

# Influence of role models on the entrepreneurial skills of science and technology undergraduates

Influence of role models on undergraduates' skill

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## Abstract

**Purpose** – This study examines the perspectives of undergraduate science and technology students in Thailand regarding the influence of various role models on their entrepreneurial skills.

**Design/methodology/approach** – This study employed the single case study research method. Purposive sampling was used to select the participants. The sample consisted of 142 key informants, whose responses were analysed using a direct content analysis method.

**Findings** – From the students' perspectives, entrepreneurial role models indirectly influenced their entrepreneurial skills.

**Practical implications** – The findings have clear implications for educators and policymakers. Educational institutions should design and implement educational strategies that help connect informal learning gained from the family with formal training at higher education institutions. On-the-job or apprenticeship training should also be included as a component of course content.

**Originality/value** – Our findings regarding the influence of role models differ from those of previous studies in relation to two of the four role models considered here. First, according to the students, their family environment has no direct impact on their entrepreneurial skills. In addition, science- and technology-based educational environments should adopt an entrepreneurial orientation to help students understand various market and business pressures, which will enable them to make a positive contribution to the workplace.

**Keywords** Entrepreneurship education, Science and technology students, Role models, Informal training, Business skills, Management

**Paper type** Research paper

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**Plain Language Summary:** Entrepreneurial education is an important strategic policy in Thailand. Based on empirical evidence from a leading science and technology university in Thailand, we show that the influence of role models differs from the conclusions of previous studies in relation to two of the four role models considered.

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## 1. Introduction

The concept of the entrepreneurial university has transformed the role of contemporary higher education. According to the World Economic Forum (WEF, 2019), establishing partnerships with industries is key for educational institutes to successfully nurture entrepreneurial skills. Specifically, these partnerships are successful when the collaborating parties have complementary assets and common values. However, before entering into a partnership, the parties should reach a consensus on how they can create synergies and derive value (WEF, 2019).

According to the blueprint for Thailand 4.0, Thailand has been caught up in the “middle-income” trap for many years, as the country has been losing its competitive edge owing to higher labour costs. To revitalise the economy, the Thai government has proposed a new growth engine under “Thailand 4.0” to focus on technological development and innovation. Technology start-up companies are considered the primary growth engines. The government has established measures to promote the growth of technology start-up companies, such as tax incentives, investment funds and ecosystem development. The Entrepreneurship Education Programme is one of these strategic national policies. The Programme aims to create a curriculum on entrepreneurship that will be offered in universities and vocational schools; it will include lectures, special projects, project contests and internships (Buasuwan, 2018).

The importance of role models in the promotion of entrepreneurial skills has been widely investigated in the literature (Cope, 2005; Hamilton, 2011; Hoffmann *et al.*, 2015; Pittaway and Thorpe, 2012; Rae, 2005, 2010; Toledano and Urbano, 2008; Trivedi, 2016; Zozimo *et al.*, 2017). For instance, Bosma *et al.* (2012) found that famous people such as Steve Jobs, former colleagues or even family members can serve as role models. The term “role models” is commonly used to refer to individuals who set examples that are emulated by others, and who inspire other individuals to make certain (career) decisions or achieve certain goals (Basow and Howe, 1980; Wright and Carrese, 2002; Wright *et al.*, 1997). The relevance of role models to entrepreneurs is evident from the abundance of stories in the business press about entrepreneurial endeavours and successes that have influenced other entrepreneurs.

In this study, we aim to understand the influence of role models as well as life experiences on the skills of students pursuing non-business degrees to engage in entrepreneurial activities and, subsequently, become entrepreneurs.

## 2. Literature review

### 2.1 Entrepreneurship education

Over the last decade, it has become clear that entrepreneurship can be taught. Consequently, universities have started offering courses on entrepreneurship education (EE) (Fayolle, 2005; Kuratko, 2005; Rae, 2005, 2010). One of the main areas of interest in the development of EE is identifying relevant academic courses and skills to be taught. Several studies have noted that entrepreneurship skills tend to comprise both hard skills, such as financial planning, market analysis, new product development, business or project planning and strategy, and soft skills, such as confidence, initiative, idea generation, creativity, problem identification and solutioning (Van der Kuip and Verheul, 2003; Wiklund and Shepherd, 2005). At the same time, other studies have focused on how people develop an entrepreneurial mindset. Rae (2005, 2010) concluded that, whereas education can create cultural awareness and entrepreneurial knowledge and skills, the “art” of entrepreneurial practice is learnt experientially in business, rather than through education (Toledano and Urbano, 2008; Preece, 2016; Zozimo *et al.*, 2017). Moreover, in the context of an increasingly globalised and interconnected world, universities are no longer seen as the primary knowledge producers. As such, they should connect more collaboratively with other knowledge producers and other sources of knowledge. There is a growing understanding that the world’s challenges require collaborative solutions, which also

