

**EDUCATING TO ENTREPRENEUR AND INNOVATE: THE EXPERIENCE OF AN  
ACADEMIC HACKATHON**

**EDUCAR PARA EMPREENDER E INOVAR: A EXPERIÊNCIA DE UM HACKATHON  
ACADÊMICO**

**EDUCAR PARA EMPRENDER E INNOVAR: LA EXPERIENCIA DE UN  
HACKATHON ACADÉMICO**



Frederico PIFANO DE REZENDE<sup>1</sup>  
e-mail: fredpifano@gmail.com



Afsaneh HAMEDİ D'ESCOFFIER<sup>2</sup>  
e-mail: afsanehamedi@gmail.com



Marco BRAGA<sup>3</sup>  
e-mail: marcobraga@namelab.education

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**Deputy Executive Editor:** Prof. Dr. José Anderson Santos Cruz

<sup>1</sup> Federal Institute of Espírito Santo (IFES) and Federal Center for Technological Education (CEFET-RJ), Rio de Janeiro – RJ – Brazil. Professor of the Production Engineering Course and PhD candidate in Production and Systems Engineering.

<sup>2</sup> Oswaldo Cruz Foundation (FIOCRUZ), Rio de Janeiro – RJ – Brazil. Researcher. Post-Doctorate (Federal Center for Technological Education - RJ).

<sup>3</sup> Federal Center for Technological Education (CEFET-RJ), Rio de Janeiro – RJ – Brazil. Professor of the Postgraduate Program in Production and Systems Engineering and the Postgraduate Program in Science, Technology and Society. Post-Doctorate (University of California Berkeley: Berkeley, CA, US).

**ABSTRACT:** The present study investigated an academic hackathon and how universities can promote entrepreneurship beyond the academic experience, considering the perceptions of students who decided to create a startup. The research, of a qualitative nature, focused on the event promoted by Texas A&M University (USA), with participants from COPPE/UFRJ and CEFET-RJ. Data collection was carried out through semi-structured interviews and focus groups. It was observed that the entrepreneurial initiative was motivated by the experience gained during the event, as the university did not offer education in entrepreneurship nor support for the group's entrepreneurial endeavors. It was also found that hackathons stimulate innovation but are insufficient in fostering entrepreneurship. Therefore, a Startup Development Program is proposed to assist universities in innovation by building support structures for students beyond the events. This program aims to strengthen education for entrepreneurship and innovation, providing students with the necessary resources to embark on entrepreneurial ventures.

**KEYWORDS:** Education. Entrepreneurship. Innovation. Hackathon. Engineering.

**RESUMO:** O presente trabalho estudou um hackathon acadêmico e como as universidades podem promover o empreendedorismo que transcenda a experiência acadêmica, considerando a percepção de estudantes que decidiram criar uma startup. Pesquisa de natureza qualitativa, teve como campo o evento promovido pela Universidade Texas A&M (EUA), com componentes da COPPE/UFRJ e do CEFET-RJ. A coleta de dados aconteceu por meio de entrevistas semiestruturadas e grupos focais. Percebeu-se que a iniciativa empreendedora foi motivada pela experiência vivida no evento, uma vez que a universidade não ofereceu educação para o empreendedorismo e nem suporte à iniciativa de empreender do grupo. Constatou-se que hackathons estimulam a inovação, mas são insuficientes no fomento ao empreendedorismo. Propõe-se um Programa de Desenvolvimento de Startups para que as universidades auxiliem o processo de inovação, construindo estruturas de apoio para estudantes em etapas posteriores aos eventos, fortalecendo uma formação que contemple o educar para empreender e inovar.

**PALAVRAS-CHAVE:** Educação. Empreendedorismo. Inovação. Hackathon. Engenharia.

**RESUMEN:** El estudio investigó un hackathon académico y cómo las universidades pueden promover el emprendimiento que trascienda la experiencia académica, considerando las percepciones de los estudiantes que decidieron crear una startup. De naturaleza cualitativa, se centró en el evento promovido por la Universidad Texas A&M (EEUU), con participantes de COPPE/UFRJ y CEFET-RJ. La recolección de datos se llevó a cabo a través de entrevistas semiestructuradas y grupos focales. La iniciativa emprendedora fue motivada por la experiencia adquirida durante el evento, la universidad no ofrecía educación en emprendimiento ni apoyo para los esfuerzos emprendedores del grupo. Se encontró que los hackathons estimulan la innovación, pero son insuficientes para fomentar el emprendimiento. Se propone un Programa de Desarrollo de Startups para ayudar a las universidades en el proceso de innovación. Este programa tiene como objetivo fortalecer la educación para el emprendimiento y la innovación, proporcionando los recursos necesarios para embarcarse en empresas emprendedoras.

**PALABRAS CLAVE:** Educación. Emprendimiento. Innovación. Hackathon. Ingeniería.

## Introduction

Academic hackathons are events that aim to spark interest and develop skills in the area of innovation and entrepreneurship. The Engineering department at *Texas A&M University* (TAMU), in the United States (USA), created an experiential learning event to develop an entrepreneurial and innovative mindset in engineering students (Boehm, 2020). Called “*Aggies*”, the events last 48 hours and aim to create a structured, intensive and innovative design experience. During this period of time, students are grouped, receive a type of needs to be problematized, define a problem, create and prototype a solution, presenting their projects in a *Pitch format presentation* to a panel of judges from companies and other institutions.

In 2018, TAMU expanded this event on a global scale, inviting universities from all continents to participate in the initiative. A new modality of the event then emerged, called “*Invent for the Planet*” (IFTP), based on the model of the already existing “*Aggies Invent*”. The IFTP aims to challenge students from different parts of the world to find solutions to problems provided by international institutions, as well as the United Nations Sustainable Development Goals (UN Brazil, 2022).

