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How Entrepreneurial Education and Environment Affect Entrepreneurial Readiness of STEM and Business Students? A Longitudinal Study

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This paper explores how entrepreneurial education and entrepreneurial environment affect entrepreneurial readiness (ER) of students from Science, Technology, Engineering, Mathematics (STEM), and business, i.e., economics and management (E&M) studies. Moreover, it examines how the combination of the aforementioned factors affect the difference in ER between STEM and E&M students. The evaluation is performed on the sample of 595 university students. The results show that two sources of entrepreneurial learning, entrepreneurial experience in the family environment and entrepreneurial education at university, combined with the field of studies represent significant factors that predetermine students' ER. To be able to reach the highest level of ER, the combination of having entrepreneurial environment and entrepreneurial education is crucial for both E&M and STEM students. However, since E&M students show higher level of ER, the paper emphasises the importance of fostering systemic entrepreneurial education among STEM students.

Keywords: *Entrepreneurial Readiness; Entrepreneurial Intention; Entrepreneurial Education; Entrepreneurial Environment; Entrepreneurial Learning; Factors; STEM Students; Business Students; Developing Country.*

Introduction

Various definitions, covering different aspects of entrepreneurship, point to a great interest of both academics and practitioners for this phenomenon. Entrepreneurship is defined as *"the process by which individuals pursue opportunities without regard to resources they currently control"*, as *"art of turning an idea into a business"* (Stevenson & Jarillo, 1990, p. 23; Barringer & Ireland, 2010, p. 30), as *"a social function of creating new values through the creative combination of business resources"* (Omerbegovic-Bijelovic, 2010, p. 234), and as *"the process of creating something new with value by devoting the necessary time and effort, assuming the accompanying financial, psychic, and social risks, and receiving the resulting rewards"* (Hisrich *et al*., 2017, p. 8). Entrepreneurs identify market opportunities, i.e. discover customers' unfilled needs and use them to launch successful business ventures by meeting those needs (Hsieh *et al*., 2007; Moore *et al*., 2008, p. 6). Various authors also stress that entrepreneurs drive the economic growth of a country (Van Praag & Versloot, 2007; Keat *et al*., 2011; Zampetakis *et al*., 2013) by triggering employment and productivity growth and creating and commercializing high-quality innovations. Thus, the most common groups of definitions relate to entrepreneurship as a business or economy *process*; *input and output* from different business processes; a business or social *function*; and *skill* of talented people.

Souitaris *et al*. (2007) and Zampetakis *et al*. (2013) suppose that motivation for entrepreneurship comes from the emotional chemistry between an individual and specific business chance. Two key factors that may direct the initiation of a successful business venture are an entrepreneurial opportunity and a person's tendency towards entrepreneurship (Hisrich *et al*., 2017). While entrepreneurial opportunity is an promising set of circumstances that generate a need for an innovative or novel product or service (Barringer & Ireland, 2010, p. 66); person's propensity to entrepreneurship is defined as an entrepreneurial intention (De Clercq *et al*., 2013). Thompson (2009) describes entrepreneurial intention as an individual's intention of setting up a business venture in the future. Solesvik *et al*. (2013) define it as an entrepreneurial mindset. Entrepreneurs begin with "some extent" of entrepreneurial intention prior to the set-up of a new venture (Koe *et al*., 2012). Understanding that all entrepreneurial activities are intentional-based (Krueger *et al*., 2000) and that entrepreneurial intention is of crucial importance for future venture creation, this field of entrepreneurial research calls for detailed and continuous examination.

One of the widely-known psychological theories that explain an individual's intention is the Theory of Planned Behaviour (TPB). Ajzen (1991) proposed this concept and defined intention as "a person's readiness to perform a given behaviour". According to this definition, intention and readiness can be considered as synonyms. Following TPB, entrepreneurial intention can be defined as the intention to start up and engage in entrepreneurial behaviours (Paul *et al*., 2017), and also presents an effort that a person will make to carry out that entrepreneurial behaviour (Linan & Chen, 2009). In the entrepreneurial context, the intention is seen as the "self-acknowledged conviction by a person who intends

and plans to set up a new business venture at some point in the future" (Thompson, 2009, p. 676). Entrepreneurial intentions are motivational factors that guide individuals to pursue entrepreneurial outcomes (Hisrich *et al*., 2017, p. 16).

Lewis and Massey (2003) incorporate and connect two characteristics, entrepreneurial readiness and entrepreneurial intentions in their diagnostic framework created for young entrepreneurs. Level of readiness for entrepreneurship includes the level of business skills and exposure to entrepreneurial experience in education and real life. Level of entrepreneurial intention includes the desire to start a business venture in the future. According to Ruiz *et al*. (2016), readiness for entrepreneurship can be defined as a set of personal features that distinguishes individuals as especially competent to observe and analyze their environment in such a way of directing their high creative potential, need and capability for self-achievement.

This paper considers entrepreneurial readiness as a broader concept than entrepreneurial intention. It is observed as a personal competence and potential for entrepreneurship, which includes entrepreneurial intention as a part, and is determined by a wide set of individual and environmental factors (see Theoretical background for explanation). Bearing this in mind, the main aim of this paper is to examine which of the three chosen factors (field of studies, entrepreneurial environment, and entrepreneurial education) affects entrepreneurial readiness of Science, Technology, Engineering, Mathematics (STEM) students and business, i.e., economics and management (E&M) students. Moreover, it examines how the combination of two factors (entrepreneurial environment and entrepreneurial education) affects the difference in the total entrepreneurial readiness between STEM and E&M students, as well as how it affects the difference in all five defined dimensions of entrepreneurial readiness. All with the aim to be able to create such learning environments that will encourage students' desire for entrepreneurship.

Since self-employment, i.e. entrepreneurship becomes attractive career choice among students all over the world (Koe *et al*., 2012), students represent a very interesting and most usual group to be observed for this kind of study. The rationale behind choosing to analyse STEM and E&M students in particular lies in the following. STEM students are highly-skilled population, particularly important for developing innovative business ideas and high-tech ventures. Only STEM can generate such innovation which drives sustainable growth and development (Nikitina *et al.,* 2022). However, there are researchers who identified certain barriers in entrepreneurial mindset development for STEM students (Sitaridis & Kitsios, 2019). On the other hand, business students show higher start-up intention compared to STEM (Paray & Kumar, 2020). Stating this, combination of STEM and business students represent the core human resource for creating successful innovative high-tech ventures. Comparison of these two groups of students is usual in the literature on entrepreneurial orientation, readiness and intention, since it enables the fine tuning of examined factors to make STEM students become more entrepreneurially oriented. In broader sense, this is of great interest to a country's economic development, since by influencing the creation of adequate learning environments that encourage entrepreneurship, we create an army of students ready to start new ventures and transform ideas into businesses. In line with this statement, Akrami (2022) claims that educational institutions can provide a suitable field for developing talents and abilities of learners by choosing the most appropriate approach to teaching.

To the best of our knowledge, previous studies on entrepreneurial readiness, intention or capabilities of young people (Sergeant & Crawford, 2001; Damon, 2009) showed that most of the young people did not consider themselves ready for entrepreneurship in terms of their attributes, experience or knowledge for entrepreneurship. Analysing STEM and business students, Nikitina *et al.* (2022) showed that there are significant differences between these two groups of students when analyzing their individual entrepreneurial orientation. While STEM students obtain significantly lower scores for risk-taking and innovativeness, they obtained higher score for proactiveness compared to business students. Kumar *et al.* (2020) found that management and entrepreneurship students depict a higher (mean) t-value of student's entrepreneurial orientation and intentions than science and engineering students do. Their study claimed that management and entrepreneurship background students showed higher entrepreneurial intention, and also, risk-taking, innovativeness, and proactiveness compared to science and technology students. Maresch *et al.* (2016) showed that entrepreneurial education is generally effective for both business and science and engineering students in supporting their entrepreneurial intentions, highlighting that business students may profit more from entrepreneurial education. Also, Herman and Stefanescu (2017) showed that entrepreneurial intentions of engineering students are influenced positively much more by entrepreneurial family background than by entrepreneurship education. What we want to investigate in this paper is whether engineering students whose entrepreneurial education is supplemented by experience from family and close environment are highly oriented towards entrepreneurship. Maresch *et al.* (2016) highlight that students who have previously obtained business education are more likely to acquire and process knowledge related to entrepreneurship. We want to challenge this state due to prevailing opinion that STEM graduates are leaders in setting up new technology-based ventures (Astebro *et al.* 2012; Colombo & Piva, 2020). Due to that, we choose to compare these two groups of students (STEM, E&M). We assume that appropriate entrepreneurial teaching with a positive experience and role models still may have mitigated the Matthew effect in education (Walberg & Tsai, 1983) which describes positive effect that prior educational background, current education and motivation may have on further achievement. The results of Nikitina *et al.* (2022) where STEM students showed higher proactiveness compared to business students, encourage us to investigate how entrepreneurial education and environment affect entrepreneurial readiness of STEM and business students. To fill this gap, we analyze how entrepreneurial education and environment contributes to differences in STEM and E&M entrepreneurial readiness, with the aim to justify establishment of learning subject and courses for STEM, as well as specific learning models and mechanisms, fine-tuned to the necessities of each group of students. We expect that entrepreneurial education and entrepreneurial role

