

# Are andragogy and heutagogy the secret recipe for transdisciplinary entrepreneurship education?

Andragogy  
and heutagogy

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## Abstract

**Purpose** – This study aims to construct an entrepreneurship educational pattern applicable to all disciplines at the undergraduate level. The proposal focusses on two-course models of transdisciplinary entrepreneurship education (TEE), which involve andragogy and heutagogy as the basis of entrepreneurial competency development.

**Design/methodology/approach** – The competencies acquired during the proposed course models for TEE are analysed through Bayesian methods. The study is conducted using 400 opinions of students from Tecnológico de Monterrey in Mexico City.

**Findings** – The proposed TEE models are auspicious for establishing an educational pattern to develop entrepreneurship competencies in undergraduate students with the independence of their school of origin.

**Originality/value** – Nowadays, universities recognise the importance of providing entrepreneurship education as part of their mission. However, well-defined canons to guide such teaching are still non-existent. This paper fills a gap on what and how to teach TEE. By providing a new competency classification based on soft and technical skills, the authors contribute to the pattern of what to teach in entrepreneurship. The authors provide guidance on the teaching methods for TEE through two-course models based on andragogy and heutagogy. Moreover, their efficacy is measured using the students' perception of the acquired competencies and their usefulness.

**Keywords** Andragogy, Heutagogy, Entrepreneurship competencies, Entrepreneurship model courses, Transdisciplinary education

**Paper type** Research paper

## 1. Introduction

Entrepreneurship has become extremely important for social and economic development (Acs *et al.*, 2008). The European Commission has established the “sense of initiative and entrepreneurship” as one of the eight key competencies that all individuals need for their personal development, inclusion in society and economic development (Bacigalupo *et al.*, 2016). Scholars have proposed the inclusion of entrepreneurship in universities' missions under a new labour immersion for their graduates (Bell, 2016; Moreland, 2006). Although mainly related to the generation of new companies (Lamine, 2017), employers also demand competency (Jackson, 2009).

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Several scholars have called for establishing an optimal path for teaching entrepreneurship (Jones *et al.*, 2014); nevertheless, a gap remains in the way entrepreneurship education (EE) is taught in universities (Gibb, 2002; Kirby, 2004). This study contributes to establishing an appropriate EE pattern that can be incorporated into the curricula of all undergraduate knowledge areas. The literature has established the term EE for enterprise and entrepreneurship education (QAA, 2018; Jones *et al.*, 2019); however, this present study refers to EE for entrepreneurship education only and transdisciplinary entrepreneurship education (TEE) for TEE.

Many universities have implemented EE as an institutional policy (Vesper and McMullan, 1998; Fiore *et al.*, 2019), and hence the relevance of establishing a common denominator regarding educational themes and methods involved in the discipline (Neck and Corbett, 2018). This study analyses the competency framework that students develop in two transdisciplinary entrepreneurship courses designed on andragogy and heutagogy; this leads to the establishment of TEE parameters. By providing a competency classification based on soft and technical skills, we contribute to the consensus of competencies centred on the teaching and the establishment of an educational pattern to develop entrepreneurship competencies in undergraduate students independent from their school origin. Section 2 presents a literature review on entrepreneurship practices, competencies, TEE, andragogy and heutagogy. Section 3 discusses the cases. Section 4 presents the competency analysis and results obtained from a Bayesian method. Section 5 presents the discussion and conclusions.

## 2. Literature review

### 2.1 Entrepreneurship practices

Implementing entrepreneurial practices in universities has spread worldwide (Fayolle and Gailly, 2015). However, no standard parameters exist at the curricular level (Ramsgaard and Christensen, 2018). In the wide entrepreneurship courses, some parameters act as promoters of the discipline and some are completely designed to culminate projects generating sales into the market (Sarfraz, 2017).

Universities have developed various formats for teaching entrepreneurship. Nevertheless, no fundamental model has been agreed upon from which the academy capitalises on experience (Attali and Yemini, 2017; Neck *et al.*, 2014).

Amongst the performance measures of entrepreneurship practices, the following stood out: students' satisfaction (Henri *et al.*, 2017), employee or entrepreneurship orientation (Agarwal and Upadhyay, 2009) and created company scores (Garavan and O'Conneide, 1994). Students' perception is a key factor when measuring course success (Sarfraz, 2017; Ustav and Venesaar, 2018); thus, we consider it by focussing on competencies to design the TEE.

