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Machine learning analysis of the impact of entrepreneurial mindset dimensions on entrepreneurial intentions of students in EU member countries and an EU candidate country: comparative study

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Introduction: This study investigates and compares the students' entrepreneurial mindset dimensions and intentions from EU member countries Italy, Austria, Sweden, and Greece, and an EU candidate country Bosnia and Herzegovina, which are important for fostering start-ups, economic development, and job creation. By analyzing students' entrepreneurial mindset dimensions, demographic and academic characteristics, and availability of resources, the research aims to identify factors that impact students' entrepreneurial intentions. Findings provide valuable insights into how these factors vary across different educational, economic, and social contexts with guidance for enhancing education to better support students' entrepreneurial aspirations.

Methods: Machine learning Random Forest was used to analyze the impact of entrepreneurial mindset dimensions, resources, and demographic and academic characteristics on students' entrepreneurial intentions of students from EU member countries and Bosnia and Herzegovina. SHapley Additive exPlanations (SHAP) values were utilized to analyze feature importances and contributions to the model's predictions. Statistical hypothesis tests were also conducted to compare differences of students' entrepreneurial mindset dimensions, intentions and availability of resources between the EU member countries and Bosnia and Herzegovina.

Results: High values of entrepreneurial mindset dimensions have positive impact on entrepreneurial intentions in both EU member countries and Bosnia and Herzegovina. The availability of resources and orientation to innovations were the most impactful features for students in EU and Bosnia and Herzegovina, respectively. Gender and academic characteristics showed minimal influence. There are no significant differences in all dimensions between EU member countries and Bosnia and Herzegovina, except for confidence dimension and entrepreneurial intentions, which are significantly greater in Bosnia and Herzegovina.

Discussion: Findings suggest that tailored educational interventions focusing on key entrepreneurial mindset dimensions and resource access could significantly

enhance entrepreneurial intentions among students. For policymakers and educators, this study provides a foundation for developing targeted strategies that align with the specific contexts of both EU member countries and Bosnia and Herzegovina. In this way higher education institutions can better support students' entrepreneurial aspirations, contributing to broader economic development and job creation. This research offers recommendations for improving entrepreneurship education across diverse educational, economic, and social contexts and more balanced and inclusive economic development in Europe.

KEYWORDS

entrepreneurial intention, entrepreneurial mindset, machine learning, random forest, SHAP, hypothesis tests

1 Introduction

Entrepreneurship is one of the key components of economic growth, innovation, and job creation, but the factors that shape entrepreneurial intentions can vary widely across different educational, economic, and social contexts. In order to encourage entrepreneurship and an entrepreneurial intention, it is very important to identify these factors. EU member countries benefit from more advanced support systems that encourage entrepreneurship, while EU candidate countries like Bosnia and Herzegovina (BIH) face distinct and unique challenges (in December 2022, BIH was granted candidate country status by the European Council, and in March 2024, the European Council decided to open accession negotiations with BIH.) This disparity presents an opportunity to explore and compare how entrepreneurial mindset dimensions and the availability of resources influence students' intentions to pursue entrepreneurial activities in these different environments. This comparative analysis offers valuable insights into how tailored educational and policy interventions can enhance entrepreneurship education and support, ultimately contributing to sustainable economic development in both well-established and emerging European economies, as well as fostering more balanced and inclusive economic growth across Europe.

By analyzing the entrepreneurial mindset dimensions and their influence on entrepreneurial intention, guidelines for educational strategies and policies can be created to improve the entrepreneurial capacities of young people. Through education students should acquire the knowledge and skills they need to start their own businesses and it not only opens up new opportunities for young people, but also contributes to the creation of a more resilient and innovative society that is able to face the challenges of the future. There is a large amount of literature that deals with research on the importance of entrepreneurship, the impact of entrepreneurial education on entrepreneurial intention, and development and use of numerous tools for assessing entrepreneurial capacities that influence the improvement of those capacities, indicating the importance of this topic in higher education.

Entrepreneurship has been defined so far in different ways. [Drucker \(1985\)](#) defines entrepreneurship as an “innovative act, which includes endowing existing resources for new wealth-producing capacity” and in the same year, [Gartner \(1985\)](#) describes it as the creation of a new organization. Coming to nowadays many authors define entrepreneurship in their unique ways. [Kop \(2012\)](#) explains it as a comprehensive process of certain unique resources that create

new values. [Rieckhoff and Larsen \(2012\)](#) view entrepreneurship as a drive that enables entrepreneurs to believe that the hard work they do will make their dreams come true by overcoming difficulties. [Chowdhury et al. \(2014\)](#) describe entrepreneurial passion as a powerful, active, and decisive emotion that drives individuals to invest time and energy in entrepreneurial activities, and it is deeply rooted in their self-identity. [Hartmann and Herb \(2015\)](#) focus out that one of the most important trademarks of entrepreneurship is motivation, passion, and success.

Following the previous definitions of entrepreneurship, one of the most important determinants of entrepreneurial success is entrepreneurial intention. Nowadays, entrepreneurial intention has become an important topic in the research activities related to entrepreneurship success ([Bird, 2015](#); [Liñán and Fayolle, 2015](#)). [Shapero and Sokol \(1982\)](#) significantly advanced the study of entrepreneurship through their development of the Entrepreneurial Event Model (EEM). Their work proposes that the decision to start a business could be predicted by a person's perceived desirability and feasibility of becoming an entrepreneur. Following this research, numerous scholars have built upon their Entrepreneurial Event Model (EEM), further enriching the academic discourse on entrepreneurial intention ([Veciana et al., 2005](#); [Lee et al., 2011](#); [Liñán and Fayolle, 2015](#); [Tognazzo et al., 2016](#)). According to [Escobar-Liamazares et al. \(2019\)](#), entrepreneurship intention is determined by psychological and socio-educational factors, and additionally according to [Baluku et al. \(2019\)](#) and [Cuberes et al. \(2019\)](#) to relational factors. Entrepreneurial intention was shown as dependent on many cognitive and contextual factors that could influence it in many positive and negative ways, often by representing them in combinations or interrelations ([Feder and Nițu-Antonie, 2017](#)).

To understand entrepreneurial intentions one of the most used approaches in research is the Theory of Planned Behavior ([Ajzen, 1991](#)) where attitudes toward behavior, subjective norms, and perceived behavioral control can predict intentions to perform different kinds of behaviors. Research ([Díaz-García and Jiménez-Moreno, 2010](#)) takes into account individual variables like social norms, self-efficacy, attitude toward entrepreneurship, gender, entrepreneurship education, having a role model of business-owner in the family, and locus of control. The results of the research of [Rauch and Hulsink \(2015\)](#) indicate that entrepreneurship education is beneficial. Notably, students involved in such educational programs experience enhanced attitudes and perceived behavioral control. Additionally, by the conclusion of the program, these students exhibit

stronger entrepreneurial intentions. Research by [Rajh et al. \(2018\)](#) incorporates variables from the Theory of Planned Behavior along with personality traits and contextual factors, aiming to clarify the entrepreneurial intentions among students studying economics and business in four South-East European countries: Bosnia and Herzegovina, Croatia, Macedonia, and Serbia. The correlation between the behavioral intent as predictor variable and targeted behavior as response variable in these cases shows an average correlation of 0.73 ([Engle et al., 2010](#)). Many other studies show that Theory of Planned Behavior can be used to predict entrepreneurial intention on an international level ([Krueger Jr et al., 2000](#); [Autio et al., 2001](#)).