In 2019, Brazil began to regularly participate in the IFTP with 40 students involved, divided into six competing teams. These students come from COOPPE/UFRJ and CEFET-RJ. These institutions provided the organizers and mentors for the Brazilian edition of the IFTP. Three teams were awarded, with emphasis on the team called Tupan, which won the Brazilian stage of the event. The team developed an accessibility project, consisting of two low-cost artifacts that allowed visually impaired people (of varying levels) to be guided in their daily commute, seeking to improve their quality of life. The first artifact developed was a cap with sensors that allow the identification of obstacles in front of the user. The other was a sensor (*Wii Remote*) that, when pointed at directions on the ground, allowed the detection of holes and obstacles, serving as a Walking Aid Device (DAM), or in the popular sense, an electronic cane.

As a reward for the first place obtained, the Tupan team was invited to participate in the IFTP world final that took place at TAMU headquarters. Competing with teams from four other countries, the Tupan team became champions of the 2019 edition of the IFTP, receiving a prize of 5000 dollars. Upon returning to Brazil, the now champions of an International *Hackathon*, enthusiastic and with social and altruistic purposes, decided to create a business initiative with the same name as the team. The *startup* appears Tupan, who would develop and commercialize the developed product. In 2020, they expanded their concept into an accessibility solutions company.

IFTP is not the only academic *Hackathon* out there. On the contrary, initiatives of this kind are offered and developed in various types of educational institutions and at different educational levels. Every year, several teams present excellent solutions to the proposed problems, but few students continue their innovations and effectively establish a startup derived from these *hackathons*. The perception is that these events, although successful in awakening innovation skills, fail to make students have the willingness to take action to undertake. The transformation of the Tupan group into *a startup* was an unprecedented experience for the organizing institutions.

Therefore, this research is based on the following question: based on the perception of students participating in *hackathons*, how can universities promote entrepreneurship that transcends the academic experience?

Using the success case of the Tupan group, we sought indications regarding the entrepreneurial potential of these students and the role of the university in promoting entrepreneurial professionals and, thus, starting to educate to innovate and undertake. With this knowledge in hand, it will be possible to outline strategies so that the university is able to stimulate the acquisition of skills so that students can progress with their innovative ideas.

## **Theoretical Reference**

### **Entrepreneurship and its importance in society**

After all, what is entrepreneurship? The volume of research and publications over the last 20 years (Sreenivasan; Suresh, 2023) has brought advances in understanding the topic, especially applied to education. Entrecomp, the European reference framework for skills for entrepreneurship, used the definition used by the Danish Entrepreneurship Foundation and defined entrepreneurship as “action on opportunities and ideas and their transformation into value for others. The value that is created can be financial, cultural or social” (Mccallum *et al.*, 2018, p. 8, our translation).

It is worth noting that entrepreneurship, as these authors discuss, is not restricted in scope to opening businesses and companies. In the current understanding, value creation takes the leading role. Entrepreneurship researchers-professors in the USA corroborate European thinking by saying that “[...] entrepreneurship is a way of thinking, acting and being that combines the ability to find or create new opportunities with the courage to act on them” (Neck; Neck; Murray, 2020, our translation).

The concepts presented point to the connection between entrepreneurial activity and the construction of opportunities for the future in a society permeated by local and global challenges. Population growth, for example, generates more and new demands for products and services, which must be overcome, whether by public authorities or civil society. In turn, the economic sector is increasingly dynamic, changing paradigms and making people have to innovate, even to guarantee their livelihood in the face of constant changes in the world of work.

Entrepreneurship is one of the aspects that most influence the economy and, consequently, society. For Schumpeter (1994), it is the desire and potential to convert a new idea into a successful innovation, change the economy and introduce new products or services to the market. It should be noted that there is a big difference between being a businessman and being an entrepreneur. An entrepreneur is characterized as the owner of a business that generates profits. On the other hand, the entrepreneur carries out projects, discovers opportunities and creates innovative solutions, without fear of taking risks. Therefore, the second requires a much larger set of skills than the first (Schumpeter, 1994).

In this sense, innovation is closely related to entrepreneurship, as it contributes to the success of the enterprise. Entrepreneurs, like innovators, are not satisfied with just one solution to a need. They keep coming up with ideas until they come up with multiple solutions. Innovation is the foundation of entrepreneurship and competitive advantage. This innovation does not need to be associated with technology, here understood as the way in which entrepreneurs explore change as an opportunity for a different business or service. This is a competency that refers to proficiency in performance and can be improved through practice and training, therefore, it can be learned (Drucker, 1993).

### **Entrepreneurship Education**

Entrepreneurial behavior depends on the motivation to achieve goals and the skills needed to achieve them. Competencies have been extensively studied (Mitchelmore; Rowley, 2010), and are characterized by the ability to take risks, self-determination, communication, initiative, leadership, innovative thinking, among others (Robles; Zárrega-Rodríguez, 2015). Drucker (1993) states that: “Entrepreneurship is no magic, it is no mystery and it has nothing to do with genes. It's a discipline. And, like any other discipline, it can be learned.” Therefore, it is clear that entrepreneurship skills are available to everyone and it is likely that there is an entrepreneurship education capable of stimulating the creation of an entrepreneurial culture.

Studies show that traditional methods, such as readings, exams, etc., do not activate entrepreneurship (Gibb, 2002; Sogunro, 2004), and may even inhibit the development of these skills (Kirby, 2004). Therefore, education for entrepreneurship must be based on skills-based learning, in a controlled environment, aimed at experiential learning in real contexts or business simulations, associated with social practices (García *et al.*, 2017), being an integration of knowledge, skills, and experience.

