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Technology-based entrepreneurship enabling factors in higher education institutions with a limited entrepreneurial trajectory in Colombia

Factores habilitantes del emprendimiento de base tecnológica en instituciones de educación superior con limitada trayectoria emprendedora en Colombia

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Abstract

Higher education institutions as Technology-Based Entrepreneurship Development Centers (TBE) are among the strategic bets to encourage the creation and consolidation of companies with a solid scientific-technological component. This study seeks to identify those factors enabling the promotion of a TBE culture in higher education institutions with limited experience in entrepreneurship in Colombia, based on a case study in Universidad del Valle's (Colombia) regionalization system. The methodology applied the *World Café* technique on interdisciplinary group sessions with coordinators of Universidad del Valle - Palmira Campus - academic programs, who were asked about their perceptions regarding TBE and were also asked to identify strengths, weaknesses, opportunities, and threats under a collaborative work scheme, which were subjected to content analysis. The results prove that developing a TBE culture demands abundant resources, and the strategic leadership needs special strengthening to have TBE included in strategic and tactical planning and the goals and indicators set to allow monitoring over time. Likewise, institutional capabilities, budgeting, the qualification of human resources, investment in laboratories, and relationships with the actors in the entrepreneurial ecosystem need strengthening. Finally, the conclusion is drawn that TBE is an opportunity for the University-Company-State-Society articulation and the consolidation of companies that energize the business fabric and bring resources and recognition to higher education institutions.

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Keywords: Technology-based Entrepreneurship, Emerging Organizations, University Entrepreneurship, Disruptive Innovation, World Café.

Resumen

Las instituciones de educación superior como centros de desarrollo de Emprendimientos de Base Tecnológica (EBT), son una de las apuestas estratégicas para incentivar el surgimiento y consolidación de empresas con alto componente científico-tecnológico. Este estudio busca identificar los factores habilitantes del fomento de una cultura por el EBT en instituciones de educación superior con limitada trayectoria en emprendimiento en Colombia, a partir de un estudio de caso en el sistema de regionalización de la Universidad del Valle (Colombia). La metodología empleó la técnica *World Café* en sesiones de grupo interdisciplinarias con coordinadores de programas académicos de la Universidad del Valle, sede Palmira, a quienes se indagó por sus percepciones sobre el EBT y se solicitó bajo un esquema de trabajo colaborativo la identificación de fortalezas, debilidades, oportunidades y amenazas, que se sometieron a análisis de contenido. Los resultados reflejan que el desarrollo de una cultura por el EBT exige un elevado uso de recursos y se requiere especialmente fortalecer el liderazgo estratégico que permita incluir el EBT en la planeación estratégica y táctica, así como en la definición de metas e indicadores para su seguimiento en el tiempo. Así mismo, deben fortalecerse las capacidades institucionales, prever un presupuesto, la cualificación del talento humano, inversión en laboratorios y relacionamiento con actores del ecosistema emprendedor. Finalmente, se concluye que el EBT es una oportunidad para la articulación Universidad-Empresa-Estado-Sociedad y la consolidación negocios que dinamizan el tejido empresarial, generan recursos y reconocimiento para las instituciones de educación superior.

Palabras Clave: Emprendimiento de base tecnológica, Organizaciones emergentes, Emprendimiento universitario, Innovación disruptiva, World Café.

1. Introduction

Higher Education institutions (HEIs) at a global level, as future professionals' training centers or settings, are known as key actors in addressing socio-environmental issues and the positive transformation of society, where research, technological development, and innovation are central elements. Likewise, HEIs' potential for creating innovative companies is well known (Ocampo, Ramirez Rendon, and Velez, 2019), wherefore Technology-based Entrepreneurship (TBE) has become States' strategic bet through public policy. Also, an institutional framework has emerged to encourage science, technology, and innovation transferring and the growth of companies with a solid scientific-technological component (Kantis and Angelelli, 2020).