One of the most significant influencing factors on entrepreneurial intention is confidence. [Ho and Koh \(1992\)](#) state that self-confidence is a required entrepreneurship characteristic and it is strongly related to psychological characteristics. [Ferreira et al. \(2012\)](#) mention that empirical study in the entrepreneurial literature shows that entrepreneurs have higher confidence levels than people who are not entrepreneurial. [Dahalan et al. \(2015\)](#) examine the relationship between attitude and entrepreneurial intention among the research community. The attitude is focused on attitude toward money and attitude toward start-up. The research shows that both attitudes toward money and attitudes toward start-ups influence entrepreneurial intention. [Erken et al. \(2018\)](#) research points that there is the absence of evidence for a long-term relationship between entrepreneurship and economic growth. The results of this study indicate that entrepreneurship consistently drives productivity, having a stable and significant effect on both the development of productivity levels and productivity growth. According to [Shariff and Saud \(2009\)](#) the attitude of individuals to get involved in entrepreneurship is driven by push and pull factors. It is noticed that the push factors incorporate frustration resulting from limited opportunities, economic downturn, and dissatisfaction. This can also be confirmed with the work of [Iakovleva et al. \(2011\)](#) who presented key findings that developing countries have stronger entrepreneurial intentions than those from developed countries. The study includes students from 13 different countries, 8 developed countries (Australia, Canada, Czech Republic, France, Germany, Norway, Spain, and Netherlands) and 5 developing countries (Brazil, Mexico, Romania, Russia, and Ukraine).

Recent advancements in ML and AI can predict entrepreneurial intentions by identifying complex patterns in data. [Djordjevic et al. \(2021\)](#) used various statistical methods, including ARIMA regression and QUEST classification trees, to analyze predictors such as demographics and social environment among Serbian students. The study concluded that these methods effectively predict entrepreneurial intentions and align with findings from similar research. In [Sowmya et al. \(2010\)](#) a survey is conducted among first-year business students in different countries, including Australia, Portugal, Finland, Germany, Slovenia, Poland, the United Kingdom, and the United Arab Emirates. The results show that the majority of students are interested in entrepreneurship, but that they also need additional education in this regard, indicating the potential role of universities in encouraging their interest in entrepreneurship. [Krueger Jr et al. \(2000\)](#) examine the ability of individuals to recognize entrepreneurial opportunities, and through the analysis it was emphasized how education can increase the self-confidence of individuals in their ability to undertake entrepreneurial initiatives. [Jones et al. \(2011\)](#) investigate the attitude and motivation of Polish students toward

entrepreneurial activities, focusing on the effects of entrepreneurial education. This research contributes to the understanding of how entrepreneurship education can influence students' perception and aspiration, and highlights the importance of adapting educational programs to the specifics of the local economic and cultural context.

[Anjum et al. \(2023\)](#) examine the role of universities in the development of students' entrepreneurial competences. The results indicate that entrepreneurial education and desire for entrepreneurship have a direct impact on entrepreneurial intentions. [Neneh \(2012\)](#) investigates the level of entrepreneurial mindset within the South African SME sector with particular reference to factors that are lacking and need to be improved in order to foster entrepreneurial success. [Arranz et al. \(2019\)](#) analyze the factors that influence the entrepreneurial intentions of students. In addition to the high level of entrepreneurial intentions among students, there is a significant obstacle in turning these intentions into real entrepreneurial initiatives, with the lack of practical knowledge and skills being the main obstacle. In analyzing the impact of entrepreneurship education and choice of academic major on social entrepreneurial intentions, the theory of planned behavior reveals how education can improve understanding and readiness for entrepreneurship, especially among students of social sciences and humanities ([Chang et al., 2022](#)). The paper emphasizes the need for the integration of entrepreneurial education into broader academic programs.

In works [Bolton and Lane \(2012\)](#), [Davis et al. \(2016\)](#), [Li et al. \(2016\)](#), [Shaver et al. \(2019\)](#), [Athayde \(2009\)](#), various instruments were developed for measuring entrepreneurial competences and entrepreneurial mindset among individuals, including students and the general population. The instrument for measuring individual entrepreneurial orientation tested on university students aims to define entrepreneurial inclination through five dimensions ([Bolton and Lane, 2012](#)). On the other hand, the entrepreneurial mindset profile measures traits, motivations, attitudes and behaviors relevant to entrepreneurial success ([Davis et al., 2016](#)). The instrument developed in the context of the Kern Entrepreneurial Engineering Network focuses on engineering students, measuring the entrepreneurial mindset through 27 items grouped into 10 factors and provides insight into the development of an entrepreneurial mindset among engineering students, and supports the role of entrepreneurial education in the education of engineers ([Li et al., 2016](#)). The MindCETTE Entrepreneurial Test covers a wide range of characteristics of an entrepreneurial mindset, identifying 11 dimensions ([Shaver et al., 2019](#)). In research done by [Athayde \(2009\)](#) the need for effective measurement of the impact of entrepreneurship and education programs in schools is investigated. The survey instrument is designed to measure entrepreneurial potential in young people through attitudes toward characteristics associated with entrepreneurship. The results of the study show that participation in an entrepreneurship program can encourage positive attitudes toward self-employment, with participants showing greater entrepreneurial potential than non-participants. These instruments represent important tools for understanding and improving the entrepreneurial way of thinking, useful for both academic and practical application in the field of education and entrepreneurship.

Papers [Arranz et al. \(2019\)](#), [Athreye et al. \(2023\)](#), [Fearon et al. \(2021\)](#), [Lindholm Dahlstrand \(2007\)](#), and [Franco et al. \(2010\)](#) indicate a significant influence of the region on entrepreneurial competences of people and students. The analysis of students' entrepreneurial

intentions highlights the obstacles in turning those intentions into reality, emphasizing the role of universities in providing the necessary support and resources for entrepreneurial development (Arranz et al., 2019). In Nigeria (Athreye et al., 2023) research shows that academic staff motivation and entrepreneurial intentions exist despite limited institutional support, suggesting that increased support could encourage greater entrepreneurial activity. The Young Entrepreneurs program in Netherlands (Fearon et al., 2021) illustrates how educational initiatives can develop entrepreneurial skills, pointing to the importance of regional educational policies in the promotion of entrepreneurship. A study on new technology-based firms in Sweden shows the importance of large local enterprises in the development of entrepreneurial competences (Lindholm Dahlstrand, 2007). These works show how the region plays an important role in shaping the entrepreneurial environment, through education, institutional support, and the development of local infrastructure. Franco et al. (2010) investigate the entrepreneurial intentions of students in different European regions in eastern and western Germany and central Portugal. It was concluded that the motivation for entrepreneurship differs between regions and that regional specificities should be taken into account to encourage entrepreneurial intentions.

Papers (Bird, 1988; Cassar, 2009) point out the importance of understanding entrepreneurial intentions and expectations for the progress of research in the field of entrepreneurship. These papers explore how entrepreneurial intentions and expectations form the foundation for future business initiatives, strategic management and ultimate organizational outcomes. This contributes to a better understanding of the entrepreneurial mindset, which is crucial for the assessment of management teams, the viability of financing new ventures, and the advancement of entrepreneurship research.

