Emerging Support Systems for Entrepreneurship Education in the Context of an Ambitious National Reform in Chilean Engineering Schools

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Abstract

The purpose of this study is to characterize the support systems for entrepreneurship education in five Chilean engineering schools that were part of Ingeniería 2030, a national program launched in 2012. This program sought to strengthen applied research, technology transfer, and entrepreneurship education in engineering schools. Overall, Ingeniería 2030 granted about US$60 millions over a six-year period. As a result, engineering schools implemented unprecedented efforts to promote and support entrepreneurship among undergraduate students. In this context, we pose the following question: What are the main strategies the selected engineering schools use for the promotion of entrepreneurship education? To address this question, we conducted 20 semi-structured interviews with professional staff (12) in the newly created entrepreneurship units, as well as top administrators (3) and faculty members (5). We also analyzed archival documentation, such as web sites and Ingeniería 2030 reports. The results indicate that the main strategies for supporting entrepreneurship education are related to four issues. First, a tension exists in these mostly traditional schools in terms of their role as conventional institutions and what is expected of them as entrepreneurial schools. Second, schools struggle with balancing and connecting curricular and co-curricular activities. Third, professional staff and administrators view engineering faculty members as conflicted by research demands on the one hand, and pressure to get involved in entrepreneurship educational initiatives on the other. Fourth, regular academic demands are seen as a barrier to get more students involved in entrepreneurial activities. These issues must be addressed in order to understand how the national policy for stimulating innovation and entrepreneurship in engineering schools is reshaping the university ecosystems in ways that are more or less consistent with institutional contexts.

Introduction

In 2012, the Corporación de Fomento Productivo (CORFO), a governmental agency, launched "Una Nueva Ingeniería para el 2030" Program (Ingeniería 2030), whose main purpose was to strengthen the capacities of engineering schools in the areas of applied research, development and technology transfer, and innovation and entrepreneurship. The Program granted close to US$ 60 million, in a period of 6 years, to 10 schools, organized in three alliances and two individual projects. Thus, each engineering school promoted unprecedented initiatives to encourage and support entrepreneurship, in particular at the undergraduate level. These initiatives produced a number of changes and faced several challenges. This research aims to reveal some of them, analyzing comparatively five out of ten schools participating in Ingeniería 2030.

Literature review

As the engineering profession continues to adapt and respond to the changes of this century, the need for innovation and entrepreneurship increases [1]. However the calls for more entrepreneurship in engineering education have a long history. Indeed, as early as 1952, The

Committee on Evaluation of Engineering Education convened by the American Society for Engineering Education (ASEE), stated that engineering education should provide students with the means and inspiration to grow on their own initiative, before and after graduation [2]. Along the same line, half a century later, the National Academy of Engineering of the United States [3] emphasizes (1) a creative process in engineering, (2) the embracement of creativity, invention and interdisciplinary fertilization to create new fields of activity, (3) leadership in the movement towards the use of sustainable economic development and (4) that faculty members and engineers, together, undertake an effort so that engineering education addresses the challenges and social opportunities of the future.

In seeking to respond to these demands, universities have been encouraged to play a more active role in economic development by supporting policies and funding programs for commercialization of technology and entrepreneurship education [4]. This occurs when economic news shows how global competition, downsizing, decentralization, re-engineering, mergers, and new technologies have made careers more complex and uncertain for graduates from all sectors [5,6]. In this context, political, economic and academic leaders conceive entrepreneurship as one of the keys to innovation and economic growth. Thus, organizations would seek engineers who are capable of identifying opportunities, understand how market forces work, commercialize new products, communicate and direct teams, in addition to having solid scientific and technical skills [7].

As a result, engineering schools have incorporated various programs to bring entrepreneurship to their students. Each program examines entrepreneurship from their perspective and defines it in a particular way [8]. On the other hand, students are increasingly interested in entrepreneurial activity, which has pushed universities to take notice of this interest. In this context, we ask: What are the strategies that engineering schools are employing in Chile to support and encourage entrepreneurship in their undergraduate students, in the context of Ingeniería 2030?