The technological environment is well-known as ever-changing at the business level, highly influenced by the development of scientific advancements, which lead to recurrent changes in business models, production processes, and the value offer to customers (Autio, 1997; Shih and Aaboen, 2019; Martínez, Guillo, and Santero, 2019). That field recognizes TBE's ability to strengthen a country's business fabric because it offers the market services and products of extraordinary capabilities and novel solutions to unsatisfied and emerging needs, based on innovation and undoubted economic and social impact. Also because it facilitates technology transfer from creation (HEIs) to markets and society (Martínez *et al.,* 2019).

HEIs are called to be genuine agents of change, and the multiple actors are expected to play the role of disruptors in creating TBE, based on a paradigm shift and the role that HEIs play for society (Cimoli, Calza, Laplane, Martínez, and Rovira, 2010; Cruz and Quilapay, 2014; Christensen, Ojomo, and Dillon, 2019). This field has begun to see changes globally. For example, at Sweden's Linnaeus University, doctoral students enroll in entrepreneurship courses that encourage them to think up business models (Kantis and Angelelli, 2020).

While it is accepted that HEIs should encourage TBE and foster links with society for adopting progress and scientific-technological developments (Clark, 1998; Howard and Sharma, 2006; Shane, 2009; Cimoli *et al.,* 2010; Perkmann *et al.,* 2013; Fichter and Tiemann, 2018), advancements are limited in Latin America. HEIs' closest approximation to such a missional duty is disseminating and commercializing patents registered by their researchers. Furthermore, publications in high-impact journals have been academics' main target, as well as their career as researchers, while result transferring to productive models has not been continuous (Kantis and Angelelli, 2020). Likewise, in Latin America and particularly in Colombia, the capabilities and

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resources available to HEIs to promote TBE are regionally disparate.

In the face of such a context, this paper seeks to identify those factors enabling the promotion of a TBE culture in higher education institutions with limited experience in entrepreneurship in Colombia, based on a case study in Universidad del Valle's regionalization system.

2. Theoretical Framework

2.1. Technology-Based Entrepreneurship

TBE originated in the work of Little (1977), who conceived it as independently owned businesses based on the exploitation of an invention or technological innovation by undertaking substantial technological risks for no more than 25 years (Little, 1977). However, this paper addresses TBE as organizations that produce goods and services, oriented to designing, developing, and producing new products and/or innovative manufacturing processes by systematically applying technical and scientific knowledge (US Congress Office of Technology Assessment, 1992).

Research, knowledge, innovation, scaling, and entrepreneurial spirit underpin TBE. It also focuses on customer and user benefits from producing high added value goods and/or services. TBE can be integrated into into an existing company or in a university context through research and development (Colciencias, Corporación Ruta N Medellín and Corporación Tecnnova UEE, 2016). Nevertheless, as specialized knowledge is required, the human factor needs to be better educated and skilled (Morales and Castellanos, 2007).

Knowledge management, as new business models' essential process to success, affords TBE a leading role as a crucial player for the development of economies since its raison d'etre is to yield innovative products or services based on the applicability of knowledge and immersion in new technologies (Morales and Castellanos, 2007).

According to the Organization for Economic Cooperation and Development [OECD] (2017), in recent years, venture capital investments, both in the United States and Europe, have concentrated in information and communication technologies (ICT) and life sciences; 53.6% and 20.7%, respectively, in the US. In Europe, the ICT sector drew significant venture capital investments (44% of the total), followed by life sciences (27%) (OECD, 2017).

Entrepreneurship is intensely concentrated in the services sector, mediated by easily accessible digital tools and platforms (e-commerce, matchmakers, video-streamings, and crowdfunding). These have begun to harness knowledge intensively, reconfiguring the worldwide business fabric dynamics. This will bring innovative digital and technology-based ventures accelerated development and growth to (OECD, 2017).

In the face of such a global panorama, Latin America is lagging on account of substantial innovation gaps, not only in technological research and development and patents but also in product and process innovation. Even Latin American multinational companies are behind on innovation (World Bank, 2014). The foregoing is partly explained due to broad-scoped innovative entrepreneurship policies' focus, the weaknesses and gaps in national innovation systems, and the limited attention paid to TBE, failing to acknowledge differentiated needs (Kantis and Angelelli, 2020).