Although studies on pedagogical interventions are still recent (Sreenivasan; Suresh, 2023), entrepreneurial education usually takes place according to three main approaches: teaching “about” entrepreneurship – theoretical and content-based, aiming at a general understanding of the subject, “for” entrepreneurship – providing introductory, professionally oriented and “through” entrepreneurship knowledge and skills – students go through a real, transdisciplinary, entrepreneurial learning process where characteristics, processes and experiences are connected to the core discipline (Lackéus, 2015). These approaches are also identified as the “supply” model (behaviorist, focused on the transmission and reproduction of knowledge), “demand” (subjectivist, through exploration, discussion and experimentation) and the “competence” model (interactionist theory, with the active problem solving in real-life situations) (Nabi *et al.*, 2017).

Higher education plays an important role in creating the foundations for the development of entrepreneurial skills, being of great importance for sustainable development, especially in developing countries. American and Japanese universities, for example, set goals for entrepreneurial education, cultivating the entrepreneurial spirit and assisting in academic development through multidisciplinary combinations, using the “through” approach. However, in most higher education institutions, they are restricted to the “about” approach, with great variation in content (Mwasalwiba, 2010).

Even universities that use a “through” approach pedagogy, for the most part, still view entrepreneurship as a business curriculum. Therefore, it is offered within certain areas, such as Administration, Marketing or Finance courses. In other courses, entrepreneurship content is articulated in other disciplines, focusing on the “for” approach. Harfst (2010) had already addressed the issue. Even with a growing number of universities offering entrepreneurship courses and programs, this situation has not changed. Although there are gaps in research related to which specific courses entrepreneurship is taught and what the curriculum model is, these programs continue to be offered primarily in business courses and more recently in Engineering (Ridley *et al.*, 2017). This fact may be a reflection of the students’ intentions. Statistics show

that the majority of those who choose to start their businesses come from Economics, Business or Marketing courses, although 85% of high school students demonstrate entrepreneurial intentions (Cheng *et al.*, 2018).

### **Academic Hackathons and IFTP**

The term *hackathon* emerged in 1999 by open-source software developers, from the words “*Hacking*” (programming) and “*Marathon*” (Briscoe; Mulligan, 2014). Therefore, for many years, this type of event was exclusive to the software area. Over the years, the experience was generalized to different areas.

Academic *hackathons* are events that take place in educational institutions, such as schools and universities, with the aim of promoting innovation, creativity and collaboration among students. They offer opportunities for participants to develop practical solutions to academic challenges and explore new areas of knowledge (Gama, Alencar Gonçalves, Alessio, 2018). During these events, students work in multidisciplinary teams to solve problems in a limited period of time. Depending on the theme of the event, they may focus on specific areas.

Academic hackathons are designed to allow students to develop skills such as critical thinking, problem solving, and teamwork. Furthermore, they encourage creativity and innovation, encouraging them to think beyond established paradigms and seek unique (innovative) solutions.

According to Warner and Guo (2017), the greatest motivation of students participating in academic *hackathons* for the first time is related to social aspects, and for others, the search for technical knowledge is the motivational factor.

The IFTP studied here is an academic *hackathon model* with a dynamic based on SPRINTS (Schwaber, Sutherland, 2020), which are periods of work with time-limited deliveries (status review), to create consistency, inspect and adapt how the work is done and what is being worked on. SPRINTS are a fundamental part of the SCRUM methodology (Sutherland, Sutherland, 2014), as they allow the team to work in a focused way and deliver value incrementally, ensuring constant feedback and allowing continuous adjustments in product planning and development. To support SPRINTS, some mentors are invited and interact with the teams discussing the direction of the project, but without providing pre-conceived answers or solutions (Boehm, 2020).

## Methodology

### Study object

The object of study consisted of an academic *hackathon* developed by the Engineering and Entrepreneurship Program at the *University of Texas A&M* (EEP/TAMU), lasting 48 hours involving universities from different countries. The *hackathon* took place in two stages. The first at the headquarters of the participating universities and the second at TAMU, where the winning projects are taken to the final.

The winning group of the Brazilian and International stage in 2019 was made up of members from two institutions that are Brazilian references in education, based in the State of Rio de Janeiro, the Tupan team was formed by five students from the Celso Federal Center for Technological Education Suckow da Fonseca (CEFET/RJ) and a student from the Federal University of Rio de Janeiro (UFRJ). Of the six students, all engineering, four were undergraduates and two were postgraduates. After the team's victory in the IFTP, four members created the startup Tupan with the aim of continuing the entrepreneurial possibilities. Participation in the research was voluntary.

### Data collection

The data were obtained in two distinct phases, which involved, as a collection instrument, participant observation (during the IFTP), carrying out semi-structured interviews individually with the members of the Tupan group who participated in the IFTP and, finally, carrying out of focus groups.

The first phase of the research was participant observation, where researchers were directly involved as the object of study (Mack *et al.*, 2005). It took place during the month of March 2019. It was possible to see throughout the 48 hours of activities that the Tupan group stood out from the others due to their skills with electronic components and the empathetic way they dealt with the problem chosen to solve: accessibility and transportation for the blind.

Winners of the Brazilian edition, there was no indication that the solution would be taken forward in the form of research or commercially, it was just the satisfaction of winning a competition.

The victory at the international IFTP occurred in April 2019, and it was from that moment on that the students began to realize that they had something bigger in their hands than just a championship title. Still in the USA, the Tupan group was invited to present its innovation



to a startup incubator. The incubator offered to purchase the patent for the devices created. The students understood that there was marketing and financial potential in the solution offered, so they refused to sell the patent and decided, upon returning to Brazil, to create Tupan as a Startup selling the devices developed (Figure 1).