Conceptual Framework

We use two conceptual frameworks to explore the emerging strategies used by our selected Ingeniería 2030 schools to promote entrepreneurship. First, the Input-Environment-Output model [9] allows us to understand the educational environments as a process that receives and gets shaped by students with particular qualities and characteristics and that produces graduates with a certain set of skills and knowledge. In the educational environment of engineering schools, both the curriculum and the co-curriculum are vital to understand entrepreneurship education [10]. The co-curricular refers to unstructured and non-for-credit experiences that offer students a wide range of opportunities to develop entrepreneurship that complement what they are learning in their discipline.

Second, regarding managing the educational environment, Graham identifies two models through which universities promote innovation and entrepreneurship [11]. On the one hand, the bottom-up model, run by the community and driven mostly by students and alumni, which generates an inclusive ecosystem that creates strong ties among local entrepreneurs and the university. On the other hand, the top-down model is directed by central university authorities and implemented through formal university structures. The evidence presented by Graham

suggests that the combination and emphasis of the basic components of an enterprising and innovative university vary between the two models [11].

Methodology

To answer our question we adopted a qualitative exploratory approach [12]. The data is based on semi-structured interviews with actors that are part of the support systems for entrepreneurship education in five engineering schools in Chile: Universidad de Chile (UChile), Pontificia Universidad Católica de Chile (PUC), Universidad de Santiago (USACH), Universidad Adolfo Ibáñez (UAI) and Universidad de of Talca (UTalca). The selection criteria prioritized the variability of Ingeniería 2030 schools. The sample considers one university from each of the selected projects. Each Ingeniería 2030 project commits to transform engineering in Chile following a different strategic plan, but with similar central guidelines specified by CORFO. The sample represents approximately 20% of undergraduate engineering students enrolled in Chile.

Overall, 20 people were involved in this research through a semi-structured interview. The invitations to participate were sent via email to an initial group selected from the schools websites. We were looking primarily for Ingeniería 2030 professional staff members who work supporting and promoting student entrepreneurship. Next, a snowball method was used to invite more participants. Thus, 13 professional staff, 4 authorities (assistant directors, project and school chairs), and 3 faculty members were interviewed. The interviews were typically one hour long and were subsequently transcribed verbatim. The interview consisted of experiences in supporting and encouraging entrepreneurship in their school, describing the support systems in place, and identifying their critical aspects. Along with the interviews, an exhaustive review of documents and web sites was carried out to guide the study and increase trustworthiness.

The analysis of the interviews was conducted along with the review of a field diary, notes taken by the researchers right after each interview, which helped glimpse the common patterns and issues that need to be further investigated. In the interest of full disclosure, it is important to note that the authors are interested parties at one of the selected schools (UChile), which presents limitations in terms of potential biases, but also important prior knowledge of the phenomenon under study. Furthermore, both authors met frequently to compare and discuss the analysis of the interviews and documents.

Results

Our findings suggest that the strategies from the five engineering schools used to support entrepreneurship education can be divided into four themes regarding tensions and challenges. (1) A tension between these mostly traditional schools and what is expected of them as entrepreneurial institution, distinguishing two models: a bottom-up model, in which there is an evangelization effect, led by Ingeniería 2030 staff, students, and some faculty who are motivated by the idea of introducing entrepreneurship in the school. On the other hand, schools follow a top-down model, in which university authorities push entrepreneurship throughout the organization. (2) A struggle to balance and connect curricular and co-curricular activities. In some schools, the entrepreneurship curriculum has a universal structure that seeks to impact all students, while in others the structures are less clear and with a smaller target student population.

In terms of co-curriculum, there are key differences regarding frequency of activities and student participation. (3) A tension between research and entrepreneurship incentives for faculty members, which is seen as a barrier to engage them in entrepreneurial education initiatives. (4) Finally, we observed the challenge of balancing students' academic demands and their interest in participating in entrepreneurship activities, regardless of their socio-demographic characteristics or academic records. These four themes are related to each other as shown in Figure 1.