The Colombian panorama is akin to the Latin American, wherefore among the existing challenges is gearing research, technological development, and scientific advancements towards the development and creation of TBE. Although there is an amounting number of startups being created and expanding in Colombia (Pérez, 2019), and entrepreneurship has gained a prominent place in the government's economic development strategy, which explains why entrepreneurial ecosystems have grown in the country's main cities (where chambers of commerce, universities, and municipalities participate along with startups incubators, firms venture capital, angel investors and innovation labs (GEM, 2020)), innovation-oriented public and private investment falls quite short compared against countries with higher development indexes. According

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to Lucio-Álvarez, Guevara-Rey, Perea, Garavito-Muñoz, Segura-Sguerra, Ramírez-Sánchez, Romero-Riaño, Cifuentes-Mirke, Castellanos, Zárate-Rincón, Mora-Holguín, Caho-Rodríguez, and Rocha- Gutiérrez (2020), investment in science, technology and innovation in Colombia barely reached 0.74% of the 2019 national GDP.

2.2. TBE-HEIs relationship

HEIs are playing a leading role in promoting innovative and technology-based ventures (Åstebro, Bazzazian, and Braguinsky, 2012) since they have understood that efforts should be focused on promoting the spin-offs that build on research projects results and on seeing themselves as innovation centers intertwined with other actors in the entrepreneurial ecosystem to which they belong. A more open posture towards developing companies mediated by knowledge and the use of digital technologies is sought out (Kantis and Angelelli, 2020).

Lately, HEIs have undertaken the third mission as societal agents of change, the so-called outreach and/or social projection (Bueno, 2007). This way, HEIs have the opportunity to project knowledge generated towards society through the development of enterprises based on scientific-technological advancements, which favors the emergence of new TBEs (Gómez, 2019).

In fact, TBEs as productive units might be the way to boost productivity and, therefore, the government policies work in favor of promoting the third HEIs mission. Furthermore, they encourage university-company-state-civil society relationships, which are conducive to employment generation and social cohesion (Clark, 1998; Howard and Sharma, 2006; Cimoli *et al.,* 2010; Fichter and Tiemann, 2018; Gómez, 2019).

Regarding the Colombian context, legally speaking, it is essential to highlight that Law 1014 of 2006 fosters a culture of entrepreneurship. Also, the National Entrepreneurship Policy was enacted in 2009, which seeks to simplify creation procedures, improved access to financed capital, and support counseling services for entrepreneurs. Likewise, Law 1838 of 2017 seeks to promote "science, technology and innovation through the creation of technology-based companies (*Spin-off)*" (Law 1838, 2017). Said Law also wants public or private HEIs to generate technology-based ventures, also known as spin-offs, derived from research projects, where researchers, teachers, students, and other actors are strongly encouraged by exploiting their outputs.

The Colombian regulatory framework is conducive to TBE advancement at the level of HEIs and can be an alternative for them to bring about tax revenues and technology businesses capable of international competition (Rasmussen and Wright, 2015). However, per Gómez (2019), HEIs resources need strengthening and boosting to develop and promote a TBE culture. Along these lines, Hernández, Álvarez, Blanco, and Carvajal (2013) argue that there are gaps or little clarity regarding economic rights and intellectual property concerning the development of TBE. Also, researchers, teachers, students, and other interested parties face challenges in avoiding conflicts of interest regarding the economic interests of these ventures.

Framed therein, TBEs carry a close relationship with HEIs because their definition explicitly lies in exploiting scientific-technological knowledge in favor of the generation of products or services. That does not mean that other knowledge-intensive organizations do not exploit their intangible resources in this same way. Therefore, HEIs, on account of their raison d'être, must harness their resources to foster the entrepreneurial spirit, strengthen relationships with companies and create alliances to boost their intangible resources in favor of TBE.

