DETECTING STUDENTS' ONLINE ENTREPRENEURIAL ACTIVITIES BY FUZZY STATISTICS

Dian-Fu Chang[1,*], Wen-Ching Chou[2] and Fong-Yee Nyeu[1]

[1]Graduate Institute of Educational Policy and Leadership
Tamkang University
No. 151, Yingzhuan Road, Tamsui District, New Taipei City 25137, Taiwan
*Corresponding author: 140626@mail.tku.edu.tw; fy.nyeu@gmail.com

[2]Department of Education Policy and Administration
National Chi Nan University
No. 1, University Road, Puli, Nantou County 545, Taiwan
julinchou@yahoo.com.tw

Abstract. *Reviewing the related literature, we found the phenomena of web businesses are the primary creators of innovation and new jobs. E-commerce has quickly become a preferred way for people to shop. This study aims to realize the students' entrepreneurial activities on web. We applied a self-designed fuzzy questionnaire to collect data. The fuzzy interval data were analyzed by using fuzzy mean, center, radius, and fuzzy distance. We considered the gender and majors to compare the group differences. The finding suggests that the students favored the entrepreneurial activities on web in terms of interpreting their intention and feasibility. While both intention and feasibility are at medium level in our fuzzy scale. The gaps between the online entrepreneurial intention and feasibility are small. This study suggests more institutional provisions are necessary in this field.*
Keywords: Online entrepreneurial activities, Entrepreneurship, Fuzzy statistics, Fuzzy distance

1. **Introduction.** With new technologies, we rely more and more on their productivities in life. For example, buying books and vehicles is using online shopping. Many companies are also jumping into the trend which might challenge the traditional commerce patterns. E-commerce has quickly become a preferred way for people to shop. According to a study commissioned by United Parcel Service Inc., seventy percent of more than 3,000 online shoppers surveyed that they prefer to shop their favorite retailer online [1]. Doing business in the Internet shop implies new business and new opportunities for new comers. Consequently, more people are engaged in this new battle for pursuing profits. It is also representing that this market is more competitive and more attractive. Under this circumstance, students are increasingly considered as an important part of on campus's entrepreneurial activities which contribute to the knowledge transfer to the market, while creating an e-commerce is not possible to promise the case will success.

1.1. **Online entrepreneurial activities.** Web businesses are one of the primary creators of innovation and new jobs. The impact of web startups on economic growth and job creation will further increase as the functionalities of Internet expand. We believe entrepreneurs are the key drivers of tomorrow's innovations and integral to creating a thriving economy. In response to this trend, the higher education has also shifted its attention towards using higher education as a means to promote social entrepreneurship. The higher education institutions are providing suitable foundation for the development and promotion of social entrepreneurship in the country. However, in this regard, Said et

al. found lack of financial support to higher education institutions for the development of social entrepreneurship. On the basis of their review, they recommend that there must be a strong political and financial support for the higher education institutions for the promotion of social entrepreneurship [2].

1.2. **Individual perception on entrepreneurship.** Stuetzer et al. find no direct link between regional knowledge creation, the economic context and an entrepreneurial culture on the one side and individual business start-up intention and start-up activity on the other side. However, the findings point to the importance of an indirect effect of regional characteristics as knowledge creation, the economic context and an entrepreneurial culture have an effect on the individual perception of founding opportunities, which in turn predicted start-up intention and activity [3]. The survey of 512 students at the MIT School of Engineering broadly confirms the model. Personality traits have a strong impact on the attitude towards self-employment. The entrepreneurial attitude is strongly linked with the intention to start a new venture. The students' personality, therefore, shows an indirect effect on intentions. Furthermore, the entrepreneurial intention is directly affected by perceived barriers and support factors in the entrepreneurship-related context. The findings have important implications for policy makers inside and outside universities [4]. Using 20,046 observations from the adult population survey (APS) collected according to the global entrepreneurship monitor (GEM) methodology, a logistic regression analysis controlling for robust interaction term is used to determine the direct and interaction effect of perceived entrepreneurial ability and actual ability in influencing the decision to initiate nascent entrepreneurial activities. The study finds evidence of a positive interaction effect suggesting that perceived entrepreneurial ability is a key determinant of entrepreneurial initiatives among those with high actual ability [5]. Although connections between university enterprise courses and entrepreneurial activity have been examined, less work has investigated the intended timing of future entrepreneurial activities [6]. Based on the notions of previous studies, we will focus on the entrepreneurial activities on web related to students' intention and their ability to engage.

In this study, we applied fuzzy questionnaire and fuzzy statistics to realizing how this phenomenon works in terms of students' perceptions on entrepreneurial activities on web. This is a different way to tackle the issues compared to the traditional method. For this purpose, this study addresses the following questions:

(1) How do we interpret the online entrepreneurial activities with fuzzy statistics?

