Learning a Bayesian structure to model entrepreneurial intentions and attitudes towards business creation among Emirati students

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**Abstract**

Purpose. Economic growth in most advanced countries is driven by small and medium enterprises and most countries prioritize entrepreneurship for economy growth and innovation. This is very apparent in the UAE where an average of about 39% of adults want to start a business in the next 3 years. As such, Entrepreneurial intentions have been a major focus of research but they have always been studied using generic models. We use Bayesian Networks as a relatively new technique to model entrepreneurial intentions as it provides an advantage over classical methods.

Methodology. Using the Theory of Planned Behavior as a foundation, a cross-sectional study was conducted among a random sample of 324 Emirati University students in the UAE. We implemented Unsupervised Structural learning within BayesiaLab using the SopEQ unsupervised algorithm to minimize the “Minimum Description Length” score.

Findings. Our model provides confirmation of and more robust statistical support for existing theoretical frameworks. It helped not only finding relationships among the different entrepreneurial factors, but also assess the effects of changes in these variables on intentions.

Originality. One of the strengths of our study is the inclusion of attitudes towards entrepreneurship and self-efficacy variables. Accordingly, the main conclusions that can be drawn from our model is that Entrepreneurial intentions are highly affected by attitude, self-efficacy, subjective norms, and opportunity feasibility. The results can be used by professionals for proposing new policies for university opportunity and government support.

Keywords

Bayesian Network; Entrepreneurship; Intention; Attitudes; Self-Efficacy; Subjective Norms.

Classification:

**Introduction**

Economic growth in most advanced countries is driven by large numbers of small and medium enterprises across all sectors, and most countries prioritize the importance of entrepreneurship for economy growth and innovation. Therefore, it is vital for a country’s advancement to stimulate a culture of entrepreneurship at early age through the educational systems. For this purpose, higher education institutions should commit to helping students achieve their full potentials through personal and entrepreneurial development as well as opening new opportunities for future growth through multi-disciplined lens. In addition to economic growth, entrepreneurial activity is a key driver of employment, innovation and productivity and it is generally assumed to be a vital driver of economic development and transformation through the prevalence of an innovative environment. Indeed, entrepreneurship doesn’t only add to entrepreneurs themselves, but also adds to the overall economy through jobs creation in the market at all levels (Al Saiqal, 2017). This starts with universities whose role is to provide their students with entrepreneurial skills and supply the country with qualified entrepreneurs who are able to create new innovative businesses and contribute to the country’s economic growth (Chrisman *et al.*, 2012; Henderson, 2000).

Despite the fact that most universities are criticized for not being able to deliver qualified graduates with practical skills (Del Arco & Enciso, 2011), and while most studies agree on the significance of the entrepreneurship education to starting a business, others found that even though the entrepreneurship education does not have a significant impact on business performances, it has a big impact on graduates’ motivation to start a business (Henderson, 2000).

In the Global Entrepreneurship Monitor Report 2019/2020 (GEM, 2020), it was stated that firms are increasingly valuing entrepreneurship skills among employees. In the United Arab Emirates (UAE), the United Kingdom and Australia, more than 8% of employed adults are involved in entrepreneurial activities, such as developing new goods or services, as part of their employment, compared to less than 1% in 16 of the 50 economies. Moreover, 13 economies have 5% or more of adults starting or running a new business and expecting to employ an extra six or more people within the next five years, including two with over 10% in this position (Chile with 13% and the UAE with 11%). Furthermore, the intention for starting a business was relatively high among the innovation driven economies: on average, about 39% of adults want to start a business in the next 3 years in the UAE. The GEM report also indicated that while 71% of adults consider it is easy to start a business in the UAE, only 13.7% have entrepreneurial intentions and 35.1% declared facing the fear of failure if they had the opportunity to start a business.

The National Agenda of the UAE aims for the country to be among the best in the world in entrepreneurship as it plays a key role in unlocking the potential of nationals and enables them to be a driving force of the UAE’s economic development through small and medium enterprises in the private sector. Furthermore, the National Agenda strives to instill an entrepreneurial culture in schools and universities to foster generations endowed with leadership, creativity, responsibility and ambition. This will allow the UAE to be among the best in the world in the ease of doing business, innovation, entrepreneurship and R&D indicators. Thus, entrepreneurship is now regarded as an important element to be integrated in the curriculum offered by higher education institutions in the UAE, making it an ideal context for studying Entrepreneurial attitudes.

Entrepreneurial attitudes refer to the extent to which students think there are good opportunities for starting a business, or the degree to which they attach high status to entrepreneurs. Measuring entrepreneurial attitudes is important because they express the general feelings towards entrepreneurs and entrepreneurship. Other relevant attitudes may include the level of risk that individuals might be willing to bear and individuals perception of their own skills, knowledge and experience in business creation. Since entrepreneurial attitudes can influence entrepreneurial activity, they can be influenced as well by entrepreneurial activity.

Although the entrepreneurial attitudes and intentions are not new phenomena, they have always been studied using the generic entrepreneurial intention models (Aljuwaiber, 2020). We propose in this paper to use Bayesian Networks (BNs) as a relatively new technique that can model entrepreneurial intentions and attitudes, that provides some advantages compared to classical methods.

BNs are a set of statistical methods used to model problems, extract information, and make decisions. They are a formalism of probabilistic reasoning increasingly used in several fields such as industry, health, finance and image processing. We will use BNs to model relationships among the different factors involved in this study.