3. Methodology

3.1. The Universidad del Valle and the regionalization system: a case study

The Universidad del Valle is a regional-scope public higher education institution in western Colombia, headquartered in Santiago de Cali and it has eight regional facilities in Valle del Cauca in Caicedonia, Zarzal, Cartago, Tuluá, Buga, Buenaventura, Yumbo, Palmira and a facility in the department

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Table 1. Univalle's Institutional Entrepreneurship Program Components

Component	Description
Training	Complementary elective courses: Creativity Development, Customer Development, Entrepreneurial Project Development, Entrepreneurship, Culture and City, Entrepreneurship and Social Innovation
Entrepreneurial Pathway	Ideation workshop using the Design Thinking methodology. Validation workshop based on the Lean Startup methodology. Prototyping workshop (methodology not listed) Business plan and model workshop, grounded in the Canvas Business Model.
Counseling and Follow-up	Students who have a business idea are provided personalized counseling. That counseling seeks to structure entrepreneurship projects for submission to calls and/or contests for seed capital.
Strengthening Entrepreneurial Culture	Sinergy Coffee Space: monthly space for graduates and entrepreneurs. UV Ágora: annual thematic space (seminars, symposia, business fairs, etc.) that provides practical foundations and regional context-appropriate tools.

Source: Adapted from the website of the Universidad del Valle of the Entrepreneurs Program (www.univalle.edu.co)

of Cauca, specifically in Santander de Quilichao. The regional facilities make up the regionalization system that historically has been more teaching-oriented, the contributions of which are noteworthy concerning professional and technologists' training. The University has in place an internal policy to promote entrepreneurship based on its outreach and social projection axes[1]. However, despite a long history and relevance, the high-value entrepreneurship promotion policy has yielded differentiated results. It has failed to significantly advance entrepreneurship regionally speaking, even though the university's various facilities are located in subregions with high potential for business development and creation.

Entrepreneurship is enshrined in the "Institutional Entrepreneurs Program" (IEP) created on December 12, 2005, and enacted under Resolution No. 073, the purpose of which is to strengthen students' entrepreneurial potential through the development of skills to conceive, plan and launch new for-profit or non-profit, self-managed, collective or associative organizations (Table 1).

Although the Cali headquarters have seen some progress in implementing the entrepreneurship policy, yielding results in pre-incubation, support in incubation processes; also, a range of complementary courses have been developed. At the regional facilities, the offer of entrepreneurship courses is at the programs' coordinator's office discretion, and it is alliances with external initiatives such as the ValleInn program[2] and the different local entrepreneurship networks that mainly support entrepreneurship, primarily oriented towards validated and ongoing ventures.

In particular, the case study focused on the Palmira campus, which offers majors such as Business Administration, Public Accounting, Industrial Engineering, Systems Technology, Food Technology, Electronics Technology, Agro-environmental Technology, Agroforestry Technology, Technology in Logistics Management, Technology in Mobility and Road Safety, Technology in Maintenance of Electromechanical Systems, Technology in Welded Constructions, Psychology, Bachelor's Degree in Physical Education, Bachelor's Degree in Literature and Diploma Courses and Workshops. Concerning postgraduate studies, the facility offers a Master's Degree in Project Management. Entrepreneurship at the facility has benefited from its articulation with the I +[3] Entrepreneurship Network. Nevertheless, a large share of the results in entrepreneurship from this regional facility come from individual initiatives, wherefore

[1] Universidad del Valle (2015) 2015-2025 Strategic Development Plan, Universidad del Valle, Cali, Colombia.

[2] An Entrepreneurship program that provides multiple services and personalized and specialized advice to people in the process of ideating a business or to companies being consolidated in a market. It works through the nine Valle INN Entrepreneurship and Innovation Centers, located throughout the Valle del Cauca: Cali, Palmira, Yumbo, Buga, Tuluá, Cartago, Caicedonia, Zarzal, and Buenaventura." Per the Valle Governorate and retrieved from HTTPS: //www.valledelcauca.gov.co/competitividad/publicaciones/60455/que-es-valle-inn/ on April 11, 2021.

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there is no historical documentation, records in the institutional platforms and systems, information on the undertaking's evolution, or management indicators that enable traceability over time.

3.2. Methods

The methodological strategy followed a qualitative, exploratory, and descriptive approach. A *World Café* was implemented for primary-source information gathering purposes. Ten professors in charge of academic programs at the HEI subject matter hereof, who have been in university teaching for more than 15 years, participated, thus contributing to a broad and holistic outlook of the entrepreneurial landscape from an interdisciplinary perspective.