### 2.2 Competencies

Competencies are the capacities of individuals needed for the proper performance of occupation; they involve knowledge, skills and aptitudes and are inseparable from the ability to execute (Martínez and Echeverría, 2009). Although an entrepreneur's competencies may have relative coincidence (Baena-Luna *et al.*, 2020), a gap exists in determining the most appropriate method to develop them (Gibb, 2002). To fill this gap, we classify an intrinsic competency framework to the addressed topics whilst developing TEE.

We identify 14 competencies based on soft and technical skills, which used to be called personal and cognitive skills (Varela and Bedoya, 2006; Ahmad *et al.*, 2010). The proposed competency classification in this study implies academic themes according to their names (Table 1) and these competencies are supposed to be developed in the transdisciplinary courses described in Section 3.

Classification	Competency	Orientation	Author
Competencies based on soft skills	Opportunity identification	Propose solutions for some population's needs or problems	Shane and Venkataraman (2000); Baručić and Umihanic (2016); Wang <i>et al.</i> (2013)
	Analysis and critical thinking	Analyse solution alternatives according to a criteria diversity in a complex environment	Simon (1955); Saaty (1977), Lombard <i>et al.</i> (2020)
	Creativity	New ideas generation	Puccio (2017); Ritter <i>et al.</i> (2020); Sagone <i>et al.</i> (2020)
	Empathy	Identify a market segment's needs, problems, desires or conditions	Bohnsa and Flynn (2021)
	Resilience	Adaptation to changes and persistence against difficulties	Brand and Jax (2007); Sagone <i>et al.</i> (2020)
	Leadership	Positive influence on others by promoting team integration, well development and orientation of goals	Mintzberg (2006); Wu and Lin (2018)
	Negotiation	To gain an advantage, resolve differences and reach agreements	Richards <i>et al.</i> (2020); Lewicki and Hiam (2010)
Competencies based on technical skills	Marketing	Knowledge of clients and communication channels with them	Kotler and Keller (2016)
	Finance	Investing, costs, incomes and utility management	Chang (2020); Esubalew and Raghurama (2020)
	Normativity	Identification and compliance to project's legal aspects	Hodgson (1998); Casson (2000)
	Strategy	Analysis of the environment and paths to action	Mintzberg (2007); Porter (1980)
	Human resources management	Conform teams and manage tasks and responsibilities	Moustaghfir <i>et al.</i> (2020)
	Prototyping	Building first products or services models to testing market desirability	Fuewen (2019); Otto and Wood (2001)
Innovation	Introduce novelty products, services or business models	Keeley <i>et al.</i> (2013); Salas Gironés <i>et al.</i> (2020); Su <i>et al.</i> (2020)	

**Table 1.**  
Competencies to be developed in TEE

Source: Own elaboration

We call academics and practitioners to classify entrepreneurship competencies in association with those developed during the courses. Currently, the framework of competencies is wide open (Tittel and Terzidis, 2020) and a general classification has not reached a consensus. To consolidate our proposal, we identify previous classifications in a sample of papers, books and institutional reports summarised in Table 2. Subsequently, we make a similarity map amongst them and our proposal (Table 3).

According to the competency classifications (Table 2), we suggest focussing on what will be developed in the entrepreneurship courses, instead of phases (Bacigalupo *et al.*, 2016) or even in general areas of knowledge (Silveyra *et al.*, 2021). The reason is that these competency categories may be interchangeable amongst their own classifications; for example, in Bacigalupo *et al.* (2016), the “learning through experience” competency could be part of “ideas and opportunities, resources or into action”. Likewise, in Silveyra *et al.* (2021), the “human resources management” competency could be present in any of their four typologies (entrepreneurship, management and business, human resources or interpersonal). Therefore, we propose to unify the competency classification according to

