Entrepreneurship Education: the impact of different teaching models on the development of new ventures

ENTREPRENEURSHIP EDUCATION:

THE IMPACT OF DIFFERENT TEACHING MODELS ON THE DEVELOPMENT OF NEW VENTURES.

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ABSTRACT

The creation of innovative businesses (startups and spinoffs) is a phenomenon capable of stimulating the economy. The literature finds that entrepreneurship education (EE) impacts entrepreneurial intention. The aim of this research is to enter the black box of entrepreneurship teaching models in order to uncover their different impact on the creation of university entrepreneurial outcome. University entrepreneurial outcome is measured by the number of spinoffs created by 80 US universities in the Association of University Technology (AUTM) database from 2011 to 2014. This research, through analyses of 1,262 entrepreneurship courses in US universities along a time span of 4 years, shows that demand models and the competence models have a positive impact on the creation of academic spinoffs. Implications for professors teaching entrepreneurship, universities, policy makers and students are discussed.

***Keywords**: Entrepreneurship Education, Pedagogical Models; University entrepreneurship; University spinoffs; Universities' Entrepreneurial Outcome.*

1. INTRODUCTION

The growing global interest in entrepreneurship has led universities to devote more attention to entrepreneurship education (e.g., Wennekers & Thurik, 1999; Volkmann et al., 2009; Von Graevenitz et al., 2010; O'Connor, 2013). The importance of Entrepreneurship Education (EE) is reflected by an increasing number of courses offered by universities in recent years (e.g., Kuratko, 2005; Martin et al., 2013; Rauch & Hulsink, 2015; Siegel & Wright, 2015; Torrance, 2013). For instance, the number of entrepreneurship programs offered by American universities steeply increased from a negligible amount in 1970 to more than 2,200 in 2003 (Kuratko, 2005). Today, the number of courses in US universities has more than doubled, to about 5,000 (Torrance, 2013). This increasing interest is mainly driven by the fact that entrepreneurship programs raise entrepreneurial attitudes and intentions in students – such as building confidence and promoting self-efficacy (e.g., Peterman & Kennedy, 2003) - suggesting that entrepreneurship can be taught (e.g., Fiet, 2001a, b). However, EE has peculiarities that question the usefulness of traditional educational approaches (Fiet, 2001a, b). Indeed, many university lecturers teach entrepreneurship in different ways. This fragmentation is due to a lack of empirical research helping lecturers and universities to identify ways in which entrepreneurship could be taught (Nabi et al., 2017). In fact, it is not clear which are the most effective ways of teaching entrepreneurship (Nabi et al., 2017). In the same vein, it is important to understand the best way to teach this subject (Kuratko, 2005; Nabi et al., 2017; Streeter et al., 2002) especially if universities' goals are to foster the creation of new ventures and to provide students with entrepreneurial tools enabling the development of startups and spinoffs.

The objective of our paper is to contribute to fill this gap. Our study tries to disentangle the effectiveness that different courses have on the creation of entrepreneurial outcome measured as the number of spinoffs created by the university. The results contribute to understand the impact of different entrepreneurship teaching models (Béchard & Grégoire, 2005) on the development of new ventures. New ventures are analyzed identifying the number of spinoffs created from 2011 to 2014 by 80 US universities in the Association of University Technology (AUTM) database. By doing this, we respond to a specific call for research by Nabi et al. (2017). Our findings can be useful for lecturers in entrepreneurship as well as for their universities in shaping entrepreneurship courses and programs.

The paper is organized as follows. Section 2 presents the literature review on this subject and the hypotheses we wish to verify. Section 3 explains the sample and the methodology. Section 4 presents the empirical results. In section 5 we discuss the implications of the results. Section 6 presents the conclusion and the limitations of our research.