According to Brown and Isaacs (2006), the *world café* is a technique devised to allow the people who will be the subjects of a study to make connections between concepts, ideas, and people, thus fostering active listening, respect, participation, and the creation of knowledge to be shared through working in small groups gathered around thematic tables. During the *world café* exercise, the participants switched conversation groups to partake in all conversations, make contributions, and build knowledge through their knowledge and experiences, based on thematic axes and guiding questions (Table 2).

Table 2. Description of the thematic axes and questions by analysis category

Thematic Axis	**Competencies and capabilities for TBE**	**Development and adaptation of university conditions**	**Emerging business models for economies in transition**	**TBE sustainability follow-up, evaluation, and monitoring**
Axis description	Includes a discussion regarding the technical knowledge and skills necessary for TBE development.	TBE development requires harnessing scientific-technological knowledge. Therefore, it is necessary to identify favoring university conditions.	Incorporating TBEs requires consolidated innovative business models adapted to the reality and economic, social, environmental, and cultural trends.	TBEs require resources and capabilities sustainable over time and reduced investment risk.
Category	**Questions by Category**			
Infrastructure	What infrastructure (laboratories, equipment) is needed to promote entrepreneurship, as available at the university?			
Human Resources	What are the specific competencies (for teachers, researchers, and students) necessary to develop disruptive entrepreneurship or TBEs in the university? What gaps (weaknesses) should be closed in the university regarding human resources? What are the university strengths that need boosting based on the development of human resources? How to articulate competencies in the university's academic offer? What changes does training require to ensure future professionals capable of disruptive ventures or TBE that impact business models through knowledge and sustainable resource use?			
Social, environmental and economic impact	What services should the university offer? What alliances and agreements are needed to promote disruptive ventures or TBE? How could the varying initiatives born in each program be articulated to foster collaborative and multidisciplinary ventures?			
Impact on the Departmental Innovation Index of Colombia (IDIC pr its acronym in Spanish)	What are the critical factors for university entrepreneurs to increase innovation as the basis for new business models?			

Source: Authors' own elaboration.

[3] It fosters an entrepreneurial culture and the development of competitive and innovative companies through institutional articulation in the municipalities of Palmira, Pradera, Florida, and Candelaria (Valle del Cauca), which provide comprehensive support services to the processes conducive to company positioning and growth; a contribution to the region's social and economic development (per the Palmira Chamber of Commerce).

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Each participant answered the guiding questions on *post-it notes* and classified them as strengths, weakness, opportunity, or threat in a matrix and according to their criteria. Subsequently, the information collected was systematized, analyzed, and cross-referenced to establish the enabling factors. The content analysis technique was employed for the approach. It allows extracting the meaningful message from the qualitative information collected (Aktouf, 2001; Abela, 2002; Cáceres, 2008)

4. Results and discussion

4.1. Professors' perspective on TBE in HEIs being studied

The *world café made it* possible to identify the professors' thoughts on TBE for the case study. For teachers, institutional strengths are evident in the teaching body because of their trajectory or experience in research and the installed capacity of laboratories and equipment. They also accounted for weaknesses such due to the lack of a research agenda, a high-value entrepreneurship culture, since the emphasis has been placed on subsistence entrepreneurship (traditional approach), and the lack of financing during early stages, among other things. Regarding opportunities, the teachers referred to technological programs, global economic trends, the local entrepreneurial ecosystem, among other things. The threats are in the form of the lack of continuity in the facility's institutional commitment to entrepreneurship and the lack of a budget for implementation of an entrepreneurship unit, among others (Table 3).

The participants in the world café hold the provision of a battery of processes and laboratories for experimentation and research in the field of chemistry, biology, food, and electronics as a strength. Regarding simulators, the institution has some simulated modeling and experimentation software; however, these are not exclusive to the facility. For its part, human resources are also regarded as a strength. The teachers' profiles show cutting-edge knowledge compatible with the scientific-technological advancements trending worldwide. However, the participants sustain human resource tenure, and stability is a weakness due to institutional liaisoning, which prevents long-term undertakings.