model may support different educational background in formation of entrepreneurial readiness. In other words, this study contributes to the body of knowledge by providing an answer to the doubt whether the combination and synergy of two factors – entrepreneurial education and environment affect the difference in entrepreneurial readiness of STEM and E&M students and how, apart from analyzing two factors separately. The results show that E&M students have higher ER than STEM students do. However, original findings of this paper show that although entrepreneurial education is more important factor for E&M students, and entrepreneurial environment is for STEM students (as it is explained later in Figure 2), for both E&M and STEM students, the combination of having entrepreneurial environment and entrepreneurial education is crucial for their entrepreneurial readiness.

In this paper, entrepreneurial readiness of students is measured through five dimensions: entrepreneurial intention, perceived ability, perceived attractiveness, learning orientation, and passion for work, following De Clercq *et al.*'s (2013) study. The survey sample covers students from STEM and business, i.e., economics and management studies. Additionally, the results obtained for each of the five dimensions are aggregated to find an overall measure of entrepreneurial readiness of university students and make the comparison between STEM and E&M students.

The paper is organized as follows. Section 2 provides a systematic literature review on important factors that affect entrepreneurial readiness of students and presents the research model. Section 3 explains the research method and the survey sample. It also describes measuring tools in the questionnaire. Section 4 presents and discusses the results and provides answers to the posed research questions. Section 5 concludes the paper and presents implications and future research directions.

Theoretical Background

Literature shows that entrepreneurial behaviour is usually explained through entrepreneurial motives, intentions, and readiness. Papulova and Papula (2015) summarize entrepreneurial motives into four groups. The first group includes motives connected to profit – entrepreneur's interests in gaining an economic effect based on their work. The second group refers to professional self-realization and emotional motives. These motives are dominant among people who are professionals in a certain area and want to gain satisfaction without managers' limitations. The third groups of motives are social motives. In inert economic regions, entrepreneurs can be motivated to create jobs for others – family, relatives, and friends. The fourth group of motives results from external stimulations – through funding programs of local authorities, states, European Union or business agencies. Entrepreneurial motivation is an important link between intention and action (Solesvik, 2013). Entrepreneurial intentions, defined as "the conscious state of mind that precedes action and directs attention, experience and knowledge toward entrepreneurial behaviours" (Bird 1988; Moriano *et al*., 2012, p. 165; Zhao *et al*., 2010; Esfandiar et., 2019, p. 173), can also be supported with individual competencies. Robles and Zarraga-Rodriguez (2015) use the Delphi technique for exploring key individual competencies of entrepreneurs, which can strengthen entrepreneurial readiness. Those refer to risk assumption, initiative, responsibility, dynamism, troubleshooting, search and analysis of information, results orientation, change management and quality of work. Coduras *et al*. (2016) highlight that entrepreneurial readiness is determined by a wide set of personal and environmental factors. They assure that tool to measure an individual's readiness for entrepreneurship must include a wide set of factors and items related to three essential fields: sociological characteristics; personal/family-based characteristics; and business and management background. Based on the extensive literature review, this observation is extended in this paper by differentiating between four groups of factors that affect entrepreneurial readiness: psychological factors, socio-demographic factors, education and work factors, and entrepreneurial knowledge and experience (see Table 1). One can notice that numerous factors are significant for determining individual's entrepreneurial readiness. It is important to notice that this is an open list of factors which calls for continuous re-examination.

Table 1

Systematization of Factors Affecting Individual's Entrepreneurial Readiness

Group	Factor	Author(s)
Psychological factors	Personality and psychological factors	Schmitt-Rodermund & Vondracek (2002); Linan & Santos (2007); Damon & Lerner (2008); Kickul *et al*. (2010); Zhao *et al*. (2010); Zampetakis *et al*. (2011; 2013); Dinis *et al*. (2013); Sesen (2013); Yukongdi & Lopa (2017)
	Learning orientation and passion for work	De Clercq *et al*. (2013)
	Ability and desirability for entrepreneurial career	Linan & Santos (2007); Fitzsimmons & Douglas (2011); Gerba (2012)
Socio-demographic factors	Age	Levesque & Minniti (2006); Hatak *et al*. (2015)
	Gender	Minniti & Nardone (2007); Lee *et al*. (2011); (Dabic *et al*., 2012); Zhang *et al*. (2013); Joensuu *et al*. (2013); Yukongdi & Lopa (2017); Kumar *et al.* (2021)
	Economic environment	Ghatak *et al*. (2007); Minniti & Nardone (2007); De Clercq *et al*. (2013); Paul & Shrivatava (2016, 2015); Coduras *et al*. (2016); Yukongdi & Lopa (2017)
	Culture at the country level	Kristiansen & Indarti (2004); Veciana *et al*. (2005); De Pillis & Reardon (2007); Thornton *et al*. (2011); Figueroa-Armijos *et al*. (2012); Autio *et al*. (2013); Coduras *et al*. (2016); Terjesen *et al*. (2016); Paul *et al*. (2017); Yukongdi & Lopa (2017)

Group	Factor	Author(s)
Education and work factors	Level of education	Guerrero *et al*. (2008); Wu & Wu (2008); Fitzsimmons & Douglas (2011); Nabi *et al*. (2010); Linan *et al*. (2011); Joensuu *et al*. (2013); Zhang *et al*. (2013); Hatak *et al*. (2015); Coduras *et al*. (2016); Hisrich *et al*. (2017, p. 17); Xuan *et al*. (2020)
	Field of studies	Wu & Wu (2008); Gerba (2012); Zhang *et al*. (2013); Maresch *et al.* (2016); Herman and Stefanescu (2017); Xuan *et al*. (2020); Kumar *et al.* (2021); Nikitina *et al.* (2022).
	Work history	Barringer & Ireland (2010, p. 78); Kautonen *et al*. (2010); Fitzsimmons & Douglas (2011); Moog *et al*. (2015); Coduras *et al*. (2016); Hisrich *et al*. (2017, p. 18)
	Work environment	Henley (2007); Lee *et al*. (2011); Hatak *et al*. (2015); Yukongdi & Lopa (2017)
Entrepreneurial knowledge and experience	Entrepreneurial education	Franke & Luthje (2004); Matlay (2006); Pittaway & Cope (2007); Souitaris *et al*. (2007); Coduras *et al*. (2008, 2016); Wu & Wu (2008); Gurel *et al*. (2010); Zampetakis *et al*. (2011); Gerba (2012); Hsiao *et al*. (2012); Dinis *et al*. (2013); Farashah (2013); Solesvik *et al*. (2013); Van Auken (2013); Walter *et al*. (2013); Zhang *et al*. (2013); Chen *et al*. (2015); Vilcov & Dimitrescu (2015); Maresch *et al*. (2016); Barba-Sanchez & Atienza-Sahuquillo (2018); Wegner *et al*. (2019); Galvao *et al.* (2020); Paray & Kumar (2020); Rodriguez & Lieber (2020).
	Entrepreneurial environment	Krueger (1993); Hundley (2006); Minniti & Nardone (2007); Barringer & Ireland (2010, p. 40); Altinay *et al*. (2012); Gerba (2012); Dinis *et al*. (2013); Solesvik *et al*. (2013); Zhang *et al*. (2013); Karimi *et al*. (2014); Herman & Stefanescu (2017); Sitaridis, & Kitsios (2019).