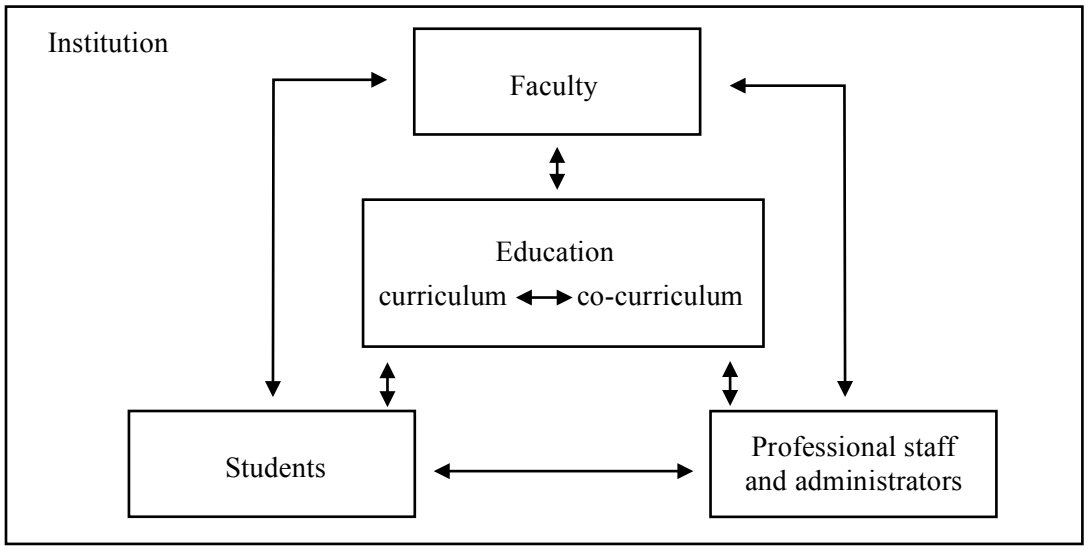

Figure 1. Themes of student entrepreneurship support strategies.

Institutional tension: traditional or entrepreneurial university

Universities such as PUC, UChile, USACH and UTalca tend to have rigid structures and bureaucratic processes, while entrepreneurship by definition implies fluidity and rapid adaptation to change and failure. Thus, entrepreneurship must overcome several discussions and procedures, which generate a gap between the aspiration of becoming entrepreneurial and what the organization actually values and does. This tension is less present at UAI, a small and private institution with a strong business orientation.

The institutional effort to overcome this tension can be characterized by two models: bottom-up and top-down. In the bottom-up model there is an "evangelizing" effect, where Ingeniería 2030 staff and a handful of faculty members or students prone to entrepreneurship begin a process of convincing others. The idea of supporting student entrepreneurship at UChile, for example, is mainly bottom-up: a group of staff, who joined UChile with the Ingeniería 2030 project, are the ones who have assumed the mobilization role. They started working specifically with faculty members in their courses. By showing results and seeking allies, they have tried to convince the institution of the importance and impact of entrepreneurship education.

> At the end of the day, we are a bit alone here, trying to promote something. It is like if we were not part of the School. I feel it in that way […] We are a couple of people seated here, trying to move an elephant, to move a car, but not because this is important for us. It

> is because others are going to benefit, and that is what moves me. Because I know how important this is for students. I know how much they change reality when you give them tools; you can achieve incredible things (Ingeniería 2030 staff member, UChile).

The idea of an engineering school left behind by the global trends is an idea the Ingeniería 2030 staff use to push their organizations to embrace entrepreneurship education. Thus, moving from their traditional role towards an entrepreneurial institution is seen as a transition to a new state in engineering education. According to Ingeniería 2030 staff, this transition has been a success at USACH. The newcomer staff were seen at the beginning as "odd buds inside the structure". The faculty authorities did not have a clear understanding of the concept of entrepreneurship when Ingeniería 2030 began, but with time they integrated it. Authorities integrate entrepreneurship into their discourse, which mobilized people.