The participants identified the generation of ideas (ideation process and creativity) as a potential and, therefore, a strength. They also remind of consolidated business-experienced entrepreneurs who have gained experiences and knowledge, which could be a motivator.

The offer of entrepreneurship-oriented courses is an institutional strength as they are transversal to the academic programs. Nevertheless, some weaknesses include unsustainability in the programs' offer, limited development in entrepreneurship as a transversal axis across academic curricula, unlinked pedagogical strategies (casuistry), and the absence of training models in experiential entrepreneurship, where the master class and the traditional evaluation predominate.

Concerning opportunities, the participants spoke of nine technologists' programs focused on practical knowledge as attested in their micro-curricula; the weakness stems from the fact that entrepreneurship is not involved to complement the disciplinary component. Moreover, even though most teachers are real sector-experienced, which transcends the entrepreneurial itself, they fall short in involving topics such as innovation and business creation in their lectures.

Another strength the participants identified is the "entrepreneurial institutional program," which supports "outreach and social projection" within the frame of the institution's third missio goal, where a pathway for entrepreneurship is laid out. Regarding the case study, activities to promote entrepreneurship are evident; however, these do not fall under an agenda or work plan in articulation with the aforementioned program, which has shed light on a weakness. Furthermore, no resources have been allocated so as to maintain and sustain a detailed medium- and long-term program or plan framed within the program in question.

TBE culture-supporting alliances, agreements, or networks that might arise are among the opportunities the participants

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Table 3. TBE culture-given strengths, weaknesses, opportunities, and threat

Strengths	Opportunities
Full-time professors and adjunct faculty members for entrepreneurship (in). Laboratories (electronics, physics, chemistry, biology, food, and process plant) (i). Courses for entrepreneurship (f). Ideation potential (c). Institutional entrepreneurship program (in). Programs transversal to academic programs (f, in). Entrepreneurial spirit (c). Social networks and institutional channels (in). Consolidated entrepreneurs (c)	Promotion Programs (seed capital) (pp) Conpes Verde (3934) (pp) Alliance entrepreneurship-promoting networks, programs, and institutions (r) Geographic Location - (vc) Trends in collaborative economy - (en) Trends in ecological economy - (en) Articulation to bio-business initiatives (en) Seminars and Congresses on entrepreneurship (f, r) Entrepreneurship mainstreaming (f, in) New skills for entrepreneurship Entrepreneurial ecosystem (en, pp) Offer of technological programs (f)
Weaknesses	**Threats**
Research agenda at the facility (inv, in) Entrepreneurs division (i) Disarticulated laboratories (in) Laboratories for creativity and ideation (i) Operational staff for entrepreneurship (in) Business simulators (f, in) Traditional approach culture (c) Lack of knowledge about trends and new business models (en, f) Lack of knowledge about the institutional entrepreneurship policy, the Spin-offs Act, intellectual property, and the innovation reports route (pp, in, f) Curricular integration and innovation in the classroom (f) Continuity in entrepreneurship courses (in, f) Budget for entrepreneurship (in) Articulation among programs (in) Systematization and databases (in)	Tax reforms (pp) High facility directors turnover (in) Rotary planning and policies (in) Budget for higher education (pp) Budget for science, technology, and innovation (pp) Institutional recognition and credibility (in) Protection culture and use of biodiversity (c, en)

* i: Infrastructure; f: training and teaching; in: Institutional; inv: research; pp: public policy; r: networks; vc: competitive advantage; in: external environment; c: culture.

Source: Authors' own elaboration.

identified. In this regard, the regional facility is participating in a local entrepreneurship network in articulation with other higher education institutions, public institutions, and government agencies, which allows learning about events, training, and affords seed capital through prizes and contests, among other things. In addition, the need to build a database of entrepreneurs from the facility was made evident in the search for adding value to all actions implemented.

Other weaknesses the participants pointed out are the lack of an entrepreneur services-specialized office, decoupling between academic programs and laboratories, and the non-existence of a laboratory specialized in ideation, creativity, and design thinking that allows entrepreneurs to take their first steps in the path of entrepreneurship, prototyping, modeling, simulation running, market assessment, etc. Additionally, human resources are lacking to operationalize the entrepreneurial path laid down. There is no centralized monitoring of those activities carried out within the academic programs, which recurrently occur in isolation but are intended on generating a culture of entrepreneurship. The preceding also carries implications for curriculums and the teachers' initiatives within their academic freedoms.