**Literature Review**

Attitudes towards entrepreneurship has become an important factor in not only describing but also explaining entrepreneurial behavior in recent entrepreneurship research. There are several models that were developed to study entrepreneurial attitudes. One of the first models that takes into consideration desirability and feasibility was introduced in (Shapero & Sokol, 1982). This model argues that Entrepreneurial Intentions variable depends on perceptions of desirability, feasibility, and propensity to act. It was later updated in (McMullen & Shepherd, 2006) to point out the role of societies where an entrepreneur lives. Perceived desirability was defined as a subjective norm regarding the perceived social support and the personal interest to perform the entrepreneurial behavior, while perceived feasibility was defined as the perceived ease or difficulty of performing the entrepreneurial behavior and the perceived self-competence regarding entrepreneurship.

In (Krueger *et al.,* 2000), *Subjective Norms* variable was defined as a person’s perception of a specified behavior such as starting a business, which may be influenced by family, friends, society, educators, and so on. Furthermore, role models, usually associated with parents and friends, have been established as a factor that positively affects entrepreneurial behavior. Other models suggest adding additional factors they consider important in entrepreneurial intentions and attitudes. Obstacles or barriers to business creation and also the support available to entrepreneurs are examples of such factors. Regardless of the model used to study entrepreneurial intentions among students, we believe that there is a need to promote entrepreneurship and understand the role of universities in fostering entrepreneurship among students.

There exist a number of studies that analyze the entrepreneurial attitudes of university students (Ruiz-Ruano & Puga, 2019; Moriano *et al.,* 2012;Luiz & Mariotti, 2011; de la Cruz Sánchez-Escobedo, 2011; Harris & Gibson, 2008). Few studies have been conducted on the topic in the Middle East region (Saleh & Salhieh, 2014; Sayed & Ben Slimane, 2014), in Saudi Arabia (Wassim, 2016), in Kuwait (Wajeeh & Al-Yacoub, 2016), in Bahrain (Al-Shammari & Waleed, 2018), in Jordan (Abualbasal & Badran, 2019; Al-Mohammad, 2010), in Lebanon (Hendieh *et al.*, 2019), in Oman (Bakheet & Varghese, 2013; Bakheet, 2018), and in Egypt (Sharaf *et al.*, 2018). In the UAE, we were able to identify a limited number of research studies directed towards entrepreneurship attitudes, in general, and students in particular.

The first study to examine entrepreneurial intentions among 544 UAE senior Business and Engineering undergraduate students inside and outside the country was (Saiqal & Yousif, 2017). The collected data were analyzed using Structural Equation Modeling (SEM) and revealed that gender, age, entrepreneurship experience and family role model have direct and indirect effect on entrepreneurship. The study also revealed that Emirati males have stronger intention than females.

Jabeen and Faisal (2018) looked into the enablers of 224 UAE female entrepreneurs and their behavior using interpretive structural modelling. The results showed that the most important enables were spotting market trends and consumer needs, management skills development, and sustainable competitive advantage. According to this study, women in the UAE do not consider entrepreneurship as an option because of the lack of education in business skills. In addition, Vracheva *et al.* (2019) looked into the factors affecting entrepreneurial intent of a group of 151 UAE female students and found that family business exposure didn’t affect the entrepreneurial intent. It also found that the university-based subjective norms and the exposure to business classes were not significantly associated with entrepreneurial intent. Pauceanu *et al.* (2018) looked into the factors that influence students to start a business. Using the same dataset from Vracheva *et al.* (2019), the study focused on gender, age, and parents self-employment status and 23 entrepreneurial and culture support features to explain students intentions to start a business. Entrepreneurial confidence was the only significant factor that directly influence students intentions to start a business. Finally, Mohammed (2019) **investigated the factors that influence entrepreneurial intentions to start a business using linear regression. The study found that perceived educational support had a significant strong relationship with entrepreneurial intentions. However, the study was done on a small sample of only 53 students, the majority of whom were females.**

All of the above studies in the UAE were conducted using generic models. To our knowledge, no study in the UAE has ever used the BNs framework to model entrepreneurial intentions. The close exception is one study (Sohn & Lee, 2013), where authors examined the dynamic relationship among early stage entrepreneurial attitudes, activities, and aspirations using BNs. They looked at how attitudes affect the entrepreneurial activities and aspiration of the current year. Therefore, we will be the first to use BNs as a tool to look into students entrepreneurial intentions and attitudes towards starting a business in the UAE.

On the world level, we were able to find a limited number of studies that investigated entrepreneurial attitudes using BNs (Ruiz-Ruano & Puga, 2019; García *et al.*, 2014; López *et al.*, 2012). In (Ruiz-Ruano & Puga, 2019), the authors used BNs to explain the variables involved in entrepreneurial intention such as self-efficacy, desirability, attitude and social norm directly affecting entrepreneurial intention among a sample of 1068 university faculty from Spanish public universities such as self-efficacy, desirability, attitude and social norm directly affect entrepreneurial intention. The structure of the BN in this study was automatically learned from the dataset and compared to the basic postulates of the generic model (Shapero & Sokol, 1982).

Another example is (García *et al.*, 2014) were authors combined both theory and statistical evidence to create a BN model. The study started from a plausible theoretical model and then tested it using automatic learning algorithms to build BNs using the BNlearn algorithm implemented within R (Nagarajan *et al.*, 2013). The obtained BN showed that entrepreneurial behavior depends on perceived desirability and feasibility. Moreover, it indicated that desirability and feasibility related to normative beliefs, attitudes and obstacles, which was substantially different from theory and results in other studies.