(2) What are the differences between online entrepreneurial intention and feasibility?

(3) What are the differences of the intention and feasibility considered gender and majors in these online entrepreneurial activities?

(4) How many gaps are between the intention and feasibility among the online entrepreneurial activities?

2. **Method.**

2.1. **Research framework.** In this study, we applied self-designed fuzzy questionnaire to collect data. Fuzzy interval data were analyzed by using fuzzy mean, center, radius, and fuzzy distance. We considered their gender, students' major, and their social economic status (SES) to compare the group differences. The students' intention and their judgment of the feasible entrepreneurial activities on web were determined by fuzzy means and their distances. The research framework was presented as Figure 1.

2.2. **Data collection.** We designed a fuzzy questionnaire to collect data. Each item of the questionnaire was designed using a scale of 1 (minimum weight) to 7 (maximum weight) for collecting fuzzy interval data. For example, if N reviewer believed that weighting for item K is 4-6, the reviewer circles 4 and 6 on the scale. The fuzzy data transform
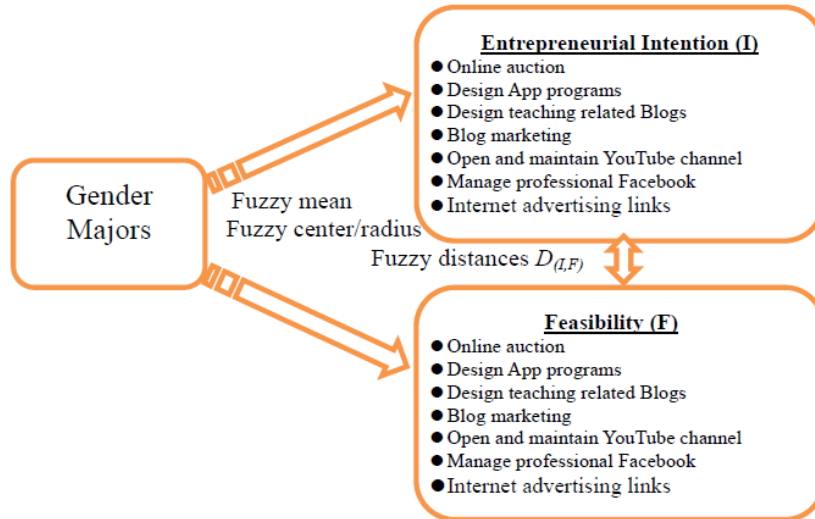
FIGURE 1. Research framework

FIGURE 2. An example of fuzzy questionnaire

was used to rank the property for the entrepreneurial activities. The example of the fuzzy questionnaire is listed as Figure 2.

In this study, we invited 1,500 students to join in this survey based on their voluntary participation in Taiwan. Considering students' gender and majors differences, the invited students have been classified into three groups in terms of humanities, social science, and technology roughly. Finally, we got 1,069 fuzzy questionnaires, which represents 71.27% valid return rate from 6 universities. Specifically, there are 544 females (50.89%), and 525 males (49.11%). Students with humanity major are 316 (29.50%), with social science are 324 (30.31%), and with technology are 429 (40.13%).

2.3. **Fuzzy statistics.** Interval fuzzy data can be defined as a well-distributed membership function with fuzzy numbers. The symbol of "[ ]" represents a closed interval. If $a, b \in R$ and $a < b$, $[a, b]$ is interval fuzzy number. We consider a is the lower bound of $[a, b]$ and b is the upper bound of $[a, b]$. If $a = b$, $[a, b] = [a, a] = [b, b] = a = b$, and a (or b) is a real number. Similarly, a real number k can be defined as $[k, k]$ [7,8].

If $[a, b]$ is an interval fuzzy set, $c_o = \frac{a+b}{2}$ and $s_o = \frac{b-a}{2}$, which represent the center and radius, respectively. In addition, an interval fuzzy number is expressed as follows:

$$[c_o; s_o] \Rightarrow [c_o + s_o, c_o - s_o] = [a, b].$$

The length of the interval data is $\ell = b - a$.

In this study, the center represents the point that might take the largest fuzzy membership function, and the radius is the variance of the fuzzy interval data.