In research conducted by Pasic et al. (2022), the development of service-oriented entrepreneurial competencies in the context of higher education in the countries of Southeast Europe was investigated. Through the analysis of educational programs and practices in higher education, the paper emphasizes the need for the integration of formal and informal learning. The authors suggest strengthening cooperation between higher education institutions and the service sector, and improving methodologies for assessment and validation of competencies in order to improve the competitiveness of graduates on the labor market. Analysis of the development of entrepreneurial competencies of students of the University of Sarajevo - Faculty of Mechanical Engineering in Pasic et al. (2023) shows that both formal and informal education contribute to the development of entrepreneurial competencies, although the formal curriculum was not created with the aim of developing these competencies. The research emphasizes the importance of interaction with entrepreneurs and the need to include entrepreneurial competencies in curricula. This research points to potential reforms in the education of engineers with the aim of better preparation for entrepreneurial challenges.

The level of economic development influences both demand and supply side of entrepreneurship. Demand side of entrepreneurship for example reflects through perceived environmental opportunities to start a business. Supply side of entrepreneurship reflects for example through the availability of financial and other resources for business start-ups, and the level unemployment (Wennekers et al., 2002). In research of unemployment and entrepreneurship (Audretsch and Thurik, 2001) authors assumed a two-way causation between changes

in unemployment and entrepreneurship: “Schumpeter” effect of entrepreneurship reducing unemployment and a “refugee” or “shopkeeper” effect of unemployment enhancing entrepreneurship.

This research focuses on the analysis of 9 dimensions of the entrepreneurial mindset and entrepreneurial intentions of students from EU member countries and Bosnia and Herzegovina (BIH) which are crucial for the creation of start-ups, economic development, and the creation of new jobs. The analysis also includes demographic and academic characteristics of students and the availability of resources to support the development of new entrepreneurial initiatives. The entrepreneurial mindset dimensions analyzed in this research are: Idiosyncrasy/Peculiarity (PEC), Innopreneurship (INPR), Confidence (CON), Orientation to Innovations (INNO), Experience (EXP), Risk Acceptance (RISK), Orientation to Action (ACT), Need to Achieve (ACH), and Persistence (PERS). Resources (RES) are defined as support for the development of new entrepreneurial initiatives in terms of the existence of regulations and infrastructure (such as IT, connectivity, transportation, communication, etc.) at national/regional levels, access to financial resources and the presence of investors, regional/local presence of incubators and technological parks, as well as university support. Demographic and academic characteristics are represented by age, gender, and level of study cycle in which students are enrolled (Master's, Bachelor's, or PhD).

The importance of this analysis is that it represents direct support and contributes to the more successful entrepreneurial activities of students and graduates and points into related strengths and weaknesses in education process. Since the creation of start-ups encourages innovation and the development of new technologies the findings of this research will help to make necessary interventions in education of university students in order to boost development of new entrepreneurial initiatives and will help in the development of recommendations for educational strategies and policies with the aim of encouraging and strengthening the entrepreneurial and innovative way of thinking and entrepreneurial intentions of students.

The aims of this research are to determine whether there are significant differences in the entrepreneurial mindset dimensions and intentions between students from EU member countries and those from Bosnia and Herzegovina; to assess whether there is a significant difference in resources to support the development of new entrepreneurial initiatives between EU member countries and Bosnia and Herzegovina; and to evaluate the impact of specific entrepreneurial mindset dimensions, resources, and academic and demographic characteristics on the entrepreneurial intentions of these students, with the goal of identifying key factors that should be targeted in higher education to enhance the entrepreneurial intentions of students.

Thus, this study aims to answer the following research questions:

RQ1: Do the entrepreneurial mindset dimensions of students in Bosnia and Herzegovina and students in EU member countries differ significantly?

RQ2: Are the entrepreneurial intentions of students in Bosnia and Herzegovina significantly different from those of students in EU member countries?

RQ3: Does the availability of resources to support the development of new entrepreneurial initiatives differ significantly between

students in Bosnia and Herzegovina and those in EU member countries?

RQ4: How do the entrepreneurial mindset dimensions, resources, and demographic and academic characteristics influence the entrepreneurial intentions of students in Bosnia and Herzegovina compared to those in EU member countries?

This research makes several contributions to the understanding of entrepreneurial intentions and mindsets among students in Europe and between different educational, economic and social contexts in Europe. First, it introduces new knowledge regarding the influence of entrepreneurial mindset dimensions on students' intentions to pursue entrepreneurship, highlighting how these factors vary between EU member countries and Bosnia and Herzegovina, an EU candidate country. Second, the research also contributes in understanding the role of resource availability, demographic factors like age and gender, and academic characteristics such as study cycle, how they impact entrepreneurial students' intentions. Third, by applying advanced scientific methods, including machine learning Random Forest and SHAP values, and statistical hypothesis testing, the research uncovers critical differences between students in well-established EU economies and those in Bosnia and Herzegovina, offering a new knowledge and better understanding of the challenges and opportunities in these distinct educational, economic and social contexts. Forth, the research findings offer practical recommendations for educators and policymakers to enhance entrepreneurship education and support, suggesting targeted strategies to foster a stronger entrepreneurial mindset and increase entrepreneurial intentions among students, thereby contributing to economic development and job creation across Europe.

The structure of this paper includes an introduction with motivation, literature review, research questions, and contributions; methodology section covers questionnaire, data collection, and methods applied for data analysis, results from machine learning random forest and SHAP value analysis and statistical hypothesis testing, and discussion of findings and implications section; and a conclusion section summarizing the contributions and practical recommendations for educators and policymakers.

2 Methodology

The methodology is discussed in terms of the questionnaire, data collection, and data analysis methods.

2.1 Questionnaire and data collection

The questionnaire used in this research and data were collected within the project of the European Institute for Innovation and Technology (EIT) Universities for huMAN-centered Entrepreneurship - UMANE. The basis for the development of questionnaire was Entrepreneurial Potential and Innovation Competences (EPIC) assessment tool developed by HEInnovate, which included 19 items within 6 categories, and the model developed by Davis et al. (2016), which included 14 items, through several phases. Initially, the EPIC questionnaire was completed by students

from 5 universities across Europe: the University of Modena and Reggio Emilia (UNIMORE) in Italy, FH Joanneum University of Applied Sciences (FHJ) in Austria, Harokopio University of Athens (HUA) in Greece, Mid Sweden University (MIUN) in Sweden, and the University of Sarajevo (UNSA) in Bosnia and Herzegovina. After factor analysis was performed, the questionnaire was refined to 5 dimensions and 12 items, with adjustments made to the names and structures based on factor loading values. Subsequently, following Davis et al. (2016), 4 new dimensions comprising 10 items were incorporated, enhancing the tool's scope and ensuring a more thorough evaluation. Further refinements based on test feedback introduced a resources dimension with five additional items. The final questionnaire comprised 11 dimensions with 33 items: 9 dimensions with 23 items related to entrepreneurial mindset assessment, and 2 dimensions related to entrepreneurial intention and resources, with 5 items each, as well as questions regarding students' demographic and academic characteristics, such as age, gender (with options: male, female, and prefer not to say), and study cycle (bachelor's, master's, or PhD). The final entrepreneurial mindset tool with entrepreneurial intention and resources is given in Table 1.

Students were asked to indicate their level of agreement or disagreement with the statements in the questionnaire on a numerical rating scale ranging from 1 to 7, with equal intervals between the numbers on the scale, where 1 stands for "I completely disagree" and 7 stands for "I completely agree." Labels or anchors in this instrument were provided only at the extremes of the scale. Harpe (2015) states that data collected using an instrument with numerical values and having at least five categories can generally be considered as continuous data. Evans (2012) points out that data collected using instruments with only a numerical scale without descriptive labels are treated as interval data by many users. It was emphasized that completing the questionnaire was completely anonymous and voluntary.