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involves the expansion of the service-learning curriculum and an exploration of the ways in which knowledge boundaries can become more porous (Preece, 2016).

### *2.2 Role models*

Role models are individuals whose lives and activities inspire other people's conception of some ideal or expected behaviour. When the role is career related, such as entrepreneurship, role models can help shape both the outcome expectations and self-efficacy of individuals, causing them to pursue entrepreneurial skills as well as an entrepreneurial career (Toledano and Urbano, 2008). Previous studies on role models have argued that role behaviour is learnt through socialisation (Toledano and Urbano, 2008). Socialisation is concerned with the learning of behaviour at various stages of life. The first stage occurs in the family environment, whereas the second encompasses education and employment. Therefore, entrepreneurial role models can emerge from family and friends, or from educational institutions and businesses (Gorman *et al.*, 1997). Interestingly, having relatives and friends who are entrepreneurs can be an important source of social capital (Davidsson and Honig, 2003), whereas the educational and employment environments can indicate an individual's inherent human capital. The social capital theory is primarily concerned with the significance of relationships as a resource for social action (Nahapiet and Ghoshal, 1998). In contrast, the human capital theory analyses individuals' investments in productivity-enhancing skills and knowledge (Becker, 1993). Several studies have pointed out that both social and human capital are critical resources for potential entrepreneurs (Becker, 1993; Davidsson and Honig, 2003; Toledano and Urbano, 2008; Zozimo *et al.*, 2017). In this study, we aim to understand how role models influence the aspiration of undergraduate students pursuing non-business degrees to engage in entrepreneurial activities and then become entrepreneurs.

### *2.3 Family background*

Although role models and family are conjectured to influence the emergence of entrepreneurial aspirations and skills, the concept of a role model is wider and includes other people besides the immediate family. Current literature indicates that the family background can be a push or pull factor in driving people towards entrepreneurship (Van der Zwan *et al.*, 2016). The push factor, or negative motivation, usually takes the form of poverty, insecurity or childhood neglect. The pull factor, or positive motivation, comes from the presence of a family business with parental role models, the assumption of significant family responsibilities at a young age and opportunities to engage in entrepreneurial activities. As a result, children with a positive motivation learn and develop the skills, values, confidence and experience necessary for an entrepreneurial career. Previous research also suggest that a high level of prior exposure to family business is positively associated with entrepreneurial intentions (Begley *et al.*, 2005; Veciana *et al.*, 2005; Carr and Sequeira, 2007; Toledano and Urbano, 2008; Looi and Khoo-Lattimore, 2015).

### *2.4 Educational environment*

The educational environment related to science and technology (ST) courses emphasises basic science, health science and engineering. It involves the acquisition of innovation skills along with the application of ST knowledge to occupations that improve humans' environment (Onwuachu and Okoye, 2012). This includes careers in engineering, pharmacy, agriculture and home economics. Cooney and Murray (2008) suggested that entrepreneurship modules are increasingly being incorporated into non-business courses; more significantly, interest in and demand for these modules is growing in the science, engineering and arts faculties. It is no longer considered adequate to graduate with a purely technical education. Professionals are required to be entrepreneurial to understand various market and business pressures and make positive contributions to the workplace (Toledano and Urbano, 2008; Ernest *et al.*, 2015; Zozimo *et al.*, 2017).

### *2.5 Work environment*

Through the work experience gained from employment, potential entrepreneurs enhance their knowledge, skills and commercial awareness. In other words, the past and present work experiences of potential entrepreneurs act as incubators, which exert a central, and often pivotal, influence on their ability to effectively engage in opportunity recognition and exploitation. Moreover, men and women can have different work experiences (Cooper and Park, 2008; Looi and Khoo-Lattimore, 2015; Toledano and Urbano, 2008).