**Figure 1** – Devices developed by the Tupan group



Source: Startup Tupan Components

The second phase of data collection was carried out in two stages, between September and October 2021 and January 2023. This time gap is justified, as during the second half of 2019 there was no information about the development of the startup and the pandemic resulting from COVID-19, in 2020, paralyzed research activities and possible contacts with students. During this phase, using the digital platforms *Google Meet* and *Zoom*, semi-structured interviews were carried out with the aim of getting to know the students better and their trajectories and focus groups (Morgan, 1997) were carried out to triangulate the young people's opinions, impressions and vision of the future entrepreneurs. The use of this methodology aimed to obtain a collective mental reconstruction of the process they went through.

Three questions were the basis for the investigation:

- What motivations led the team to undertake?
- What type of support did they receive from the university (funding, mentoring, costs, etc.)?
- What entrepreneurship training did you have at university?

The script for the focus groups and semi-structured interviews was divided into three moments related to the experiences at the IFTP event (before, during and after the event).

## Data analysis

Initially, during participant observation, the research was only exploratory in nature. With the interviews and focus groups, the recorded reports were analyzed in a qualitative approach (Morgan, 1997), using a methodology inspired by content analysis, aiming to obtain indicators (quantitative or not) that allowed the inference of knowledge related to production conditions /reception (inferred variables) of these messages (Bardin, 1977). From this action, the information was written into analysis categories.

## Results

Using the same script established for the interviews and focus groups, the results will be presented in three blocks – “*team report, context, prognosis*”.

## Team Report

Participants reported that they had no experience in entrepreneurship or similar activities. During their university education, they were focused on the technical aspects of the courses. Technical skills (Hard Skills) have always been the biggest attraction for students, as they believed that this guaranteed them greater employability after graduation.

Participation in the IFTP was encouraged by its teachers, with no initial interest on the part of the students. At first, they believed that they would participate in some type of training activity in which their technical skills would be required. The entrepreneurial perspective or the creation of a startup never crossed their minds, although the topic of entrepreneurship aroused some curiosity. In essence, they attended the event out of consideration for the teachers. Therefore, there was no contact with entrepreneurial or innovation training during the course.

*[...] I participated out of consideration for professor “A”, he asked for support and I went because I thought it would be useful for my CV [...] (graduate 1, our translation);*

*[...] I never thought about having a business, being an entrepreneur, I always looked for a job where I could put my skills into practice [...] (postgraduate student 1, our translation).*

Engineering courses maintain a traditional profile, in their opinion. According to the students, only two subjects were closer to the issue of entrepreneurship, much more focused on content (reading, classes) than practical knowledge, as described below:

*[...] the “E” subject, which covered entrepreneurship, explained a little about the law, how companies and some bureaucracies work, etc... and the other subject was very focused on what is happening in the world today in day, industry 5.0, internet 5.0, the internet of things. The teachers are good, but they don't know the practice [...] (graduate 1, our translation).*

It was found, in this block, that the students, although very technically competent, had no previous history with subjects such as marketing, pricing, management of financial or human resources. This was not the focus of the course, nor of their attention. It is also noted that in its formation the subject of entrepreneurship was a concept, not an experience, with information relatively distant from the dynamics of the companies that operate the market.

## Context

There were ten themes of global social demand, suggested by partner organizations and inspired by the sustainable development objectives of the United Nations (UN Brazil, 2022) for the group to choose from in the IFTP. The choice for the theme “Increased quality of life” was due to the fact that the mother of one of the members works with disabled children. Aiming to improve the quality of life of a specific audience, they chose to search for solutions that would make life easier for people with visual impairments, helping with travel, without giving up independence and removing the stigma of the traditional cane. The perspective was always altruistic, the focus was on producing something to help people in need, not commercialization. During the interviews, it was noticed that there was a desire to produce something that would reach the defined audience, without any notion of the role of entrepreneurship in the process. It was a solution and nothing more.

*[...] our prototype was not to cure blindness, but to improve the quality of life of these people (graduate 2, our translation).*

The idea for creating the product came from the team members' ability to use sensors. The prototype was tested with a member of the group using a blindfold. They realized that it was relatively easy to use the prototype under development.

The victory in the Brazilian edition of IFTP signaled the usefulness and practicality of the product. Confident in the quality of the project, the group took advantage of the one month before traveling to the world stage to improve the prototype, making it more efficient and

visually more attractive. They also tested the prototype with an effectively blind person, to validate the proposal.

Competing with four countries, the Tupan team became the international winner of the event. Despite their confidence in the project, they never imagined having a product capable of winning the International IFTP, reporting:

*We are immensely happy to see the disabled person satisfied with our equipment, which we produced in such a short time. We only managed it because the event was well organized [...] (graduate 3, our translation).*

*We never thought about winning the award in the United States. The guys there are super prepared. Winning here was already very good (postgraduate student 2, our translation).*

A relevant fact observed in the Brazilian edition was that, when chosen to participate in the final phase of the event, the team did not have financial support for the trip to the USA, and the organizing universities were not in a position to offer support, even with the media visibility generated by the victory in the regional section. The Tupan group was interviewed in newspapers and widely circulated channels in Brazil, in addition to gaining many followers on social media. A first entrepreneurial challenge arose, finding resources for the trip to the USA. The anxiety to be able to go to the final was demonstrated in the speech:

*If we can't go..., we won't make it [...], we have to show up anyway, and we have to make them see us (postgraduate student 2, our translation).*

After discussions and suggestions, the team decided to create a campaign on social media (known in Brazil as the electronic kitty) to raise contributions for the trip. They were successful in the campaign.