Table 2 shows demographic and academic characteristics of students who completed the questionnaire from the four EU member country universities (Italy, Sweden, Austria, and Greece) and one university from Bosnia and Herzegovina, an EU candidate country.

From Table 2 it can be seen that the questionnaire was completed by 301 students in total, with 51.83% of students from EU member countries and 48.17% from BIH, an EU candidate country. Among the EU students, 63.46% were male and 36.54% were female, while in BIH, 53.79% were male and 46.21% were female. The average age of EU students was 25.42 years, whereas the average age of BIH students was 22.83 years. The overall average age of students from both the EU and BIH was 24.12 years. The table provides a comparative overview of student distribution across different levels of higher education – bachelor's, master's, and PhD – in the European Union and Bosnia and Herzegovina. For bachelor's programs, EU students constitute 43.59% and BIH students 40%. In master's programs, EU students account for 50%, while BIH students make up 56.55%. There were 6.41% of students enrolled in the PhD study cycle from the EU, while 3.45% of students from BIH were enrolled in the PhD cycle. The table totals show that of all students, 41.86% were enrolled in the bachelor's study cycle, 53.16% in the master's study cycle, and 4.98% in the PhD study cycle.

The dataset for this research consists of students from five universities all of which are partners in the UMANE project. The focus on UMANE partner universities eliminates potential sampling bias as

TABLE 1 Final entrepreneurial mindset assessment tool, entrepreneurial intention, and resources.

Dimension	Item
Idiosyncrasy/Peculiarity (PEC)	PEC1 – I often get unique ideas – item from EPIC dimension Idiosyncrasy
	PEC2 – I can identify different combinations of resources more easily than many others – adapted item from EPIC dimension Idiosyncrasy: I can identify combinations of resources differently than many others
	PEC3 – I can spot and forecast trends more quickly than others – adapted item from EPIC dimension Idiosyncrasy: I can spot trends more quickly than others
Innopenreursnip (INPR)	INPR1 – Inventing new solutions to problems is an important part of who I am – item from EPIC dimension Entrepreneurial passion
	INPR2 – I am motivated to make existing products/services better – item from EPIC dimension Entrepreneurial passion.
	INPR3 – I tend to find new or different solutions to known problems – adapted item from EPIC Innovative employee dimension: Solve problems in new ways
Confidence (CON)	CON1 – I believe in the quality of my own ideas from the very start – item from EPIC dimension Confidence
	CON2 – I trust my own judgment – adapted from EPIC dimension Confidence: I trust my own judgment and act on it
	CON3 – I usually act based on my own judgment – adapted from EPIC dimension Confidence: I act on my own judgment regardless of other people's opinions
Orientation to innovations (INNO)	INNO1 – I like to create my own ideas – adapted from EPIC dimension Innovative employee: Work on my own ideas
	INNO2 – I like to define my own tasks – adapted from EPIC dimension Innovative employee: Define my own tasks
Experience (EXP)	EXP1 – It is easy for me to apply my past experience in novel contexts – adapted from EPIC dimension Experience: It is easy for me to use my experience to find patterns in novel contexts
	EXP2 – I am able to relate new and unaccustomed challenges to my past experience – adapted from EPIC dimension Experience: I am able to relate most new and unaccustomed challenges to my past experience
Risk acceptance (RISK)	RISK1 – I tend to implement my plan although conditions are uncertain
	RISK2 – I'm willing to take a certain amount of risk to achieve goals - adapted from Davis et al. (2016) : I'm willing to take a certain amount of risk to achieve real success
	RISK3 – I tend to act boldly in situations in which high risk is involved (Bolton and Lane, 2012)
Orientation to action (ACT)	ACT1 – I do things without being told to do so
	ACT2 – I take the responsibility for making things happen
	ACT3 – I am often the one who takes initiatives
Need to achieve (ACH)	ACH1 – I want everything to do to the best of my ability - adapted from Davis et al. (2016) : I want to be the best at what I do
	ACH2 – I want to continuously improve my performances
Persistence (PERS)	PERS1 – I do not give up easily - adapted from Davis et al. (2016)
	PERS2 – I am committed to finish what I begin to do
Entrepreneurial intention (EI)	EI1 – Starting my own business is an attractive idea to me - adapted from Krueger et al. (2000)
	EI2 – Starting my own business is desirable for me - adapted from Krueger et al. (2000)
	EI3 – Starting my own business is feasible for me - adapted from Krueger et al. (2000)
	EI4 – If I start a business in the near future, it is likely that it would succeed - adapted from Krueger et al. (2000)
	EI5 – It is likely that I start a new business from an own idea - adapted from Sowmya et al. (2010)
Resources (RES)	RES1 – The regulations at national/regional levels do support the development of new entrepreneurial initiatives
	RES2 – The infrastructure (like IT, connectivity, transportation, communication, etc.) at national/regional levels do support the development of new entrepreneurial initiatives
	RES3 – The access to financial resources and the presence of investors (i.e., business angels and venture capital funds) do support the development of new entrepreneurial initiatives
	RES4 – Regional/local presence of incubators and technological parks do support development of new entrepreneurial initiatives
	RES5 – My university does support new entrepreneurial initiatives

these universities are engaged in fostering entrepreneurship making them an appropriate context for analyzing entrepreneurial mindset dimensions among students. The sample is well-aligned with the

objectives of the research to compare entrepreneurial mindset dimensions and intentions from two different educational, economic and social backgrounds.

TABLE 2 Demographics and academic characteristics of students.

Location	Total	Male	Female	Average age	Bachelor students	Master students	PhD students
EU	156	99	57	25.42	68	78	10
BIH	145	78	67	22.83	58	82	5
Total	301	177	124	24.12	126	160	15

2.2 Data analysis methods

The differences between each entrepreneurial mindset dimension, as well as entrepreneurial intentions and resources, of students from the University of Sarajevo in BIH and students from four universities in EU member states (University of Modena and Reggio Emilia in Italy, FH Joanneum University of Applied Sciences in Austria, Harokopio University of Athens in Greece, and Mid Sweden University in Sweden) were assessed using statistical hypothesis testing for differences between two population means with an $\alpha = 0.05$ level of significance. Additionally, 95% confidence intervals for the difference between the two population means were constructed for each entrepreneurial mindset dimension, as well as for entrepreneurial intention and resources.

The impact of each entrepreneurial mindset dimension, resources, and demographic and academic characteristics on the entrepreneurial intentions of students from the University of Sarajevo in BIH and students from the four universities in EU member states was analyzed using the machine learning method Random Forest, while feature importance was analyzed using SHAP values. The dataset was divided into training and test set in ratio 80:20 in order to prevent overfitting and to ensure that model performs well on unseen data. SHAP analysis was performed on test set. Random Forest machine learning method was used because of its ability to capture complex, non-linear relationships between entrepreneurial mindset dimensions, resources, demographic and academic characteristics, and entrepreneurial intentions of EU and BIH students. It ensures robustness with respect to dataset and type of variables used as well as interpretability through feature importance analysis, making it well suited for objectives of this research.

3 Results and discussion

This section focuses on two analyses:

- Analysis of the differences in entrepreneurial mindset dimensions, entrepreneurial intentions, and resources between EU students and BIH students.
- Analysis of the impact of entrepreneurial dimensions, resources, and demographic and academic characteristics on the entrepreneurial intentions of students from EU member countries and BIH.