2. LITERATURE REVIEW: ENTREPRENEURSHIP TEACHING METHODS AND MODELS

University education may lead indirectly to universities' entrepreneurial activities such as spinoffs (Siegel & Wright, 2015). For instance, several studies analyzed the impact that EE has on students' entrepreneurship intention (e.g., Rideout & Gray, 2013; Bae et al., 2014; Huber et al., 2014; Fayolle & Gailly, 2015; Gielnik et al., 2015; Piperopoulos & Dimov, 2015; Rauch & Hulsink, 2015; Entrialgo & Iglesias, 2016; Karimi et al., 2016; Maresch et al, 2016). However, on the one side a small number of studies show a non-positive impact of EE (e.g., Oosterbeek et al., 2010). On the other side, a lot of studies show that EE has a positive impact on desirability and entrepreneurial feasibility (Peterman & Kennedy, 2003; Souitaris et al, 2007; Lanero et al., 2011; Rauch & Hulsink, 2015), entrepreneurship intention (Galloway & Brown, 2002; Sánchez, 2013; Bae et al., 2014; Karimi et al., 2014; Zhang et al., 2014; Fayolle & Gailly, 2015; Gielnik et al., 2015; Rauch & Hulsink, 2015; Entrialgo & Iglesias, 2016 Maresch et al, 2016) and students' subjective norms and perceived behavioral control (Karimi et al., 2014; Entrialgo & Iglesias, 2016). Indeed, through a quantitative review of the literature, Martin et al (2013) found a significant relationship between EE and entrepreneurship outcome, such as starting or growing a new business. Moreover, Arasti et al. (2012) argued that entrepreneurship can be taught like any other subject. As a matter of fact, professional and teaching skills can be taught in any field such as medicine, law, and engineering. In conclusion there is a large amount of research that shows that it is possible to teach entrepreneurship (e.g., Raffo et al., 2000; Fiet, 2001a, b; Bae et al., 2014; Valerio et al., 2014; Gielnik et al., 2015). A logical consequence of this stream of literature is – therefore - to identify optimal ways to teach this subject (Kuratko, 2005; Streeter et al., 2002).

In the context of the US, EE programs have been widely common in most universities for many years now (Katz, 2003; Kuratko, 2005). However, the courses offered vary greatly from one university to another in terms of content, target groups and teaching methods, being seldom uniform. For instance, current literature (e.g., Solomon, 2007) has recognized different teaching methods for entrepreneurship: lectures, seminars, e-learning, discussions, computer simulations, projects, business plans and prototyping. Lectures contemplate frontal lessons in which the professors act as the active side while students are the passive learners (Duval-Couetil et al., 2016; Rauch and Hulsink, 2015; Solomon, 2007). Seminars represent peculiar lessons as students often join seminar events centered on successful entrepreneurs and other important guest lecturers (Duval-Couetil et al., 2016 e Mwasalwiba, 2010). E-learning implies the use of virtual platforms such as forums and blogs by students, lessons that are held partially or completely virtually, video on demand analysis and extensive data research to start ventures (Solomon, 2007). The discussion category includes group discussions and presentations that refer to interactive lessons (Mwasalwiba, 2010; Solomon, 2007 e Rauch and Hulsink, 2015). This methodology involves professors and students in the same measure, through presentations created by both. It stimulates critical thinking and helps store acquired knowledge, as well as develop problem-solving capabilities. Computer simulations include business simulations, game and competitions and problem solving. It implies virtual simulations of business (Mwasalwiba, 2010; Solomon 2007). The project method includes individual projects, group projects and research projects. The students' point of view is crucial in this category. Pragmatism and the learning-by-doing principle imply the creation of (individual or joint) projects by students, in which case the approach is based on concrete and practical teamwork (Mwasalwiba, 2010; Solomon, 2007). Business plans imply the use of an innovative entrepreneurial idea or successful startup as an example to realize a complete business plan or business model (Duval-Couetil et al., 2016; Mwasalwiba, 2010; Solomon, 2007). Prototyping revolves around students working on product prototypes and services for startups, that are ultimately delivered to the final user to test and evaluate. The aim of prototyping is to comprehend the product's requisites, evaluating its viability and gathering the feedback from future clients and investors.

Additionally, Béchard & Grégoire (2005) identified three teaching models in higher education: supply model, demand model, and competence model. In this work we aim to test the impact of these three models on entrepreneurial intention.

2.1 THE SUPPLY MODEL

This model revolves around the supply-side of education, namely the teaching delivered by professors. It is based on theories such as behavioral psychology, which states that individuals are affected by stimuli from the environment (Watson, 1925), and reproduction theory, stating that education must be transmitted or reproduced (Goslin, 1965). Both these theories lead to the importance of the educator, who plays a key role as external driver of knowledge. The supply model is usually based on education apprehended by teachings conceived as "telling a story" (Ramsden, 2003) or "imparting information" (Kember, 1997). For instance, the teacher acts as the presenter while the student is the passive recipient (Kember, 1997), with the knowledge to be taught relying on academic research primarily. Raffo et al., (2000) point out that passive methods of teaching EE don't stimulate students. Plaschka & Welsch (1990) suggest that EE needs to include creative, multidisciplinary and process-oriented approaches, theory-based practical applications with more proactive problem solving and a flexible approach, rather than the rigid, passive-reactive concept and theory-emphasized functional approach. Indeed, Todorovic (2004) suggests that EE needs to go beyond the theoretical methods. However, Anderson et al. (2001) state that the primary goals of teaching are to remember and apply (retrieve useful information from long-term memory and use it to solve problems or complete tasks). This model emphasizes knowledge taught theoretically (i.e. general, abstract, and de-contextualized), to be applied to a broad range of situations. Finally, the supply model accentuates the transmission and reproduction of knowledge, hence the application of procedures (lectures in form of printed material, listening to or visualizing audio-visual documents). The evaluation aims to assess the retention of knowledge taught and the mastery of a subject (evaluation of written exams or essays). In the analyses we test the impact of this model on entrepreneurial intention. More precisely our hypothesis is the following:

H2a. The supply model has a positive impact on the creation of academic spinoffs

2.2 THE DEMAND MODEL

This model emphasizes the importance of internal factors affecting students' behavior. Another theory this model relies on is the human capital theory, as education is perceived to grant capital that benefits both the student and the environment. Education should build an environment dedicated to the acquisition of knowledge through teaching (Kember, 1997). Roberston (1999) describes education as the way teaching affects individuals' beliefs and knowledge, in which case teachers should emphasize students' aims and needs (aliocentrism). The model relies on activities such as discussion and exploration, experimentation (interactive learning arising from both teachers' and learners' key role). Ultimately, the demand model evaluation is at the same time summative and formative (not always written exams but often presentations or other oral methods delivered by students); not only it requires to assess the retention of knowledge as the supply model, but also it provides feedback to grant students the chance to analyze their learning process (evaluation may be graded or not, possibly repeated throughout the education process). In the analyses we test the impact of this model on entrepreneurial intention. More precisely our hypothesis is the following:

H2b. The demand model has a positive impact on the creation of academic spinoffs

2.3 THE COMPETENCE MODEL

This model relies on interactivity between the two previous models, namely the supply and demand of knowledge. Learning exists as interaction between individuals and the environment, meaning both internal and external stimuli affect the education process. The model is associated with the perception that knowledge to be taught should be aimed at solving learners' problems in a real-life scenario. Students are the central driver of lectures, which are enhanced by their academic output. This way, teaching allows students to organize knowledge and abilities at their disposal into competences to solve even complex tasks[1]. This education system thus contemplates the interaction between students, teachers and the environment as a model called systemocentrism (Robertson, 1999). Anderson et al. (2001) explain that the teaching goals are primarily to evaluate and create (assess a task based on criteria and reorganize elements in brand new patterns and schemes). This model also stresses the importance of gaining competences in order to solve complex problems by assembling relevant educational resources like knowledge and networks (Le Boterf, 1998). Real-life problems are often ambiguous, meaning that there is no simple or unique answer. For this reason, students should decide how to address the task, how to gather and apply data and resources gained through learning and ultimately how to use taught material to solve the problem at hand (Biggs, 1999: 179). The competence model addresses students not as blank slates ready to be taught, but as individuals whose capabilities and already-faced experiences may influence future learning, thinking in a critical way and revisiting pre-existing knowledge. Such are the bases for this model. Unlike the other two models, this one emphasizes discussion and communication alongside production (students' projects and essays are a key factor, on top of basic interactivity introduced by the demand model). As far as the evaluation goes, the educator applies various methods to assess the education outcome in scenarios that are closely related to real-life situations. In this model authentic assessment methods are applied, where students are at the core of the lessons. The purpose of this kind of assessment is "to reflect the complex performances that are central to a field of study (Laurillard, 2002: 204)". In the analyses we test the impact of this model on entrepreneurial intention. More precisely our hypothesis is the following:

H2c. The competence model has a positive impact on the creation of academic spinoffs

[1] Ramsden, 2003, use the sentence "teaching as making learning possible"

Table 1 presents a summary of the models.

Table 1 Three Entrepreneurship Teaching Models

	Supply model	Demand model	Competence model
Teacher	Teacher as presenter	Teacher as tutor and facilitator	Teacher as coach or developer
Student	Student as passive learner	Student as active participant, interactivity with teacher	Student as active participant, central role instead of teacher during lessons
Content	Content derives from academic research	Content derives from student's needs	Content derives from student's projects, which rely on problems to be solved by competent players in real-life scenarios
Knowledge	Knowledge is theoretical	Knowledge is based on student's demand of topics	Knowledge is acquired in practical ways, student is the central driver of lessons
Evaluation	Evaluation on written output with grades	Evaluation on written output and/or student's oral presentation and constant feedback	Evaluation of performance in real-life scenarios
Goal	Remember and apply: retrieve from memory and solve simple problems	Understand and analyze: give meaning to acquired information and organize it	Evaluate and create: reaching conclusions and critical thinking on tasks