Finally, López *et al.* (2012) used same data from García *et al.* (2014) and looked into entrepreneurial attitudes among Spanish women entrepreneurs using BNs, but this time they modeled feasibility using two different dimensions, opportunity feasibility and resource availability. The results showed that the BN with both added dimensions of feasibility predicted better entrepreneurial intentions.

In our study we will be looking at entrepreneurship intention and attitudes among students who are not yet entrepreneurs and see how this can affect their intention in stating a business. Conclusions are stemming from the existing Emirati social construct (people-centric society of the Arab world, rather than system-centric society of the Western world). This has created value-added contribution of the paper to the research questions. Furthermore, BNs have been used in many domains such us in industry, marketing, health, computer sciences, economics and management. However, there use in psychology and behavioral studies is still limited (Sohn & Lee, 2013). This study will contribute to this area.

**Methodology and Data Analysis**

*Bayesian Networks*

Bayesian Networks (BNs) - also known as probabilistic graphical models - are statistical tools to represent and handle uncertainty in different domains (Pearl, 1988). BNs represent the joint probability distribution (JPD) of a set of selected random variables of an area of knowledge and can handle both qualitative and quantitative dimensions of any domain. The qualitative part consists of the structure of the BNs that consist of a set of random variables (nodes) and directed edges connecting the nodes to form a directed acyclic graph. The quantitative part of the BNs consists of the conditional probability tables associated with each node. In fact, each edge between two nodes A and B in the BNs structure indicates a statistical dependence between the two variables, i. e., correlation between A and B (Pearl, 1988). The direction of the edge does not necessarily mean cause and effect. If the edge is directed from A to B we dispose of the probability distribution of A conditioned by B (P(A|B)). Therefore, every variable in the BN is associated with a probability distribution conditioned by the set of its parents (direct ancestors in the graph). This conditional probability distribution is represented as a probability distribution table (PDT) as all variables in the BN will be discretized.

BN can be built by either using experts knowledge or learned from data. Learning a BN from data means finding the BN structure that best represent the JPD that is sampled by the data. There are two families of methods for learning BNs, the constraint based methods and the score based methods. In the second family of methods, a score that measures the BNs structure with respect to the data is defined. The Minimum Description Length (MDL) score, the shortest description of the data as the best model, is one of the well know and used scores in BNs learning. The learning algorithms will then find the BNs structure that minimizes the defined score taking into account not only the structure capacity to encode the data but also the BN complexity.

We used the entropy and the logarithmic loss to evaluate the goodness of fit of the BN model and carried out a sensitivity analysis to evaluate the impact of each variable in the model on the intentions variable. Entropy reduction (or mutual information) is referred to the expected reduction in the query variable (intentions in our case) due to a finding in any other variable of the model (Bayesia, 2021).

One of the main challenges of adopting BNs is learning their structure from data. This task is complicated by the huge search space of possible solutions and by the fact that the problem is *NP*-hard. This is most of the time necessitates approximations.  However, as our sample is limited in terms of number of variables and size of the data, it is considered a small BNs comparing to BNs using hundreds of variables and millions of rows of data. The software used in this study, BayesiaLab (Bayesia, 2021), is a powerful software that can handle big BNs, in our example no approximation was needed.

*Materials and Methods*

A cross-sectional study was conducted among a random sample of 324 Emirati students attending a university in the UAE. Out of 324 students, 87% were females and 13% were males aged between 17 and 35 years. The average age of participants was 22.7 years with a standard deviation of 3.1 years. The majority of participants were from the Emirate of Dubai (52.2%), followed by Abu Dhabi (28.4%).

Students were recruited by choosing classes randomly through Excel from the list of 2020 Summer and Fall semesters, contacted by emails, briefed about the study aim and were asked to fill out the survey instrument that was developed for the study. The online survey consisted of three main parts. The first part included socio-economic and demographic questions about gender, city of residence, age, field of study, high school, language of instruction at their high school, year of study at the university, GPA, campus (Dubai or Abu Dhabi), employment status, parents level of education, parents employment status, and their job sectors.

The second part collected general background information on Entrepreneurship such as how they learned about entrepreneurship, earlier activities on starting a business and their attitudes towards it, whether students had a specialized course in entrepreneurship, read about it, or took part in workshops and conference, and also their plans after graduation. The last part of the survey measured students perceptions of entrepreneurship and entrepreneurs, entrepreneurship effect on the individual and on the society, student’s attitudes towards entrepreneurship, entrepreneurial opportunities, entrepreneurial environment within the university, the UAE entrepreneurial environment, limitations of starting a new business, and entrepreneurial characteristics and behavior, interest in one’s own enterprise, and entrepreneurial motives. In each question, students were able to choose their answers on a Likert scale of 1 to 5 from 1 being “strongly disagree” to 5 being “Strongly agree”.

The different statements to measure students intentions, attitudes, opportunity feasibility, self-efficacy, subjective norms, perceived risk, country opportunity feasibility, university opportunity feasibility, and obstacles were taken from (Ruiz-Ruano & Puga, 2019; Moriano *et al.,* 2012;Luiz & Mariotti, 2011; Abualbasal & Badran, 2019; Al-Mohammad, 2010; Moriano *et al.*, 2008). We reformulated, added and/or deleted some of the items to suit our population.

