Co-creation of Entrepreneurship Learning Environment in Partnership with an Actor from the Innovation Ecosystem

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Abstract. In the educational context, elective courses focused on entrepreneurship challenge educators to adopt contemporary teaching approaches, centered on the student and with active methods that lead to learning and are lined up with market practices. Faced with the need to create a transdisciplinary educational environment, the following problem was listed for the study: "how to co-create a transdisciplinary learning environment for entrepreneurship, student-centered and integrated into the innovation ecosystem?" The objective of this research was to explain the process of co-creation of an entrepreneurship learning environment for a school subject of a Materials Engineering course, which involved the university and an actor from the innovation ecosystem. A qualitative method, action-research, was adopted, with the active participation of academic and non-academic researchers. The co-creation of the learning environment has theoretical foundations in constructivism, experiential and reflective learning, and Design Thinking (DT). The university's integration with the innovation ecosystem, with latter in protagonism from the teaching program definition phase to the execution of the discipline, has the potential to transform the classroom into a hub for connecting ideas and people and an arena for student self-knowledge and personal planning. By describing the process of co-creation, this article brings to entrepreneurship educators the transdisciplinary approach and the elucidation of practices that can be adopted in educational approaches of this kind.

Keywords: entrepreneurial education · learning environment · co-creation

1 Introduction

Entrepreneurial education (EE) acts as a central pillar of the new knowledge economies (Blesia et al. 2021) and has an important role to play as a catalyst for innovation. Although, at first, its genesis was linked to the scope of business courses, given its notoriety for economic and social development (Loi et al. 2022), the field today enters different

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areas, such as arts, health and engineering (Aadland and Aaboen 2020, Holzmann et al. 2018), the latter being the focus of this work.

In this context, university education, as a critical center of knowledge, is called upon to stimulate the formation of future entrepreneurs, who will work in uncertain arenas, permeated by digital transformation and with complex economic, social and environmental challenges. Therefore, some subjects need to be rethought and reformulated to meet the demands imposed by society that is constantly changing.

This research reveals the results of the co-creation of the Engineering and Innovation Management subject of the undergraduate course in Materials Engineering at the Federal University of Santa Catarina (UFSC) - Brazil, with a focus on entrepreneurship and innovation. The subject program was co-created by the Nucleus of Studies in Intelligence, Management and Technologies for Innovation (IGTI) of the Post-Graduation in Engineering and Knowledge Management at the Federal University of Santa Catarina (PPEGC/UFSC), in partnership with the Santa Catarina Technology Association (Acate), more specifically with Miditec - Acate business incubator. Miditec constitutes an important actor of the innovation ecosystem[1] of the Brazilian system, elected by the UBI Global 2019/2020 award as the fourth best private incubator in the world.

Based on the research question: "how to co-create an entrepreneurship learning environment in a transdisciplinary way, student-centered, and integrated into the innovation ecosystem?", the article presents the educational foundations of the proposal, the teaching-learning methodology and the relationships established between full professor, PPEGC/UFSC doctoral students who worked as interns in the classroom, along with the mentors of the innovation ecosystem. The project's objectives focus on improving the student's entrepreneurial training, with greater interaction with the innovation ecosystem and also expanding UFSC's partnerships with society.

This study intends to fill a gap pointed out by Holzmann et al. (2018) regarding the low number of studies on EE in engineering, which contrasts with the innovation potential of the area. The research also responds to calls for studies aimed at the design of learning environments in specific fields of entrepreneurship and the lack of attention to the role of educators in creating these environments (Ilonen 2021).

A learning environment constitutes the entire domain in which the student learns, be it formal (planned intentionally), informal (socialization of individuals) or non-formal (everyday and experience). It consists of objective and observable characteristics, such as programs, teaching plan, physical space and, above all, dialogic interactions between students and educators and their subjective perceptions (Frenzel et al. 2007). Ilonen (2021) defines an entrepreneurial learning environment as a self-regulated and co-created environment in which students with heterogeneous characteristics learn from each other.

Developing an EE program with a focus on the student and their learning process implies the adoption of methodologies and pedagogical practices capable of effecting the co-creation of value for and with the student. To this end, one of the approaches pointed out by EE research is the application of design thinking (DT) (Huq and Gilbert 2017, Fialho and Machado 2022). Its introduction in education generates innovation to face the challenges of the teaching-learning process (Fialho and Machado 2022).