3. RESEARCH DESIGN

3.1 SAMPLE AND DATA COLLECTION

To explore our research question, we focus on one specific context, one nation, to reduce the impact of other variables (e.g. different economic contexts). We focus on the US context, because it has the most effective entrepreneurial ecosystem in the World (Graham, 2014) and many universities to be analyzed. We assembled a dataset including observations on university technology transfer activities starting with the AUTM database. From this database, the main indicators concerning more than 100 universities, from 1991 to 2014, are: spinoffs created, TTO employees and budget allocated to research. The AUTM database was intersected with the Times Higher Education (THE) world ranking. THE makes use of a sophisticated and solid method for the creation of a comprehensive ranking of most of the universities in the World. Universities included in AUTM have very different THE rankings. For our analyses, we employed the time span 2011-2014, as some universities did not offer an online course catalogue and schedule prior to 2011 (e.g. Stanford University). In addition to this, THE world ranking uses the same ranking methodology for this period. Finally, taking into consideration four years allows to narrow the research, in line with previous research in the field (Di Gregorio & Shane, 2003). At the end of this merge, eighty universities compose the resulting sample.

3.1.1 ONLINE COURSE CATALOGUES AND SCHEDULE

For each university, an online course catalogue and schedule containing all the courses offered for the years 2011-2014 was considered. Within the catalogues, entrepreneurship courses were selected according to six main key words: *entrepreneurship*[2]*; start-up, startup or start up; new venture; venture creation; venture development; new business; business development* and *business plan.* Such research led to an extrapolation of 1,262 entrepreneurship courses. For each course, we read

[2] Actually, the word "*entre*" only was used as a key word in order to display results containing such terms as *Entrepreneur* and *Entrepreneurial.*

its description identifying the teaching methods applied, according to those discussed by Solomon (2007) and Mwasalwiba (2010). One entrepreneurship course may use more than one entrepreneurship method. Following Béchard and Grégoire (2005), we then identified under which teaching model each course takes place.[3] To do this we used this correlation:

Table 2 - From entrepreneurship methods to entrepreneurship models

Supply model	Lecture
	Seminar
	E-learning
Demand model	Discussion
	Computer simulation
Competence model	Project
	Business plan
	Prototyping

In addition to this, for each course we have also taken in consideration in which level of education (undergraduate, graduate and PhD) this course is offered.

3.2 DEPENDENT AND PREDICTOR VARIABLES

Our dependent variable is the count of the number of spinoff companies generated by 80 US universities from 2011 to 2014. This number comes from the AUTM database.

In order to test our hypothesis, we use three predictor variables that include the entrepreneurship models of teaching. The entrepreneurship teaching models considered for our analysis are the models presented by Béchard & Grégoire (2005): supply, demand and competence models. The value of these variables ranges from 0 to 1. It means that a variable is equal to 0 if a university does not use those models for any of its entrepreneurship courses offered in a *t* year. On the other hand, the value is equal to 1 if a university uses only that model for all its entrepreneurship courses offered in a *t* year. The sum of these different models can be higher than 1 because an entrepreneurship course may be associated with more than one model.

3.3 CONTROL VARIABLES

NUMBER OF ENTREPRENEURSHIP COURSES

We consider the number of entrepreneurship courses offered by a university because we suppose that if a university offers more entrepreneurship courses it is easier to create an entrepreneurial culture inside the university itself. Thanks to this we believe that there is an increment of the number of university spinoffs.

UNIVERSITY RANKING

The universities' ranking from the THE ranking can affect the creation of spinoffs because the higher the ranking, the higher their reputation. It can be correlated with more founding and partnership. For instance, Di Gregorio & Shane (2003) point out that, *cateris paribus*, an increase of the university' ranking[4] leads to an increase in the number of university spinoffs created. Powers &

[3] We did not use the hybrid models present by Béchard and Grégoire (2005).
[4] Di Gregorio & Shane (2003) measured the universities' ranking through the Gourman Report.

McDougall (2005) claim that universities with higher prestige have a higher success for the technology transfer. In addition to this, with a high-ranking university it is easier to attract star scientists that, as Zucker et al. (1998) point out, positively impact the creation of new firms. Lastly, O'shea et al., (2005) find that university ranking slightly impacts the creation of universities' spinoffs.

Class dimensions

Oosterbeek et al., (2010) suggest looking at the class dimensions in order to better understand the impact of EE. This is because in a small class, students are more easily encouraged to participate in the lecture and connect with their professors. We use the student-teacher ratio (also called student-faculty ratio) from the THE ranking for measuring the class dimensions.