This paper focuses on three main factors that can highlight the importance of entrepreneurial learning and knowledge, and that can enable the distinction between student profiles regarding their entrepreneurial readiness. Those are the field of studies, entrepreneurial education, and entrepreneurial environment.

Field of Studies

Together with the level of education, an educational background also has a significant indirect impact on entrepreneurial intention (Wu and Wu, 2008; Zhang *et al*., 2013, Gerba, 2012; Herman and Stefanescu, 2017). Studies show that engineering students (Wu and Wu, 2008) and students form technological universities (Zhang *et al*., 2013) have higher entrepreneurial intention compared to students from other fields of study. Looking into more details, Gerba (2012) showed that students who had taken entrepreneurship course (business field of study) tend to have better entrepreneurial intention than the ones studying in the engineering field. Herman and Stefanescu (2017) came to the same conclusion for Romanian students as well. On the other hand, Paray & Kumar (2020) suggest that social science and management students have high start-up intention in compare to science, engineering and technology students. Still, the same results suggest that the students enrolled in Entrepreneurship courses are having higher intent to start a new business. Kumar *et al.* (2021) showed that management and entrepreneurship background students showed higher entrepreneurial intention, comparing to science and technology students. Nikitina *et al.* (2022) compared business and STEM students, analyzing their individual entrepreneurial orientation through three components: proactiveness, risk-taking, and innovativeness. In comparison to business students, STEM students showed higher proactiveness, and lower risk-taking and innovativeness. On the contrary, Xuan *et al*. (2020) showed negative relationship between the entrepreneurial intention and the field of studies. Additionally, they found that entrepreneurial intentions are significantly higher among business students than engineering students. Still, Herman and Stefanescu (2017) did not prove that entrepreneurial intention are significantly greater among business students than engineering students.

Entrepreneurial Education

The main purpose of entrepreneurship education is to develop an individual's entrepreneurial intentions or to help someone to understand entrepreneurial career (Nikitina *et al.*, 2022). This form of education in childhood and adolescence was confirmed as significant for later entrepreneurial intentions (Dinis *et al*., 2013). Entrepreneurial education is positively related to self-employment intention (Gerba, 2012; Walter *et al*., 2013). Franke and Luthje (2004) and Maresch *et al.* (2016) proved that entrepreneurial education and university support had a positive impact on entrepreneurial intentions. According to Galvão *et al.* (2020), participation in entrepreneurship education and training programs positively influences individual entrepreneurial orientation and entrepreneurial skills. The same authors proved that entrepreneurship education program has strengthened participants' capacities and competencies, making them more independent in facilitating their future venture creation. Gerba (2012) strongly suggests the need to incorporate entrepreneurship education in the curriculum of technical disciplines at observed Ethiopean universities. In the recent study, Paray and Kumar (2020) also signify a positive impact of entrepreneurial education for stimulating the start-up intention of students. Rodriguez and Lieber (2020) highlight that students with entrepreneurship education show significant increase in entrepreneurial mindset, specifically in communication and collaboration, opportunity recognition, and critical thinking and problem-solving.

GEM studies (Coduras *et al*., 2008) explained a positive correlation between the individuals' entrepreneurial education and training and their interest in starting a business. Besides entrepreneurial education, Coduras *et al*. (2016) point out the importance of business and management skills as support to individual's entrepreneurial readiness.

Zampetakis *et al*. (2011) recognized entrepreneurship courses and education as a factor that may affect entrepreneurial intention. Various studies showed that there

is a positive relationship between entrepreneurship education and entrepreneurial intention (Farashah, 2013; Pittaway & Cope, 2007; Solesvik *et al*., 2013; Souitaris *et al*., 2007; Wu & Wu, 2008; Zhang *et al*., 2013). Farashah (2013) differ three types of entrepreneurial education. The first type of education is learning to understand entrepreneurship. Second is learning to act in an entrepreneurial way and third is learning to become an entrepreneur. Vilcov and Dimitrescu (2015) analysed entrepreneurship education and the development of entrepreneurial competencies of youth. They concluded that entrepreneurial education directs students to comprehend daily life problems, helping them identify and assess the consequences of personal decisions. Barba-Sánchez and Atienza-Sahuquillo (2018) identify the role and confirm the positive contribution that entrepreneurship education plays in the development of engineers' entrepreneurial intentions. Entrepreneurship education can increase both the quality and the number of graduate entrepreneurs (Matlay, 2006). Besides the academic survey and research, entrepreneurial education was recognised as an important policy action for fostering entrepreneurship among both youth and mature (European Commission, 2006). Contrary to previous results, Chen *et al*. (2015) showed that the entrepreneurial intentions of students have not been improved after the pre-test and post-test experimental design on a single group of technical university students. They conclude that entrepreneurship education does not teach students to "pursue an entrepreneurial career" (Chen *et al*., 2015). Entrepreneurial education can be further detailed observed through teaching method, teaching environment and learning resources (Chen *et al*., 2015). Wegner *et al*. (2019) showed that students entrepreneurial push strategy at university, which means developing entrepreneurship courses, organizing entrepreneurship competition and offering incubation activities and resources do not show any differences compared to students from other university with classical managerial education.

Hsiao *et al*. (2012) investigated students of logistics and marketing departments, at 22 universities, and came to a result which did not show the correlation between students' entrepreneurial intentions and their entrepreneurial education. Gurel *et al*. (2010) also found that education in entrepreneurship did not advance the entrepreneurial intentions of students of tourism department in both Turkey and the UK. Gurel *et al*. (2010) point out that entrepreneurship which includes creativity, innovation, partition in risk and search for pursuing opportunities cannot be taught with a traditional teaching method. Ultimately, Van Auken (2013) proposed two possible results of entrepreneurship education: firstly, improvement of entrepreneurial intentions of students, and secondly, students' help to understand that an entrepreneurial career is not what they are looking for. Wegner *et al*. (2019) stress the importance of university evaluation of the effectiveness of their efforts in promoting entrepreneurial education.

Entrepreneurial Environment

Successful entrepreneurs from the close environment, such as parents, siblings, other relatives, may present a role model for future entrepreneurs. Role models, whether positive or negative, are very important for nascent entrepreneurs (Minniti & Nardone, 2007; Karimi *et al*., 2014). Sitaridis and Kitsios (2019) found that lack of entrepreneurial experience and skills, together with knowledge, is the one of the main barriers to entrepreneurship, constraining forces in developing students' entrepreneurial intention. Family and friends are an excellent source of entrepreneurial capital (skills, knowledge, values, advice). This can be more crucial than capital from other sources (Hundley, 2006; Zhang *et al*., 2013). Karimi *et al*. (2014) finding confirms the positive effects of a successful entrepreneurial role model from the environment on motivational factors of persons' entrepreneurial intention. Students with entrepreneurial family background have higher propensity to choose an entrepreneurial career and start a business (Herman and Stefanescu (2017). Therefore, the entrepreneurial environment of a person has a strong impact on its entrepreneurial intention. Krueger (1993) also determined that young people whose families own businesses are more likely to start their own business too. Dinis *et al*. (2013) emphasize the importance of the surrounding environment and family for the development of secondary students' entrepreneurial intention. People with self-employed parents or with the family entrepreneurial background are more likely to become entrepreneurs (Solesvik *et al*., 2013; Altinay *et al*., 2012; Zhang *et al*., 2013). The same relation is proven for those who have entrepreneur acquaintances (Barringer and Ireland, 2010, p. 40). On the other hand, Gerba (2012) did not find a significant difference in entrepreneurial intention of students with exposure to entrepreneurial activity through family, compared to those who had no such exposures. Nevertheless, entrepreneurial role model is suggested for the promotion of entrepreneurial spirit among engineering students (Maresch *et al.*, 2016; Sitaridis & Kitsios, 2019).

To conclude, in this paper we analyse which of the three main factors observed (field of studies, entrepreneurial environment, and entrepreneurial education) affects entrepreneurial readiness of STEM and E&M students. All with the aim to be able to create learning environments that will encourage students' desire to try themselves as entrepreneurs. We assume that based on these results suggestions on curricula development could also be made. For this purpose, we set three main research questions (see the Research Model in Figure 1):

RQ1: Does the students' field of academic studies predetermine their entrepreneurial readiness?