**Table 2.**  
Competency  
classification by  
authors

Author	Classification	Competencies
<b>Gibb (2002)</b>	Behaviours Attributes Skills	Finding opportunities, grasping opportunities, bringing networks together effectively, taking initiatives, taking risks under conditions of uncertainty and through judgement, persevering to achieve a goal and strategic thinking Motivation to achieve, self-confidence and self-belief, creativity, autonomy and high locus of control, hard work, commitment and determination
<b>Wagner (2008)</b>	Unspecified	Negotiation, persuasion, selling, proposing, project management, time management, formulating strategy and creative problem-solving Critical thinking and problem-solving, collaboration across networks and leading by influence, agility and adaptability, initiative and entrepreneurship, effective oral and written communication, accessing and analysing information, curiosity and imagination
<b>Mitchelmore and Rowley (2010)</b>	Entrepreneurial Business and management Human relations Conceptual and relationship	Identification and definition of a viable market niche, development of products of services appropriate to the firm's chosen market niche/ product innovation, idea generation, environmental scanning, recognising and taking advantage of opportunities and formulating strategies for taking advantage of opportunities Development of the management system necessary for the long-term functioning of the organisation, acquisition and development of resources required to operate the firm, business operational skills, previous involvement with start-ups, managerial experience, familiarity with the industry, financial and budgeting skills, previous experience, management style, marketing skills, technical skills, industry skills, the ability to implement strategy (e.g. develop programmes, budgets, procedures, evaluate performance), familiarity with the market, business plan preparation, goal setting skills and management skills Development of the organisational culture management feel is necessary to guide the firm, delegation skills, the ability to motivate others and in groups, hiring skills, human relations skills and leadership skills Conceptual competencies, organisational skills, interpersonal skills, the ability to manage customers, mental ability to coordinate activities, written communication skills, oral communication skills, decision-making skills, analytical skills, logical thinking skills, deal-making skills, commitment competencies Spotting opportunities, creativity, vision, value ideas, ethics and sustainable thinking Self-awareness and self-efficacy, motivation and perseverance, mobilising resources, financial and economic literacy, mobilising others Taking initiative, planning and management, coping with ambiguity, uncertainty and risk, working with others, learning through experience
<b>Bacigalupo et al. (2016)</b>	Ideas and opportunities Resources Into action Unspecified	Being a leader and communicator, successfully managing a business, commercialising a new idea or development, managing innovation within a firm, building up a professional network, identifying new business opportunities, creating new products and services Identification of opportunities, evaluation of opportunities, exploitation of opportunities Strategic, management, previous knowledge and experience of the business Leadership and motivation and human resources management Social
<b>Sieger et al. (2016)</b>	Entrepreneurship Management and business	
<b>Silveyra et al. (2021)</b>	Human resources Interpersonal Based on soft skills Based on technical skills	
<b>Proposal (2021)</b>		Identifying opportunities, creativity, empathy, marketing, critical thinking and leadership Normativity, finance, negotiation, innovation, strategy, resilience, human resources management and prototyping

**Source:** Own elaboration

Proposal	Gibb (2002)	Wagner (2008)	Mitchelmore and Rowley (2010)	Bacigalupo et al. (2016)	Sieger et al. (2016)	Silveyra et al. (2021)
Identifying opportunities			*	*	*	*
Creativity		*	*	*		
Empathy	*		*	*	*	*
Marketing	*		*	*	*	*
Critical thinking	*	*	*	*		
Leadership	*	*	*	*		*
Normativity			*	*		*
Finance			*	*		
Negotiation	*		*	*		*
Innovation		*	*	*	*	
Strategy	*	*	*	*		*
Resilience	*	*	*	*		
Human resources management	*	*	*	*	*	*
Prototyping			*	*		

**Table 3.**  
Similarity  
competency map

**Note:** \*means that the competency is indicated in the work of the referred author

**Source:** Own elaboration

what students will develop in the courses (Gibb, 2002), which are competencies based on soft and technical skills (Ahmad et al., 2010).

To contribute to the competency classification consensus, we made a similarity map with our proposal and those indicated by Gibb (2002), Wagner (2008), Mitchelmore and Rowley (2010), Bacigalupo et al. (2016), Sieger et al. (2016) and Silveyra et al. (2021) (Table 3). The names of the competencies differ (Table 2), but the orientations are similar.

### 2.3 Transdisciplinary entrepreneurship education

Entrepreneurship must be taken as a discipline that strengthens the third mission of universities (Ierapetritis, 2019); therefore, EE requires equipping students with additional knowledge, attributes and skills to apply in creating new businesses (QAA, 2018). Moreover, establishing teaching patterns (Kirby, 2004) and designing global curriculum schemes (Jones et al., 2014) become fundamental.

Teaching models for TEE has become essential. Fayolle (2010) analysed EE practices in different disciplinary areas and he noted that the challenge is finding ways to unify these practices, even more, making the instructional methods available to researchers and practitioners. Likewise, Rauch and Hulsink (2015) accounted for how entrepreneurship should be taught in a transdisciplinary environment.