In the USA, shortly after the winners were announced in the final stage, a researcher external to the event invited the group to a meeting with professionals specializing in patents from TAMU. The objective was to guide the commercialization of the product on a larger scale, mainly with regard to the patent. It is important to note that, at this point, the IFTP organization no longer had any influence on the process. At this meeting, the team received a proposal of US\$10,000.00 to file the patent in the USA and for the product to be developed in partnership with TAMU university.

Given the difficulties evident in the process of requesting patent filing by foreigners, and the costs involved, they rejected the proposal. It should be noted here that the Tupan group had no experience on the subject, nor did they have support in understanding this process. They reported in the focus group that, with appropriate guidance, selling the patent could be an

interesting possibility, but they only managed to understand this after a year and a half of the startup.

Realizing the interest in the prototype, they decided to file the patent in Brazil and develop the product nationally. Enthusiasm and hope were the keynote of the new entrepreneurial engineers.

## Prognosis

On the trip back to Brazil, still on the plane, the team met a businessman from the communications sector. Interested in the project, he proposed a partnership to create the startup. This businessman helped them with bureaucratic issues to create the startup, in addition to looking for other companies willing to invest financial capital in the project. The group experienced yet another challenge: there were no companies or development organizations willing to invest money in the project (Venture Capital). Thus, the only investment for the creation of the startup and production of the equipment came from the cash prize won at IFTP Internacional. It is possible to interpret this investment as equity, as many Brazilian enthusiasts do.

Despite the creation of the startup, the team was unsure about this venture, the excitement about the success of the prototype was what drove them:

*Until that moment we had no idea, no vision of the future, like, yeah, can we do something more than that, at the moment our minds were only on making the prototype [...] (undergraduate 1, our translation).*

As an alternative, they sought out the CEFET/RJ technology-based business incubator. However, they realized that this incubator did not have an acceleration program, nor did it offer business management training. They were offered space and information on how to seek funding through government funding agencies. In their understanding, the incubator did not mean any effective difference.

Right at the beginning of their activities, the members of the Tupan team realized that they did not receive training or knowledge at university that would prepare them for the business environment, for the world of work, as entrepreneurs. They knew engineering tools and techniques, but were unaware of management or business modeling aspects. One of the students interviewed could not remember any course related to the topic of entrepreneurship:

*If I had it, it wasn't relevant at the time (graduate 2, our translation).*

This record demonstrates that the subject was not specifically addressed during graduation. According to the speech of one of the students, it is clear that the experience at the event stimulated entrepreneurial thinking, making them look beyond what traditional degrees can offer:

*It's not worth going to college just to get a good grade, close the gym and get a diploma at the end. If you do this, you won't add anything. You have to research the thing for yourself, what you want to do next. And if you just leave college with a degree and get a job, you keep repeating the same robotic work... I think that doesn't add much to what you'll be able to build.” (graduate 1, our translation).*

From interviews, participant observation and focus groups, it was possible to identify gaps in: training, guidance, mentoring, incubation process and capital for risk investment.

## Discussion

Students who participate in courses focused on entrepreneurship tend to get involved in activities and ideas for new businesses (Bergmann, 2018). Furthermore, entrepreneurship education is one of the missions of education, which are teaching, research and economic development through business technology or its creation by students and teachers (García *et al.*, 2017).

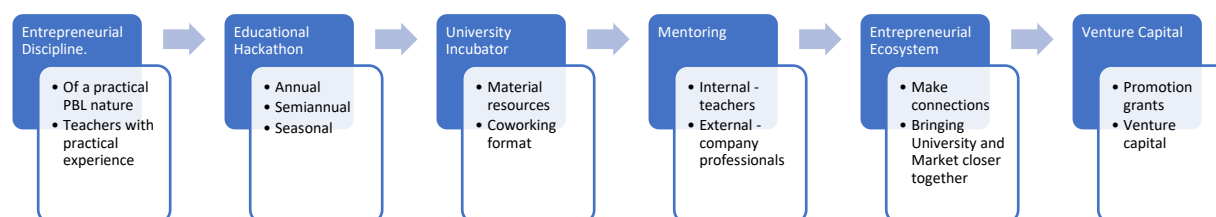
In this sense, entrepreneurial education should begin at the elementary school level. Even students at very young ages develop interests in this field and relate entrepreneurial aspects to everyday life (Din *et al.*, 2016).

Although the teaching of entrepreneurship has gained strength since the 1970s, especially in American universities (Joshi, 2014), higher education institutions do not usually have entrepreneurship included in their curricula, limiting themselves to complete courses aimed at this purpose. On the other hand, one of the main objectives of entrepreneurship training is experience in interdisciplinary work, with people from different backgrounds and orientations, to allow the evaluation of opportunities from different perspectives.

Given this, the creation of academic *hackathons* is a strategy to encourage innovation and entrepreneurship. However, although there are hundreds of these *hackathon models* taking place every year at various universities around the world (Devpost, 2023), few works resulting from these events become a startup. Hence the importance of the study presented here.

Based on the reflections and analysis of the data collected, in the case that illustrates this study, a startup development program is proposed with initiatives that dialogue with professional activity, which can integrate the curriculum of Universities, Technological Centers and Federal Institutes of Education with a view to offering training that includes education to innovate and undertake.

**Figure 2 – Startup development program**



Source: Startup Tupan components

In the paragraphs below, we will briefly explain each step of the model.

### Entrepreneurship Discipline

It's not just about having an entrepreneurship course, but about presenting the possibilities to the student from the first moment of graduation. Furthermore, teachers who teach entrepreneurship courses must have some entrepreneurial experience, they will only be able to effectively understand the process if they live the experience (empathy), as is the case in some British, US and German universities, which employ entrepreneurs to train students for entrepreneurship (Cheng *et al.*, 2018). If this teaching profile is impossible, inviting companies to partner with the university is crucial.