3.1 Differences of entrepreneurial mindset dimensions, entrepreneurial intentions and resources between EU students and BIH students

Statistical hypothesis tests were performed using a significance level of $\alpha = 0.05$. For this research, both one-tailed and two-tailed tests

were conducted. For the one-tailed test, the null hypothesis (H_0) and the alternative hypothesis (H_1) were defined as shown in Equations 1-2:

$$H_0 : \mu_{BIH} - \mu_{EU} = 0 \quad (1)$$

$$H_1 : \mu_{BIH} - \mu_{EU} \neq 0 \quad (2)$$

where μ_{BIH} – mean value of entrepreneurial mindset dimensions of students in BIH.

μ_{EU} – mean value of entrepreneurial mindset dimensions of students in EU member countries.

For each hypothesis test, the p -value was calculated, and based on the p -value, a decision was made whether to reject or not reject the null hypothesis H_0 . Under the assumption of the null hypothesis H_0 , the p value is the probability of obtaining a statistic equal to or greater than the observed result from the sample. Results with $p < 0.05$ were considered statistically significant, leading to the decision to reject the null hypothesis H_0 with the conclusion that there was statistical evidence that the statement in the research hypothesis H_1 was true. Results with $p > 0.05$ led to the decision not to reject the null hypothesis H_0 with conclusion that there was insufficient statistical evidence of a difference between two means.

If the null hypothesis was rejected, an upper one-tailed test was considered to determine whether the mean value of that particular entrepreneurial dimension for BIH students was greater than those of students from EU member countries. For the two-tailed test, the null hypothesis (H_0) and the alternative hypothesis (H_1) were defined as shown in Equations 3-4:

$$H_0 : \mu_{BIH} - \mu_{EU} \leq 0 \quad (3)$$

$$H_1 : \mu_{BIH} - \mu_{EU} > 0 \quad (4)$$

Table 3 depicts sample means \bar{x}_{BIH} and \bar{x}_{EU} , differences between sample means ($\bar{x}_{BIH} - \bar{x}_{EU}$), 95% confidence intervals for ($\mu_{BIH} - \mu_{EU}$), p values, and decisions on whether to reject or not to reject the null hypothesis.

From Table 3, it can be seen that there is insufficient statistical evidence of a difference between the two population means for BIH and EU students in the following entrepreneurial mindset dimensions: PEC, INPR, INNO, EXP, RISK, ACT, ACH, and PERS, as well as for RES as a control variable. Additionally, Table 3 shows that for the entrepreneurial mindset dimension CON and for EI, the two-tailed test indicates that there is statistical evidence of differences between the two means. Therefore, for CON and EI, an upper one-tailed test was conducted to determine if the mean values of CON and EI for BIH students are significantly greater than those of students from EU member countries. Decisions regarding both CON and EI were to

TABLE 3 Hypothesis tests for the differences between two population means.

EMD, EI and RES	\bar{x}_{BIH}	\bar{x}_{EU}	Difference of sample means ($\bar{x}_{BIH} - \bar{x}_{EU}$)	95% CI for difference ($\mu_{BIH} - \mu_{EU}$)	p value one- tailed test	Decision two-tailed test $H_0: \mu_{BIH} - \mu_{EU} = 0$ $H_1: \mu_{BIH} - \mu_{EU} \neq 0$	p value two-tailed test	Decision one-tailed test $H_0: \mu_{BIH} - \mu_{EU} \leq 0$ $H_1: \mu_{BIH} - \mu_{EU} > 0$	Cohen's effect size d	95% CI for Cohen's effect size d
PEC	4.73	4.69	0.04	(-0.20; 0.27)	0.747	Do not reject H_0			0.04	(-0.19; 0.27)
INPR	5.11	5.01	0.10	(-0.16; 0.34)	0.478	Do not reject H_0			0.09	(-0.14; 0.32)
CON	5.48	5.06	0.42	(0.18; 0.65)	0.000	Reject H_0	0.000	Reject H_0	0.41	(0.19; 0.64)
INNO	5.35	5.23	0.12	(-0.14; 0.38)	0.371	Do not reject H_0			0.11	(-0.12; 0.33)
EXP	5.11	5.12	-0.01	(-0.24; 0.23)	0.944	Do not reject H_0			-0.01	(-0.24; 0.22)
RISK	4.85	4.74	0.11	(-0.13; 0.34)	0.389	Do not reject H_0			0.10	(-0.12; 0.33)
ACT	5.23	5.14	0.09	(-0.15; 0.34)	0.477	Do not reject H_0			0.08	(-0.14; 0.31)
ACH	5.90	5.87	0.03	(-0.20; 0.26)	0.808	Do not reject H_0			0.03	(-0.20; 0.26)
PERS	5.89	5.92	-0.03	(-0.29; 0.23)	0.819	Do not reject H_0			-0.03	(-0.25; 0.20)
RES	4.44	4.61	-0.17	(-0.43; 0.08)	0.175	Do not reject H_0			-0.15	(-0.38; 0.07)
EI	5.21	4.59	0.62	(0.34; 0.90)	0.000	Reject H_0	0.000	Reject H_0	0.49	(0.26; 0.72)

reject the null hypotheses, leading to the conclusion that the entrepreneurial mindset dimension confidence (CON) and the entrepreneurial intentions (EI) of students in BIH are significantly greater than those of students in EU member countries. Also, in order to compare differences between the two population means for BIH and EU students, like in independent samples *t*-test, Cohen's *d* method for assessing the effect size was used. In this research, difference of the means between the groups was standardized. Cohen's effect sizes *d* and 95% confidence intervals (CI) were calculated for each entrepreneurial mindset dimension and entrepreneurial intention. From Table 3 it can be seen that effect size of the origin of students, EU or BIH, for all entrepreneurial mindset dimensions is very small with 95% CI including zero, except for CON with significant Cohen's effect size *d* = 0.41 (95% CI: 0.19; 0.64). Also, significant Cohen's effect size *d* was calculated for EI with the value of 0.49 (95% CI: 0.26; 0.72).

Regarding the first research question (RQ1): "Do the entrepreneurial mindset dimensions of students in EU member countries and students in Bosnia and Herzegovina differ significantly?" there is evidence to conclude that 8 entrepreneurial mindset dimensions - PEC, INPR, INNO, EXP, RISK, ACT, ACH, and PERS - are not significantly different, while the entrepreneurial mindset dimension CON is significantly greater among students in BIH than among those in EU member countries.

With respect to the second research question (RQ2): "Are the entrepreneurial intentions of students in EU member countries significantly different from those of students in Bosnia and Herzegovina, an EU candidate country?" there is evidence to conclude that the entrepreneurial intentions of students are significantly greater in BIH compared to those in EU member countries. This conclusion is in line with work of [Iakovleva et al. \(2011\)](#).

In relation to the third research question (RQ3): "Does the availability of resources to support the development of new entrepreneurial initiatives differ significantly between students in EU member countries and those in Bosnia and Herzegovina?" there is evidence to conclude that there is no significant difference in the availability of resources in BIH compared to EU member countries.