[1] Innovation ecosystem is a network developed between actors and entities that aim at technological development and innovation (JACKSON, 2011).

In the learning environment, Gibb (2011) declares that students' exposure to the entrepreneurial ecosystem is important. Mediation with mentorships, in the author's view, is a way of expanding the limited relationships between students and teachers. This gives importance to external stakeholders in the formulation of the learning environment (Illonen 2021), and brings the challenge of establishing transdisciplinary practices, concerning the co-creation of the educational environment itself, its respective instructional design processes and classroom dynamics. of class. The perspective of transdisciplinarity, in Piaget's (1972) approach, is not limited to recognizing the interactions and reciprocity between specialized research, but a higher stage of interdisciplinarity that establishes links within a larger system, without stable borders. There is an overcoming of the reductionist paradigm in favor of the expansion of knowledge with the creation of value.

In the following section, the educational theoretical foundations are presented. Next, the method is exposed, followed by the results and their discussion. The article ends with the final considerations and the presentation of the references.

2 The Theoretical Educational Foundations

One of the first steps of the co-creation process was the definition of the theoretical basis of the program. In order to obtain a synthesis of knowledge, an integrative literature review was carried out with results embodied in the research by Kangerski et al. (2022).

Kangerski et al. (2022) pointed out constructivism as the main theoretical aspect of learning. Methods centered on the teacher, with a behaviorist basis and focused on the transmission of knowledge from the teacher to the students, give way to active methodologies, with convergence in the students and the teacher acting in the role of facilitator.

Constructivism emphasizes the creation of knowledge by the student himself, involving his cognitive aspects and his reflections from the context and his experience (Bel 2021). By providing a more effective explanation of how knowledge is created by the dynamics of entrepreneurship (Bel 2021), the constructivist educational current is referred to as an approach that is closest to entrepreneurial learning.

Kolb's theory of experiential learning - in which the student learns from lived experiences, alongside Dewey's theory of reflective learning - whose learning stems from the relationships between individuals and the tensions between habitual experiences and their environment, gain importance for foster innovation, intellectuality and creativity in students (Kangerski et al. 2022). For Kolb and Kolb (2009), experiential learning depends not only on cognitive processes, but also on a dynamic that enables the integrated functioning of the student's thinking, feeling, perceiving and acting.

Another point highlighted in the integrative literature review stage was the educational approaches to entrepreneurship. Kangerski et al. (2022) point to studies from the systematic review by Nabi et al. (2017), whose classification indicates the existence of four segmentations: i) supply (behavioral emphasis); ii) demand (constructivist, active participation in seminars, events and extracurricular activities); iii) competence (real business practices) and iv) hybrid methods. According to Nabi et al. (2017), competence would be the closest approach to the entrepreneurial experience.

As a basis for the methodology adopted in the subject, a theme that emerged from the analysis by Kangerski et al. (2022) was design thinking (DT). Its use is in line with contemporary EE needs, as it is student-centered, iteratively oriented to problem solving and creating potential solutions, encouraging students to think entrepreneurially and face the fear of failure (Huq and Gilbert 2017). The application of DT in EE occurs both as an approach to teaching entrepreneurship and for the creation of new business models (Kangerski et al. 2022). As an educational approach, Active Methodology (teaching strategies aimed at the autonomous participation of the student) and Flipped Classroom (previous study by the student before the class) are examples of the use of DT in the classroom from the constructionist perspective (Fialho and Machado 2022).

In Brown's (2009) conception, DT is based on three non-linear stages: i) inspiration, with exploration and identification of the problem; ii) idealization of the idea to research, create, develop and test, and iii) implementation of the ideas. Such phases are aimed at meeting the needs of its users, linked to six key aspects: empathy, brainstorming, divergence, convergence, prototyping and storytelling (Brown 2009).