Definition 2.1. *Let U be the universe of discourse. Let $\{\chi_i = (a, b, c), i = 1, 2, 3\}$ be three samples from U with center $C_i = \frac{a_i+b_i+c_i}{3}$, $h_i = 1$, and area $A_i = \frac{(c_i-a_i)*h_i}{2}$. The distance between the triangle samples χ_1 and χ_2 is defined as $\chi_1 \rightarrow [C_1, A_1]$ and $\chi_2 \rightarrow [C_2, A_2]$ [7,9]. Therefore,*

$$d(\chi_1, \chi_2) = |C_i - C_j| + \left| \frac{\ln(1 + |A_i|)}{|A_i|} - \frac{\ln(1 + |A_j|)}{|A_j|} \right|$$

TABLE 1. Intention and feasibility of online entrepreneurial activities perceived by students

| Online entrepreneurial activities	Intention			Feasibility		
	FM	Center	Radius	FM	Center	Radius
Online auction	[3.95, 5.47]	4.71	0.76	[4.20, 5.60]	4.90	0.70
Design App programs	[3.93, 5.36]	4.64	0.99	[4.00, 5.35]	4.67	0.67
Design teaching related Blogs	[3.64, 5.08]	4.36	0.72	[3.76, 5.12]	4.44	0.68
Blog marketing	[3.38, 4.80]	4.09	0.71	[3.55, 4.91]	4.23	0.68
Open and maintain YouTube channel	[3.91, 5.34]	4.62	0.72	[4.09, 5.44]	4.76	0.67
Manage professional Facebook	[4.10, 5.53]	**4.82**	0.72	[4.24, 5.61]	**4.93**	0.69
Internet advertising links	[3.37, 4.76]	4.07	0.70	[3.56, 4.90]	4.23	0.67
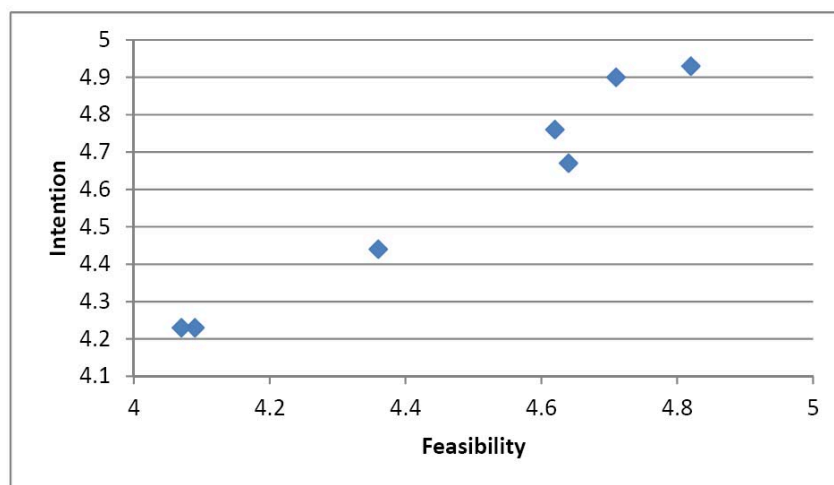
FIGURE 3. The distributions of intention and feasibility

The fuzzy distances represent the variation between the intention and feasibility of these online activities.

3. **Results.** Table 1 shows the results of students' fuzzy intention and feasibility of online entrepreneurial activities. The FM represents the fuzzy mean in both intention and feasibility of these activities perceived by 1,069 students. The centers of intention are less than 5 in our fuzzy scale. The centers of feasibility are also small, ranging from 4.23 to 4.93. Both intention and feasibility are weighted at medium level in this survey.

Considering the intention and feasibility of online entrepreneurial activities, this study demonstrates the distributions of intention and feasibility are located in 4 to 5 in our fuzzy scale, see Figure 3. Figure 3 also presents the moderate level of intention and feasibility in our survey.

Table 2 shows the gender differences in these online activities. Typically, both females and males are favored "managing professional Facebook" to attract their customers with $C = 4.78$ and $C = 4.89$ respectively. Following their intention, males are more wanted to engage in designing App programs ($C = 4.72$), while females are interested in online auction ($C = 4.78$). Considering the feasibility of these online activities, the results reveal their fuzzy means and centers are higher than that of intention.

Comparing the differences by students' majors, the results reveal that the students' intention and feasibility of the online activities are different in majors at humanities, social science and technology. Students with technological majors are tended to select designing APP programs and will consider the online auction is the most feasible activity. Table 3 displays that students major at humanity and social science are more preferred engaging in managing professional Facebook, while their intention and feasibility in doing

TABLE 2. Fuzzy intention and feasibility of online entrepreneurial activities compared by gender