*Validity and Reliability of the Questionnaire*

A professional translator translated the English version of the questionnaire into Arabic. A second bilingual speaker cross-checked the Arabic version word by word with the English version. Content validity of the Arabic version of the questionnaire was assessed by a panel of experts in the field to evaluate the items readability, language simplicity and suitability and to evaluate the relationship of each item to the whole scale. The panel was composed of a Professor of Economics and a Professor of Entrepreneurship. Based on their comments, changes were made. The internal consistency reliability of the Arabic version of the questionnaire was assessed using Cronbach’s  which was 0.976 based on a pilot study of 10 students. Students in the pilot study were not included in the main study.

*Ethical Consideration*

Ethical clearance was obtained from the university Research and Ethics Committee. Students were invited to participate in the study on a voluntary basis. Confidentiality and anonymity of the participants were assured by not asking for their names and just identifying them by codes. All data were kept undisclosed, and participants were informed about the type of data to be collected and that it would be used for scientific purpose only. The published results of the study contain only statistical or group data from which no individual participant can be identified.

*Method*

The scales generated from the different statements included in the survey are entrepreneurial intentions (INT) , entrepreneurial attitudes (ATT) , entrepreneurship self-efficacy (SE), subjective norms (SN), opportunity feasibility (OF), university opportunity feasibility (UOF), country opportunity feasibility (COF), perceived risk (PR), obstacles (OBS), and family and friend support (FFS). The INT scale was created using seven statements form the questionnaire. The value of intention reported here is the average agreement of the statements. Higher scores on the intention scales indicate a higher intention towards starting a new business with a Cronbach’s of 0.79.

To measure ATT, a scale of 10 items was used, high scores on the attitude scale indicate a more positive attitude towards business creation, with a Cronbach’s of 0.89. The SN was computed based on a set of 14 items and showed a reliability of 0.92. The highest scores of the subjective norm scales indicate stronger support for business creation within the potential entrepreneur’s social milieu. The results of all variables are summarized in Table 1.

Table 1. Descriptive statistics and internal consistency coefficients

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Variables | Number of statements | Cronbach’s | Mean | Standard Deviation |
| Intention | 7 | 0.79 | 3.34 | .54 |
| Attitudes | 10 | 0.89 | 3.83 | .69 |
| Opportunity feasibility | 5 | 0.79 | 3.40 | .59 |
| Self-efficacy | 11 | 0.79 | 3.07 | .61 |
| Subjective norms | 14 | 0.92 | 3.83 | .64 |
| Perceived risk | 5 | 0.74 | 3.00 | .69 |
| Country opportunity feasibility | 5 | 0.89 | 3.86 | .84 |
| University opportunity feasibility | 15 | 0.94 | 3.52 | .74 |
| Obstacles | 10 | 0.86 | 3.26 | .72 |
| Family and friends support | 1 | - | 3.99 | 1.03 |

*Data Analysis*

There exists a number of BN learning algorithms. In this paper, we use Unsupervised Structural learning implemented within BayesiaLab (Bayesia, 2021) which is one of the BNs software available in the market. We tried a couple of unsupervised algorithms and selected the one that minimized the “Minimum Description Length” (MDL) score defined on BNs. We considered Maximum Weigh Spanning Tree, Taboo, and SopEQ algorithms and found SopEQ to provide us with the lowest MDL score.

SopEQ algorithm is a search algorithm based on heuristics. It first identifies the set of potential parents of each node, then, for the addition of edges, it explores the equivalence class space where both edges’ orientations are equivalent with respect to the encoded joint probability. Edges’ directions are then added after all conditional dependencies have been identified. The scores of the different scales were discretized into three bins using R2-GenOpt for discretizing continuous variables available within BayesiaLab (Bayesia, 2021). The BN output is based solely on the collected data and no expert knowledge was used to determine any type of association between the variables.

**Results**

The fitted BN is shown in Figure 1. According to the obtained BN model, entrepreneurial attitude, self-efficacy, and opportunity feasibility play an important role in shaping entrepreneurial intentions. Additionally, attitude is directly affected by subjective norms, therefore the subjective norms variable has an influence on intention which is mediated by attitude.

Diagram

Description automatically generated

Figure 1. The learned BN Structure

On the other hand, the subjective norms variable is a direct parent of the perceived risk variable and a direct descendant to the “Family and Friends’ Support” variable, which is an indication that “Family and Friends’ Support” has an impact on intention which is mediated by attitude. The same applies to the “Country Opportunity Feasibility” variable as a direct parent to the “Family and Friends’ Support” variable.

Furthermore, “Country Opportunity Feasibility” influences both “Family and Friends’ Support” and “University Opportunity Feasibility”. The strength of the relationships represented by the arcs of the BN are given in Table 2.

Table 2. Relationships Analysis.

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Parent | Child | KL Divergence | Relative Weight | Overall Contribution | Mutual Information | Symmetric Normalized Mutual Information | GKL-test | p-value | Pearson Correlation |
| Subjective Norms | Attitude | 0.62 | 1.00 | 0.23 | 0.62 | 0.39 | 276.97 | <0.0001 | 0.78 |
| Country Opportunity Feasibility | Family and friends support | 0.45 | 0.74 | 0.17 | 0.45 | 0.23 | 203.67 | <0.0001 | -0.21 |
| Family and friends support | Subjective Norms | 0.39 | 0.64 | 0.14 | 0.39 | 0.20 | 176.11 | <0.0001 | -0.21 |
| Perceived Risk | Obstacles | 0.37 | 0.61 | 0.14 | 0.37 | 0.24 | 168.03 | <0.0001 | 0.62 |
| Attitude | Intention | 0.23 | 0.37 | 0.08 | 0.12 | 0.07 | 103.66 | <0.0001 | 0.30 |
| Country Opportunity Feasibility | University Opportunity Feasibility | 0.23 | 0.37 | 0.08 | 0.23 | 0.14 | 103.17 | <0.0001 | 0.50 |
| Opportunity Feasibility | Intention | 0.17 | 0.28 | 0.06 | 0.08 | 0.05 | 76.74 | <0.0001 | 0.30 |
| Self Efficacy | Intention | 0.16 | 0.26 | 0.06 | 0.05 | 0.03 | 88.44 | <0.0001 | 0.22 |
| Subjective Norms | Perceived Risk | 0.10 | 0.16 | 0.04 | 0.10 | 0.06 | 44.08 | <0.0001 | 0.12 |