RQ2: Do the students who have entrepreneurs in their family or close environment have a higher level of entrepreneurial readiness than those students who do not have family entrepreneurs?

RQ3: Do the students with formal entrepreneurial learning experience have a higher level of readiness for entrepreneurship?

Moreover, we examine how the combination of two factors – entrepreneurial environment and entrepreneurial education affects the difference in the total entrepreneurial readiness between STEM and E&M students.

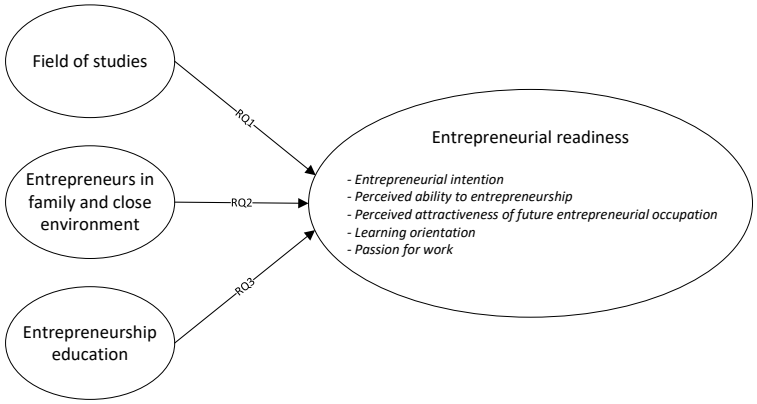

Figure 1. Research Model

Methodology

This study is based on the primary data collected at the University of Belgrade (Republic of Serbia) in the period December 2018 – December 2020. For collecting the data on students' opinion about entrepreneurial readiness, we modified De Clercq *et al.*'s (2013) questionnaire. De Clercq *et al*. (2013) surveyed and proved the positive impact of learning orientation and passion for work on the relationship between perceived ability and attractiveness on the one side, and the entrepreneurial intention on the other. Based on De Clercq *et al.*'s (2013) findings, entrepreneurial readiness in this paper is defined as an integral measure with five dimensions: *Entrepreneurial intention* as an individual's intention to set up business in the future; *Perceived ability* as the potential with which people see them capable of becoming successful entrepreneurs; *Perceived attractiveness* as the perception of the attractiveness for becoming an entrepreneur or desirability of becoming an entrepreneur; *Learning orientation* as people's tendency to update and expand their current knowledge continuously; and *Passion for work* as the degree to which people love work-related activities.

Next sections explain the questionnaire, as well as the sampling procedure, data collection and processing.

Questionnaire

The applied questionnaire was organised into two sets of questions. The first set of questions refers to socio-demographic information: student's gender, age, educational background and field of study, year of studies, average grade point at studies, student's living place, students' field of study (E&M, STEM), family entrepreneurial background (information about entrepreneurs in students' family and close environment), and education in entrepreneurship (information whether students attended lectures in entrepreneurship).

The second part of the questionnaire contains five previously defined dimensions of entrepreneurial readiness. All questions about these five dimensions are given later in Table 3. Five-point Likert scale was used for all statements, ranging from strongly disagree (coded 1), disagree (2), neither disagree nor agree (3), agree (4) to strongly agree (5).

Sampling, Data Collection and Processing

The survey was conducted in the period between December 2018 and December 2020. Students were asked to complete the self-administered questionnaire based on modified De Clercq *et al.*'s (2013) research. The responding rate was 81.4 %, as 595 students out of 731 responded.

The respondents were students from STEM and economics and management, i.e. business studies from the University of Belgrade (UB) which is the oldest and the largest university in Serbia, founded in 1808. Teaching staff educated at UB founded all state and several private universities in Serbia. Today, UB incorporates 31 faculties, 11 research institutes, one university library and 7 university centres. It has nearly 94,000 students and 4,200 teaching staff. According to the ARWU list (The Academic Ranking of World Universities, 2017), the best ranking position of the UB was between 201st and 300th place.

The first group of E&M students was selected for this study as they are future business leaders and managers. STEM students were selected because they are close to new technologies and innovation. It is important to stress that in the Republic of Serbia, entrepreneurship becomes more and more attractive among young population (Jakopin, 2018).

Data were analysed using the *IBM SPSS Statistics 22* software. The pre-analysis was performed using descriptive statistics and internal reliability tests. For answering the previously defined research questions and for performing deeper analysis, we used the techniques of statistical inference based on the analysis of the t-test and multivariate analysis.

Results with Discussion

Sample Structure and Pre-Analysis

Categorical variables and frequencies of values obtained from the survey sample are presented in Table 2. Out of 595 participants, 262 (44 %) are male and 333 (56 %) are female respondents. 72.3 % of students do not have entrepreneurs in their family or close environment and 76.5 % of them did not have any entrepreneurship education. Most of the students are fourth year of undergraduate studies. 66.4 % of them live in the capital city. Detailed distribution according to all variables (gender, faculty, field of studies, year of studies, living place, entrepreneurs in family and entrepreneurship education) are presented in the following table.

Table 2

Structure of the Sample and Categorical Variables and Frequencies

Categorical variables (for N = 595) *		Number	Percentage
Gender	Male	262	44 %
	Female	333	56 %
Faculty	Faculty of Organizational Sciences	153	25.7 %
	Faculty of Economics	113	19.0 %
	Faculty of Electrical Engineering	80	13.6 %
	Faculty of Transport and Traffic Engineering	49	8.2 %
	Faculty of Mechanical Engineering	45	7.5 %
	Faculty of Civil Engineering	44	7.4 %
	Faculty of Architecture	38	6.4 %
	Faculty of Technology and Metallurgy	16	2.7 %
	Faculty of Mathematics	11	1.8 %
	Belgrade Business School	26	4.4 %
	Others	20	3.4 %
Field of studies	Management and Economics	279	46.9 %
	Engineering and Technology	303	50.9 %
	Others (Arts and humanities; medical)	13	2.2 %
Year of studies	First	21	3.8 %
	Second	58	10.4 %
	Third	116	20.9 %
	Fourth	279	50.2 %
	Graduated	8	1.4 %
	Master	74	13.3 %
Living place	The Capital city (Belgrade)	118	36.6 %
	Outside of the Capital city (Non-Belgrade)	223	66.4 %
Entrepreneurs in family	Yes	165	27.7 %
	No	430	72.3 %
Entrepreneurship education	Yes	137	23.5 %
	No	445	76.5 %

* *The number of respondents who answered the questions*

The second set of questions measures students' entrepreneurial readiness. The entrepreneurial readiness measurement includes five groups of questions defined through the five dimensions. All these questions are formulated as statements with five-point Likert-scale answers, from 1 – "completely disagree" to 5 – "completely agree". These questions were interspersed throughout the questionnaire to avoid bias in responses. Average values of Likert-scale answers are presented in Table 3. Also, apart from providing details on five dimensions of ER, this table shows the descriptive statistics of two-scale variables from the first part of the questionnaire (students' age and grade point average – GPA).

Table 3

Scale Variables and Descriptive Statistics

Variables	**Mean** (M)	**Std. deviation** (SD)
Age	22.40	2.07
Grade point average (GPA)	8.22	0.78
Entrepreneurial readiness	**3.45**	**0.69**
Entrepreneurial intention (Likert scale 1-5):	**2.80**	**1.16**
I am likely to start my own business soon.	2.89	1.18
I have been preparing to start my own business.	2.71	1.27
Perceived ability (Likert scale 1-5):	**3.15**	**1.02**
It is highly feasible that I could start my own business.	2.85	1.17
I feel certain that I would be able to start my own business if I wished to do so.	3.45	1.10
Perceived attractiveness (Likert scale 1-5):	**3.54**	**1.16**
I have a strong desire to start my own business.	3.48	1.29
I feel a strong urge to become self-employed.	3.60	1.18
My overall wish is to have my own business.	3.60	1.18
Learning orientation (Likert scale 1-5):	**4.16**	**0.59**
I often read materials (articles, internet, books, etc.) to improve my abilities.	3.88	0.88
I often look for opportunities to develop new skills and knowledge.	4.12	0.59
For me, developing my abilities is important enough to take risks.	3.94	0.88
I enjoy challenging and difficult tasks through which I can learn new skills.	4.18	0.79
I prefer to work in situations that require a high level of ability and talent.	4.21	0.75

Variables	Mean (M)	Std. deviation (SD)
I like to take on a challenging task from which I can learn a lot.	4.31	0.76
Passion for work (Likert scale 1-5):	**3.69**	**0.66**
I derive most of my life satisfaction from working hard.	3.88	0.88
I love to work hard.	3.88	0.88
I accomplish a lot because I love to work hard.	4.03	0.93
Sometimes I wish that I could be working harder when I am not.	3.79	1.13
I look forward to returning to work when I am away from it.	3.10	1.10

From Table 3, we see that the average age of the respondents is 22.4 (SD = 2.07) and mean GPA is 8.22 (SD = 0.78). It can also be noticed that mean value of entrepreneurial readiness for the whole sample is 3.45 (SD = 0.69). The total value of entrepreneurial readiness is calculated as an average value of equally-weighted values of its five dimensions: Entrepreneurial intention (M = 2.80); Perceived ability (M = 3.15); Perceived attractiveness (M = 3.54); Learning orientation (M = 4.16); Passion for work (M = 3.69). Consideration of different weighting coefficients among dimensions can be the subject of future work.