Online entrepreneurial activities	Male				Female			
	Intention FM	C	Feasibility FM	C	Intention FM	C	Feasibility FM	C
Online auction	[3.88, 5.39]	4.64	[4.13, 5.60]	4.87	[4.02, 5.55]	4.78	[4.28, 5.68]	4.98
Design App programs	[4.09, 5.36]	4.72	[4.09, 5.35]	4.72	[3.77, 5.19]	4.48	[3.91, 5.26]	4.58
Design teaching related Blogs	[3.52, 5.08]	4.30	[3.64, 5.12]	4.38	[3.76, 5.18]	4.47	[3.88, 5.24]	4.56
Blog marketing	[3.29, 4.80]	4.05	[3.46, 4.91]	4.19	[3.46, 4.90]	4.18	[3.64, 4.97]	4.31
Manage YouTube program	[3.91, 5.34]	4.62	[4.07, 5.44]	4.76	[3.90, 5.31]	4.60	[4.10, 5.42]	4.76
Manage professional Facebook	[4.02, 5.53]	**4.78**	[4.15, 5.61]	**4.88**	[4.18, 5.60]	**4.89**	[4.33, 5.70]	**5.02**
Internet advertising links	[3.43, 4.76]	4.10	[3.54, 4.90]	4.22	[3.32, 4.69]	4.00	[3.58, 4.88]	4.23

TABLE 3. Fuzzy intention and feasibility of online entrepreneurial activities compared by majors

	Humanity				Social science				Technology			
	Intention FM	C	Feasibility FM	C	Intention FM	C	Feasibility FM	C	Intention FM	C	Feasibility FM	C
Online auction	[3.76, 5.38]	4.57	[4.10, 5.57]	4.83	[4.11, 5.63]	**4.87**	[4.27, 5.66]	4.97	[3.97, 5.43]	4.70	[4.23, 5.57]	**4.90**
Design App programs	[3.64, 5.11]	4.38	[3.79, 5.16]	4.48	[3.93, 5.36]	4.65	[3.97, 5.33]	4.65	[4.14, 5.54]	**4.84**	[4.17, 5.50]	4.84
Design teaching related Blogs	[3.59, 5.05]	4.32	[3.32, 4.80]	4.47	[3.73, 5.16]	4.45	[3.92, 5.27]	4.60	[3.60, 5.04]	4.32	[3.63, 4.98]	4.30
Blog marketing	[3.56, 4.91]	4.06	[3.56, 4.91]	4.23	[3.45, 4.88]	4.17	[3.69, 5.08]	4.39	[3.37, 4.74]	4.05	[3.45, 4.78]	4.12
Manage YouTube program	[3.89, 5.30]	4.60	[4.03, 5.42]	4.73	[3.82, 5.26]	4.54	[4.10, 5.42]	4.76	[3.98, 5.43]	4.70	[4.13, 5.46]	4.79
Manage professional Facebook	[4.15, 5.17]	**4.86**	[4.25, 5.60]	**4.93**	[4.09, 5.49]	4.79	[4.28, 5.70]	**4.99**	[4.08, 5.52]	4.80	[4.21, 5.55]	4.88
Internet advertising links	[3.25, 4.69]	3.97	[3.44, 4.80]	4.12	[3.47, 4.83]	4.15	[3.73, 5.01]	4.37	[3.39, 4.77]	4.08	[3.53, 4.87]	4.20

TABLE 4. The fuzzy distances between intention and feasibility analyzed by gender and major differences

Online entrepreneurial activities	Total	Male	Female	Humanity	Social Science	Technology
Online auction	0.17	0.22	0.18	0.25	0.08	0.19
Design App programs	0.02	0.0002	0.09	0.09	0.01	0.01
Design teaching related Blogs	0.07	0.07	0.09	0.13	0.16	0.03
Blogs marketing	0.14	0.13	0.11	0.15	0.22	0.07
Manage YouTube program	0.13	0.12	0.15	0.13	0.24	0.10
Manage professional Facebook	0.10	0.10	0.13	0.06	0.20	0.09
Internet advertising links	0.15	0.13	0.22	0.14	0.23	0.13

"Internet advertising links" are relatively low. This phenomenon is also various reflected by the students with technological majors.

According to the fuzzy distances, both intention and feasibility of online entrepreneurial activities are slight. It implies that the differences between intention and feasibility of the

online activities are very similar perceived by these students regarding their gender and majors. The details of fuzzy distances are presented in Table 4.

4. **Conclusions.** This study demonstrates the students' online entrepreneurial intention and feasibility with fuzzy statistics. The finding suggests that the students favored the online entrepreneurial activities in terms of their intention and feasibility. While both intention and feasibility are at medium level in our fuzzy scale. Considering the students' gender and majors, their intention and feasibility of online entrepreneurial activities have shown a little difference. The gaps between the entrepreneurial intention and feasibility on web are small. The finding contributes to the widely discussed phenomena by answering questions related to entrepreneurial activities on web. This study suggests more institutional provisions are necessary in this field. Although the students' intention of online entrepreneurial activities is weighted in conservative level, the higher educational institutes do need to enhance students' capability of risk management.

This study provides an example for higher education institutions to tackle the issue. For future study, we suggest more feasible items related to the online entrepreneurial activities needed to be developed. Specifically, a selected fuzzy questionnaire should consider the different settings may confront dissimilar issues.

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