### *2.6 Entrepreneurial education environment*

University education is vital for the development and nurturing of entrepreneurial capital (Cooper and Park, 2008). Some researchers have found that a specialisation in business studies positively and strongly influences entrepreneurial skills and intentions (Fukuda, 2014; Tkachev and Kolvereid, 1999). Langowitz and Minniti (2007) found that non-business education has no significant relationship with students' intention to start a business, which means that even a high level of educational attainment may not stimulate students' entrepreneurial skills. By contrast, Wilson *et al.* (2007) suggested that providing access to EE is critical to promote entrepreneurship among students because such education can improve their skills, self-efficacy and, ultimately, their entrepreneurial intentions (Looi and Khoo-Lattimore, 2015; Toledano and Urbano, 2008; Zozimo *et al.*, 2017).

### *2.7 Entrepreneurial skills*

Several studies have been conducted on entrepreneurial skills over the past few decades. Wickham (2006) stated that entrepreneurs are creative, seek and discover niches for market innovations, bear risks, are growth-oriented and driven to maximise profits or investors' returns. Shook *et al.* (2003) stressed the importance of exploitation and stated that entrepreneurship is about entrepreneurial individuals interacting with their environments, and consequently engaging in discovery, evaluation and exploitation to take risks and identify entrepreneurial opportunities. Moreover, entrepreneurial alertness, comprising sensing and searching information, cognitive ability, knowledge and experience, personality factors, networking capabilities and an entrepreneurial environment (Sharma, 2019), is a key component in developing entrepreneurial skills. This is because constant, automatic opportunity recognition gives the entrepreneur the ability to formulate a mental image of the future (Suomala *et al.*, 2006). Furthermore, Lambing and Kuehl (2000) list the following as essential, entrepreneurial traits and skills: a passion for business, a tolerance of obstacles, perseverance, trust, determination, risk management, a positive attitude towards change, a tolerance of uncertainties, initiative, a need to achieve, punctuality, an understanding of timeframes, creativity, an understanding of the big picture and motivation. In addition, the European Commission (2012) indicated that entrepreneurial skills include creativity, analysis, motivation, networking, adaptability and financial management. Gürol and Atsan (2006) found that entrepreneurially oriented students have a higher risk-taking propensity, an internal locus of control, a higher need for achievement and higher innovativeness than students who have no entrepreneurial desire. Furthermore, Lazear (2005) showed that individuals with a balanced and wide range of skillsets are more likely to become entrepreneurs than those who are focused on one role at work or one subject at school (Ernest *et al.*, 2015; Taatila, 2010; Wang and Chugh, 2014).

## **3. Framework and research questions**

### *3.1 Conceptual framework*

Examining key literature in the area of EE (Begley *et al.*, 2005; Carr and Sequeira, 2007; Cooper and Park, 2008; Ernest *et al.*, 2015; European Commission, 2012; Ernest *et al.*, 2015;

Rae, 2005, 2010; Taatila, 2010; Toledano and Urbano, 2008; Trivedi, 2016; Van der Kuip and Verheul, 2003; Veciana *et al.*, 2005; Wiklund and Shepherd, 2005; Zozimo *et al.*, 2017) and entrepreneurship (Kuratko, 2005; Phan, 2004), the authors have developed a conceptual framework (see Figure 1) to examine the influence of various environmental factors as role models for the entrepreneurial skills of non-business students.

### 3.2 Research questions

The main research question and sub-questions of this study are:

*RQ1.* How do role models influence the entrepreneurial skills of undergraduate ST students?

Sub-questions:

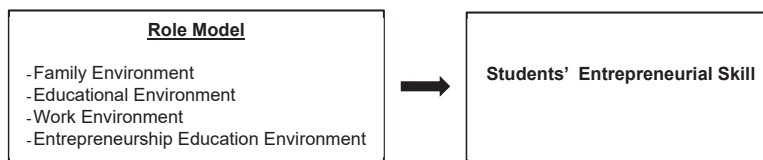
- (1) How does the family environment influence the entrepreneurship skills of undergraduate ST students?
- (2) How does the educational environment influence the entrepreneurship skills of undergraduate ST students?
- (3) How does the work environment influence the entrepreneurship skills of undergraduate ST students?
- (4) How does the EE environment influence the entrepreneurship skills of undergraduate ST students?