When the idea of entrepreneurship is present in the discourse of the highest authority, the idea flows downwards and transcends faculty members, staff, and students. In our sample, the top-down model is best reflected at the PUC case. Here, the Ingeniería 2030 project strengthened an already existing emphasis already in the dean, increasing its importance among the faculty members and other actors, who did not necessarily share the vision of the entrepreneurial engineer. One strategy was to make them see that this was a public policy matter and not some whimsical move on the part of the authorities in charge. It was the country that was pushing these changes forward. Thus, the faculty members began to realize that something had to be done. Professors sought to involve their students in projects and talked about it in their lectures. The resistance was reduced to a minimum.

> When you are innovating, there would be always an institutional challenge. The institution pushes you backwards, especially in big universities such as PUC and UChile, which are very bureaucratic. But when I present Ingeniería 2030, I say 'this without a dean who pushes the institution does not exist.' I mean a dean getting into fights with people with old ideas. Our dean pushed this ship because he did all the necessary things for this to happen. (Faculty member, PUC)

UTalca, located in the Maule Region and a smaller institution than PUC, UChile and USACH, responds to a different context. The institutional support comes mainly from the authorities at the central level. UTalca presents a top-down model, where the commitment to entrepreneurship starts from the President and flows downwards. However, at the school of engineering, only some departments are embracing entrepreneurship—Industrial Engineering, Mechatronic Engineering, and Mechanical Engineering. Their majors have integrated the concept of entrepreneurship and pushed the rest to continue on this path. At UAI, a similar phenomenon takes place. Although these institutions have a different orientation, both have convinced authorities and continue to push for change, trying to reach other faculty members and academic units. For now, a staff notes they are still 'stepping on uncharted waters'.

Curricular trajectory and co-curricular potential

On one hand, regarding the curricular trajectory of entrepreneurship, we can observe a wide spectrum of cases, from schools with none or occasionally elective entrepreneurship courses to a

whole sequence of courses that includes mandatory and elective ones. On the other hand, there are co-curricular activities called to complement the curriculum. Here, we also observed cases from those with a handful of activities over the semester to those with a highly dense group of co-curricular activities.

UChile, USACH and UTalca present an undefined curricular trajectory for those students interested in entrepreneurship. There has not been a 'curricular disruption.' In these schools, students have the possibility of taking some courses where they are introduced the concepts of innovation and entrepreneurship, but these courses are rather isolated, and disconnected from each other.

> The strategy for training these [entrepreneurial] skills is a longitudinal one, throughout the whole academic plan, in a curricular trajectory. [But] we always try to make this by putting courses in certain points of the academic program, even complementing with extra-curricular activities, with the risk of students not getting well trained […] (Ingeniería 2030 staff member, USACH)

Understanding the need for a curricular trajectory brings about the questions about its design. One alternative is a partial trajectory, where first year students are introduced to entrepreneurship issues, and then they have the option to follow a sequence of entrepreneurial courses. This is the PUC case, where students are faced with a flexible curriculum, which allows them to direct their training toward entrepreneurship if they wish. However, this is not mandatory for all. Another model is a universal trajectory, which consists of a progression of compulsory courses inclined to the practice and learning of entrepreneurship. This is the UAI case. The institution supports entrepreneurship through the curriculum, generating a track of courses throughout the program, across all engineering majors.

The co-curricular initiatives to support entrepreneurship are usually open and occur in collaborative spaces, in which people have the chance to do networking everyday. In these spaces people come to develop and receive help to materialize an idea. They are rather informal spaces, where informal language is used and relationships are horizontal. The characteristics that these co-curricular initiatives adopt, and how they interact with the curriculum, allow us to identify schools where these structures are less empowered, that is to say, with sporadic activities and little coordination with the program core curriculum. For example, UAI is still working on having their co-curricular initiatives in harmony with their track of courses. Their co-curricula initiatives are intermittent. There used to be an open door space whose mission was to receive student projects, but it did not have the expected performance, so it stopped operations, and it is under redesign.

