Service (Sebrae) has proven to be a relevant player in the development of knowledge about entrepreneurship and it works nationwide. And the government presents bureaucratic barriers to partnerships, especially with private entities. Anyway, successful models are important to bring reflections and possibilities for improvement, especially when looking for inspirations for constructive partnerships.

To conclude, once analyzed the elements related to the innovation ecosystem of PUCPR, as well as the testimony of several of the actors connected to it and the documentation available, it was verified that the university managed to build an innovation and entrepreneurship ecosystem in five years' time. Though the period of 2014-2019 the institution was able to:

- a) Generate a system that works as a co-innovation network;
- b) Exchange efforts and knowledge production between the several actors of the system;
- c) Generate the creation of wealth and shared values;
- d) Obtain a prominent role in local development, impacting the regional ecosystem in which they function as both creator and member.

Another relevant aspect to highlight is the importance they deposit in having a structured department specialized in entrepreneurial education. This seems to be the basis that give support to all the entrepreneurial and innovative activities they develop in more advanced stages. The Entrepreneurship Hub, as they, named it, is responsible for planting the seeds of entrepreneurship in the students since their technical high school courses available in the institution until their graduates and pos-graduates. Finally, it could be attested that there were favorable institutional conditions that were, and still are, essential for the creation and maintenance of the university ecosystem.

6. Final considerations

This article aimed to describe a case study of a university entrepreneurship ecosystem, located in Southern Brazil. A review of the literature in the area demonstrates that there is still a gap regarding the concept of university innovation and entrepreneurship ecosystems, as well as the description of cases of such universities. Therefore, this article sought to contribute theoretically to the debate by presenting the case of PUCPR's innovation and entrepreneurship ecosystem, as well as its dynamics. In addition, it was demonstrated how the studied university managed to evolve from a strategy primarily focused on developing intellectual property until it became a nucleus with complex actions that intertwine with the economic, social, and educational demands in its surroundings.

The analysis supports the conclusion that the referred university managed to reach a position of innovation and entrepreneurship ecosystem in few years' time once they invested in favorable institutional conditions for entrepreneurship, reinforced their innovation agency and prioritize a structured department of entrepreneurship education that gives incentives and the primary basis to future entrepreneurs that emerge in the university.

It is concluded that a university innovation and entrepreneurship ecosystem can be built in an environment that invests in integrated educational programs and infrastructure for their entrepreneurial activities such as: incubators, accelerators, technology parks, innovation agencies as well as a set of university favorable regulations. In addition, elements that strengthen the culture of

entrepreneurship, promotes a shared perception that partnerships are beneficial for everyone, and incentives networking and value creation possibilities are undoubtedly important.

Once the empirical results obtained demonstrated how a university can mature its entrepreneurial activities to reach the level of university innovation and entrepreneurship ecosystem in few times it is believed that this paper may serve as inspiration for other Brazilian universities that are looking for taking this path and that could take the case described as a model in some way.

As limitations of this work, it is presented the fact that the research strategy was based on a single case study that does not allow its conclusions to be generalized to other cases or other university institutions. To overcome this limitation, it is suggested that future studies use multiple cases to allow analytical generalizations and comparisons with other cases. Another suggestion is a study including the differences between ecosystems formed by public and private universities aiming to find the more favorable and the more challenging aspects they faced in creation and development.

7 References

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