## 4. Methodology

### 4.1 Research design

Qualitative methods are ideal for collecting detailed data and creating deep understanding about the phenomena and concepts of interest (Elo and Kyngäs, 2008). We employed the single case study method. Case-study research is recommended for studying complex and under-explored areas (Cresswell, 1998; Eisenhardt, 1989; Yin, 1984, 2003, 2013, 2017). Specifically, the single-case-study approach was selected to gain insights on how entrepreneurial skills are promoted among undergraduate ST students.

This qualitative case study is part of a larger study, that focused on a sequential exploratory mixed-methods approach with the goal of designing an instrument for Mahidol University, a science-based higher education institution in Thailand. Mahidol University was chosen because, although it is a leading ST university in Thailand, it is actively attempting to evolve as an entrepreneurial university in response to the Government's policy (Buasuwan, 2018). Researchers use a mixed-methods design when existing instruments, variables and measures may be unknown or unavailable to the population under study (Cresswell, 2012). Sometimes, there are existing theories or prior research about a phenomenon that are incomplete or would benefit from further description, or there is a need to test the similarity of meaning of concept in a different setting. In such cases, a deductive approach is based on an



Source(s): Adapted from the model of Toledano and Urbano (2008)

**Figure 1.**  
Conceptual framework

earlier theory or model (Toledano and Urbano, 2008). Therefore, a direct content analysis method was used to determine and develop the entrepreneurial education concept, which still faces major challenges as role models related to improving the entrepreneurial skills and mindsets of students (Eisenhardt, 1989; Yin, 1984, 2003, 2013, 2017). In addition, our study adopted the strategy of developing relevant research questions based on the existing literature. This approach provided us with a well-defined focus, facilitating the systematic collection of specific data.

#### *4.2 Sample unit and size*

The purposive sampling technique was employed in this study for selecting informants (Bernard *et al.*, 2016). Informants were chosen by the researcher based on their research area and community of ST-based students. Purposive sampling is a non-random technique that does not require underlying theories or a set number of informants, as the researcher determines what must be known and sets out to find people who can and are willing to provide the relevant information by virtue of their knowledge or experience (Bernard *et al.*, 2016). The data collection consisted of several primary and secondary data sources, including semi-structured and field interviews (McFoy, 2004).

#### *4.3 Key informants*

A population sample of 142 informants was chosen from among the students. The key informants were ST students who were selected purposively with respect to relevant studying academic majors, undergraduate education years and the current status of students who are studying at Mahidol University in Thailand. Inclusion criteria were an agreement to participate and the ability to communicate, share information and express their feelings and opinions. The sample size was justified as sufficient, and relevant knowledge was collected from experienced key informants who were studying in relevant ST fields, including health and medical sciences and engineering and information technology. The 142 key participants of the study, comprised of 74 students majoring in medical and health science (MHS) and 68 students majoring in science information technology and engineering (SITE), were interviewed (see Table 1).

#### *4.4 Data collection*

The qualitative component of the study was conducted in 2021 with the key informants, who study in the college's classes related to MHS and SITE of Mahidol University in Thailand. In the first batch of data collection, we conducted 40 semi-structured interviews, and we conducted 102 additional semi-structured interviews in the last batch. These interviews started with open-ended questions such as "how are you today?", "how many years have you been studying?", "do you understand role models and entrepreneurial skills?", followed by "can you explain more?", "in your opinion, how and why do role models influence entrepreneurial skills?" and "how can you identify vital skills required for entrepreneurship?". The interviews were continued until data saturation was reached, meaning that no new findings were added.

#### *4.5 Data analysis*

Existing theory or research can provide predictions about the relationships among variables, thus helping to determine the initial coding scheme or relationships between codes. A qualitative, directed content analysis approach has three main phases: preparation, organisation and reporting. The preparation phase starts with selecting the unit of analysis, deciding what to analyse and selecting a unit of meaning. Next, in the analytic