\* **GKL-**test: The independence test G is computed from the Kullback-Leibler divergence of the relationship

The BN model is the best compact representation of the JDP. To evaluate the performance of the model, we evaluated the joint probabilities of all the observations described in the data, which is given in Figure 2 where the probability of each instance of the dataset is computed using the BN structure. The lower the probability, the higher is the cost to encode the information in the dataset.

![Chart, histogram

Description automatically generated]()

Figure 2. The BN network performance

The density graph in figure 2 summarizes the distribution of the log-loss values corresponding to the multidimensional observations described in the dataset. The global performance index of the network over our data consists of the entropy obtained with the fully connected BN when we assume all variables are dependent. The normalized entropy obtained with the fully unconnected BN when we assume all variables are independent (straw model). The Contingency Table fits represents the degree of fit between the BN JDP and the data, and the deviance that measures the difference between the average log-likelihood of the BN and the Data.

The probability distribution of intention conditional to attitudes, self-efficacy, and opportunity feasibility is given in the Table 3. We can read from this table, as an example, that there is a 60.87% chance of an intention average higher than 3.57 (high intention) given that attitude is higher than 4, self-efficacy is between 2.64 and 3.36 (moderate), and opportunity feasibility is higher than 3.5 (high).

Table 3. Conditional probability Table of Intention given Attitudes, Self-Efficacy, and Opportunity Feasibility

| Intention | | | | | |
| --- | --- | --- | --- | --- | --- |
| Attitude | Self Efficacy | Opportunity Feasibility | 2.86 | ≤ 3.57 | >3.57 |
| ≤ 3.2 | ≤ 2.64 | ≤ 2.67 | 64.71 | 35.29 | 0.00 |
| ≤ 3.5 | 33.33 | 66.67 | 0.00 |
| >3.5 | 33.33 | 33.33 | 33.33 |
| ≤ 3.36 | ≤ 2.67 | 40.00 | 60.00 | 0.00 |
| ≤ 3.5 | 31.82 | 68.18 | 0.00 |
| >3.5 | 0.00 | 100.00 | 0.00 |
| >3.36 | ≤ 2.67 | 33.33 | 33.33 | 33.33 |
| ≤ 3.5 | 33.33 | 66.67 | 0.00 |
| >3.5 | 33.33 | 33.33 | 33.33 |
| ≤ 4 | ≤ 2.64 (1/3) | ≤ 2.67 | 33.33 | 66.67 | 0.00 |
| ≤ 3.5 | 23.08 | 73.08 | 3.85 |
| >3.5 | 0.00 | 100.00 | 0.00 |
| ≤ 3.36 (2/3) | ≤ 2.67 | 100.00 | 0.00 | 0.00 |
| ≤ 3.5 | 18.60 | 74.42 | 6.98 |
| >3.5 | 13.04 | 82.61 | 4.35 |
| >3.36 (3/3) | ≤ 2.67 | 33.33 | 33.33 | 33.33 |
| ≤ 3.5 | 7.69 | 76.92 | 15.38 |
| >3.5 | 5.88 | 58.82 | 35.29 |
| >4 | ≤ 2.64 | ≤ 2.67 | 83.33 | 16.67 | 0.00 |
| ≤ 3.5 | 26.67 | 66.67 | 6.67 |
| >3.5 | 0.00 | 66.67 | 33.33 |
| ≤ 3.36 | ≤ 2.67 | 33.33 | 33.33 | 33.33 |
| ≤ 3.5 | 9.09 | 54.55 | 36.36 |
| >3.5 | 8.70 | 30.43 | 60.87 |
| >3.36 | ≤ 2.67 | 33.33 | 33.33 | 33.33 |
| ≤ 3.5 | 6.25 | 37.50 | 56.25 |
| >3.5 | 0.00 | 15.22 | 84.78 |

To explore the impact of each variable in the BN model on entrepreneurial intentions, we ran a sensitivity analysis as shown in Table 4.

Table 4. Overall Analysis with Intention.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Node | Mutual Information | Relative Significance | Prior Mean Value | X2-test | P-value |
| Attitude | 0.118 | 1.000 | 3.832 | 53.178 | 0.000% |
| Opportunity Feasibility | 0.085 | 0.718 | 3.401 | 38.155 | 0.000% |
| Subjective Norms | 0.056 | 0.470 | 3.835 | 24.982 | 0.005% |
| Self Efficacy | 0.054 | 0.455 | 3.066 | 24.187 | 0.0073% |
| Family and friends support | 0.021 | 0.178 | 1.772 | 9.438 | 30.674% |
| Country Opportunity Feasibility | 0.009 | 0.077 | 3.864 | 4.082 | 39.504% |
| Perceived Risk | 0.003 | 0.028 | 2.970 | 1.492 | 82.812% |
| University Opportunity Feasibility | 0.002 | 0.018 | 3.526 | 0.936 | 91.930% |
| Obstacles | 0.001 | 0.006 | 3.256 | 0.323 | 98.826% |

Table 4 shows the nodes in descending order according to the information they bring to the knowledge of the target node Intention. Mutual information represent the amount of information brought by each node to Intentions, Relative Significance represents the ratio between the mutual information and the maximum mutual information value(0.118). Prior Mean value is the variables’ mean values. The independence X2-test is computed from the BN structure for each of its variable the target Intention. While the P-value represents the independence probability between each variable of the BN and Intentions as the target node.