Before comparing different groups of students, we verified the reliability and validity of the measurement scale, which is used for measuring entrepreneurial readiness. For this purpose, we used Cronbach's Alpha coefficient and average inter-item correlation between five dimensions of entrepreneurial readiness. These results are obtained using reliability analysis in *IBM SPSS Statistics 22*. For five dimensions of entrepreneurial readiness, Cronbach's Alpha was at the level of 0.785. The reliability criterion is satisfied since Cronbach's Alpha needs to be higher than 0.7, according to Nunnally (1978) and DeVellis (2011). Another way to measure the reliability of the measurement scale is by using the inter-item correlation. According to Briggs and Cheek (1986), this value needs to be between 0.2 and 0.4, as an optimal range of correlation between the items. This condition is also satisfied because inter-item correlation equals 0.424. Table 4 shows the correlations among the dimensions of entrepreneurial readiness. Compared to entrepreneurial readiness, entrepreneurial intention, perceived attractiveness and perceived ability have large correlation coefficients (0.872; 0.828, and 0.785 respectively), while learning orientation and passion for work show medium correlation (0.620 and 0.521). All correlation coefficients are statistically significant at the level of $p<0.01$.

Table 4

Pearson's Correlation Coefficient among Variables

Variables:	**Mean**	**St. deviation**	**(ER)**	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**
(ER) Entrepreneurial readiness	**3.45**	**0.69**	1					
(1) Entrepreneurial intention	**2.80**	**1.16**	0.872**	1				
(2) Perceived ability	**3.15**	**1.02**	0.785**	0.606**	1			
(3) Perceived attractiveness	**3.54**	**1.16**	0.828**	0.713**	0.547**	1		
(4) Learning orientation	**4.16**	**0.59**	0.620**	0.398**	0.385**	0.346**	1	
(5) Passion for work	**3.69**	**0.66**	0.521**	0.319**	0.241**	0.229**	0.483**	1
**Correlation is significant at the 0.01 level (2-tailed).								

Further analysis (Tables 5 and 6) presents the differences in students' entrepreneurial readiness based on their socio-demographic characteristics (gender, living place, age, study year, GPA).

Table 5

Mean Values of Students' ER by Categorical Variables: Gender, Living Place

Variables and the mean value	**Gender**		**Living place**	
	Female N = 330	**Male** N = 260	**Capital city** N = 117	**Other** N = 228
(ER) Entrepreneurial readiness	3.336	3.602	3.601	3.468
(1) Entrepreneurial intention	2.571** ~	3.083** ~	3.141** ¬	2.805** ¬
(2) Perceived ability	2.945	3.406	3.318	3.146
(3) Perceived attractiveness	3.355	3.782	3.743	3.593
(4) Learning orientation	4.143	4.169	4.192	4.169
(5) Passion for work	3.749	3.629	3.703	3.734
Stat. significance:	* p<0,05 (T - test); ** p<0,01 (T - test)			
Eta square:	° 0,12-0,13 (large effect size); • 0,09-0,10 (medium-large effect size); ~ 0,05-0,07 (medium effect size); 0,03-0,04 (small effect size).			

The results in Table 5 show a statistically significant difference ($p<0.05$) between male (M=3.083) and female students (M=2.571), regarding their attitudes towards entrepreneurship. This difference has the middle effect size (eta square: 0.047). This result indicates that male students expressed higher intention towards entrepreneurship than female students did. However, the existence of a relationship between students' gender and their entrepreneurial readiness is not proven, since the mean values of two groups (male, female) do not differ significantly ($p>0.05$).

Further, we analysed the influence of living place on students' entrepreneurial readiness. Two groups of students are observed – those who live in the capital city and those who live out of the capital. This research analysis is interesting, since Belgrade as the capital city and the most developed part of Serbia, provides better market and other opportunities for setting up a business. On contrary to the capital city, other places in Serbia are underdeveloped, and some of them are rural, with unsatisfactory economic conditions, which can be an initial impulse for push model in entrepreneurship. In this analysis, 250 students were excluded due to unspecified living place. According to the results presented in Table 5, there is no statistically significant difference between these two groups. Thus, students' living place does not predetermine their entrepreneurial readiness. However, there is a difference between these two groups of students regarding their entrepreneurial intention (Δ0.336, $p<0.01$), which points to the conclusions that Belgrade as the capital city inspires or encourages entrepreneurial activities.

Next, Table 6 presents the correlation coefficient analysis among students' age, GPA and particular dimensions of entrepreneurial readiness. Regarding the value of correlation coefficients, it is not possible to prove the existence of relation between students' age and their entrepreneurial readiness. Obtained correlation coefficients are not statistically significant and are very close to zero. Due to that statistical result, students' age does not predetermine their entrepreneurial readiness.

Analysing further the results presented in Table 6, a statistically significant correlation is not obtained between the students' grade point average (GPA) at studies and their entrepreneurial readiness. Values of the correlation coefficients for a particular dimension of entrepreneurial readiness are very low (Perceived attractiveness, Learning orientation, Passion for work) or statistically insignificant (Entrepreneurial intention, Perceived ability). It is very interesting to notice that the values of Pearson's correlation coefficient between GPA and learning orientation is 0.191, which is a low correlation according to Cohen (1988, p. 79-81)'s guidelines.

Table 6

Entrepreneurial Readiness and Students' Age, GPA and Study Year

Variables:	**Pearson's Correlation Coefficient**			
	Age	**GPA**	**Study year**	
			Final N = 362	**Non Final** N = 195
(ER) Entrepreneurial readiness	0.081	0.005	3,419	3,508
(1) Entrepreneurial intention	0.097*	-0.036	2.758	2.873
(2) Perceived ability	0.054	-0.047	3.089	3.227
(3) Perceived attractiveness	0.014	-0.102*	3.465*¬	3.729*¬
(4) Learning orientation	0.094*	0.191**	4.139	4.152
(5) Passion for work	0.059	0.137**	3.713	3.647
Correlation coefficient and stat. significance	** 0.01 level (2-tailed); * 0.05 level (2-tailed).			
T-test stat. significance and eta square value	* p<0,05 (T - test); ¬ 0,03-0,04 (small effect size);			

Table 6 also provides analysis on how the year of studies impact students' entrepreneurial readiness. This analysis is based on the assumption that final-year students, who passed more exams, think more about their future employment, so they could have a higher level of readiness for self-employment. Unlike them, students at earlier years of studies are more oriented towards passing their exams. Two groups of students were analysed (Table 6). The first group (Final) consists of students that are close to finishing their studies (4th year of undergraduate studies or master level studies). The second group (Non-Final) consists of students that are not close to finishing their studies (3rd, 2nd or 1st year of undergraduate studies). These two groups are compared in terms of their entrepreneurial readiness using t-test. From the results in Table 6, it is noticed that there is no statistically significant difference between these two groups of students (Final, Non-Final), in terms of their entrepreneurial readiness. Considering all five dimensions separately, there is a difference in perceived attractiveness ($p<0.01$). According to our analysis, entrepreneurship is more inspiring for students who are not at the end of their studies. These results might be justified with the fact that final year students at Belgrade University have an opportunity for internship programs in various international and domestic companies. This activity can divert student from starting their own business.