Batch	Gender	Academic major	Undergraduate education year	Number of interview	% of interview	Average interview length (minutes)
1	Male	MHS	1st year	2	1%	30
2	Male	MHS	2nd year	15	11%	44
3	Male	MHS	3rd year	18	13%	46
4	Male	MHS	4th year or more	7	5%	38
5	Female	MHS	1st year	3	2%	32
6	Female	MHS	2nd year	7	5%	35
7	Female	MHS	3rd year	17	12%	48
8	Female	MHS	4th year or more	5	4%	38
<i>Subtotal</i>				74	52%	39
9	Male	SITE	1st year	5	4%	32
10	Male	SITE	2nd year	5	4%	34
11	Male	SITE	3rd year	19	13%	36
12	Male	SITE	4th year or more	5	4%	34
13	Female	SITE	1st year	4	3%	34
14	Female	SITE	2nd year	10	7%	45
15	Female	SITE	3rd year	16	11%	48
16	Female	SITE	4th year or more	4	3%	34
<i>Subtotal</i>				68	48%	37
<i>Grand total</i>				142	100%	38

**Note(s):** MHE = medical and health science; SITE = science information technology and engineering

**Source(s):** Authors' research data

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**Table 1.**  
Summary of key informants' characteristics

process, the researcher strives to make sense of the data and to learn “what is going on” and obtain a sense of the whole. In the organising phase, the next step is to develop a categorisation matrix and code the data according to the categories of the model. In the reporting phase, the researcher generates a link between the results and the data (Elo and Kyngäs, 2008). As to this study, we used the direct content analysis method (Hsieh and Shannon, 2005), in which researchers identify key concepts or variables as initial coding categories. Next, operational definitions for each category were determined using the theory. The data were collected primarily through interviews, using an open-ended question followed by targeted questions about the predetermined categories. After an open-ended question, we used probes specifically to explore participants' experiences. We used a combination of two coding strategies. Coding can begin with one of two strategies, depending on the research question. If the goal of the research is to identify and categorise all instances of a phenomenon, such as emotional reactions, then it might be helpful to read the transcript and highlight all text that, on first impression, appears to represent an emotional reaction. The next step would be to code all highlighted passages using the predetermined codes. Any text that could not be categorised with the initial coding scheme would be given a new code. The second strategy is to begin coding immediately with the predetermined codes. The data that cannot be coded are identified and analysed later to determine if they represent a new category or a subcategory of an existing code. The choice between these approaches depends on the data (Hsieh and Shannon, 2005). The data triangulation helped us improve the completeness of the information (Eisenhardt, 1989) and the degree of correctness of this study's findings (Jick, 1979).

## 5. Results and discussion

Of the key informants interviewed, most were male (54% of all participants), and most were third-year undergraduates (49% of all participants). Moreover, the mean interview length was 38 min. The descriptive data of the participants are presented in Table 1. The final

analysis yielded 142 units of analysis dispersed in seventeen generic-categories and subcategories belonging to four main categories (see [Table 2](#)).

5.1 Family environment as a role model

The findings indicate that the family environment has no direct impact on participants' entrepreneurial skills.

Our parents see us focusing on our science and technology studies and do not have time for sharing, training, or even coaching us. (*ST-based students who are in family business environments*)

Although we have entrepreneurs in our family, our parents allow us to study science, technology, and/or medicine. Therefore, they do not think it is necessary to transfer formal business knowledge to us because they need us to focus on our ST studies at university. In addition, they are willing to let us choose our own careers in the future. (*ST-based students who are in family business environment*)

In fact, developing entrepreneurial skills may not even be a priority among the informants in this study, as more than 50% do not formally discuss business issues with their families. Moreover, family members do not actively try to improve students' entrepreneurial skills, even if they are entrepreneurs. These findings differ from those of previous studies

Main categories	Generic categories	Subcategories
Family	Pull factor	Business families need students studying in ST, but demotivate entrepreneurial skills
	Push factor	Non-family-business environments lack entrepreneurial knowledge and support students employed by large firms
ST Education	Laboratories	Laboratories are used to improve ST skills
	Classrooms	Classrooms are designed to be suitable for learning in ST
	Faculty members	Lecturers, both full and part-time members, teach in ST fields
	Guest speakers	Inviting guest speakers, who are professional scientists, to share and inspire ST practical knowledge and ST career path
	Teaching materials	Tools are used to share in-depth technical knowledge
Work	ST curricula	Courses are developed to conform with ST major objectives
	ST knowledge	Knowledge bodies focused on ST technical knowledge
	ST business firms	Students work at ST business firms, such as hospital and technological firms, along with studying at universities
	Business incubators	ST students work part-time jobs at business incubators where nurture start-ups, together with studying at universities
Entrepreneurial education	EE curricula	Developing entrepreneurial education courses to be a part of university's courses
	Maker space	Preparing suitable infrastructures to incubate and innovate students' entrepreneurial skills
	University projects	Initiating university project activities to support entrepreneurial skills such as boot camp, hackathon campaign, and so on
	Funding	Networking with investors to seek students' opportunities for funding access such as crowdfunding, angel investors, and so on
	Mentors	Combining ST class with inviting entrepreneurial mentors as guest speakers to inspire and share skills and experiences
	EE knowledge	Supporting relevant entrepreneurial knowledge