Research expenditures

Because the intellectual property exploited by universities is created through investment in research, the amount of research inputs is likely related to spinoff creation (Algieri et al., 2013; Di Gregorio & Shane, 2003; O'Shea et al., 2005; O'shea et al., 2008). Indeed, Friedman & Silberman (2003) show that universities' funding positively impacts TTO activities. Therefore, we control for the logarithm of the research expenditures in the university-year. We gather this data from information reported by the universities to AUTM.

Regional environment

Several researches (e.g., Friedman e Silberman, 2003) suggest that a favorable ecosystem encourages the creation of new ventures. We measured this data from the Gross Domestic Production (GDP) of the State where the university is situated by the US Bureau of Economic Analysis (BEA)[5] database. In our regression analysis we control for the logarithm of the GDP by state.

TTO Employees

Siegel & Wright (2015) in their literature review point out that the TTO is a key component in promoting entrepreneurship activities even if Fini et al (2010) show that many universities' entrepreneurial outcomes occurs outside the university intellectual property system. However, Di Gregorio & Shane (2003) find, in some regression models, a positive correlation between TTO staff members and spinoff activities. Additionally, O'shea et al. (2005) show a positive impact of the amount of Professional Full Time Equivalents (FTEs) dedicated to university technology transfer on the number of university spinoffs. Therefore, we control for the number of TTO employees measured in FTE as for the previous research. (Gregorio & Shane 2003; O'shea et al., 2005). This data comes from the AUTM database.

Presence of Medical School

Pressman et al. (1995) and Powers (2003) suggest that the presence of a medical school within the university may be an important institutional factor for the university's entrepreneurial outcome. This data comes from the AUTM database.

Technical universities

[5] Link: http://bea.gov/iTable/

Institution type can be correlated with the entrepreneurial culture of the university (O'shea et al., 2005). Zhang et al., 2014 show that students from technological universities[6] have higher EI than students from other universities. Therefore, we control if a university is technological or not.

LEVEL OF TEACHING – UNDERGRADUATE, GRADUATE E PH.D.

Due to the fact that entrepreneurship courses offered at different levels can have a different impact we control for the regression variable for it. The value of these variables ranges from 0 to 1. The sum of these value can be higher than 1 because an entrepreneurship course may be associated with more than one level of teaching.

YEAR

In order to account for annual variation in universities' spinoff activity, we include the year dummy variable of the sample period.

The next table illustrates the definition of all these variables.

Table 3 - Variable definition

Name	Definition	Data source
Academic spinoff	Count number of spinoff companies generated by university *i* at time *t*.	AUTM
Supply model	Value that varies between 0 and 1, that indicates how many entrepreneurship courses offered by university *i* at *t* time use the supply model	Universities' online course catalog
Demand model	Value that varies between 0 and 1, that indicates how many entrepreneurship courses offered by university *i* at *t* time use the demand model	Universities' online course catalog
Competence model	Value that varies between 0 and 1, that indicates how many entrepreneurship courses offered by university *i* at *t* time use the competence model	Universities' online course catalog
N. of entrepr. courses	Number of entrepreneurship courses offered by university *i* at time *t*.	Universities' online course catalog
University ranking	University *i* ranking at time *t*	THE
Class dimension	Student-teacher ratio (also called student-faculty ratio) of university *i* at time *t*	THE
Research expenditures	The logarithm of total research expenditures for university *i* at time *t*	AUTM
Regional environment	The logarithm of GDP of the country where university *i* is.	BEA
Presence of med. school	Presence of medical school (1 = yes)	AUTM
TTO employees	Number of professional technology transfer staff for university *i* at time *t*.	AUTM
Technological un.	Dummy variable is equal to 1 if the university *i* is technological and 0 if the university *i* is not.	Universities' online course catalog
Und. Lev. courses	Number of undergraduate entrepreneurship courses offered by university *i* at time *t*.	Universities' online course catalog
Graduate Lev. courses	Number of graduate entrepreneurship	Universities' online course catalog

[6] We define a technological university as a university that does not present humanistic courses. Some technological universities present also a medical school.

	courses offered by university *i* at time *t*.	
PhD Lev. courses	Number of Ph.D. entrepreneurship courses offered by university *i* at time *t*.	Universities' online course catalog

3.4 MODELS SPECIFICATION

According to Hausman et al., (1984) there are two ways to deal with the discrete nature of count data: The Poisson regression model or the negative binomial model. We analyzed the 4-year panel compiled for this study using Poisson models with random effects. The negative binomial model assumes a high frequency of zeros in the data (Cameron & Trivedi, 1998). This assumption is violated in our data.[7] In essence, the Poisson model provides a solution to this problem. In addition to this, we use the random effect because we employ some dummy variables (such as the presence of a medical school) in our analysis. As shown by Di Gregorio & Shane (2003) and O'shea et al., (2005) the unobserved heterogeneity is randomly distributed.