We can say that developing entrepreneurial thinking is a new and important skill for engineers of the future.

### Educational Hackathon

These are innovative educational actions, with varying frequency. They have a mobilization and awakening effect, but they do not promote entrepreneurship alone.

The period in which a *hackathon takes place* (48 hours) is insufficient for any project to have a level of maturity capable of allowing it to take place on the market. There is a need for time to develop the technology to customize it for your purpose. Academic hackathons

stimulate innovation, but require post-event support actions to enable the continuity of the innovative projects created.

### University Incubator

Innovative business ideas have originated in university environments. Startups require guidance on the market, on how to put together a model and a business plan, ways to access resources, in addition to having access to the use of laboratories with inputs. This incubation process includes contacting other startups to receive *feedback* and learn from the experience of other entrepreneurs in similar situations. It is collaborative learning, not solitary. Undergraduate engineering students in the Brazilian context need to look for internships and jobs to cover their personal expenses. In an incubation, grants and promotions must be made possible in order to overcome the difficulties inherent in the initial process of a new business.

Conceptually, the proposal for a university incubator in Brazil is almost 30 years old and its suggestions range from supporting development and innovation to accessing the global market. In practice, they maintain their main focus only on technology, encouraging the creation and development of technologically innovative companies (Faustino da Silva *et al.*, 2021), and are not prepared to receive projects of another nature.

### Mentoring

Mentoring is offered by people with specialized knowledge, inserted in the entrepreneurial ecosystem, with practical experience. More than a provider of answers, the mentor is a formulator of questions, provocations, problematizations and sharing of experiences that help the development of new entrepreneurs. There is a need for systematic and regular mentoring on entrepreneurship in the incubation process. This would avoid predictable errors, reducing the time spent on the trial-and-error process. The guidance on the business model and plan is also worth highlighting, as, although the tools are easy to understand, reflection on their content is not automatic for university students. This is likely due to a lack of maturity and life experience.



## Entrepreneurial Ecosystem

One of the most important actions is the need to bring the university closer to the local entrepreneurial ecosystem. Innovation ecosystems are knowledge networks (Callon, 1986) where there is an exchange of information and learning (Braga; Guttmann, 2019). Collaboration in creative work and the development of ideas builds collective intelligence involving different stakeholders within the university and external to it (Braga; Schettini, 2019). The practice of *networking* facilitates startups' first steps because it combines experiences from other companies at different stages of maturity. Discovering complementarities can boost the business. Therefore, students need to have contact with business creators, small business owners and former students who faced the challenges of opening and developing a business, whether successful or not. In other words, interaction with the outside world is important, to learn from entrepreneurs and companies (Lewrick *et al.*, 2011). To this end, some authors defend the idea of the triple helix model, with collaboration between universities, government entities and industry (Lackéus, 2015).

## Venture Capital

This is a challenge for every startup or small business: how to survive without initial financial support. There is a need to provide some risk capital to student entrepreneurs. Foster (2021) states that venture capital is generally used for a new idea or new product that, even with little market certainty, presents the potential for above-average returns to the investor.

It is believed that the experience of the Tupan group, as well as that of other students who participate in educational *hackathons* and are interested in activities that promote entrepreneurship, would be largely made possible through access to a program that presents a set of possibilities for theoretical articulation -practice, during the training path in higher education institutions.

## Final remarks

The startup in question, created during 2019, survived the lack of guidance, lack of resources, lack of infrastructure, the pandemic period (2020-2021), as well as other challenges for implementing a new business. However, despite all the effort and innovation, at the beginning of 2023 the founders decided to end the entrepreneurial experience. The proposal presented here was the result of the “pain” of talented students.

The study provides several lessons on the role played by universities in the entrepreneurial training of engineers. The relevance of academic *hackathons* such as *IFTP* is evident, where nothing prevents real cases of innovation from emerging from these events and gaining market share through entrepreneurial students. However, neither events nor universities are prepared to support students in this process. Universities must be attentive to innovation that comes from the bottom up, from the base, from students, and not from research carried out in their laboratories.

Current training does not offer the means or knowledge to make projects viable. Good ideas end up being wasted, making academic *hackathons* mere motivational events without a defined purpose. Therefore, it is essential to build support structures that help these students in the post-event stages, such as curriculum reviews, efficient incubators and risk financing. To achieve this, a change of mentality is necessary in universities, so that they can identify themselves as responsible, not only for the present intellectual formation of students, but also for their professional future, that is, promoting entrepreneurship that transcends the academic experience and promotes leading professionals, strengthening the perspective of educating to innovate and undertake.

We recognize that this work has limitations and does not end here. New studies must be carried out with other groups of students who have undertaken business as well as with those who have not shown interest in entrepreneurship. Other academic *hackathons* should also be studied. However, we hope that this study has offered a way for other scholars on the subject to understand the potential of entrepreneurial education, beyond carrying out sporadic actions and short-term events. Encouraging entrepreneurial skills must occur from the moment they arrive in training. In this process, academic *hackathons* can contribute as catalysts for innovative ideas and practices.