Becker's (1993) human capital theory suggests that the complement of disciplines strengthens the innovation mindset, and therefore, entrepreneurship teams composed of members from different fields of knowledge perform better than others (Colombo and Grilli, 2005). In this orientation, Fiore et al. (2019) also explained that entrepreneurship must be taught in a transdisciplinary environment and stipulate that creating an extracurricular course is easier because university policies and regulations often present barriers. The term "transdisciplinary" refers to new knowledge introduced to many disciplines (Sotolongo, 2010). For our study cases, we consider this perspective and establish "TEE".

TEE must construct teaching patterns as typically, courses models vary even within the same institution (Neck et al., 2014). Even more, the maturity of students should be considered to provide them with the most pertinent information and a method according to

their experience (Lamine, 2017). Under this orientation, we consider andragogy and heutagogy as the main basis of entrepreneurship course design (Neck and Corbett, 2018; McAuliffe and Winter, 2014).

#### 2.4 Pedagogy, andragogy and heutagogy as methods for transdisciplinary entrepreneurship education

To design entrepreneurship courses, we have pedagogy, andragogy and heutagogy (PAH), amongst the educational methods. Pedagogy has been the base for teaching design; this method is centralised on the instructor. In 1975, Knowles postulated andragogy as an alternative for adult learning. Years after, Hase and Kenyon (2000) stated a flexible, immersive and student-centred method called heutagogy, which is inspired by ancient Greek for “self”. Heutagogy implies positioning oneself in the world of the learner. Moreover, teachers should focus on objectives and delivery (Murthy and Pattanayak, 2020), avoiding teacher-centred learning to encourage students to explore and learn from self-directed actions, besides knowing how to master self-determined learning (Gairnett and O’Beirne, 2013).

Following Gairnett and O’Beirne (2013) and Jones *et al.* (2014), we identify that the PAH methods transit amongst general knowledge, applied knowledge and development of personal projects, respectively. The main aspects usually considered in teaching methods are experience, learning style, disposition, the role of teachers and students and the applicative approach (Table 4).

In PAH, an inverse relationship exists between the autonomy of the students and the course control implemented by instructors. In the opposite direction, if students increase their maturity (Jones *et al.*, 2019; McAuliffe and Winter, 2014), teachers could decrease control and increase flexibility; this is a transition amongst PAH schemes, where andragogy could be the equilibrium (Figure 1).

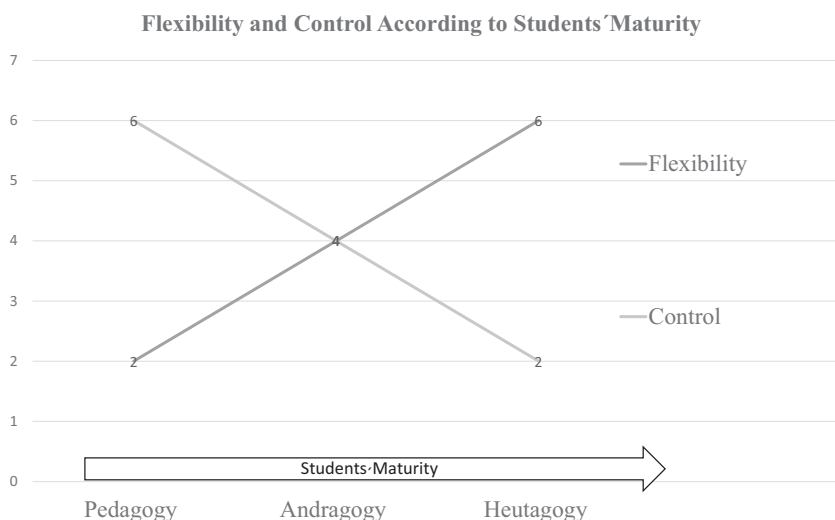
Heutagogy and andragogy offer a better way to redesign teaching practices under personalised learning schemes (Bray and McClaskey, 2013), where educational practices are not limited to curriculum standards.

Granting TEE in different disciplinary fields makes it necessary to implement flexible models according to the knowledge previously acquired by students, in both soft and technical skills (Varela and Bedoya, 2006). Although entrepreneurship teaching has focussed on pedagogy (Henri *et al.*, 2017; Mouasher and Lodge, 2016), incorporating andragogy and heutagogy schemes is convenient (Kapasi and Grakova, 2018; Neck and Corbett, 2018) when seeking flexibility, depending on the students’ maturity degree. According to Gairnett and O’Beirne (2013), pedagogy is an appropriate basis for course design (Mishra and Koehler, 2006) in which the teacher’s control is exclusive and students assume a passive role. Nevertheless, if control is shared and students increase their activity,