4. ANALYSIS

4.1 DESCRIPTIVE ANALYSIS

The sample of 80 US universities is diverse. Indeed, the number of students is very varied from 2,243 at California Institute of Technology to 83,236 at Arizona State University. The average number of students is 26,424, while the median is 24,203. In addition to this, they present a different worldwide ranking. [8] Additionally, as suggested by the literature, we found an increase in numbers of EE in our sample period. In 2011 the number of entrepreneurship courses offered by 80 US universities was 753, while in 2014 it rose to 1208. However, we found that the most widely used entrepreneurship teaching method is through lectures, even if this method presents a negative trend in the sample period. This is in line with what we found in the literature. The second most used entrepreneurship teaching method is through projects. On the contrary, the project method presents a positive trend in our time period.

4.2 REGRESSION ANALYSIS

The next table shows our regression analysis. We use three different analyses in order to evaluate different time periods. The aim is to understand the impact of the different entrepreneurship teaching models on spinoff creation. In the first regression we estimate the impact of the entrepreneurship model present in *t* of the spinoffs created in the same year. In this regression no entrepreneurship teaching model presents a statistically significant value. However, the universities' ranking, the class dimensions, the research expenditures and TTO employees present a statistically significant value. Only the universities' ranking has a negative value, while the other variables have a positive value. This is explained by the fact that the university being worse shows a higher ranking. It means that the lower the ranking a university has, the more spinoffs they will have. Also in this case it is strange that class dimensions show a positive value. For the second regression we study the effect of entrepreneurship model at *t-1* on the creation of spinoffs at t. In this case, the demand model and the competence model have a statistically significant and positive value. Additionally, the number of entrepreneurship courses offered, the research expenditures and TTO employees present a statistically significant and positive value, while the ranking has a statistically significant and negative value. Lastly, in the last regression analysis we estimate the impact of the three entrepreneurship models offered at *t-2* on the number of spinoffs. Also in this case, the

[7] The frequency of zeros is 4.68%.
[8] 6% are in the top 10, 21% are in the 11-50, 18% are in the 51-100; 35% are in the 101-300, 20% are in 301-500. Data comes from the THE.

demand model and the competence model present a statistically significant and positive value. Moreover, the number of entrepreneurship courses offered, the universities' ranking, the class dimension, the research expenditures and TTO employees present a statistically significant value. Only the ranking has a negative value, while the other variables have a positive value.

Table 4 Random effects Poisson regression estimate spinoff production by entrepreneurship models

	(1) Model 1 (t)		(2) Model 2 (t-1)		(3) Model 3 (t-2)	
Supply model	-0.165	(0.466)	0.246	(0.323)	0.291	(0.311)
Demand model	0.880	(0.591)	1.161^{*}	(0.566)	1.261^{*}	(0.580)
Competence model	0.404	(0.442)	1.071^{**}	(0.373)	1.163^{**}	(0.370)
N. of entrepr. courses	0.007	(0.006)	0.011^{+}	(0.006)	0.012^{+}	(0.007)
University ranking	-0.001^{*}	(0.001)	-0.001^{+}	(0.001)	-0.001^{+}	(0.001)
Class dimension	0.022^{+}	(0.011)	0.017	(0.011)	0.019^{+}	(0.011)
Research expenditures	0.226^{***}	(0.045)	0.214^{***}	(0.047)	0.223^{***}	(0.052)
Regional environment	0.074	(0.068)	0.034	(0.067)	0.032	(0.070)
Presence of med. school	0.137	(0.169)	0.192	(0.174)	0.135	(0.189)
TTO employees	0.014^{*}	(0.006)	0.015^{*}	(0.007)	0.013^{+}	(0.007)
Technological un.	0.375	(0.294)	0.358	(0.290)	0.179	(0.312)
Und. Lev. courses	-0.250	(0.234)	0.123	(0.252)	0.074	(0.281)
Graduate Lev. courses	-0.1226	(0.2302)	-0.031	(0.246)	0.122	(0.281)
PhD Lev. courses	-0.1680	(1.1015)	0.412	(1.122)	0.540	(1.223)
Constant	-4.590^{***}	(1.2447)	-5.137^{***}	(1.284)	-5.332^{***}	(1.406)
Observations	267		206		143	
Log likelihood	-631.997		-489.6278		-348.623	

Standard errors in parentheses. Clustered SE at household level. Year dummy variables are included in all these regressions. McFadden's pseudo-R2 equal 1 - (L^{*}/ L_0) is 0.006 for Model 1; 0.230 for Model 2; 0.451 for Model 3. The first column reports the estimated coefficients from the order probit. The reported marginal effects are divided into four columns: $^{+}$ $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