3 Methodology

The method adopted is qualitative in nature (Creswell and Creswell 2021). It is also classified as an action research - an empirical social research aimed at solving a collective problem, in which researchers and participants in the problem situation are involved in a cooperative or participatory way. In this case, it involved researchers from the university and an actor from the innovation ecosystem in a cooperative way to create the learning environment. One of the limitations of this type of research is the development time and the impartiality of the researchers, as they are active in the environment. Regarding impartiality, the diversity of actors in the team allows for the reduction of such bias. The research was developed from December 2021 to July 2022.

As for data collection, initially, an integrative literature review was carried out by the members participating in the project and based on the publication by Kangerski et al. (2022). Fayolle (2013) argues that one of the shortcomings of EE is the lack of anchoring in a theoretical basis, which makes the area of knowledge fragmented. The results of this bibliographic research were presented in the first section of this article, and served as a theoretical-empirical lens to establish the educational bases of the project in question and will be punctuated throughout the article.

Another technique adopted was document analysis (Creswell and Creswell 2021) which used course programs, teaching plans, and dissertation and audiovisual records of team meetings.

4 Results e Discussion

The next sections are organized to describe how co-creation was established, the associated educational foundations and the teaching proposal.

4.1 The Starting Point of Co-creation

The subject of Engineering and Innovation Management makes up the curriculum of the Materials Engineering course at UFSC in the optional modality, that is, it is not mandatory. This makes it possible to enroll university students from other higher education courses within the limits of UFSC, stimulating heterogeneity in the students' profile. The workload is 72 h with a biannual offer, subdivided into 18 weekly meetings of four hours in person or remotely (when in the pandemic period). The starting point of the co-creation was to carry out an analysis of the classes already offered.

The objectives of the original subject were based on: a) preparing the student to invest in his career in an innovative way, whether as an intrapreneur or entrepreneur; b) grant opportunities to design a business plan, starting from the identification of problems/opportunities, generation of ideas to the creation of an innovation potential and, c) collaborate with the development of the student's reflective, critical, systemic thinking and collaboration.

Learning by project was the foundation of the subject. During the semester, students, working in teams, identified a gap in the market, generated ideas for solutions with transformation into a business model. The end result was the delivery of a business plan, presented using the pitch technique (a brief presentation lasting 3 to 5 min). The entire process was carried out progressively by the teams throughout the course, alternating classes of guidance and discussions, with production in teamwork. The expository-dialogue classes provided theoretical support for the development of the project, encouraging students to seek additional knowledge, according to the focus chosen by the team. The identification of gaps in the market and the solution to be designed by the teams were freely identified by the students themselves, as well as the definition of the purpose of the business. However, in the pedagogical sequences of the classes, there was an incentive to create solutions aimed at meeting the Sustainable Development Goals (SDGs) adopted by all United Nations member states in 2015, in order to create value for society.

Two central issues motivated the restructuring of the subject. The first of these was the need for greater interaction with the entrepreneurial and innovation ecosystem, in order to bring students closer to real experiences and also enable interaction with innovation habitats around UFSC. The proactivity of the external partner in providing its knowledge and that of its team of mentors, was central. The second motivating point of the project was the need to replace the emphasis on the causal approach (Sarasvathy 2003), based on developing market opportunities based on planning and predictability - a common practice of the business plan, with the effectuation approach (Sarasvathy 2003), sustained in the creation of opportunities with the resources available at the time and in conditions of uncertainty and risk.

A work team composed of eight internal members and one participant external to UFSC (Chart 1) was structured to define new competencies, knowledge and skills, deliver value to the subject for students and define learning paths. The external member acted, simultaneously, as a representative of Miditec responsible for the partnership and as a mentor in the classroom.

Chart 1. Multidisciplinar team

Degree	Institution	Role in the project
Math/PhD	PPGEGC/UFSC	Professor
Administration/MsC		Teaching intern
Administration/MsC		Pedagogical support
Agronomist Eng./MsC		Teaching intern
Social Communication-Public Relations/PhD		Pedagogical support
Pedagogy/PhD		Pedagogical support
Materials Eng./Bachelor	ACATE/Miditec	Mentorship coordinator

Source: Prepared by the authors.

In addition to the team responsible for reformulating the course plan, seven more MIDITEC mentors worked with the students. Such interactions will be discussed in Sect. 4.2.