Method:	Pedagogy	Andragogy	Heutagogy
Experience:	Beginner	Intermediate	Advanced
Learning style:	About	To	Through
Disposition:	Curiosity	Hooked	Confident
Teacher role:	Presenter	Facilitator	Coach
Student role:	Theoretical-passive	Demand	Empirical-active
Approach:	General knowledge	Applied knowledge	Personal project

**Table 4.**  
Transitive factors in  
PAH

**Source:** Own elaboration based on Gairnett and O’Beirne (2013) and Jones *et al.* (2014)



**Source:** Own elaboration

**Figure 1.**  
Control and flexibility  
as dependent  
variables of students'  
maturity

andragogy schemes are presented. When the students determine the learning pace and they take a practitioner and active role, the heutagogy is the optimal guide for designing the curricula to be implemented.

Jones (2016) mentioned the differences between the courses based on PAH in relation to the students' experience of the discipline and their disposition for learning. TEE should allow students to transcend ideas and concepts through a model according to their needs by considering andragogy and heutagogy as educational methods in entrepreneurship courses. The acceptance of these methods can serve as a basis for establishing EE patterns whilst covering the current dispersion in the teaching models (Kirby, 2004). This study presents experiences from the top-ranked entrepreneurial university in Latin America (The Princeton Review, 2020) when given TEE a central role. The next section presents two model courses:

- (1) andragogy perspective; and
- (2) based on heutagogy.

### 3. Study cases: Model courses

Tecnologico de Monterrey is a university that fosters EE under a flexible model for common curricula. According to The Princeton Review (2020), this university is ranked fifth amongst entrepreneurial universities worldwide and first in Latin America. Its mission is "innovation, leadership and entrepreneurship for human flourishing". To fulfil this mission, Tecnológico de Monterrey offers 80 entrepreneurship programmes including one-semester courses for all disciplines, intensive one-week courses for an approach to entrepreneurship, an annual entrepreneurship festival (Inc. Monterrey), a Bachelor of Entrepreneurship and Business Creation for undergraduates, a master's degree with a specialty in entrepreneurship, a research group focussed on entrepreneurship and corporate entrepreneurship diplomas.



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Flexibility in EE provided by Tecnológico de Monterrey is observed in different course formats, even more in the environment that complements them, where students can reach escalation. The volition of the authorities to develop an entrepreneurial ecosystem as part of the institutional mission is a relevant factor for aligning the necessary actions, monitoring compliance with the entrepreneurship model and obtaining educational conditions. As a contribution to establishing teaching patterns in the discipline, we describe the characteristics of a semester course established as a mandatory course, which is based on andragogy and an elective two-semester programme based on heutagogy. Both courses are available for all disciplinary areas in Tecnológico de Monterrey.

### *3.1 Entrepreneurship programme: “training and development of entrepreneurial leadership”*

The semester course based on andragogy is called “training and development of entrepreneurial leadership”. It has a theoretical-practical orientation and is a compulsory one-semester course under the transdisciplinary curriculum scheme at Tecnológico de Monterrey. It involves a schooled process of 3 h a week for 15 weeks. The work is developed with transdisciplinary teams and a simulation is carried out in all stages of the entrepreneurship model: identification of the idea, introduction to the market and scaling up (Varela and Bedoya, 2006). The timing to identify or refine the idea, discovery and market validation is flexible (Blank and Dorf, 2020). Moreover, the students present their project to judges and all the projects are inserted in a virtual contest in which the best projects compete for a trip to the Entrepreneurship Festival of the Tecnológico de Monterrey (Inc. Monterrey) and having the opportunity to pitch to investors.

The course objective is to recognise the relevance of entrepreneurship for economic activity and problem-solving and identify the idea to be developed, market, business model and the viability and feasibility of their projects.

### *3.2 Entrepreneurship programme “Year i”*

“Year i” is a flexible programme, with a one-year duration, that promotes and strengthens the following amongst students: proactivity, identification of solutions, transparency and assertiveness, teamwork, joint decisions, care of the environment, handling tools, leadership, resilience and humility. These are part of the 21 competencies to be developed in “Year i”.

During the course, students are immersed in a real business creation environment. They must also have contact with potential clients and finish the course with billing. The programme is based on an advisory scheme – “when you need help, ask for a mentor” –, informal classes. It consists of three layers of learning (i.e. individual, company and team) developed in parallel and intertwined learning paths that link theoretical concepts, practical application and the obtained analysis results.