3.2 Impact of entrepreneurial dimensions, resources, demographic and academic characteristics on entrepreneurial intentions

In this research, a comprehensive machine learning approach was used to investigate the determinants of entrepreneurial intentions among students in BIH and the European Union, utilizing two distinct datasets. A random forest regression method, known for its robustness and ability to handle non-linear relationships, was applied to predict entrepreneurial intentions based on a set of explanatory variables (features). Two models were developed – one for EU member countries and one for BIH. The models' hyperparameters were optimized through a grid search over several configurations, including variations in the number of trees, maximum depth, minimum samples split, minimum samples leaf, and the method of selecting features at each split. For each combination of hyperparameters, the model was trained on an 80% split of the data and validated on the remaining 20%, ensuring that the models' performances were adequately tested against unseen data. The performance of each model was evaluated

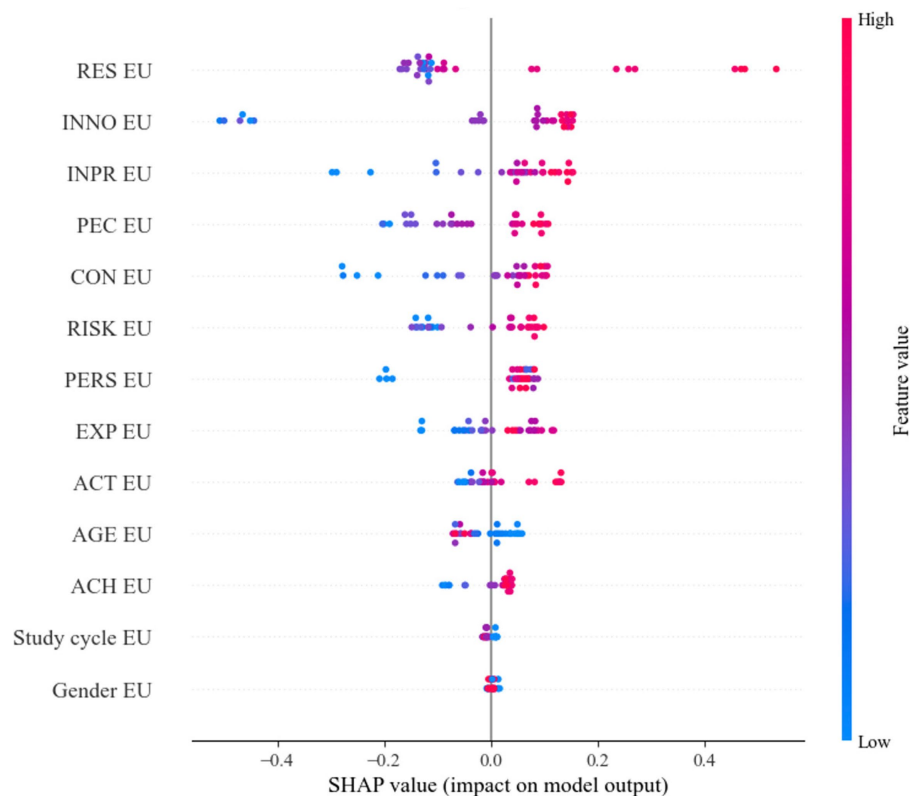


FIGURE 1
Feature impacts on entrepreneurial intentions of EU students.

using the coefficient of determination (R^2) and mean squared error (MSE), with additional metrics such as root mean squared error ($RMSE$), mean absolute error (MAE), and mean absolute percentage error ($MAPE$) calculated to provide a comprehensive assessment of prediction accuracy. The analysis was designed to minimize the difference between training and testing MSE , thereby enhancing the model's generalizability.

Furthermore, SHAP values were incorporated to interpret the random forest model's predictions, providing insights into the impact of individual features on the predicted entrepreneurial intentions. This analysis facilitated an in-depth understanding of the driving factors behind the model's predictions, highlighting the most influential variables. The SHAP values were visualized using SHAP summary plots, which showed the impact of features on predictions, with the x-axis representing SHAP values as a direct measure of how much and in what direction the features impacted the predictions. In this way, it was possible to identify the most important features in the model and understand how each feature impacted the prediction. Positive SHAP values indicated that a feature contributed to an increase in the model's prediction (positive impact), whereas negative values indicated a decrease (negative impact). The absolute SHAP value reflected the strength of this impact. The horizontal spread of the points shows the distribution of SHAP values for each feature, with features exhibiting a wide spread having a large variability in their impact on the model's output.

Figure 1 shows the SHAP summary plot for EU students. From Figure 1, it can be seen that the features are ordered by importance,

with the most impactful feature RES at the top. High values of RES tend to push the model output higher, while low values have a negative impact. Higher availability of resources, such as financial support, incubators, and university support to new entrepreneurial initiatives, is positively associated with increased entrepreneurial intentions, while students with limited access to resources show lower entrepreneurial intentions. The same trend can be observed for all 9 entrepreneurial dimensions, where high values of each dimension have a positive impact, while lower values have a negative impact. Among the entrepreneurial mindset dimensions INNO is the second most important dimension in shaping entrepreneurial intentions. Students with stronger orientation to innovation mindset dimension are more likely to develop entrepreneurial intentions. INPR and PEC are also influential mindset dimensions indicating that students with innovative entrepreneurial passion and who think uniquely are more likely to develop entrepreneurial intentions. CON and RISK are also among the high-impact features, demonstrating that students who trust their own decision-making abilities and are willing to take risks are more likely to have entrepreneurial intentions. ACH has the lowest impact among 9 entrepreneurial mindset dimensions. Age feature has low impact, where younger people tend to have higher entrepreneurial intentions. Gender and Study cycle among EU students have almost no impact on entrepreneurial intentions. Together with low impact of feature Age it can be concluded that entrepreneurial intentions among EU students is more influenced by entrepreneurial mindset dimensions rather than demographic and academic characteristics.

TABLE 4 Feature contributions to the entrepreneurial intentions of EU students.

Feature	Mean absolute SHAP value	95% CI for mean absolute SHAP value	Percentage	Cumulative
RES EU	0.179	(0.162; 0.196)	17.88%	17.88%
INNO EU	0.169	(0.145; 0.193)	16.91%	34.80%
INPR EU	0.101	(0.077; 0.125)	10.11%	44.91%
PEC EU	0.095	(0.042; 0.149)	9.54%	54.44%
CON EU	0.091	(0.078; 0.104)	9.10%	63.55%
RISK EU	0.086	(0.072; 0.099)	8.57%	72.11%
PERS EU	0.079	(0.063; 0.094)	7.86%	79.97%
EXP EU	0.062	(0.054; 0.070)	6.20%	86.18%
ACT EU	0.047	(0.031; 0.063)	4.70%	90.88%
AGE EU	0.040	(−0.004; 0.084)	3.99%	94.87%
ACH EU	0.037	(0.030; 0.044)	3.71%	98.57%
Study cycle EU	0.009	(0.008; 0.010)	0.90%	99.47%
Gender EU	0.005	(0.004; 0.006)	0.53%	100.00%

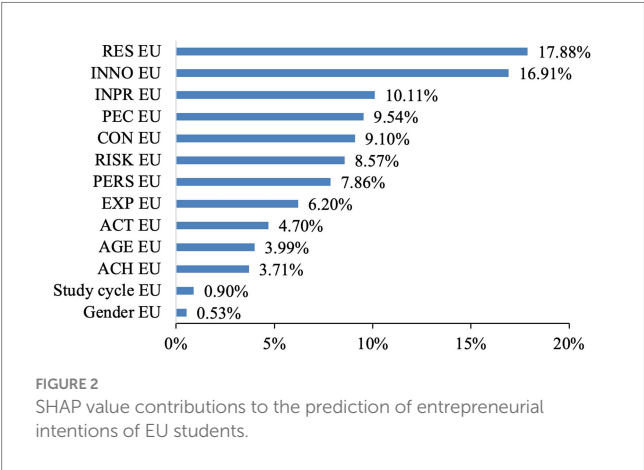


Table 4 shows the mean absolute SHAP values, percentages of contribution to entrepreneurial intention (EI) for EU students, and the cumulative percentage of contributions for EU students as well as 95% CI for mean absolute SHAP values.