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The participants maintain that leadership and direction are discontinuous processes because different types of leadership have come to pass in the last five years, influencing medium- and short-term entrepreneurship-focused actions. They further state that the facility has yet to implement an entrepreneurship policy; there only records of individual actions undertaken by teachers from the programs attached to administration to be found. Leadership credibility needs to be fostered in terms of monitoring the undertaking's program or agenda, which must pursue articulation with the institutional entrepreneurs' program.

Regarding student-developed academic work, disconnectedness among programs was exposed, despite sharing the same university campus. The participants explain that this difficulty is underpinned by the lack of an agenda that links curricular and extracurricular activities. Furthermore, they suggest that the students' entrepreneurial ventures, most often traditional, need to be interrelated with academic programs.

Another weakness coming to light was the lack of systematized experiences and the management of entrepreneurship-related information, essential for knowledge visibility, dissemination, and apprehension. Concerning research as a primary factor to advance TBE development, the participants sustain that research activities have been centralized at the university's headquarters.

A potential opportunity is the scheduling of extracurricular activities that afford techniques, tools and generate TBE-oriented competencies. The stakeholders participating in the collaborative exercise mention the necessity to regularly and actively disseminate activities favoring TBE, which must be institutional as fundamental to fostering a sense of belonging. To that end, they maintain that it is a strength that the institution has strong and highly well-known institutional social networks.

Finally, when asked about the impact on the IDIC, the participants spoke of several weaknesses: lack of knowledge on trending new business models (e.g., the convergence of technologies and emerging companies), lack of knowledge of Colombia's path and policy for creating spin-off companies, regulations on intellectual property, proprietary rights, the university's methods for knowledge and technology transferring, and the way for reporting innovations and technological development.

4.2. Enabling factors to promote a TBE culture

Based on an analysis of the *world café* output and the content analysis, different enabling factors came to light, which HEIs with limited experience in entrepreneurship must address in order to develop a TBE-oriented culture. The first enabling factor is HEIs' senior management strategic vision for promoting TBE to pursue a hard-felt impact on society. Therefore, HEIs' strategic and operational planning and TBE need to conflate through strategies encompassing all facilities and academic programs. Likewise, it is necessary to set verifiable goals and indicators to assess the policies and actions implemented over time.

Another enabling factor is TBE being incorporated into research, development, and innovation processes. It is relevant in this field that HEIs' research agendas encompass cutting-edge scientific and technological components (e.g., collaborative economy, bio-businesses, and technological convergence) and that the development of EBT is encouraged (Cimoli *et al.,* 2010). Likewise, exciting developments and leveraging could be found, such as intellectual property, proprietary rights, and innovation reporting, among other things.

The creation of entrepreneurship units that include an actual space on the university campus (ideation and creativity laboratory) and highly trained personnel in business creation is another enabling factor. Additionally, it is relevant for each HEI to create a database of its entrepreneurial community to record experiences, follow-up, and dissemination, leading to the recognition and improvement of its goodwill (Klofsten, Fayolle, Guerrero, Mian, Urbano, and Wright, 2019).

Infrastructure, equipment provision, and investing in tangible resources to conduct laboratories, workshops, and experimentation are other enabling factors,

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and adequate resource allocation to that end is considered essential. Such investments should be partly geared towards providing a laboratory for ideation and creativity, a space for the university community the external sector convergence to address productive projects. Additionally, it is advisable to invest in simulators and tools to conduct design thinking (Fichter and Tiemann, 2018).

Another enabling factor is teachers' training in entrepreneurship and innovation. According to Kantis and Angelelli (2020), teachers' and researchers' lack of training in entrepreneurship hinders entrepreneurship since the lack of a training methodology that harnesses technological tools and encourages putting theoretical knowledge into practice hinders entrepreneurship skills training(Mayorga, 2016).