We then set our target to High Intention with a desired average value above 3.57. Table 5 shows all statistics related to the estimation of the quality of the used learning method, K-fold is used for using different learning and testing sets in order to estimate the quality of the learning method and therefore the resulting BN.

Table 5. Evaluation of the Target Intention (Above 3.57)

|  |  |
| --- | --- |
| Target: Intention | |
| Value | High (>3.57) |
| Gini Index | 60.58% |
| Relative Gini Index | 82.48% |
| Lift Index | 2.063 |
| Relative Lift Index | 88.83% |
| ROC Index | 91.24% |
| Calibration Index | 43.35% |
| Binary Log-Loss | 0.320 |
| R | 0.688 |
| R2 | 0.473 |
| RMSE | 0.391 |
| NRMSE | 11.41% |
| Overall Precision | 71.60% |
| Mean Precision | 62.86% |
| Overall Reliability | 71.84% |
| Mean Reliability | 72.30% |

The relationship of all BN variables with the target Intention set to be above 3.57 (high intention) is given in Table 6.

Table 6. Local Analyzes with Target node set to High Intention

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Node | Mutual Information | Relative Significance | Mean Value | Max Bayes Factor | | | Min Bayes Factor | | |
| Attitude | 0.113 | 1.000 | 4.201 | **>4** | 76.24% | 1.843 | ≤ 3.2 | 5.95% | 0.344 |
| Self Efficacy | 0.053 | 0.471 | 3.327 | **>3.36** | 49.65% | 1.693 | ≤ 2.64 | 10.81% | 0.412 |
| Subjective Norms | 0.053 | 0.470 | 4.099 | **>4.14** | 48.85% | 1.721 | ≤ 3.29 | 6.99% | 0.365 |
| Opportunity Feasibility | 0.024 | 0.208 | 3.551 | **>3.5** | 54.21% | 1.417 | ≤ 2.67 | 7.08% | 0.675 |
| Family and friends support | 0.020 | 0.178 | 1.698 | Strongly Agree | 52.50% | 1.339 | Disagree | 2.50% | 0.477 |
| Country Opportunity Feasibility | 0.009 | 0.078 | 4.011 | **>4.2** | 38.08% | 1.272 | ≤ 3.2 | 18.79% | 0.742 |
| Perceived Risk | 0.003 | 0.027 | 2.988 | **>3.25** | 30.33% | 1.143 | ≤ 3.25 | 35.21% | 0.864 |
| University Opportunity Feasibility | 0.002 | 0.018 | 3.587 | **>3.73** | 43.29% | 1.113 | ≤ 2.6 | 7.50% | 0.838 |
| Obstacles | 0.001 | 0.006 | 3.273 | **>3.6** | 28.91% | 1.077 | ≤ 3.6 | 54.83% | 0.955 |

Tables 6 shows, in a descending order, the BN variables according to their relative contribution to high intention. Mutual Information is the amount of information that each variable brings to the knowledge of high intention. The Relative Significance represents the ratio between the mutual information and its maximum value. The mean value is the variables’ mean value while Bayes Factor represents the impact of observing Intention above 3.57 on the other variables. The posterior probability of the variables (probability of the variable conditional to high intention) that represents the Maximum Bayes Factor is highlighted in green, while the posterior probability of the variables that represents the Minimum Bayes Factor is highlighted in red.

The results from Tables 4 and 6 indicate that attitude, self-efficacy, subjective norms, and opportunity feasibility are the four most influential variables in the model. These variables are followed by family and friends support, country opportunity feasibility, and perceived risk that account for relatively important degree of influence whereas obstacles and university opportunity feasibility are the variables whose influence on entrepreneurial intention is lower as can be seen from Figure 3.

![A picture containing text, light, dark, night sky

Description automatically generated]()

Figure 3. Direct effects on High Intention (> 3.57)

Based on the BN model, when the high level of self-efficacy variable was set to 100% using ‘what–if’ analysis, intentions target (above 3.57) increased from 23.56% to 39.86%, while when the attitude variable was set to the highest level (above 4), intentions increased from 23.56% to 43.42%. Furthermore, when subjective-norms variable was set to the highest level (above 4.14), attitudes increased sharply from 41.36% to 91.30% while intention increased from 23.56% to 40.53%. Therefore, the most probable explanation for intentions to be above 3.57 is as follows: attitudes above> 4, self-efficacy between 2.64 and 3.36, opportunity feasibility above 3.5, obstacles > 3.6, subjective-norms above 4.14, perceived risk above 3.25, country opportunity feasibility above 4.2, and family and friends support set to strongly agree. This means that high intention requires high degrees of attitudes, subjective norms, country opportunity feasibility, obstacles, and perceived risk and family and friends’ support, and moderate degrees of self-efficacy.