**Table 2.**  
The main categories, generic categories and subcategories of the study

**Note(s):** EE = entrepreneurship education; ST = science and technology  
**Source(s):** Authors' research data



(Begley *et al.*, 2005; Carr and Sequeira, 2007; Looi and Khoo-Lattimore, 2015; Toledano and Urbano, 2008; Veciana *et al.*, 2005).

There may be certain entrepreneurial opportunities for students to help in the family businesses; however, there is no formal training or coaching aimed at sharing entrepreneurial knowledge.

Furthermore, ST-based students who are in non-family-business environments are not enthusiastic about improving their entrepreneurial skills either. This is because of their family members' lack of relevant entrepreneurial skills and because they aim to support themselves through employment at well-known large public or private firms instead of being business owners.

Our family members are not entrepreneurs. Our parents work as employees at either public or private companies. Thus, they lack entrepreneurial skills that they can transfer to us, or even coach us on; moreover, they want us to focus on our studies to obtain employment at large public or private firms, so that we are financially secure and work in reputed companies after we graduate. *(ST-based students who are not in family business environment)*

### 5.2 Educational environment as the role model

Our findings revealed that ST-based educational environments have not been designed to nurture students' entrepreneurial skills. The informants in this study confirmed that they focus more on major disciplines, such as medical and health sciences, basic sciences, science technology information and engineering. The learning environment is heavily laboratory- or classroom-based. More importantly, there is no integration between the science and entrepreneurial courses at the university, despite its aims to become an entrepreneurial university. The informants reported that guest speakers are rarely entrepreneurs. Consequently, students do not have opportunities to improve their entrepreneurial skills. Our result is consistent with that of previous studies, which suggest that professionals, especially in ST-based education environments, need to be entrepreneurial to understand various market and business contributions and make positive contributions to the workplace (Cooney and Murray, 2008; Ernest *et al.*, 2015; Toledano and Urbano, 2008; Zozimo *et al.*, 2017).

Our educational environment largely consists of laboratory- and classroom-based learning, ST faculty members, ST guest speakers, ST materials such as textbooks and handouts, in-depth and complex ST curricula, and ST knowledge transferred under the environment. Thus, we have neither learnt nor improved our entrepreneurial skills under the existing educational environment. *(ST-based students)*

We do not have opportunities to seek entrepreneurial knowledge or improve our entrepreneurial skills as long as we study under the current ST educational environment. *(ST-based students)*

### 5.3 Personal experiences and workplace engagement

Most informants agreed that their previous work experiences influenced their entrepreneurial aspirations and skills. In fact, most informants in this study (approximately 80%) have been engaged in part-time work in hospitals and clinics, healthcare and wellness firms and large- and medium-sized medical-technology-based firms. Some have even had part-time work at business incubators that nurture and incubate technological start-ups, such as biotech start-ups, agro-food start-ups and digital start-ups. More importantly, various activities involved in their part-time employment could promote their levels of entrepreneurial engagement and intention, such as access to mentorship and training programmes for technology transfer to business and market; practical business

infrastructure, such as business machines, software and databases; business networks; and knowledge management activities related to the transfer of technological knowledge to business and the market, including learning-by-doing activities. Although it may seem irrelevant to their science education, these business activities may boost their self-confidence in engaging in the business world. This result confirms the findings of previous research (Cooper and Park, 2008; Toledano and Urbano, 2008; Looi and Khoo-Lattimore, 2015) regarding the pivotal role of business experience in facilitating a better understanding of market realities.