5. DISCUSSION

First of all, the population analyzed is heterogeneous, composed of universities having ranking values and a wide range of students. The analysis demonstrates that the most used teaching method in EE is the "frontal lecture". This methodology presents a negative trend, as the practical "project" methodology is taking its place. Here, we will discuss the results obtained from the analysis of data gathered during the research phase and the effect of the different teaching models on the creation of academic spinoffs. The results show that no entrepreneurship teaching model has a positive and statistically significant effect at time t. However, an entrepreneurship teaching model at time *t* has a low probability to affect the creation of spinoffs during the same year. To cope with this issue, two additional analyses have been added, modifying the reference year. If we analyze the effect of teaching models applied at time *t-1* on the creation of spinoffs at time t, what emerges is that both the demand and the competence models have a positive and statistically significant effect. In other words, a university that applies a demand or competence model in their entrepreneurship courses at time *t-1,* reaps a positive impact on spinoff creation in the next year. This result is in line with findings by Solomon (2007), who has highlighted how an effective entrepreneurial training requires students to face practical experiences. Finally, the effect of teaching models applied at time *t-2* on the creation of spinoffs at time *t* was measured. The results show again that using demand and competence models have a positive and statistically significant effect. Applying the Poisson regression analysis on data panels with random effects, it is possible to assert that the demand and competence model have a statistically significant and positive impact on the creation of spinoffs.

In addition to the analysis on independent variables, we proceed to discuss the role of control variables used. It is important to notice that we evaluate the impact of all our control variables at time t on the creation of academic spinoffs at the same time t for all the three models. This means that in our models we only change the time for the predictor variables. First of all, the dimension of the TTO appeared statistically significant and positive in every regression analysis. This result is in line with the findings of O'shea et al. (2005). Additionally, Di Gregorio & Shane (2003) have highlighted how research funds are directly proportional to the number of spinoffs created. In fact, such variable results are statistically significant and positive in each case. The presence of medical schools is not significant, as found by O'shea et al. (2005). Academic ranking is statistically significant and negative in the last three analyses. This has to do with the fact that a higher ranking means greater benefits a university may receive, such as attracting better professors and students, more research funds, a better network and cohesion with the local or international environment. As discussed by Olcay & Bulu (2016), academic ranking is usually considered a useful index to compare academic performance, even though it holds certain limits. A university being technical or not seems to affect the creation of spinoffs. The same result can be seen for the regional environment evaluated through the GDP of the Country. Our analysis shows that the environment does not have an impact on the creation of spinoffs, the same result as O'shea et al. (2005). Finally, class dimensions and number of entrepreneurial courses offered in some regressions have a positive and statistically significant effect. It doesn't seem appropriate that class dimensions might have a positive coefficient. Either way, we highlight how such value was low-based on the analyzed population. The minimal value is 3.6 while the maximum is 43.7.

6. Conclusion

The results contribute to understanding the impact of different entrepreneurship teaching models (Béchard & Grégoire, 2005) on the development of new ventures. New ventures are analyzed identifying the number of spinoffs created by 80 US universities from 2011 to 2014. Furthermore, our findings can be useful for lecturers in entrepreneurship, as well as their universities, in shaping entrepreneurship courses and programs, and students interested in becoming entrepreneurs. Evidence indicates that usually practice extends students' domain-specific knowledge and skills by generating an actual enhancement of basic cognitive resources (Baron & Henry, 2010; Piperopoulos & Dimov, 2015), that is, individuals learn through experience. We argue that in order to learn entrepreneurship, practice is vital, but this does not exclude theory. Indeed, effective entrepreneurship "doing" requires a set of practices and these practices are firmly grounded in theory. Our investigation contributes to the literature in three ways. First, we measure and test the impact of EE on venture creation in a significant number of US universities. Indeed, we study the effect of academic EE in 80 US universities on the creation of spinoffs during different time spans. Second, we provide evidence about the impact that different teaching methods and models have in the context of entrepreneurship (Nabi et al., 2017). In detail, we find that practical teaching models (demand and competence model) have a positive impact on the creation of academic spinoffs. Lastly, our research demonstrates that EE impacts universities' entrepreneurial outcome. This is correlated with the concept of entrepreneurial universities presented by Etzkowitz (2004). Etzkowitz (2003) points out that at an entrepreneurial university, research and teaching results should translate into entrepreneurial activity. University management thereby generally seeks universities' entrepreneurial outcomes. In order to generate these outcomes, university-wide strategies must be employed. (Bischoff et al., 2017; Gibb & Hannon 2006). Indeed, checking the TTO and research expenditures effect we point out that EE has a positive impact of the creation of academic spinoffs, too. In this way, we contribute to strengthening the theories presented in the EE landscape testing their real effectiveness (Béchard & Grégoire, 2005; Nabi et al., 2017).