The learning path in “Year i” allows students to identify six alternative topics (finance, marketing, business models, business operations, talent management and strategic planning) to gain a deeper understanding and apply them in their entrepreneurship project. The learning path must have at least three consultations with a subject expert and must be validated by the mentor. Students must obtain 25 points each semester with total flexibility in the choice of topics and bibliography, albeit making a critical synthesis, defining how to apply the references and reporting the learning results are conditionals.

The “Year i” course has a focus on self-managed learning. The students establish commitments based on personal learning plans managed as “contract” type to fulfil such commitments. Four “contracts” are signed in the semester and students take on different



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roles when forming a “team company”. The roles are coach, team leader, financial leader, customer leader and communication leader with the following responsibilities:

- The company coach must follow up on the established objectives of each member.
- The team leader coordinates the team and communicates with his peers from other projects.
- The financial leader oversees the billing progress.
- The customer leader takes care of the relationship with customers, whereas the communication leader manages internal communication.

Thus, for better management of human resources, adequate control and strengthening responsibilities, the teams constitute a director’s board in which each one takes a leadership role. Likewise, each team has work sessions of 2 h at the beginning of the week to identify improvement areas. They also have two learning sessions (i.e. 3 h per week) for new knowledge development.

Both students and mentors record their progress in a learning log. In “Year i”, the students undergo the “birth-giving”, “learning journey” and “out-of-the-building visit” activities:

*Birth giving.* This is an innovation session with defined times and strategic planning. It is based on the Socrates method: giving birth to new thoughts and ideas with other people. Additionally, [Nonaka and Takeuchi’s \(1995\)](#) approach to learning and to innovate is considered.

*Learning journey.* It is a business trip for presenting a global project perspective. The trip is financed with the obtained billings during “Year i”.

*Out-of-the-building visits.* As suggested by [Blank and Dorf \(2020\)](#), students must make visits in three blocks: exploration, validation and sales. Each visit is collected in a format and is validated by the team members, not by the mentor. Moreover, each member must conduct 25 interviews and contribute something new to the team.

Amongst the main indicators of the project’s progress, 20,000 Mexican pesos of billing are requested and this income is audited. In addition, students must carry out the company’s valuation and verify 50 visits per year and 50 learning points.

“Year i” is offered as an optional course for undergraduate students from all Tecnológico de Monterrey schools at the Santa Fe and Mexico City campuses. To be in the sixth semester is a requirement for students. The course accreditation equals two subjects and developed projects are supported by the entrepreneurial ecosystem, especially in fundraising, dissemination and scaling phases.

#### 4. Methodology and results

Despite the academic interest in entrepreneurship competency framework ([Cox, 2014](#)), which competency students develop in entrepreneurship courses must be determined ([Gibb, 2002](#)), even more, if the interest to establish entrepreneurship as transdisciplinary curricula are increasing ([Rauch and Hulsink, 2015](#)). To validate the acquired competencies by students in entrepreneurship courses, we design empirical and mixed research, which hypothesises that the development of entrepreneurship competencies is independent of the students’ school of origin. The sample is consists of 400 alumni opinions of “TDLE” and “Year i” in Tecnológico de Monterrey, Mexico City.

The hypothesis is tested through Bayesian analysis because it establishes available evidence to calculate its validity in probabilistic terms ([Almond et al., 2015](#); [Krishnamoorthy, 2020](#)). The Bayesian factor is defined as the quotient between the probability that a null hypothesis  $H_0$  is fulfilled and the probability that the fulfilled one is the alternative hypothesis  $H_1$ . The probabilities of both the numerator and denominator are

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conditional. The evidence gathered from experimentation determines its conditional nature. If we call the set of elements that constitute experimental evidence  $D$ , then the probability that evidence is congruent with the null hypothesis is denoted by  $P(D|H_0)$ . Considering the above, we can write the Bayesian factor as:

$$BF = \frac{P(D|H_0)}{P(D|H_1)}$$

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If the value of BF is less than 1, the denominator is greater than the numerator. In that case, the probability that the evidence corresponds to  $H_0$  is greater than the probability that it corresponds to  $H_1$ . Consequently, the alternative hypothesis should be rejected in light of the available evidence. If a new set of evidence  $D$  emerges, the Bayesian factor must be recalculated to identify which hypothesis is more likely.

We operationalised the hypothesis with alumni opinions; the applied questionnaire measured five impacts (DS) related to our classification of competencies based on soft or technical skills:

DS1 = "It motivated me to develop the project".

DS2 = "It helps me overcome difficulties in entering the market".

DS3 = "I developed it within the programme".