We appreciate the opportunities we have had to work in ST-based large and medium firms, because we know that the knowledge imparted in an educational environment is not enough to improve our practical business and entrepreneurship skills. Therefore, working part-time as trainees at professional firms allows us to improve practical skills and learn more about various aspects of the real business world, such as business management, networking, commercialization and marketing, team management, business infrastructure management, training, coaching, knowledge management, and so on. (*ST-based students who have work experiences under working environment*)

We have not gleaned experience from working part-time jobs at business incubators where nurture and incubate Technological business start-ups, although we know that such experiences could help us develop additional entrepreneurial skills and gain practical business experience. However, we are not sure we will be able to manage our schedules or strike an adequate balance between studying and working. (*ST-based students who do not have work experience*)

#### 5.4 Personal experiences and entrepreneurial education

Our findings show that all informants, who had participated in activities that could be considered entrepreneurial education (EE), consider the EE environment to be vital to the development of entrepreneurial skills in students pursuing ST courses because these activities helped them acquire new knowledge and understand various aspects of entrepreneurship beyond the regular ST curricula. The EE environment refers to activities designed by the entrepreneurial university projects, which is subsidised by the government and banks; such activities include boot camp and hackathon campaigns.

These activities are regarded as the basis of entrepreneurial learning environments. EE fits with modern entrepreneurial education, whereby entrepreneurial skills can be considered as practical knowledge capacities. EE activities focus on short skill-development courses, such as product model creation (or prototype development), out-of-the-box thinking, design thinking, sales presentation techniques, pitching and negotiation, which are not typically part of the regular ST curricula. Additionally, EE reinforces the university's opportunities to develop the EE environment's vital infrastructure, such as a maker space, funding access and mentorships. Our result is in line with previous studies (Fukuda, 2014; Langowitz and Minniti, 2007; Looi and Khoo-Lattimore, 2015; Tkachev and Kolvereid, 1999; Toledano and Urbano, 2008; Wilson *et al.*, 2007; Zozimo *et al.*, 2017), which suggest that providing access to EE, especially in business studies, is critical to the promotion of students' entrepreneurship skills.

We have acquired significant knowledge from all the courses offered as part of the entrepreneurial university project. These short courses have helped us improve our entrepreneurial skills, for instance, product model creation (or prototype development), out-of-box thinking, design thinking, sales presentation techniques, pitching, negotiation skills, and so on. (*ST-based students*)

We appreciate the chances to improve our entrepreneurial skills and opportunities from University's entrepreneurial education infrastructure through a maker space, where innovates our new business ideas together with mentors who help and inspire us to learn and improve business skills, and pre-seed funding access prepared by University through investors' networking, such as alumni as angel investors and crowdfunding, and so on. (*ST-based students*)

## 6. Conclusions

Our study investigated how the family, educational and work environments of students pursuing ST-based courses affect the development of students' entrepreneurial skills. The findings indicate that students did not perceive any direct impact from their family environment on their entrepreneurial skills. They also perceived that an ST-based educational environment is not designed to inform or improve entrepreneurial skills. However, the results showed that the work environment (students' part-time jobs) did influence their entrepreneurial skills. Similarly, an EE environment was considered vital by ST students to develop entrepreneurial skills.

This study contributes to our understanding of how universities can nurture entrepreneurial skills and culture. Part of the solution could consist of building what is perceived as a "porous university" (Preece, 2016; Pimpa, 2019) to link key learning activities as well as formal and informal activities to the entrepreneurial concept. Moreover, people who work in academia often do so because of a disinterest in commercial activities. It is, therefore, important to re-establish the link between academia and entrepreneurship (Davey *et al.*, 2016).

The results confirm that the family environment can play a fundamental role in instilling awareness regarding entrepreneurial activities, but it cannot be considered as the primary catalyst; thus, students do not necessarily perceive their families as role models in the entrepreneurship context. It is important for educational institutions to design and implement educational strategies that help establish the missing links between informal learning from the family and the formal training from higher education institutions.

Overall, this study confirms that entrepreneurial skills and higher education are two extraordinary opportunities that need to be leveraged and interconnected if we are to develop the human capital required for building future societies. Entrepreneurship is the engine fuelling ideas, creativity, life opportunities, employment and economic growth. Only by creating an environment in which entrepreneurship can be learnt, irrespective of the chosen educational discipline, can society prosper.

Considering that the study was confined to a single university, future studies should involve students from various institutions to examine the perspective of undergraduate ST students regarding the influence of various role models on their entrepreneurial skills.

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