HEIs' investment in human resources should primarily focus on retaining personnel based on qualifications that support TBE activities and promotion. Likewise, teachers' role as liaison agents with students plays a fundamental part in promoting a multidisciplinary base framework that favors entrepreneurship. The offer of courses that promote entrepreneurship should be transversal and focused on creativity, innovation, research, and, above all, strengthening problem-solving, teamwork and leadership skills, and resilience. Likewise, those HEIs must strengthen and increase in implementation, monitoring, and dissemination and establish initiatives such as mixers, business fairs, science fairs, competitions, or contests among the institution's academic programs or other HEIs in the entrepreneurial ecosystem to raise awareness of entrepreneurship. The foregoing agrees with Pérez's (2019) explanation, where he argues that TBE occurs in the midst of strategic alliances with key actors.

Another enabling factor is HEIs' relationship with the agents that promote entrepreneurship; therefore, there must be continued articulation and ties with the interest groups in the entrepreneurial ecosystem: universities, NGOs, private sector, government, technology parks, etc. This relationship needs to create framework agreements, develop alliances and networks, and, of course, set up communication strategies that help disseminate them across all components of said ecosystem.

The enabling factors above coincide with the perspective of Mayorga (2016). This author posits the need to articulate all the actors into the training process and courses, contents, and transversal topics proposed for entrepreneurs' didactic and curricular training, create technological resources for greater apprehension and stimulate the participants' cognitive and volitional learning with the support of business simulators, and to host spaces that foster company-focused interaction between students, entrepreneurs and government entities, seeking to strengthen the entrepreneurial culture as supported by incubators to materialize innovative business ideas.

Finally, it should be noted that fostering a culture for TBE requires HEIs to harness resources significantly; therefore, their human resources must fall under a unified perception of TBE and the requirements for its creation. This also becomes an incentive for HEIs because the worldwide recognition for developing this kind of company due to research and scientific, technological advancements puts HEIs on the radar, together with the science-technology-innovation system betting on these developments.

5. Conclusions

Fostering a culture for entrepreneurship, specifically, a technology-based one in Colombian HEIs with a low entrepreneurship trajectory requires strengthening capabilities and overcoming several disabling factors. In this field, HEIs' top management must value TBE and incorporate it into strategic and tactical planning. Likewise, retention and adequate training for HEIs' human resources are of the essence for promoting TBE.

Professor, researcher, and student training in business models and pathways to value entrepreneurship and its practical articulation into the entrepreneurial ecosystem start by articulating courses, methodologies, content, and cross-sectional topics. This is reinforced by implementing technological resources such as information systems, simulators, virtual platforms, etc.,

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making HEIs a point of convergence for entrepreneurs, businessmen, and government entities to materialize innovative business ideas.

Furthermore, it will be necessary to close conceptual and technical gaps to establish key factors in the courses to enable students to approach company creation. Also, HEIs should think of themselves in the research-entrepreneurship relationship and strengthen their approach to qualification based on regulations, thereby promoting the creation of companies derived from scientific-technological advancements and the development of spin-offs. To that end, we suggest articulating each HEI's research agenda and entrepreneurship units into the regional research agendas and/or the needs or gaps in the environment.

As for tangible resources, TBE-committed universities must ensure investments committed to laboratories, workshops, and spaces for creation that are duly equipped to foster prototyping, simulation, and modeling, among other things. Following that train of thought, those resources can yield if services that can ultimately be converted into business models promoted by the HEIs are offered to the external sector.

Liaisoning with other actors in the entrepreneurial ecosystem is essential to strengthening HEIs' capabilities since it allows support network for conducting entrepreneurship-conducive activities and arranging, in turn, initiatives resulting in undertakings being disseminated and made aware of in the media. The foregoing also makes it possible to strengthen HEIs' ties with external agents such as private and public companies, NGOs, and society in general.

Lastly, Colombian HEIs developing TBE is an opportunity for Universities, Companies, the State, and Society, to work together and consolidate companies that drive the business fabric by creating high added value companies capable of relevant effects for the social, economic, environmental, and technological environments, to name a few, thereby causing resources to flow towards HEIs and greater social projection, favoring HEIs' footing in entrepreneurship rankings.

6. Conflict of interest

The authors declare no conflict of interest.

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