We then used an optimization tool called target dynamic profile that is based on a greedy search algorithm that generates an ordered list of priorities leading towards achieving the optimization goal which is maximizing the mean value of entrepreneurial intentions. Results are shown on both Table 7 and Figure 4 below.

Table 7. Dynamic Profile Intention (above 3.57): Probability Maximization

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Node | Hypothesis  (H) | Posterior Probability  P(High Intention|H) | Marginal Likelihood P(H) | Likelihood  P(H| High Intention) | Bayes Factor BF(High Intention,H)\* |
| *A priori* |  | 23.5552% | 100.0000% |  |  |
| Attitude | >4 (high) | 43.4213% | 41.3580% | 76.2388% | 1.8434 |
| Self Efficacy | >3.36 (high) | 64.7651% | 12.1266% | 33.3421% | 2.7495 |
| Opportunity Feasibility | >3.5 (high) | 84.7826% | 4.6410% | 16.7046% | 3.5993 |

\*BF(High Intention,H)=P(High Intention|H)/P(High Intention)

Chart

Description automatically generated

Figure 4. Dynamic profile for High Intention (> 3.57)

The Target Dynamic Profile also allows as to see the mean value of the other nodes that are not directly connected to intention and, therefore, not directly included in the policy recommendation.

Table 8. Dynamic target profile: effect on other nodes.

|  |  |  |
| --- | --- | --- |
| Node | Prior Mean Value | Posterior Mean Value |
| Subjective Norms | 3.8349 | 4.0750 |
| Family and friends support | 1.7716 | 1.7716 |
| Country Opportunity Feasibility | 3.8642 | 3.8642 |
| University Opportunity Feasibility | 3.5263 | 3.5263 |
| Perceived Risk | 2.9699 | 2.9699 |
| Obstacles | 3.2559 | 3.2559 |

The column Prior Mean Value indicates the expected values of the variables *prior* to the optimization, while the posterior Mean Value reports the expected value of the variables *after* setting the evidence as per the policy recommendations. This information is useful to see the complete picture with regard to the optimum solution, including the nodes determined by the recommended policy, plus the other nodes. In our case, High Intentions can be achieved by High Attitudes, High Self-Efficacy, High Opportunity Feasibility, and also High Subjective Norms.

**Discussion**

The most important result of the study is that entrepreneurial intentions among Emirati youth, represented by the sampled group of Emirati students, is highly affected by attitudes towards entrepreneurship, self-efficacy, and opportunity feasibility. This latter, opportunity feasibility, was shown to affect intention directly in many other studies such as López *et al.* (2012), using BNs but also in studies using traditional methods of hypothesis testing such as Shapero & Sokol, 1982 and Krueger *et al.,* 2000. Additionally, our results agree with the emphasis on the opportunity feasibility of entrepreneurship (McMullen & Shepherd, 2006). Furthermore, our results are in agreement with the Theory of Planned Behavior (TPB) which claims that entrepreneurial intention is the product of attitudes towards entrepreneurship, subjective norms, and locus of control (Ajzen & Fishbein, 2005).

In our BN model, the Subjective Norms variable has a direct effect on attitudes and indirect effect on intentions through attitudes as mediator which support the findings of (Shapero & Sokol, 1982; Sampedro *et al.*, 2014). Knowing that subjective norms directly affect attitudes and indirectly affect intentions, with attitudes as a mediator, will help policy makers emphasize the factors that can improve someone’s subjective and social norms. In our study, we do not assume any hypothesis to build the model, and this result, similar to Sampedro *et al.*, 2014, was found directly by the BN model showing the strength of the BN framework from one side and validating the theory on the other side.

One of the strengths of our study is the inclusion of self-efficacy and attitudes towards entrepreneurship in the intention model, and to show that both have direct effects on intention. This result is different from the conclusion of Ruiz-Ruano & Puga (2019) in which attitudes have an influence on intentions which is mediated by self-efficacy. However, it is important to note that Ruiz-Ruano & Puga (2019) was done among an older group of university faculty compared to our sample of youth, which may explain the difference.

In our BN model, the attitudes variable has a direct relationship with intentions, a common result found in almost all traditional models such as TPB. The direct relationship between self-efficacy and intentions was also proposed by different models such as McMullen & Shepherd (2006), Sampedro *et al.* (2014), Heuer & Lian (2013), and Schlaegel & Koening (2014). Furthermore, no direct relationship was found between country opportunity feasibility and entrepreneurial intentions, but an indirect relationship which is mediated by attitudes; while in López *et al.* (2012), resource feasibility was a direct influencer of intentions. Also, obstacles and perceived risk were connected in our BN model, a common result in traditional methods, but in López *et al.* (2012), obstacles and perceived risk were found to be independent. We believe that they should be connected since the multiple risks faced by entrepreneurs and other obstacles may be magnified by same or similar factors.

The Family and Friends’ Support variable plays an important role in entrepreneurial intentions as indicated by our BN model. It directly affects subjective norms, and it indirectly affects attitudes and intention, a similar result to López *et al.* (2012). The results of the study showed that 48.5% of the students have one or both of their parents are entrepreneurs. 21% stated that their mothers are entrepreneurs. Furthermore, 70.7% of the participants agreed or strongly agreed about the important role of family and friends in supporting entrepreneurs.