Research Questions Testing

Understanding that students' age, gender, living place, GPA, and year of study are not proven as statistically significant factors of students' entrepreneurial readiness, in the following research questions we analyse other three factors: field of academic studies, family entrepreneurship, and entrepreneurship education.

RQ1: Does *the students' field of academic studies predetermine their entrepreneurial readiness?*

In the survey sample there are two large groups of students (Table 2): E&M and STEM students. These two groups are compared in terms of their entrepreneurial readiness for all five dimensions. The results of t-test (Table 7) show a statistically significant difference between E&M students (M=3.567) and STEM students (M=3.406), regarding their readiness for entrepreneurship. The results indicated that E&M students expressed higher entrepreneurial readiness than students from STEM studies did (the difference between mean values is Δ0.16; $p<0.05$). Comparing these groups through all five dimensions, the differences in favour of E&M students are captured for entrepreneurial intention (Δ0.259) and perceived attractiveness (Δ0.29).

Table 7

Mean Values of Students' ER by Categorical Variables: Field of Studies, Entrepreneurs in Family, and Entrepreneurship Education

Variables and mean value	Field of study		Entrepreneurs in family		Education in entrepreneurship	
	E&M N = 279	**STEM** N = 303	**Yes** N = 165	**No** N = 422	**Yes** N = 137	**No** N = 445
(ER) Entrepreneurial readiness	3.567*¬	3.406*¬	3.629**¬	3.386**¬	3,768**~	3,353**~
(1) Entrepreneurial intention	2.984*¬	2.725*¬	3.071** ¬	2.394** ¬	3,283** ~	2,639** ~
(2) Perceived ability	3.201	3.122	3.464** ¬	3.026** ¬	3,369**¬	3,073**¬
(3) Perceived attractiveness	3.754**¬	3.464**¬	3.787** ¬	3.449** ¬	3,915**¬	3,421**¬
(4) Learning orientation	4.211	4.121	4.225	4.127	4,403**~	4,077**~
(5) Passion for work	3.741	3.675	3.682	3.703	3,927**¬	3,630**¬
Stat. significance:	** p<0,01 (T - test); * p<0,05 (T - test); ♦ p<0,08 (T - test).					
Eta square:	° 0,12-0,13 (large effect size); • 0,09-0,10 (medium-large effect size); ~ 0,05-0,07 (medium effect size); ¬ 0,03-0,04 (small effect size).					

RQ2: *Do the students who have entrepreneurs in their family, or a close environment, have a higher level of entrepreneurial readiness, than those students who do not have family entrepreneurs?*

Students were asked whether they have entrepreneurs in their family or close environment. Based on the responses, students are divided into two groups and analysed further. The results in Table 7 show that students who have entrepreneurs in the family or close environment (M=3.629) have a higher level of entrepreneurial readiness in comparisons to students without entrepreneurial experience in their environment (M=3.386). Furthermore, there are statistically significant differences among these two groups regarding their entrepreneurial intentions (Δ0.677), perceived ability (Δ0.438) and perceived attractiveness (Δ0.338).

RQ3: *Do the students with entrepreneurial learning experience have a higher level of readiness for entrepreneurship?*

Students are generally taught entrepreneurship through lectures during courses at studies. This knowledge can trigger entrepreneurial way of thinking and readiness for starting an entrepreneurial venture. In this survey, the students were asked if they attended entrepreneurship course within their studies. Based on the answers, two groups were generated (students who had lectures in entrepreneurship and those who did not). Comparison of the groups (Table 7) showed statistically significant results (p<0.01). Students who attended classes/lectures in entrepreneurship have higher entrepreneurial readiness (M=3.768) in comparison to the students who did not have learning knowledge in entrepreneurship (M=3.353). Differences between groups regarding each particular dimension were: entrepreneurial intention (Δ0.415), perceived ability (Δ0.296), perceived attractiveness (Δ0.494), learning orientation (Δ0.326) and passion for work (Δ0.297). The results also showed that students who had taken entrepreneurship courses expressed higher intention, ability and attractiveness towards entrepreneurship than students who had not taken entrepreneurship courses/lectures. This result may indicate the existence of the effect of entrepreneurship education on entrepreneurial readiness and intentions towards self-employment and entrepreneurship as a profession.

The research question (RQ1, RQ2 and RQ3) were also analysed using multivariate analysis (MANOVA) in order to further explore the statistically significant differences in entrepreneurial readiness through the linear combinations of five dimensions (entrepreneurial intention, perceived ability, perceived attractiveness, learning orientation, passion for work). MANOVA allows the comparison of several groups according to several features. We analyzed the previously defined groups of students, according to all five dimensions of ER. Those groups of cases are:

A. Students of E&M and STEM studies;
B. Students with and without entrepreneurs in their close environment;
C. Students who attended courses in entrepreneurship and those who did not.

The necessary conditions for the implementation of MANOVA, at the sample size of 595 respondents are:

1) Multivariate normality: The essence of this analysis is to check the extreme points in respondents' answers, using Mahalanobis distance. Mean Mahalanobis distance value obtained in our analysis (generated by the *SPSS statistical software*) is 4.991 and maximum Mahalanobis values are 19.374, which is not higher than the critical value for the model of five variables (which equals 20.52). This means that the assumption of the multivariate normality is proven.

2) According to Tabachnick and Fidell's (2007, p. 252, 281) guidelines, homogeneity of variance and covariance is proven. Value of statistical significance obtained in Box's test of equality of covariance matrices and Levene's test of equality of error variances is greater than 0.01.

After applying MANOVA, particular statistically significant differences in cases A, B, and C are presented. First comparison, among students of E&M and STEM, is determined regarding combinations of five dimensions of the vector entrepreneurial readiness*:* $F(5,554) = 1.809$, $p < 0.05$*, Wilks' lambda = 0.984, partial eta squared = 0.16* (representing large effect size). This result is opposite to Wu and Wu (2008) and Zhang *et al*. (2013). However, it matches with Gerba's (2012) findings. When these two groups of students are compared using the considered dimensions separately (entrepreneurial intention, perceived ability, perceived attractiveness, learning orientation and passion for work), statistically significant differences ($p < 0.05$) are determined only for the following two dimensions, in favour of E&M students: Entrepreneurial intention:

F(1,554) = 6.199, p = 0.013, partial eta squared = 0.11 (representing medium-large effect size); and Perceived attractiveness: *F(1,554) = 7.535, p = 0.008, partial eta squared = 0.06* (representing medium effect size). Dimension with the greatest impact on the observed groups of students is entrepreneurial intention. A statistically significant difference between the students of E&M and STEM is not obtained for dimensions perceived ability, learning orientation and passion for work.

The second comparison was in case B: Students with and without entrepreneurs in their family or close environment. The results for difference among two groups of students in MANOVA for all five dimensions of entrepreneurial readiness, were statistically significant: *F (5,562) = 4.721, p <0,01, Wilks' lambda = 0.959, partial eta squared = 0.041 (representing small effect size).* Two groups of students are further compared for each dimension separately. Statistically significant differences ($p < 0.01$) are determined for the following three dimensions: Entrepreneurial intention: *F(1,562) = 11.646, p = 0.001, partial eta squared = 0.020 (representing small effect size)*; Perceived ability, *F(1,562) = 18.890, p = 0.000, partial eta squared = 0.033 (representing small effect size)*; and Perceived attractiveness, *F(1,562) = 9.751, p = 0.002, partial eta squared = 0.017 (representing small effect size).* Dimension with the greatest impact on the observed groups of students is perceived ability. We conclude that the most significant benefit of an entrepreneurial environment is the feeling of students that they are capable of undertaking entrepreneurial ventures. We understand that entrepreneurial environment which provides experience-based learning is an important basis for developing and acquiring new knowledge through additional courses and training. This is an interesting result that confirmed previous results found in the literature (Minniti & Nardone, 2007; Altinay *et al*., 2012; Solesvik *et al*., 2013; Zhang *et al*., 2013; Karimi *et al*., 2014). A statistically significant difference between the students with and without entrepreneurs in their close environment is not obtained for the dimensions learning orientation and passion for work.