Although the study provides some interesting findings, some limitations should be noted. We were not able to analyze the direct impact, because we did not know who followed the entrepreneurship courses and who is the owner of spinoffs. However, we analyzed this impact from an ecosystem level with the use of some proxies. We know the numbers of spinoffs but we do not know their value. (Wright et al., 2004).

Additionally, since EE is an important worldwide field, it would be useful to expand the geographical scope of the study.

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APPENDIX

Table 5 - Variable description

Name	N	Mean	Median	SD	Min	Max
Academic spinoffs	305	7.26	5	8.41	0	75
Supply model	320	0.44	0.46	0.21	0	1
Demand model	320	0.10	0.08	0.10	0	0.5
Competence model	320	0.36	0.35	0.17	0	1
N. of entrepr. courses	312	12.64	10	8.62	0	59
University ranking	305	137.93	103	113.10	1	375.5
Class dimension	294	12.60	11.70	6.50	3.6	43.7
Research expenditures	311	26.28	26.69	2.1	16.88	29.37
Regional environment	320	12.89	12.98	0.93	10.22	14.66
Presence of med. school	312	0.74	1	0.44	0	1
TTO employees	309	9.00	6	9.45	1	69
Technological un.	320	0.05	0	0.22	0	1
Und. Lev. courses	308	0.64	0.67	0.25	0	1
Graduate Lev. courses	308	0.50	0.50	0.25	0	1
PhD Lev. courses	308	0.01	0	0.04	0	0.25

Table 6 - Sample universities

University	State	University	State
California Inst. of Technology	CA	Texas A&M Univ. System	TX
Harvard Univ.	MA	Colorado School of Mines	CO
Stanford Univ.	CA	Rutgers The State Univ. of NJ	NJ
Princeton Univ.	NJ	Brandeis Univ.	MA
Massachusetts Inst. of Technology (MIT)	MA	Indiana Univ. Res. & Technology Corp. (IURTC)	IN
Univ. of Chicago/UCTech	IL	Dartmouth College	NH
Columbia Univ.	NY	Univ. of Utah	UT
Johns Hopkins Univ.	MD	Univ. of Miami	FL
Univ. of Pennsylvania	PA	Georgetown Univ.	DC
Univ. of Michigan	MI	Univ. of Iowa Research Fdn.	IA

Duke Univ.	NC	Univ. of Delaware	DE
Cornell University	NY	Arizona State Univ.	AZ
Northwestern Univ.	IL	Iowa State Univ.	IA
Carnegie Mellon Univ.	PA	Univ. of South Florida	FL
Univ. of North Carolina Chapel Hill	NC	Univ. of New Mexico/Sci. & Tech. Corp.	NM
Univ. of Illinois Chicago Urbana	IL	Univ. of Hawaii	HI
UW-Madison/WARF	WI	Colorado State Univ.	CO
Univ. of Washington/Wash. Res. Fdn.	WA	Univ. of Georgia	GA
New York Univ.	NY	Univ. of Cincinnati	OH
Washington University of St. Louis	MO	Univ. of South Carolina	SC
Georgia Inst. of Technology	GA	Oregon State Univ.	OR
Univ. of Minnesota	MN	Tulane Univ.	LA
Brown University	RI	Univ. of Missouri all campuses	MO
Penn State Univ.	PA	Drexel Univ.	PA
Ohio State Univ.	OH	San Diego State University	CA
Rice Univ.	TX	Temple Univ.	PA
Univ. of Southern California	CA	Univ. of Houston	TX
Michigan State Univ.	MI	Wayne State Univ.	MI
Univ. of Notre Dame	IN	Kansas State Univ. Research Fdn.	KS
Univ. of Arizona	AZ	Univ. of Oklahoma All Campuses	OK
Tufts Univ.	MA	Creighton Univ.	NE
Univ. of Pittsburgh	PA	Univ. of Kansas	KS
Univ. of Massachusetts	MA	Univ. of Connecticut	CT
Emory Univ.	GA	Lehigh Univ.	PA
Vanderbilt Univ.	TN	Univ. of Vermont	VT
Univ. of Colorado	CO	Washington State Univ. Research Fdn.	WA
Case Western Reserve Univ.	OH	University System of Maryland	MD
Univ. of Rochester	NY	Univ. of California System	CA
Univ. of Florida	FL	University of Texas System	TX
Univ. of Virginia Patent Fdn.	VA	Univ. of Nebraska	NE