UTalca, UChile, and USACH have a higher density of co-curricular activities. UTalca, has a clear regional orientation. UTalca generates alliances with other regional entities, such as Co-working Maule, giving access to its students to tools for the creation of new projects. At the school level, they have what is called "Unidad de Proyectos", created by Ingeniería 2030, which offers funding for students and other people for the region. Co-curricular activities are initiated in the engineering school, but the Ingeniería 2030 staff emphasize that the participation of undergraduate students, despite of the diffusion, is low.

UChile also offers most of the support for entrepreneurship through co-curricular structures, where there are co-work spaces, which give constant guidance to students. It is perceived that these spaces would be filled with more projects if they could pick up what is coming out from mandatory courses. At USACH, there is a greater link with the university's support structure for entrepreneurship. The main promotion and support to entrepreneurship in the school is the acceleration of a project at early stages, which over time has been moving from being a contest to a training course. However, as stated, this university's structure does not go hand in hand with the engineering curriculum.

Finally, PUC solves the connection between the curricular and the co-curricular by guiding students who wish to develop a project through different lines of support, articulated through what they call an "invisible curriculum." This curriculum feeds from the projects that come out of the courses and from co-curricular activities. There are acceleration programs for scientific-technological, social innovation, and software projects, and the dissemination of these activities aims to generate an entrepreneurial culture at the school and the entire University.

In sum, Figure 2 classifies schools according the institutional and curricular theme.

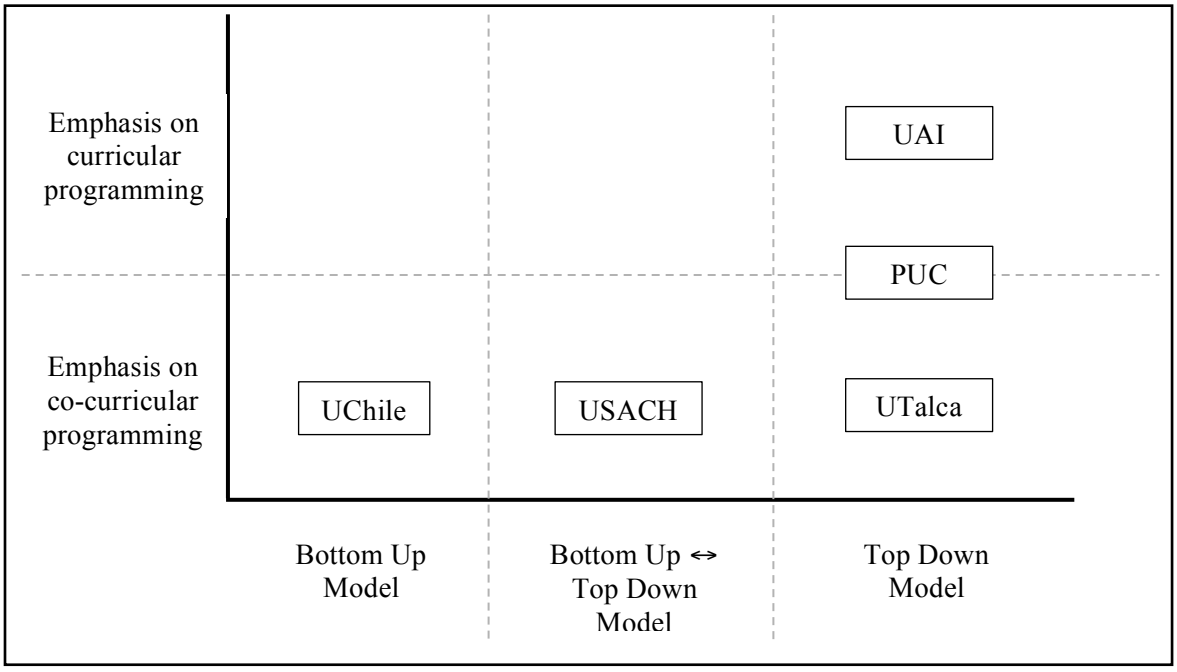

Figure 2. Institutional approaches to change and curricular emphases by schools

Engineering faculty members: research demands as a barrier for entrepreneurship education.