Third comparison in case C was among students who attended courses in entrepreneurship and those who did not. Regarding combinations of the five dimensions of the vector entrepreneurial readiness, MANOVA shows statistically significant result*: F (5,559) = 5.598, p < 0,001, Wilks' lambda = 0.906, partial eta squared = 0.048 (representing medium effect size).* This result shows that there is statistically significant difference between two groups of students comparing them by linear combination of five dimensions of entrepreneurial readiness. The results of important influence of entrepreneurial education on entrepreneurial readiness is in accordance with the previous results found in the literature (Franke and Luthje, 2004; Dinis *et al*., 2013; Gerba, 2012; Walter *et al*., 2013; Coduras *et al*., 2016). For the detailed analysis in MANOVA, all dimensions are considered separately. Statistically significant differences ($p < 0.05$) are determined for every particular dimension: Entrepreneurial intention: *F(2,556) = 16.098, p < 0.001, partial eta squared = 0.055 (representing medium effect size)*; Perceived ability *F(2,556) = 4.646, p < 0.01, partial eta squared = 0.016 (representing small effect size)*; Perceived attractiveness: *F(1,556) = 10.488, p < 0.001, Partial eta squared = 0.036 (representing small effect size)*; Learning orientation *F(2,556) = 19.648, p < 0.001, Partial eta squared = 0.066 (representing medium effect size);* and Passion for work: *F(2,556) = 10.215, p < 0.001, Partial eta squared = 0.035 (representing small effect size).* These results indicate strong influence of courses on students' entrepreneurial readiness.

Thus, from these analyses, firstly we can conclude that RQ1, RQ2 and RQ3 are positively answered, meaning that a statistically significant difference is captured between E&M students and STEM students, regarding their readiness for entrepreneurship, as well as between students who have and don't have entrepreneurs in family and close environment, and between those students who have and don't have entrepreneurship education. This means that field of studies, entrepreneurial environment and entrepreneurship education affect the entrepreneurial readiness of students. Moreover, further MANOVA analysis showed that there is a statistically significant difference between these groups of students (cases A, B, C) comparing them by linear combination of five dimensions of entrepreneurial readiness.

Now, we further examined how the combination of two factors – entrepreneurial environment and entrepreneurial education affects the difference in the total entrepreneurial readiness between STEM and E&M students. Estimated marginal means of entrepreneurial readiness for E&M and STEM students are presented in Figure 2.

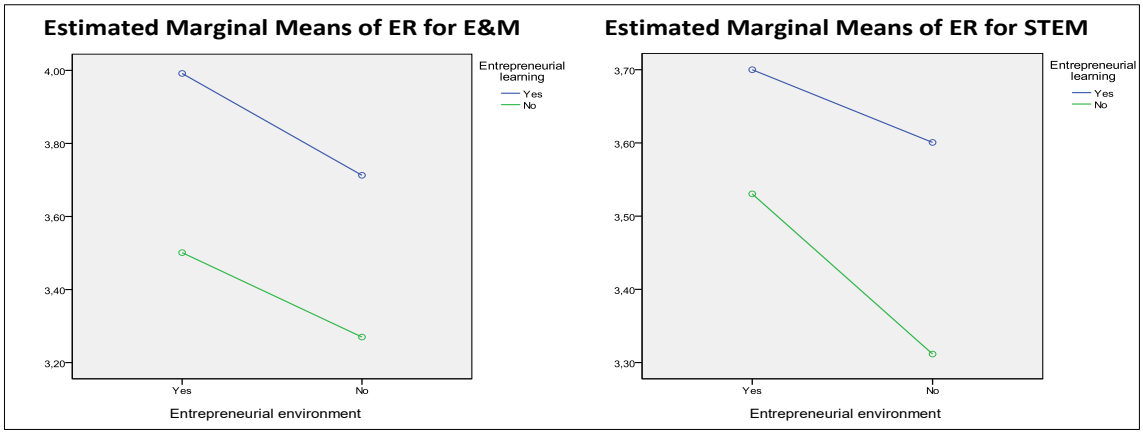

Figure 2. Marginal Means of Entrepreneurial Readiness for E&M and STEM Students: Difference in Formal Entrepreneurial Learning and Experience in the Environment

More precisely, here we distinguish the mean values of entrepreneurial readiness of STEM and E&M students observing different combinations of the following characteristics: entrepreneurial environment and formal entrepreneurship education. ANOVA analysis showed statistically significant differences F(551,1)=6.214, sig=0.013. The results in Figure 3 highlight the effect of entrepreneurship education and entrepreneurial environment on the level of difference in ER between STEM and EM students, showing mean values of ER. Thus, in this analysis we explore how entrepreneurship education and experience from environment influence the ER of particular groups of students, divided by their study profile.

Regarding STEM students with entrepreneurs in close environment, from the Figure 3 we see that the students with entrepreneurship education show higher level of ER, compared to those students without it (ς 0,17). The similar situation is with the second group of STEM students – without entrepreneurs in environment, where the difference in ER is even higher between students with and without entrepreneurship education (ς 0,29). These results point to the importance of entrepreneurship environment for STEM students for achieving higher level of ER.

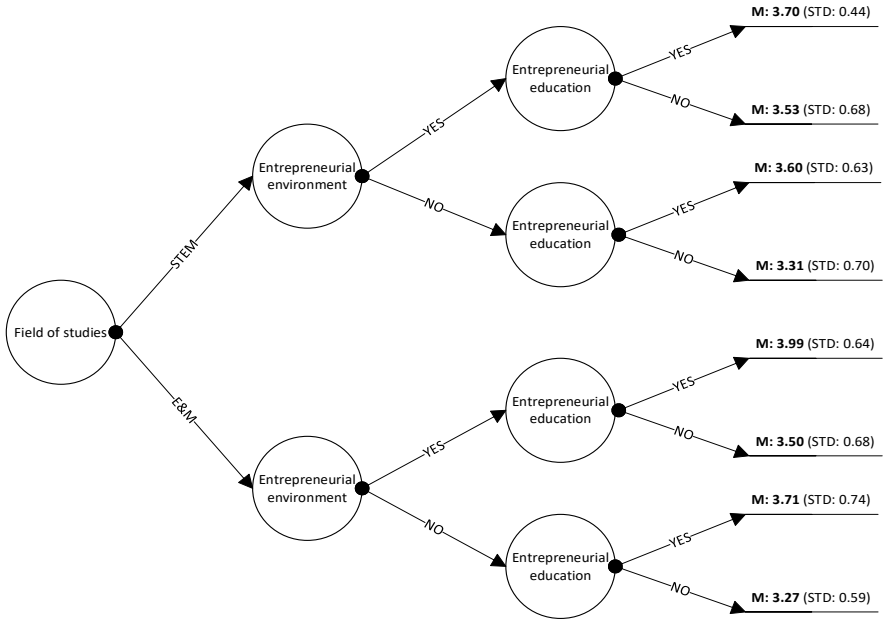

Figure 3. Mean Values of Students' ER by Categories: Field of Study, Entrepreneurs in Environment, Entrepreneurial Learning

It is obvious (Figure 3) that the combination of having entrepreneurial environment and entrepreneurial education brings the highest level of ER for both case scenarios (E&M and STEM students). Additionally, entrepreneurial education is more important ER factor for E&M students than it is for STEM, which can be explained if we observed E&M students with entrepreneurial environment where the difference of mean values for ER is slightly higher (ς 0,49) than for those without entrepreneurs in environment (ς 0,44). Students from E&M field are able to achieve the same level of ER (mean above 3.70) even without entrepreneurial experience. However, in both cases this difference is higher than for STEM students (with entrepreneurial environment (ς 0,17) and without environment (ς 0,29)), which additionally supports that having entrepreneurial environment is crucial for STEM students (as it was explained in Figure 2).

Comparing E&M and STEM students, it could be concluded that it is essentially important to provide learning opportunities for STEM students with both practical-oriented experience (entrepreneurial environment) and classical entrepreneurial course. This highlights the importance of entrepreneurial environment for learning, in terms of developing important entrepreneurial skills through its own experience or learning from someone in the family.

Since it was generally shown that E&M students have higher level of ER than STEM students, it could be explained by the fact that apart from only one Entrepreneurship course, E&M students have various management courses during studies, which enabled them to develop different managerial competencies and skills, needed for entrepreneurship as well. If we try to understand the differences in curricula, we could conclude that STEM students need to develop more entrepreneurial and managerial competencies during their studies. Thus, it is not possible to achieve this with just one course, it is necessary to introduce systematic entrepreneurial learning for STEM students.