Figure 2 shows SHAP value contributions to the prediction of entrepreneurial intentions of EU students.

From Table 4 and Figure 2, it can be seen that the RES feature’s SHAP value contributes 17.88% to the prediction of entrepreneurial intentions of EU students, followed by the INNO feature’s SHAP value contribution of 16.91%. From the very low SHAP value contributions of Gender and Study cycle, at 0.90 and 0.53% respectively, it can be concluded that gender and study cycle of students in the EU almost do not impact their entrepreneurial intentions. Additionally, almost 80% of the contribution comes from resources and six entrepreneurial dimensions: INNO, INPR, PEC, CON, RISK, PERS, and RES. Interventions or enhancements in these features within the higher education process are likely to have the greatest effect on entrepreneurial intentions among EU students. Improving or fostering these aspects can directly increase the likelihood of entrepreneurial intentions among these students. For

TABLE 5 Evaluation of the model’s performance for EU students.

Dataset	R^2	MSE	RMSE	MAE	MAPE
Training	57.824%	0.773	0.879	0.713	20.57%
Test	30.842%	1.716	1.310	1.031	33.64%

example, increasing resources (RES) or fostering innovation (INNO) among students can have a notable impact on enhancing their entrepreneurial intentions. Features with almost no contributions, such as Gender and Study cycle, have little to no impact on the prediction of entrepreneurial intentions. Focusing efforts on these areas is unlikely to yield significant results in terms of increasing entrepreneurial intentions, as the model indicates they do not strongly impact this outcome.

Table 5 depicts the evaluation metrics for the performance of the developed model for EU students: coefficient of determination (R^2), mean squared error (MSE), root mean squared error (RMSE), mean absolute error (MAE), and mean absolute percentage error (MAPE) for both training and test sets. It can be seen that the developed model demonstrates good performance.

Figure 3 shows the SHAP summary plot for BIH students. SHAP values indicate the impact of each feature on the model’s output. From Figure 3, it can be seen that the features are ordered by importance, with the most impactful feature INNO, at the top, and Gender and Study cycle, with the lowest impact on entrepreneurial intentions, at the bottom. The INNO feature has the highest contribution to the model and high values of INNO generally push the model’s output toward higher entrepreneurial intentions, while low INNO values tend to decrease entrepreneurial intentions. This finding underscores the importance of enhancing innovation-driven education programs for developing entrepreneurial intentions of students. Following INNO, RISK and CON are the next most influential features. High RISK and CON values are associated with higher entrepreneurial intentions, while low values push the prediction toward lower values. Students with willingness to take risks and with self-confidence are more likely

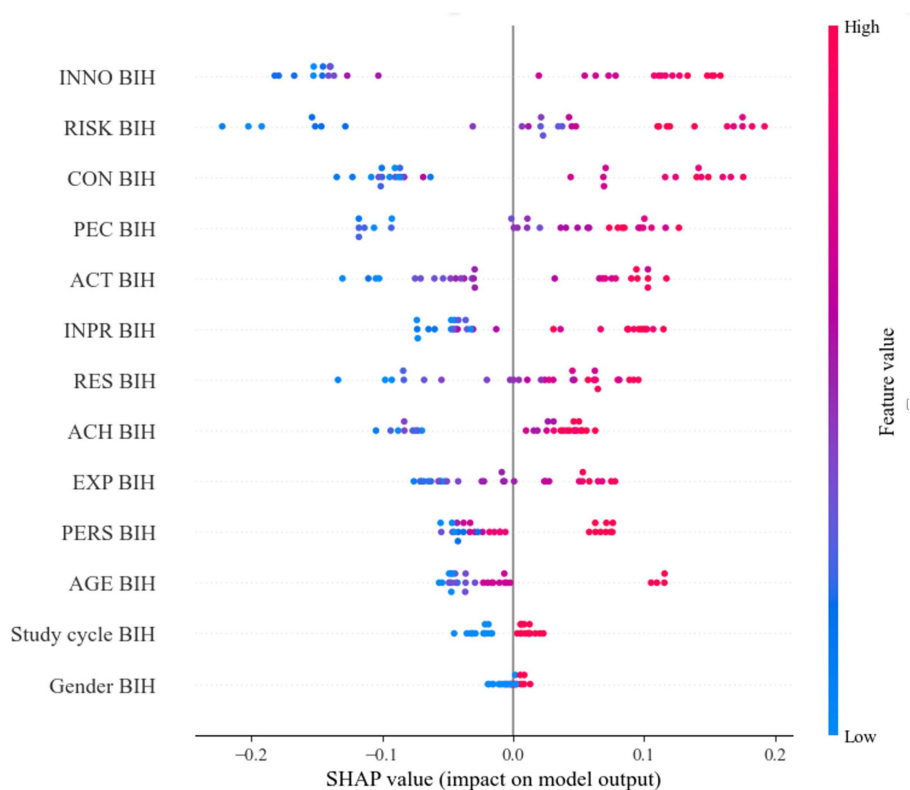


FIGURE 3
Feature impacts on entrepreneurial intentions of BIH students.

to develop entrepreneurial intentions. PEC, ACT, INPR, and RES are also among the high-impact features indicating that students with more unique thinking, action orientation, innovative entrepreneurial passion and access to resources are more likely to develop entrepreneurial intentions. Entrepreneurial mindset dimension ACH, EXP, and PERS are with lower impact. For all 9 entrepreneurial dimensions, the same trend as for INNO can be observed, where high values of each dimension have a positive impact, while lower values have a negative impact. Gender and Study cycle have minimal impact on the model's predictions, as indicated by the clustering of SHAP values near zero. Together with low impact of feature Age it leads to same conclusion as for EU students, that entrepreneurial intentions among BIH students are more influenced by entrepreneurial mindset dimensions rather than demographic and academic characteristics. Also, it can be seen that, unlike in EU, older BIH students tend to have higher entrepreneurial intention.

Table 6 shows the mean absolute SHAP value, the percentage contribution to entrepreneurial intentions (EI) for BIH students, as well as the cumulative percentage contributions for BIH students as well as 95% CI for mean absolute SHAP values.

Figure 4 shows SHAP value contributions to the prediction of entrepreneurial intentions of BIH students.

From Table 6 and Figure 4, it can be seen that the INNO feature's SHAP value contributes 15.35% to the prediction of entrepreneurial intentions of BIH students, followed by the RISK feature's SHAP value contribution of 13.37%. The very low SHAP value contributions of Gender and Study cycle, at 0.80 and 2.22% respectively, suggest that gender and study cycle have minimal impact on the entrepreneurial

intentions of students in BIH. Additionally, around 80% of the contribution to the prediction comes from seven entrepreneurial dimensions and resources features: INNO, RISK, CON, PEC, ACT, INPR, ACH, and RES. To increase entrepreneurial intentions among students in BIH, it would be most effective to focus on enhancing these entrepreneurial mindset dimensions, as these features are key drivers of the model's predictions. Low-impact features such as Gender and Study cycle have minimal or no impact on students' entrepreneurial intentions, suggesting that interventions aimed at these features are unlikely to yield significant improvements.