The third theme deals with faculty members, fundamental actors for the support of student's entrepreneurship projects. Faculty members usually guide student in the development of their projects. Among faculty members, there seems to be a tension between the demands unleashed when involved in entrepreneurial projects and the rewards of research in the academic career.

This happens across all the studied schools. When speaking of promoting and supporting entrepreneurial students, the professor appears playing a fundamental role, in particular for those ideas with a scientific-technological base. Faculty members who support the introduction of entrepreneurship skills have characteristics that make them stand out: highly committed to their teaching role throughout the duration of the course, constantly communicating with and giving feedback to students, and prone to apply different pedagogical methods in their classrooms.

Entrepreneurship in public universities such as USACH and UChile is usually understood as business development. Some faculty members argue this does not relate well with the public role these public universities should keep and promote. They see a conflict between the business orientation and the public good. This way of conceptualizing entrepreneurship usually acts as a limitation to engage professors in the Ingeniería 2030 initiatives.

> It is complex to talk about entrepreneurship, and there is not even a belief on it. They [Faculty members] say, 'we are a public university, we have no reasons to be doing business,' so I think that is a difficulty, if not a weakness, or a threat [...] In our case, which is not the case of UChile, the average age we have in our academic staff is over 60 years, and that is also an issue of why change management is a bit slower, or more complex, more uphill. (Ingeniería 2030 staff, USACH)

At UChile, the professor stands out as a guide. Ingeniería 2030 has a stable pool of faculty members who are usually the most restless when it comes to these issues, and who easily connect with students who want to raise a project. Their role is key in order to create a virtuous cycle of student support, and technical guidance is needed to generate high impact projects. At USACH, engagement with entrepreneurship happens in two ways: (1) through being mentors of student's ideas at the early stages and (2) through the acceleration of their research projects. At UTalca, engineering faculty develop projects and support entrepreneurship through their classes, or mentoring students, but there is still a long way to go in strengthening the support of professors in these issues.

PUC also identifies faculty as fundamental actors who promote entrepreneurship inside the classrooms. When pushing faculty towards the promotion of entrepreneurship, they make a strategic decision: (1) do not force professors who do not wish to enter to or do not feel convinced with the entrepreneurship world; (2) talk to them with concepts they understand; and (3) communicate that since entrepreneurship is taught through different disciplines, it should not be seen as a single concept, which also need technical knowledge from engineering disciplines.

At UAI, there is the perception that from the student's point of view, professional staff and faculty are not interested in entrepreneurship. Faculty members focus on researching and publishing, mainly due to the UAI's incentive system. The institution encourages their faculty to generate research that can be measured by the number of publications. If a faculty member does not achieve the number of publications expected by the institution, his or her teaching hours will increase the following semester. According to Ingeniería 2030 staff, "this is what a professor wants least", so instead of dedicating hours to support student projects, professors prefer to stay on the sidelines and comply with what the institution demands. The tension gest stronger,

because the institution does not generate incentives for professors to get involved in entrepreneurship projects or the generation of intellectual property related to them.

At PUC the tension can be categorized as "moderate", because the role of professors in entrepreneurship issues is understood from the perspective of research. The link with the student, a graduate student in general, to work in entrepreneurship projects is through a research project that a student proposes to a professor or vice versa. There is also a policy of incentives to generate patents, which mobilize the faculty to carry out projects. Nevertheless, PUC still has a way to go in terms of managing intellectual property generated at the university with students. At UChile, the tension is stronger, and there is no policy or incentives that mobilizes faculty to develop entrepreneurial projects. Even though there are indeed groups of professors who open the doors to students to develop projects, there is not a clear norm about student's intellectual property, which is seen as a barrier to get even more faculty engagement. At UTalca and USACH, there is also a strong tension, in terms of the objectives faculty members pursue. Generating or strengthening entrepreneurship is among them, and there are structural shortcomings around incentivizing them.