Mwasiaji *et al*. (2021) identified following entrepreneurial competencies: managing a business venture (managing time, money and staff), problem solving skills, planning and good decision making, marketing, sales and customer service skills, financial skills. Similarly, Xuan *et al*. (2020) recommended the most important competencies that future-oriented entrepreneurs should develop as: the ability to find and interpret weak signals of change and disruptions; the ability to act proactively (autonomous strategic behaviour, enterprising spirit); the ability to run strategic foresight within organization; the ability to manage change and uncertainty; the ability to create organizational vision (both collective and individual); the ability to perceive unmet

consumer needs and seeing the big picture. All of these competencies are mostly developed through various managerial subject using teaching methods that are fostering creative thinking, problem solving and innovations, like workshops, case studies, team work and collaboration, while typical STEM courses are most often laboratory exercise and practical work. Looking through entrepreneurial eyes, engineers know how to build or create the product and not what to do with it further, how to place it on the market or create a business model. Therefore, it would be recommended that in addition to subjects in the field of entrepreneurship and management that can be offered to STEM students and thus strengthen their entrepreneurial education, it would be good to adapt the teaching methods for other engineering subjects which can be used to develop entrepreneurial competencies as well.

Various studies (Matlay, 2006; Farashah, 2013; Chen *et al*., 2015) have shown the importance of entrepreneurial education for ER, and some (Souitaris *et al*., 2007; Gerba, 2012; Barba-Sánchez and Atienza-Sahuquillo, 2018) have shown that specifically for STEM students entrepreneurial intention rises with the formal learning from entrepreneurship related courses. Since our research shows that entrepreneurship is more inspiring for students who are not at their final year of studies, it would be better to offer those courses at their second or third year. The goal of educational institutions should be to provide opportunity for STEM students to develop their skills including more entrepreneurial courses in their curricula but also to create learning environment which encourages students' desire to become entrepreneurs.

Conclusions

The research results emphasize the importance of entrepreneurial education and entrepreneurial environment for both E&M and STEM students for being ready to become entrepreneurs, based on the analysis of the entrepreneurial readiness of university students.

The idea was to compare these two groups of students to understand how the combination of two factors – entrepreneurial environment and entrepreneurial education affects the difference in the total entrepreneurial readiness between STEM and E&M students. It was shown that the field of studies, entrepreneurial environment and entrepreneurship education affect the entrepreneurial readiness of students and all research questions (RQ1, RQ2 and RQ3) are positively answered.

Results could be summarized as following:

- Students who have entrepreneurs in the family or close environment have a higher level of entrepreneurial readiness especially regarding their entrepreneurial intentions, perceived ability and perceived attractiveness.
- Students who had entrepreneurship education have higher entrepreneurial readiness and they express higher intention, ability and attractiveness towards entrepreneurship.
- To be able to reach the highest level of ER for both E&M and STEM students, the combination of having entrepreneurial environment and entrepreneurial education is crucial.
- E&M students express higher level of entrepreneurial readiness than STEM students.
- Entrepreneurial education is more important factor for E&M students, while entrepreneurial environment is for STEM students.

It was shown that students of business, i.e. E&M students have grater entrepreneurial readiness than STEM students. This result can help as evidence for promoting and fostering Entrepreneurship education among STEM students, through lean start-up and business plan workshops, competitions and exhibitions of a successful entrepreneurial idea. It is well-know that the great technological innovations in any industry come from engineers. Besides that, engineers mainly develop new technology-based companies. In order to be able to benefit from their products and innovation, they need to have entrepreneurial competencies and mind-set. Promoting and fostering systemic entrepreneurship education among STEM students would enhance their entrepreneurial readiness, resulting in higher level of innovation-based start-ups. Empowering knowledge and skills of STEM students during their education process could influence potential unemployment and shortage of STEM experts. Gerba (2012) strongly suggests the need to incorporate entrepreneurship education in the curriculum of technical disciplines in Ethiopia. Fostering entrepreneurial education among STEM students would enhance their entrepreneurial readiness, and higher chance for starting up future innovation-based ventures. In Serbia, faculties educating students in the STEM field gained additional funding for new buildings, equipment, teaching staff to be able to educate more STEM students starting from 2022. There is a shortage on the labour market of STEM educated experts, especially the ones that besides engineering knowledge and skills have additional entrepreneurial competencies, are innovators, problem solvers and team players (Mwasiaji *et al*., 2021).

Furthermore, not every type of knowledge is possible to be systematized and transferred via lectures. The study showed the importance of cognition and informal experience and advice which can be obtained in the close environment of a potential entrepreneur. This result is also in connection with other more detailed and sophisticated research of Karimi *et al*. (2014) which confirms the positive effects of successful entrepreneurial role model from environment on motivational factors of persons' entrepreneurial intention. We have shown that the more significant benefit of an entrepreneurial environment is that these students will feel more capable of undertaking entrepreneurial ventures. As experience-based learning is the most important for adult learning, the entrepreneurial environment should be perceived as an important basis for the development and acquisition of new knowledge through additional courses and training. Further research can be directed to modelling different types of connections among family members or acquaintances in the entrepreneurial process and determination of influences of negative examples in the entrepreneurial environment.

Finally, the results showed the importance of students' education in entrepreneurship. This result is in line with Zhang *et al.*'s (2013) statement and recommendations that with appropriate education, potential entrepreneurs can recognize opportunities, search for business resources and set up business ventures. Therefore, it is particularly important to stimulate youth entrepreneurship and teach creative and innovative engineering students on how to start new businesses based on their ideas which leads to the economic

development of every country. Furthermore, it might be interesting for researchers to examine whether different teaching methods and learning environments would have different effects on students' entrepreneurial readiness. We assume that simulation of entrepreneurial environment in workshops and courses could help in empowering students for starting new ventures. Also, future research can be oriented towards measuring readiness for different types of entrepreneurship – corporate entrepreneurship, social entrepreneurship, green entrepreneurship, and academic or university entrepreneurship.

The results of the study have certain limitations that are reflected in the usage of a self-report questionnaire, which carries a chance of response bias. However, the obtained findings are useful for educational institutions to create educational programs for supporting entrepreneurship among students, especially at STEM studies; and the authorities to stimulate entrepreneurial economy among youth in a developing country. The results could be of special interest for the countries with the similar development stage, social values and cultural environment. The results could serve as proof that in order to have young people that are ready to engage in entrepreneurial ventures, it is essential for developing countries to invest in the development of entrepreneurial skills through formal and non-formal education programs. Developing countries should focus on creating adequate learning mechanisms for boosting STEM students' readiness for entrepreneurship, since they are the generators of innovations which commercialization drive to sustainable development and growth of countries. The results of this paper show that educational institutions should offer such models of teaching entrepreneurship which combine teaching lessons and creating entrepreneurial environments for students to boost their ER. Entrepreneurship as a process, but also knowledge and competencies from starting ventures could offer economic viability of countries, but also existence of individuals.

Main implications of the study are reflected in the following.

Research implications show that in order for students to be prepared for working in contemporary environment they need to reach the highest level of ER by developing entrepreneurial competencies. The best way for developing those competencies for E&M and STEM students is by combining entrepreneurial environment and entrepreneurial education. Specifically, Entrepreneurial education is more important for E&M students and entrepreneurial environment for STEM students, but more should be devoted in preparing STEM student to be ready for entrepreneurship.

Policy implications from this study are important – the study results could help HEIs, ministries and policy makers, to develop strategies which could results in adjusting curricula and allocating resources that could help in developing entrepreneurial skills and competencies for STEM and E&M students as well as for upskilling teaching competencies for professors.

Practice implications are reflected in promoting entrepreneurship education among STEM and E&M students. It is necessary to adapt teaching methods to be able to simulate learning within entrepreneurial environment fostering experience-based learning. Learning environments should be designed in such manner to encourage innovation commercialization, problem solving and team work.

Social implications of the study are seen in the following. The quality of education would increase resulting in enlarged number of future employees who have the skills and competencies needed to carry out entrepreneurial ventures and who are motivated to engage in these ventures. Students would be more prepared for self-employment, and the shortage of STEM-educated experts with additional entrepreneurial competencies would be reduced on the labour market.

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Authors' Biographies

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