4.2 The Co-creation of Learning Paths

The process of co-creation of the new learning environment took place from March to April 2022 through ten remote meetings with collaborative construction that redefined the objectives and competencies of the course, and the elaboration of the teaching plan and lesson plans organized into learning paths. One of the important points for effective co-creation was the conceptual and practical alignment with the external partner. The role of mentors would require alignment with internal facilitators with the partner's tacit knowledge, especially with regard to experiences, and explicit knowledge, formalized in the techniques and tools used by the business incubator to promote learning.

An undergraduate classroom and a business incubator have in common the fact that they are learning environments. However, they present different dimensions of work. The Miditec incubator emphasizes the process of creating new business models with an emphasis on company development. The subject, in turn, focuses on stimulating the student's entrepreneurial thinking and action. Understanding these different dimensions of learning and understanding the commonalities is critical. The alignment of language, concepts and practices (between professors, teaching interns and mentors) and, as a consequence, knowledge sharing, is extremely important to make student learning more fluid. Therefore, communication needs to be bidirectional, empathetic and transparent.

Four central objectives were established for the matter: i) to demonstrate the importance of innovation and entrepreneurship, sustainable development, ethical and responsible behavior in the entrepreneurial process; ii) encourage the student to seek the self-development of entrepreneurial behavior; iii) provide opportunities for innovative business modeling, and iv) stimulate reflective, critical, systemic and collaborative thinking in the student.

Three learning paths were created: i) multiple ways to start a new business and innovate; ii) from ideation to prototyping, and iii) preparation for implementation. The

main educational foundations were based on constructivism, experiential and reflective learning, and design thinking, which were identified in the integrative literature review stage exposed in the second section of this article.

As expressed in Fig. 1, the first path aims to demonstrate to the student the entrepreneurial mindset and prepare them for teamwork, focusing on: self-knowledge, entrepreneurship typology, entrepreneur profile, types of innovation, design thinking, sustainable development and the SDGs. The first path ends with a technical visit by the students to the Miditec business incubator, which allows each team to interview an entrepreneur from the incubator in loco.

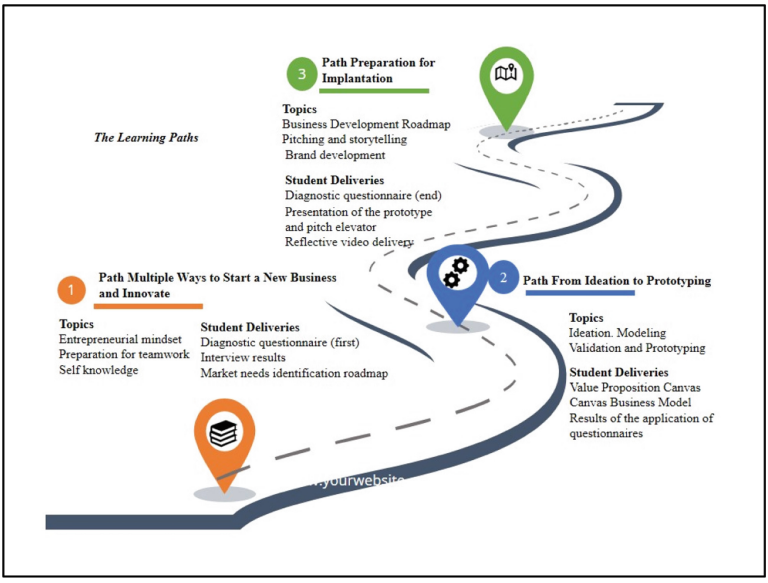

Fig. 1. The learning paths. Source: Autors.

The second learning path is predominantly practical. Classes are planned to take place in an iterative way with: dialogue-exposition of concepts, techniques and tools; applications of these by the teams in their business projects, with the support of mentorships; sharing the results of the application in class, with reflections and feedback from those involved – colleagues, professor/teacher interns, mentors. The model and type of business to be created by the teams is freely chosen, however, the stimulus for businesses aligned with sustainability or that meet the SDGs remained from the previous practice.