> The incentives are also important. This is a great weakness the universities have today. Faculty is not evaluated by [their entrepreneurial activities]. They are evaluated by other things. So, while we don't get a greater flexibility in the incentive system, their participation in our activities will be difficult. However, they are giving support, facilitating, and developing entrepreneurial skills in their students, their participation is important. (Ingeniería 2030 staff member, UChile)

Students: involved in entrepreneurial activities versus academic loads

Students are the fundamental actors Ingeniería 2030 wants to encourage and mobilize. However, when asking about their participation in entrepreneurship initiatives, we find that their motivations are diminished by the fact of facing a high academic burden from their first year. In addition, the schools do not necessarily invest time in understanding the relationship between their student's characteristics and student's involvement in entrepreneurial activities.

The high academic load at UChile is seen as a challenge when it comes to promote an entrepreneurship ecosystem. Ingeniería 2030 staff say this situation "kills" them (in a figurative sense). There are incredible projects raised by the students, but they have to throw them away because they cannot reconcile their studies with developing their projects. In this sense, the impact of the initiatives that promote entrepreneurship in students within the school of engineering at UChile is low. The initiatives try to adapt to the academic environment, but they cannot "put more stones in student's backpacks." At UTalca, the staff also acknowledge the academic load negatively influences undergraduate students' participation in entrepreneurial projects. Very few students are able to fully develop their project.

At USACH, Ingeniería 2030 staff also perceives that student's participation in entrepreneurship courses, such as competitions, is reduced due to lack of time. This was one of the reasons why the open innovation program, Lions Up, became part of the training as an elective course. Thus,

because the students could make it part of their formal academic load, the engineering school recognizes their effort through valid credits.

> Something we cannot do is to incentive students to drop their studies out, because the university's heart is to teach and help students to finish their programs. But what happens if someone wants to follow an entrepreneur's path. He or she will dropout, and that happens. There are some students who go away to start their projects and dropout from their programs, but we believe that is not the focus. There must be a way to insert them into the academic structure, to make them feel this is also part of their education. (Ingeniería 2030 staff member, USACH)

At UAI and PUC, the academic load does not appear as a factor that discourages the student's participation. This may be a sign that they give students more tools to handle their loads, or that within their curricular path they incorporate recognition of student's entrepreneurship. Following the results of this research, these two schools are those that have developed curricular trajectories around entrepreneurship, which means that students can develop projects within their formal academic load.

Just as the academic load is an important factor when developing a strategy to support entrepreneurship, the student's characteristics of those who wish to be entrepreneurs must be also understood. At UChile, the entrepreneurial student is characterized as a person who in some way or another had an experience that made him or her wake up the "little bug" for entrepreneurship. This experience may be listening to a teacher, a talk, a workshop, or some experience outside the University. In addition, it is recognized that students who participate in projects are those who are mobilized by some mission, for example, creating a solar car or assembling a nanosatellite. They get involved in these types of experiences. Once they enter into the cycle, if they fail with an enterprise, they reinvent themselves and launch another one.

USACH receives students who are mostly from low socio-economic status, and the majority is also first generation in college. This implies that students who decide to pursue a venture are not those with a "large family mattress", that is, a large family economic support. Students expect to finish their programs, get their degrees, and improve their family income. However, they are still interested in entrepreneurship, and enroll in its programs. Usually, these students see entrepreneurship as a way of generating social impact through engineering. UTalca's students share similar socioeconomic characteristics than those at USACH. For instance, about, 70% of them receive some benefit from the State. The majority of them come from the Maule region. Those that come with the "little bug" inside are those who get involved in entrepreneurship activities.

The situation at UAI is different. Most students come from well-off families. Ingeniería 2030 staff members perceive students do not understand the whole reality of the country they live in. Then, it is difficult for them to generate a project that positively impacts society. However, there are some students for whom entrepreneurship is attractive, and they get good ideas in the process, but other students have their work life already defined. In the words of one of the staff, the profile of the UAI engineering students is "management in ...". They are trained to carry out,

for example, the commercial management, or the technical and financial management of well-established companies.