DS4 = "I could not develop it within the programme".

DS5 = "It gave me the confidence to start an entrepreneurship project".

Therefore, the probability that the evidence DS1 corresponds to the null hypothesis  $H_0$  (i.e. the impact of the competencies is independent of the school of origin) is:

$$P(DS1|H_0).$$

Likewise, the probability that the evidence DS1 corresponds to the alternative hypothesis  $H_1$  (i.e. the impact of the competencies depends on the school of origin) is:

$$P(DS1|H_1).$$

Therefore, the Bayesian factor of the hypothesis test  $H_0$  versus  $H_1$  is:

$$BF(DS1) = \frac{P(DS1|H_0)}{P(DS1|H_1)}$$

Apart from the algebraic form, several statistical packages calculate the Bayesian factor of the contingency tables corresponding to the crossing of variables (e.g. impact vs school of origin) to determine whether independence exists between such variables.

For calculation, we have selected the JASP statistical package (freeware <https://jasp-stats.org>). The opinions from the survey applied to the students who completed the courses under the previously described models are introduced in JASP. The result obtained for the Bayesian factor is:

$$BF(DS1) = \frac{P(DS1|H_0)}{P(DS1|H_1)} = 1.885e - 10.$$

Given that the previous value is close to zero, the denominator of the Bayesian factor is, thus, much greater than the numerator, indicating the much greater probability that the evidence is compatible with  $H_0$  than  $H_1$ . Therefore, the variable impact of the competencies and school of origin is independent of the opinions that "it motivated me to develop the project".

Continuing with the same notation, we can configure a set of Bayesian factors corresponding to each set of evidence collected in the opinion poll. Table 5 summarises the results of the corresponding Bayesian tests. Given that in all cases, the value of the Bayesian factor is close to zero,  $H_0$  must be accepted. The foregoing strengthens the assertion that the presented educational models can be considered a transdisciplinary scheme.

For this research, two question groups were established:

- for competencies related to soft skills; and
- for competencies related to technical skills (Varela and Bedoya, 2006).

From both groups and based on alumni opinions (Kapasi and Grakova, 2018), we determined which competencies encourage motivation to be an entrepreneur and which helps overcome the difficulties in entering the market. We also determined the competencies that provide confidence to develop any entrepreneurship project and those that students developed and did not develop (Table 6).

Results reveal that the following competencies motivate students to be entrepreneurs: identifying opportunities, creativity, innovation and strategy (Table 7). Meanwhile, the competencies identified to help students overcome difficulties in entering the market are identifying opportunities, critical thinking, marketing and strategy. Finally, those that provide confidence to start any entrepreneurial project are critical thinking, identifying opportunities, finance and strategy.

The first group of questions gives an account of the usefulness of the students' competencies. They were asked specifically which competencies they developed and did not develop in the programme. Results reveal that students mostly developed identifying opportunities, critical thinking, strategy and marketing. The disclosed less developed competencies in the programmes are negotiation, resilience, normativity and finance.

Most entrepreneurship definitions consider opportunity identification as a key element (Casson, 2000; Fayole and Gailly, 2015). Our results demonstrate that students acquire this competency in the "TDLE" and "Year i" courses. We can affirm that the strategy competency is the one presented in the four positive dimensions of our analysis due to the perspective of analysing the environment and defining business actions (Mintzberg, 2007).

The previous training that students acquired in their area of specialisation does not represent an obstacle for them to develop the proposed entrepreneurship competencies. This result provides evidence of the benefit to implement TEE.

BF(DS1)	1.885e-4
BF(DS2)	0.021
BF(DS3)	0.542
BF(DS4)	0.001
BF(DS5)	5.665e-6
BF(DT1)	0.006
BF(DT2)	0.315
BF(DT3)	0.013
BF(DT4)	0.002
BF(DT5)	0.018

**Table 5.**  
Bayesian factors for  
the hypothesis  
testing of  
independence

Source: Own elaboration

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Competency/usefulness	Motivation	Overcoming difficulties	Developed	Undeveloped	Confidence
Soft skills					
Creativity	33	27	16	14	27
Critical thinking	24	33	40	8	40
Empathy	20	13	7	13	16
Identifying opportunities	38	40	50	8	32
Leadership	2	9	2	11	3
Negotiation	5	4	7	22	12
Resilience	7	6	8	18	3
Technical skills					
Finance	17	32	23	28	40
Human resources management	12	5	18	6	6
Innovation	27	4	0	0	29
Normativity	6	13	8	42	12
Marketing	25	38	32	18	13
Strategy	27	33	38	7	31
Prototyping	11	5	10	2	2