Table 7 depicts the evaluation metrics for the performance of the developed model for BIH students: coefficient of determination (R^2), mean squared error (MSE), root mean squared error ($RMSE$), mean absolute error (MAE), and mean absolute percentage error ($MAPE$) for both training and test sets. It can be seen that the developed model demonstrates good performance.

Regarding the fourth research question (RQ4): "How do the entrepreneurial mindset dimensions, resources, and demographic and academic characteristics influence the entrepreneurial intentions of students in EU member countries compared to those in Bosnia and Herzegovina, an EU candidate country?" there is evidence that the entrepreneurial mindset dimensions impact the entrepreneurial intentions of students in both EU member countries and BIH in the same way - high values of the entrepreneurial mindset dimensions push predictions toward higher values, while low values have a negative impact. However, the importance of specific entrepreneurial mindset dimensions is not the same for EU member states and BIH. The order of importance of the

TABLE 6 Feature contributions to the entrepreneurial intentions of BIH students.

Feature	Mean absolute SHAP value	95% CI for mean absolute SHAP value	Percentage	Cumulative
INNO BIH	0.126	(0.111; 0.140)	15.35%	15.35%
RISK BIH	0.109	(0.099; 0.120)	13.37%	28.72%
CON BIH	0.106	(0.094; 0.119)	13.02%	41.74%
PEC BIH	0.073	(0.059; 0.087)	8.89%	50.63%
ACT BIH	0.072	(0.064; 0.081)	8.82%	59.45%
INPR BIH	0.063	(0.038; 0.088)	7.69%	67.14%
RES BIH	0.057	(0.045; 0.068)	6.91%	74.05%
ACH BIH	0.053	(0.044; 0.061)	6.43%	80.48%
EXP BIH	0.047	(0.040; 0.055)	5.79%	86.27%
PERS BIH	0.044	(0.032; 0.056)	5.37%	91.64%
AGE BIH	0.044	(0.032; 0.055)	5.34%	96.98%
Study cycle BIH	0.018	(0.016; 0.020)	2.22%	99.20%
Gender BIH	0.007	(0.003; 0.010)	0.80%	100.00%

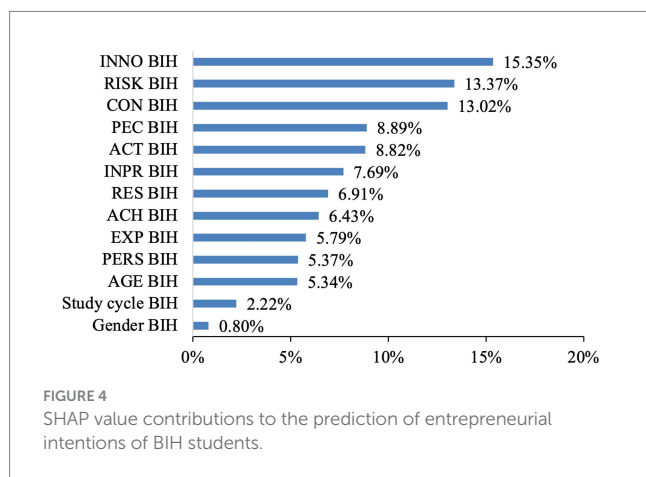


TABLE 7 Evaluation of the model's performance for BIH students.

Dataset	R^2	MSE	RMSE	MAE	MAPE
Training	48.472%	0.597	0.773	0.586	12.82%
Test	42.725%	0.674	0.821	0.678	14.31%

entrepreneurial mindset dimensions in BIH is as follows: INNO, RISK, CON, PEC, ACT, INPR, ACH, EXP, and PERS, while in EU member states the order is: INNO, INPR, PEC, CON, RISK, PERS, EXP, ACT, and ACH. The availability of resources is the most impactful feature on the entrepreneurial intentions of students in EU member countries. Gender and academic characteristics have limited or no impact on the entrepreneurial intentions of students in both BIH and EU member countries. The only difference is in the impact of age. While in both EU member states and BIH the age contribution to entrepreneurial intentions is small, in EU member states younger people tend to have higher entrepreneurial intentions, whereas in BIH, younger people tend to have lower entrepreneurial intentions.

4 Conclusion

This study has provided a comprehensive analysis of the entrepreneurial mindset dimensions and entrepreneurial intentions of students from EU member countries and Bosnia and Herzegovina, an EU candidate country. By analyzing 9 specific dimensions of the entrepreneurial mindset and their impact on entrepreneurial intentions of students, along with the availability of resources and the demographic and academic characteristics of students, this research offers valuable insights into the factors that drive entrepreneurial intentions among university students from different educational, economic and social backgrounds.

The findings reveal that while high values of entrepreneurial mindset dimensions have positive impact on entrepreneurial intentions in both EU member countries and Bosnia and Herzegovina, the relative importance of these dimensions differs between the EU member countries and Bosnia and Herzegovina. For students from EU member states, the focus should be on the development of INNO, INPR, PEC, CON, RISK, and PERS, since these entrepreneurial mindset dimensions are the most important for EI, while for BIH students the most important entrepreneurial mindset dimensions for EI are INNO, RISK, CON, PEC, ACT, INPR, RES, ACH. Despite these differences, the overall trend indicates that high values across all entrepreneurial mindset dimensions are associated with higher entrepreneurial intentions, while lower values have the opposite effect.

The analysis also underscores the important role of resources in shaping entrepreneurial intentions, particularly among EU students, where the availability of resources was found to be the most impactful feature. Conversely, demographic and academic characteristics such as gender and level of study cycle were shown to have minimal influence on entrepreneurial intentions in both EU member states and Bosnia and Herzegovina. However, age was identified as a differentiating factor: younger students in EU member countries tend to have higher entrepreneurial intentions, whereas in Bosnia and Herzegovina, younger students show lower entrepreneurial intentions.

In terms of practical implications, these findings suggest that educational interventions aimed at enhancing specific entrepreneurial mindset dimensions and improving access to resources could significantly boost entrepreneurial intentions among students. For policymakers and educators, these insights offer a basis for developing targeted strategies to foster entrepreneurship, tailored to the unique contexts of both EU member countries and Bosnia and Herzegovina. By addressing the identified gaps and leveraging the strengths highlighted in this study, higher education institutions can better support the entrepreneurial aspirations of their students, ultimately contributing to economic development and job creation and balanced economic growth across Europe.

This research not only advances understanding of the factors influencing entrepreneurial intentions of students in different educational, economic and social backgrounds, but also provides actionable recommendations for enhancing entrepreneurship education across both EU member countries and Bosnia and Herzegovina, an EU candidate country. The limitation of this research is that the impact of potential confounders like prior business exposure and family background is not addressed. Further research should include potential confounders and explore the longitudinal impact of these factors on actual entrepreneurial outcomes, as well as investigate additional factors that may play a role in shaping entrepreneurial behaviors in diverse educational contexts.

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Ethics statement

Ethical review and approval was not required for the study on human participants in accordance with the local legislation and institutional requirements. Written informed consent from the participants was not required to participate in this study in accordance with the national legislation and the institutional requirements.

Author contributions

MiP: Conceptualization, Data curation, Formal analysis, Funding acquisition, Investigation, Methodology, Project administration,

Supervision, Validation, Visualization, Writing – original draft, Writing – review & editing. BJ: Conceptualization, Data curation, Formal analysis, Writing – original draft, Writing – review & editing. FF: Conceptualization, Data curation, Formal analysis, Writing – original draft, Writing – review & editing. MuP: Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Supervision, Validation, Visualization, Writing – original draft, Writing – review & editing.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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