Furthermore, university opportunity feasibility is a direct answer to country opportunity feasibility, which is a strong indication of the role of governments in fostering entrepreneurship, and therefore encouraging universities to do the same by strengthening their education programs and training. It is also worth mentioning here that there has been a surge in the number of Entrepreneurship Education programmes in most universities. The role of education in enhancing entrepreneurship attitudes and intentions and how Entrepreneurship Education programmes can be effectively embedded into the university curricula should be looked into in more details to enhance our knowledge and propose specific programs that help build future entrepreneurs. Moreover, improving attitudes and self-efficacy can be achieved through education. The role of early school experience and its impact on intentions and attitudes towards entrepreneurship is already shown in research (López *et al.*, 2012). Furthermore, in the last edition of the Global GUESSS Report 2021 (Sieger *et al.*, 2021), when authors looked at the influencing factors, they considered the university context. The average university entrepreneurial climate for the UAE was 4.7 on a scale of 1 to 7 (with a maximum of 5.8 and a minimum of 2.8). This is an indication that universities in the UAE should further improve their entrepreneurship programs and courses to create a better entrepreneurial spirit among students. The results of our study showed that only 25.3% of the students took a specialized course in entrepreneurship, only 19.8% assessed their ability to prepare a business plan to be above average, and only 12.7% assessed that their knowledge about market research technique to be above average. Accordingly, universities should change their entrepreneurship courses in all majors to include important skills required to succeed as an entrepreneur.

**Conclusion and policy implications**

Our study adds to the knowledge and understanding of entrepreneurial intentions and attitudes of Emirati students using an innovative BN framework. It helped us not only finding relationships among the different factors related to entrepreneurship, but also assess the effects of changes in these variables on intentions, a noted advantage of using BN instead of the traditional methods of hypothesis testing. This study is useful and needed for the development of new hypothesis related to factors that affect entrepreneurial intentions and attitudes, which can be tested in a predictive context.

Our model was the best from a statistical point of view but also confirms theoretical aspects as indicated in the existing research. In addition, with the help of BN framework we were able to present explicitly the relationships between intentions, attitudes and all other factors, and how intention changes with the change in those factors. These results can be used by professionals and academics while proposing entrepreneurship training and courses. It is important to include all aspects that improve self-efficacy and attitudes towards entrepreneurship. Universities in collaboration with the industry can have a leading role in improving opportunity feasibility. Higher education institutions must play a key role in developing entrepreneurial skills among their students through well-designed programs and tailored courses to answer their students’ requirements on specific topics related to entrepreneurial activities. Universities should act as facilitators and follow similar way of funding faculty research and provide or help students to secure funds to start their projects and of course pay-back to the community and the country by hiring other students. We also strongly encourage researchers in this field to increase their efforts to investigate the factors affecting entrepreneurial intentions and think outside the box as non-traditional businesses are nowadays the backbone of the economy.

The results can be also used by professionals as a tool in proposing new policies such as the need for country support and other means of improving attitudes, individual self-efficacy, and more opportunity feasibility. The BN model can be used to simulate the results of implementing such policies without the need of collecting new data.

Self-efficacy has an impact on entrepreneurial intentions which means that empowering youth with practical skills for preparing a business plan, running and financing a business, knowing the market research techniques and threats, having a good understanding of intellectual property, equity finance, and being alert to business opportunities and new ideas are of great importance to advance entrepreneurial intentions among Emirati youth. There is a variety of measures that help improve self-efficacy such as continuously offering training and entrepreneurship courses by experts. Furthermore, the collaboration between universities and industry will increase students’ exposure to business ideas and opportunities.

As subjective norms directly impact attitudes, which in turns impact intentions, policy makers should recognize and encourage entrepreneurs for their contribution to the national economy and also to job creation for Emiratis. Local and federal authorities can help frosting entrepreneurship intentions among students by implementing incentives to help newly and future entrepreneurs to reach their expectations while contributing to employment and the economy.

Since Family and Friends’ Support has a positive impact on Emirati youth subjective-norms, involving families and friends in programs designed at universities and other entrepreneurial youth hubs may help enhance youth attitudes towards entrepreneurship. The inclusion of families in strategies related to improving students’ entrepreneurial intentions will have a strong positive impact to direct the youth towards entrepreneurial activities rather than lining-up for jobs at the government sector.

Our study may have some limitations appearing from excluding other influential variables such as skills, motivations, and other relevant environmental, economic and policy factors such as GDP growth rate impact in terms of expectations and labor mobility in the UAE. However, we focused on the main factors that may have direct effects on intentions according to theory and left out the explorations of the effects of other factors, such as risk, innovation and motivation, to future studies on the topic. We also suggest looking at the role of training program by comparing the effect on entrepreneurial intentions before and after the training programs.

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Declarations

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**Conflicts of interest/Competing interests**

The authors of this work declare that there are no conflicts of interest regarding the publication of this paper.

**Availability of data and material**

The datasets analyzed during the current study are available from the corresponding author on reasonable request.

**Code availability**

Not applicable

**Authors' contributions**

LS wrote the first draft and performed the data analysis. MA provided guidance regarding the entrepreneurship indicators and the instruments used to assess them in addition to contributing to the discussion section, WA participated in the development of the questionnaire, commented on the first draft, and edited the manuscript. HA collected articles and questions to be included in the questionnaire and managed the data collection. FK commented on the first draft, edited the manuscript, and participated in the results section. All authors have read and approved the manuscript.

**Ethics approval**

The research and ethics committee of Zayed University approved this study (REC number: ZU20\_100\_F).

**Consent to participate**

Informed consent was obtained from all individual participants included in the study.

Consent for publication

Participants signed informed consent regarding publishing their data

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