## REFERENCES

- BARDIN, L. **Análise de conteúdo**. Lisboa: Edições 70, 1977.
- BERGMANN, J. **Aprendizagem invertida para resolver o problema do dever se casa**. 1. ed. Porto Alegre: Penso, 2018.
- BOEHM, R. Aggies Invent: How an Intensive Design Experience Teaches an Entrepreneurial Mindset. **Advances in Engineering Education**, American Society for Engineering Education, 2020. Available at: <https://advances.asee.org/wp-content/uploads/vol108/issue01/Papers/AEE-26-Boehm.pdf>. Access: 15 July 2023.
- BRISCOE, G.; MULLIGAN, C. **Digital Innovation: the hackathon phenomenon**. London: Creative Works London Working Paper, 2014
- BRAGA, M.; SCHETTINI, C. Collective intelligence in robotics labs: Mapping the flows of information. *In*: SEFI ANNUAL CONFERENCE - EUROPEAN SOCIETY FOR ENGINEERING EDUCATION, BUDAPEST, 47., 2019. Budapest. **Anais [...]**. Budapest: University of Budapest, 2019. p. 36-36.
- BRAGA, M.; GUTTMANN, G. The Knowledge Networks in a Makerspace: the Topologies of Collaboration, **International Journal of Science and Mathematics Education**, [S. l.], v. 17, p. 13–30, 2019. Available at: <https://link.springer.com/article/10.1007/s10763-019-09954-7>. Access: 15 July 2023.
- CALLON, M. The sociology of an actor-network: The Case of the Electric Vehicle. *In*: CALLON, M.; LAW, J.; RIP, A. (ed.) **Mapping the Dynamics of Science and Technology**. London: Palgrave MacMillan, 1986.
- CHENG, Y.; WANG, K.; LEE, I. Application of engineering education in entrepreneurship construction system. **Eurasia Journal of Mathematics, Science and Technology Education**, [S. l.], v. 14, n. 6, p. 2185-2191, 2018. DOI: 10.29333/ejmste/86963. Available at: <https://www.ejmste.com/article/application-of-engineering-education-in-entrepreneurship-construction-system-5420>. Access: 15 July 2023.
- DEVPOST: **The home for hackathons**. Available at: <https://devpost.com>. Access: 19 jan. 2023.
- DIN, B. H.; ANUAR, A. R.; USMAN, M. The Effectiveness of the Entrepreneurship Education Program in Upgrading Entrepreneurial Skills among Public University Students. **Procedia - Social and Behavioral Sciences**, [S. l.], v. 224, p. 117–123, 2016. DOI: 10.1016/j.sbspro.2016.05.413. Available at: <https://www.sciencedirect.com/science/article/pii/S1877042816304979>. Access: 15 July 2023.
- DRUCKER, P.F. **Innovation and Entrepreneurship: Practice and Principles**. New York: Harper Ed, 1993.

FAUSTINO DA SILVA, C. M.; CORRÊA, J. S.; LEITE, D. B.; CAIRES, R. T.; TEIXEIRA, C. S. (2021). Análise das incubadoras universitárias na estrutura organizacional das instituições de ensino superior do Brasil. *In: CONFERÊNCIA ANPROTEC DE EMPREENDEDORISMO E AMBIENTES DE INOVAÇÃO*, 31., 2021, Brasília. **Anais [...]**. Brasília, DF: [s. n.], 2021. p. 10-23.

FOSTER, M. **Trucking & freight broker business startup 2021-2022: survival guide to start from scratch, grow quickly, and maintain sustainably your own company in the long term**. London: Routledge, 2021.

GAMA, K.; ALENCAR GONÇALVES, B.; ALESSIO, P. *Hackathons in the formal learning process*. *In: RÖBLING, G.; SCHARLAU, B. (ed). Proceedings of the 23rd Annual ACM Conference on Innovation and Technology in Computer Science Education*. New York: [s. n.], 2018. p. 248–253.

GARCÍA, J. C. S.; WARD, A.; HERNÁNDEZ, B.; FOREZ, J. L. Educación emprendedora: estado del arte entrepreneurial education: state of the art. **Propósitos y Representaciones**, [S. l.], v. 5, n. 2, p. 401–473, 2017. Available at: <https://revistas.usil.edu.pe/index.php/pyr/article/view/190>. Access: 5 July 2023.

GIBB, A. In pursuit of a new “enterprise” and “entrepreneurship” paradigm for learning: creative destruction, new values, new ways of doing things and new combinations of knowledge. **International Journal of Management Reviews**, [S. l.], v. 4, n. 3, p. 233–269, 2002. DOI: 10.1111/1468-2370.00086. Available at: <https://onlinelibrary.wiley.com/doi/10.1111/1468-2370.00086>. Access: 15 July 2023.

HARFST, K. The Evolution and Implications of Entrepreneurship Curriculum at Universities. **Online Journal for Workforce Education and Development**, [S. l.], v. 1, n. 3, 2010. Available at: <https://opensiuc.lib.siu.edu/ojwed/vol1/iss3/3/>. Access: 15 July 2023.

JOSHI, R. Entrepreneurship education: core, context and challenges. **Journal of Entrepreneurship and Management**, [S. l.], v. 3, n. 2, 2014. Available at: <http://www.publishingindia.com/GetBrochure.aspx?query=UERGQnJvY2h1cmVzfC8yMjQ1LnBkZnwwMjI0NS5wZGY=>. Access: 15 July 2023.

KIRBY, D. A. Entrepreneurship education: can business schools meet the challenge? **Education + Training**, [S. l.], v. 46, n. 8/9, p. 510–519, 2004. DOI: 10.1108/00400910410569632. Available at: <https://www.emerald.com/insight/content/doi/10.1108/00400910410569632/full/html>. Access: 15 July 2023.

LACKÉUS, M. **Entrepreneurship in education: hat, why, when, how**. Treto, Italy: Background paper for OECD-LEED, 2015, Available at: [https://www.oecd.org/cfe/leed/BGP\\_Entrepreneurship-in-Education.pdf](https://www.oecd.org/cfe/leed/BGP_Entrepreneurship-in-Education.pdf).