At this stage, teams need to identify a pain (market/society/community need), align with Track 1 content, model a solution, validate the need with the target audience (market/community) and prototype the product. At each class, a mentor from different expertises participates in the class and guides the teams, according to the theme of the class. The bridge between the subject itself and the team of mentors will be built by the representative member of Miditec, who will work in all classes. Track 2 adopts tools aimed at DT by students: IGTI Problem Analysis Flowchart and Empathy Map (to identify

customer pain), Value Proposition Canvas and Business Model Canvas. A prototyping workshop was designed to present free strategies and tools for designing the first draft of the product and Minimum Viable Product (MVP) – the simplest version of the product designed with the minimum of resources in order to gain market appreciation.

Although in methodological terms there are deliveries and deadlines - as required in academic subjects, the premise was established by the subject co-creation team that the entire process is iterative and dynamic, with flexibility for subsequent changes, which is in line with the thought advocated by DT. In this way, student teams will have the freedom and flexibility to update or pivot a value proposition or a certain aspect of the business model, whether based on new validation data, information from the target audience (market/community) or the learning of the students during the program. This line of thought is also part of the co-creation group's own action. At each class, according to student engagement and feedback, the following sessions will be reviewed and, as appropriate, remodeled. It is important to point out that the classes from track 1 to 3 also adopt the flipped classroom method, requiring the student to prepare in advance to participate in the classes.

The third track – preparing the implementation, was structured for the teams to finalize their productions, learn about future steps of a business modeling, and prepare for the final presentation of the created product, applying storytelling techniques. As a final delivery, each team needs to present a pitch and a prototype of the product, which will be appreciated by a panel of mentors who will evaluate the exhibitions. Although it is the end of the course, the perspective of track three is to encourage the student to continue their entrepreneurial training, identifying knowledge gaps and the search for other opportunities for self-development in the innovation ecosystem or in the university itself.

Regarding the classification by Nabi et al. (2017) on EE approaches, presented in Sect. 2, the proposal of mixing practice demand and competence practices with activities that go beyond simulation, such as validation and prototyping.

During the reformulation process, some content and methodological practices of the original version of the subject were excluded or had their approach transformed. One of the examples was the business plan (BP) – a planning tool that led the old teaching program. In the current model, the BP would be replaced by the Business Roadmap – a tool applied by Miditec to identify confirmed hypotheses, as well as planning new validation phases and establishing MVP versions.

Anchoring the program in reflective learning, evaluation and reflection actions are foreseen for each track, involving the teams themselves and the students individually. In addition to the assessment of teamwork development at the individual level, at the end of track three, students will produce a video of up to three minutes, reflecting on their experience during the course and understanding what it means to be an entrepreneur. Such activities, in addition to serving as inputs for future adjustments or during the course of the program, give the student the position of co-responsible and protagonist of their learning environment.

Student learning assessment is designed to be diagnostic, formative, and summative. Team tasks such as: interview an entrepreneur, ideation stage, validation, modeling, prototyping and pitch, will be evaluated, in parallel, with the individual participation of

students and the creation of a video (or audio) to reflect on their learning throughout the course. In the diagnostic part, in the first and at the end class of the program, students answer a questionnaire validated by Moberg et al (2014), in order to identify predispositions and knowledge about entrepreneurship. The subject is currently being offered and, at the end, a new application will be generated, following guidelines from EE researchers for pre and post evaluation of EE initiatives (Moberg et al. 2014). The first edition of the restructured course had the participation of 19 students, the vast majority from the engineering course (civil, materials, mechanics and sanitary).

5 Conclusion

The dynamics of co-creation (from the teaching program, its adaptations to execution) provided the team with reflections on entrepreneurial thinking and action, as well as updates on methodological practices, enabling a transdisciplinary look at the EE environment. Transdisciplinary work requires empathy, transparency, iterativeness, integrated and assertive communication, evaluations and adaptations. The internal members of the university are responsible for transposing the tacit knowledge of the partners, making them explicit in order to provide students with significant learning dynamics in line with the reality of the market.

In this new EE environment, students need to take a leading role in relation to their own learning. This brings challenges regarding academic engagement in the program and also in student teamwork - one of the educational principles of the subject.

DT proved to be a prolific foundation in the co-creation of the teaching program. Entrepreneurship subjects can be a student's first contact with the world of entrepreneurship and need to act as a hub, a space for student self-development and personal planning and, above all, for connecting ideas and people.