> In this University there is also a lot of sloth from students. This is a University that enrolls daughters and sons from top executives or owners of big companies, the biggest companies in Chile, mining companies, for instance. So, they know after school they will have enough resources to live, because their families have tons of resources […] However, there is also this other type of students, who have strong work ethics and that in general want to do things such as working with a professor or start an entrepreneurship. (Faculty member, UAI)

PUC students feature similar characteristics of those at UAI. Some students enroll in engineering with the idea of continuing the family business. However, the school strongly encourages the teaching of entrepreneurship skills to their students so they can develop it in their professional life, either by launching their own project or in a public or private organization. When they engage in entrepreneurship they see it as a way of generating social impact.

What are the main strategies the selected engineering schools use for the promotion of entrepreneurship education?

As a synthesis of these four theme, it is clear from the analysis of the results that the first theme deals with the institutional tension, the second theme deals with the curricular track and the co-curricular power, the third theme talks about the tension that involve to faculty members, finally, the fourth theme deals with the tension of the students to develop entrepreneurship projects. Table 1 shows levels of each theme, referred to in this article.

Table 1. Themes characterized by levels

Themes	Levels		
Institutional approaches to change	Bottom Up Model	Bottom Up ↔ Top Down Model	Top Down Model
Curricular emphases	Emphasis on curricular programming	Emphasis on curricular ↔ co-curricular programming	Emphasis on co-curricular programming
Tension on the incentives of faculty members	Weak Tension	Medium Tension	High Tension
Students: participation in entrepreneurship initiatives	Academic loads	Students motivation	

Conclusion

This article presents a general vision of Ingeniería 2030 at five selected engineering schools, from the perspective of the professional staff who is in charge of the changes in each school. Our findings follow the model described by Graham [11]. We observed the two approaches to change in action: bottom-up and top-down. Each of them responds to a particular school environment. According to Graham [11], the combination of both strategies ensures the sustainability of the changes. We see that the studied engineering schools were moving in that direction.

Over the last two decades, entrepreneurship education has become an integral part engineering education, based on curricular and co-curricular experience [10]. Chilean engineering schools are following these trends. Two of the five schools included entrepreneurship into their core curricula. The other three are promoting a wide range of co-curricular activities. PUC appears as the institution that is achieving the best balance between the two.

According to Byers et al. [13], to engage faculty is as important as the commitment of institutional authorities. In all studied cases, we found a lack of incentives for promoting entrepreneurship and a lack of definitions about intellectual property issues. These matters act as key barriers for faculty participation in the promotion of entrepreneurship among undergraduate students. This becomes crucial as institutions have strong incentive structures in place for faculty research.

The question of equity in the distribution of opportunities for entrepreneurship education and activities among a diverse group of students should be a core part of engineering education, as well. Our study suggests that students get involved in certain types of entrepreneurship activities according to their socio-demographic characteristics. If schools do not pay attention to the characteristics of the students they are or are not attracting, we run the risk of creating a structural homogeneity in the field of entrepreneurship education, which may compromise the diversity and vitality of the field. For instance, we found almost no specific concern about the participation of female students, which are underrepresented in engineering schools in Chile. Also, schools are becoming aware of the constraints of an inflexible curricular, when attracting engineering students to entrepreneurship.

This study encourages future researchers to measure the impact and the level of success of the different strategies presented here. Along the same line, this study sought to understand the strategies for the promotion of entrepreneurship education at five engineering schools from the perspective of their Ingeniería 2030 staff. Even though this narrow scope is a limitation of the study, professional staff members are the actors who are in the front line of the field, and whose voices are usually underrepresented in higher education studies. Future research should investigate the influence of Ingeniería 2030 from the perspective of other actors, such as faculty, students, and other members of the community. The research presented here contributes to understanding how ambitious national policies get enacted and shaped by the particular context of each engineering school. Understanding these organizational processes would be the key for the sustainability of this and other efforts.

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