LEWRICK, M.; OMAR, M. ROBERT, R.; SAILER, K. Education for entrepreneurship and innovation: “management capabilities for sustainable growth and success”. **World Journal of Entrepreneurship, Management and Sustainable Development**, [S. l.], v. 6, n. 1/2, p. 1–18, 2011. DOI: 10.1108/20425961201000001. Available at:

[https://www.researchgate.net/publication/235307366\\_Education\\_for\\_entrepreneurship\\_and\\_innovation\\_Management\\_capabilities\\_for\\_sustainable\\_growth\\_and\\_success](https://www.researchgate.net/publication/235307366_Education_for_entrepreneurship_and_innovation_Management_capabilities_for_sustainable_growth_and_success). Access: 15 July 2023.

MACK, N.; WOODSONG, C.; MACQUEEN, K.; GUEST, G.; NAMEY, E. **Qualitative research methods: a data collector's field guide**. Family Health International (FHI), USA, 2005. Available at: [https://pdf.usaid.gov/pdf\\_docs/PNADK310.pdf](https://pdf.usaid.gov/pdf_docs/PNADK310.pdf). Access: 15 July 2023.

MITCHELMORE, S.; ROWLEY, J. Entrepreneurial competencies: a literature review and development agenda. **International Journal of Entrepreneurial Behavior & Research**, [S. l.], v. 16, n. 2, p. 92–111, 2010. DOI: 10.1108/13552551011026995. Available at: <https://www.emerald.com/insight/content/doi/10.1108/13552551011026995/full/html>. Access: 15 July 2023.

MORGAN, D. L. **Focus groups as qualitative research**. Los Angeles: SAGE Publications, 1997.

MWASALWIBA, E.S. Entrepreneurship education: a review of its objectives, teaching methods, and impact indicators. **Education + Training**, [S. l.], v. 52, n. 1, p. 20–47, 2010. DOI: 10.1108/00400911011017663. Available at: <https://www.emerald.com/insight/content/doi/10.1108/00400911011017663/full/html>. Access: 15 July 2023.

McCALLUM, E.; WEICHT, R.; McMULLAN, L.; PRICE, A. **EntreComp into Action - Get inspired, make it happen: A user guide to the European Entrepreneurship Competence Framework**. Luxembourg: Publications Office of the European Union, 2018.

NABI, G.; LIÑÁN, F.; FAYOLLE, A.; KRUEGER, N.; WALMSLEY, A. The impact of entrepreneurship education in Higher Education: a systematic review and research agenda. **Academy of Management Learning & Education**, [S. l.], v. 16, n. 2, p. 277–299, 2017. DOI: 10.5465/amle.2015.0026. Available at: <https://journals.aom.org/doi/10.5465/amle.2015.0026>. Access: 15 July 2023.

NECK, H. M., NECK, C. P.; MURRAY, E. L. **Entrepreneurship: the practice and mindset (Second)**. Los Angeles: SAGE Publications, 2020.

ONU BRASIL. Os Objetivos de Desenvolvimento Sustentável no Brasil. **Nações Unidas Brasil**, 2022. Available at: <https://brasil.un.org/pt-br/sdgs>. Access: 07 June 2022.

RIDLEY, D.; DAVIS, B.; KOROVYAKOVSKAYA, I. Entrepreneurial Mindset and the University Curriculum. **Journal of Higher Education Theory and Practice**, [S. l.], v. 17, n. 2, p. 79, 2017. Available at: <https://articlearchives.co/index.php/JHETP/article/view/2079>. Access: 15 July 2023.

ROBLES, L.; ZÁRRAGA-RODRÍGUEZ, M. Key Competencies for Entrepreneurship. *In: Proceedings of 2nd Global Conference on Business, Economics, Management and Tourism*, Prague, Czech Republic, [S. l.], v. 23, p. 828–832, 2015. DOI: 10.1016/S2212-5671(15)00389-5. Available at:

[https://www.researchgate.net/publication/282555235\\_Key\\_Competicencias\\_for\\_Entrepreneurs](https://www.researchgate.net/publication/282555235_Key_Competicencias_for_Entrepreneurs)  
hip. Access: 15 July 2023.

SCHUMPETER, A. J. **Capitalism, socialism and democracy**. New York: Routledge, 1994.

SCHWABER, K.; SUTHERLAND, J. **The scrum guide the definitive guide to scrum: the rules of the game**. 2020. Available at: <https://scrumguides.org/docs/scrumguide/v2020/2020-Scrum-Guide-US.pdf#zoom=100>. Access: 15 Jan. 2023.

SOGUNRO, O. A. Efficacy of role-playing pedagogy in training leaders: some reflections. **Journal of Management Development**, [S. l.], v. 23, n. 4, p. 355–371, 2004. DOI: 10.1108/02621710410529802. Available at: <https://www.emerald.com/insight/content/doi/10.1108/02621710410529802/full/html>. Access: 15 July 2023

SREENIVASAN, A.; SURESH, M. Twenty years of entrepreneurship education: a bibliometric analysis. **Entrepreneurship Education**, [S. l.], v. 6, p. 45–68, 2023. Available at: <https://link.springer.com/article/10.1007/s41959-023-00089-z>. Access: 15 July 2023.

SUTHERLAND, Jeff; SUTHERLAND, J.J. **Scrum: The Art of Doing Twice the Work in Half the Time**. Rio de Janeiro: Editora Sextante, 2014.

WARNER, J.; GUO, P. J. Hack.edu: examining how college *hackathons* are perceived by student attendees and non-attendees. In: TENENBER, J.; CHINN, D.; SHEARD, J.; MALMI, L. (ed.). **Proceedings of the 2017 ACM Conference on International Computing Education Research**. New York: ACM, 2017.

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