This article is the first publication of the project to remodel the program. A new survey will be carried out to bring evidence from students and mentors about the applied methodology. The development of new studies that can bring mentors to the scene is encouraged, in an analysis focused on the process of knowledge overflow. Another field to be visited is the challenge of teachers to stimulate the development of entrepreneurial skills through teamwork by students.

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References

Blesia, J.U., Iek, M., Ratang, W., Hutajulu, H.: Developing an entrepreneurship model to increase students' entrepreneurial skills: an action research project in a higher education institution in Indonesia. Syst. Pract. Act. Res. **34**(1), 53–70 (2021)

Loi, M., et al.: Entrepreneurship education at the crossroads: challenging taken-for-granted assumptions and opening new perspectives. J. Manag. Inq. **31**(2), 123–134 (2022)

Aadland, T., Aaboen, L.: An entrepreneurship education taxonomy based on authenticity. Eur. J. Eng. Educ. **45**(5), 711–728 (2020)

Holzmann, P., Hartlieb, E., Roth, M.: From engineer to entrepreneur - entrepreneurship education for engineering students: the case of the entrepreneurial campus villach. Int. J. Eng. Pedagogy **8**(3), 28–39 (2018)

Ilonen, S.: Creating an entrepreneurial learning environment for entrepreneurship education in HE: the educator's perspective. Ind. High. Educ. **35**(4), 518–530 (2021)

Frenzel, A., Pekrun, R., Goetz, T.: Perceived learning environment and students emotional experiences: a multilevel analysis of mathematics classrooms. Learn. Instr. **17**, 478–493 (2007)

Huq, A., Gilbert, D.: All the world's a stage: transforming entrepreneurship education through design thinking. Educ. Train. **59**(2), 155–170 (2017)

Fialho, F.A.P. Machado, A.B.: Design thinking in teacher education: a new look at a educational challenges. In: Machado, A.B., Sousa, M.J., Dandolini, G.A. (eds.) Contemporany Challenges in Digital Education, pp. 113–127. Nova Science Publisher, New York (2022)

Jackson, D.J.: What is an innovation ecosystem? National Science Foundation, Arlington, VA (2011)

Gibb, A.A.: Concepts into practice 1. Meeting the challenge of development of entrepreneurship educators around an innovative paradigm. The case of the international entrepreneurship educators programme (IEEP). Int. J. Entrep. Behav. Res. **17**(2), 146–165 (2011)

Piaget, J.: L'épistémologie des relations interdisciplinaires (1972)

Kangerski, F.A., Machado, A.B., Dandolini, G.A.: Mapping pedagogical and methodological practices in context of entrepreneurship in higher education. In: Machado, A.B., Sousa, M.J., Dandolini, G.A. (eds.) Contemporany Challenges in Digital Education, pp. 129–156. Nova Science Publisher, New York (2022)

Bell, R.: Underpinning the entrepreneurship educator's toolkit: conceptualising the influence of educational philosophies and theory. Entrep. Educ. **4**(1), 1–18 (2021)

Kolb, A.Y., Kolb, D.A.: The learning way: meta-cognitive aspects of experiential learning. Simul. Gaming **40**, 297–327 (2009)

Nabi, G., Linan, F., Fayolle, A., Krueger, N., Walmsley, A.: The impact of entrepreneurship education in higher education: a systematic review and research agenda. Acad. Manag. Learn. Educ. **16**(2), 277–299 (2017)

Brown, T.: Change by Design: How Design Thinking Transforming Organizations and Inspires Innovation. Happy Business, New York (2009)

Creswell, J.W., Creswell, J.D.: Projeto de pesquisa-: Métodos qualitativo, quantitativo e misto. Penso Editora, Porto Alegre (2021)

Thiollent, M.: Metodologia da pesquisa-ação. Cortez, São Paulo (1986)

Fayolle, A.: Personal views on the future of entrepreneurship education. In: A Research Agenda for Entrepreneurship Education. Edward Elgar Publishing (2013)

Sarasvathy, S.D.: Entrepreneurship as a science of the artificial. J. Econ. Psychol. **24**(2), 203–220 (2003)

Moberg, K., et al.: How to assess and evaluate the influence of entrepreneurship education: a report of the ASTEE project with a user guide to the tools (2014)