**Table 6.**  
Competency-  
focussed assessment

**Source:** Own elaboration

Competency/usefulness	Motivation	Overcoming difficulties	Developed	Undeveloped	Confidence
Soft skills					
Creativity	33				
Critical thinking		33	40		40
Empathy					
Identifying opportunities	38	40	50		32
Leadership					
Negotiation				22	
Resilience				18	
Technical skills					
Finance				28	40
Human resources management					
Innovation	27				
Normativity				42	
Marketing		38	32		
Strategy	27	33	38		31
Prototyping					

**Table 7.**  
Higher ranked  
competencies

**Source:** Own elaboration

## 5. Discussion and conclusions

Entrepreneurship is a social discipline that is progressively being integrated into the mission of universities (Bell, 2016; Moreland, 2006). Scholars have called to set an educational pattern for entrepreneurship (Cox, 2014; Jones, 2016) and entrepreneurship appraises personal interests (Jones *et al.*, 2019). Therefore, developing students' projects require high flexibility (Gairnett and O'Beirne, 2013). The methodological framework for flexible programmes is settled by andragogy and heutagogy because they are student-centred (Gairnett and O'Beirne, 2013; Jones *et al.*, 2014; McAuliffe and Winter, 2014).

The transition between these methods is given by students' maturity and self-discovery. Moreover, the relation with the time required to develop competencies needs to be considered. We capitalise from "TDLE" and "Year i", respectively, in that when students need to be accompanied by instructors, one semester with andragogy orientation is suitable, whereas, for self-discovery schemes (heutagogy orientation), two semesters are adequate in the independence of students' area knowledge.

Besides being student-centred, entrepreneurship courses should develop students' competencies. Although several scholars have widely addressed this framework (Gibb, 2002; Wagner, 2008; Mitchelmore and Rowley, 2010; Bacigalupo *et al.*, 2016; Sieger *et al.*, 2016; Silveyra *et al.*, 2021; Tittel and Terzidis, 2020), we witness an effect of dispersion. Thus, this research proposes focussing on competencies that will be developed in the entrepreneurship courses and their relation with soft and technical skills in enabling the recognition of competencies based on the entrepreneurship programmes' teaching, instead of a wide list of those previously acquired or in trend.

The impact measured from alumni recognition of their own competencies (Kapasi and Grakova, 2018; Ustav and Venesaar, 2018) points to the route of changes in the programmes (Cox, 2014; Ierapetris, 2019). From "TDLE" and "Year i", we realised that normativity understood as the ability to identify and comply to project legal aspects (Hodgson, 1998), should be fostered.

The results evidenced that competencies were developed with the independence of the school of origin. With this approach of transdisciplinary, this study contributes to the framework of entrepreneurship competencies, tied with the construction of an entrepreneurship-education pattern. We determined the "what" and "how" to provide a TEE. We also suggest the "how long" and "how to measure" the programmes' impact (Table 8).

Our contributions imply for academics to consider the TEE with a new classification of competencies, as an attempt to generate a consensus and to avoid criteria dispersion. For practitioners, the implications are mapping out students' characteristics, designing activities according to the established competency development level and considering that when students need guidance, andragogy is the base. However, when students have a self-discovery orientation, heutagogy should be applied.

The analysis on alumni-acquired competencies contributes to establishing a TEE pattern in universities. Nevertheless, we recognise the limitations of this research. We measured only alumni opinions but failed to rank different students with possibly preceding entrepreneurship experience. Moreover, our sample was centred in the Mexico City region. Therefore, the framework for future research is related to the validation of alumni-acquired competencies by stakeholders belonging to the entrepreneurship ecosystem, besides a

Competencies we teach in TEE	Base for teaching TEE	Suggested duration for TEE	Segment of students for TEE	Measure of TEE impact
14 thematic axes for developing competencies based on soft and technical skills	Andragogy and heutagogy for education flexible models.	One semester for andragogy courses Two semesters for heutagogy courses	Undergraduates for all scientific areas (transdisciplinary curricula)	Through alumni recognition of the acquired competencies during the course and their functionality

**Table 8.**  
Contribution items to  
a TEE pattern

Source: Own elaboration

deeper analysis of students' previous entrepreneurship experience. Given the necessity to develop entrepreneurship competencies in more regions and in more universities, both at the undergraduate and graduate levels, we call to develop the TEE with programmes based on andragogy and heutagogy.

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