

Measuring the Effectiveness of Entrepreneurship Education

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Abstract

This study explores a multi-dimensional model for measuring the effectiveness of entrepreneurship education. The proposed model was validated through an empirical study involving 298 college students who have participated in entrepreneurship courses in China. The research results show that the effectiveness of entrepreneurship education can be observed through the improvement of participants' entrepreneurial competencies, the reduction of their entrepreneurial barriers and the change of their entrepreneurial intention. On this basis, this study draws on the approach of the Triangulation widely used in qualitative research and develops a 'Triangle Measurement Model for the Entrepreneurship Education Effectiveness'. The Model provides an effective tool for the development and upgrading of entrepreneurship education courses, as well as a standard framework for cross-cultural or cross-regional comparative studies of entrepreneurship education.

1. Introduction and background

In the early days of entrepreneurship education, the effectiveness of entrepreneurship education was always questioned. Entrepreneurship is a special kind of social activity that has sometimes led to the doubts of scholars, educators, administrators, entrepreneurs, students and other groups on its effectiveness. Many theories and tools have been developed and become the cornerstone of current entrepreneurship education research. With the continuous development of entrepreneurship education, educators focus on the extent to which entrepreneurship education plays a role. Hence, the effectiveness of entrepreneurship education has remained as a hot topic attracting researchers.

The effect of entrepreneurship education on students from different perspectives with various tools and theories have been explored by a number of scholars. Many indicators are used by scholars to measure the effect of entrepreneurship education, such as entrepreneurial ability, skill, intention, attitude, satisfaction, motivation, etc. [1, 2]. Although any change in these indicators can reflect the role of entrepreneurship education, the

conclusions do not indicate how much role entrepreneurship education plays in the absence of selected indicators. No studies have shown that entrepreneurial success depends on just one or two key indicators. In contrast, the quantity and scale of multi-indicator or comprehensive studies on the effectiveness of entrepreneurship education are limited. In addition, the measuring tools or scales used to study the effectiveness of entrepreneurship education are also developed for specific research purposes, so their applicability under different conditions is limited. Research on entrepreneurship education also suffers from the lack of a unified framework when comparing the effectiveness of entrepreneurship education across universities, regions or cultures.

This paper puts forward a model for the multi-dimensional comprehensive measurement of the effectiveness of entrepreneurship education. Using the proposed model, educators can measure the effectiveness of entrepreneurship education courses and programs for their continuous improvement. In addition, the proposed model can provide a unified framework in which different forms of entrepreneurship education can be compared.

Before introducing the proposed model, we need to clarify the definitions of two concepts – entrepreneurship education and the effectiveness of entrepreneurship education – for framing the scope of this study. In this study, entrepreneurship education is referred to as an education (a course or the set of courses within an entrepreneurship program) for college students to develop their entrepreneurial mindset and competencies. Therefore, it is a specific type of education on the meso level, and it is currently being offered in many universities around the world. For example, entrepreneurship education refers to an Entrepreneurship Minor that is widely prevalent in American universities. An entrepreneurship course called entrepreneurship foundation is currently being widely practiced in universities in China is another example.

As a form of education, a social practice of transforming people, entrepreneurship education will inevitably affect the participants. We define this positive impact as the effectiveness of

entrepreneurship education. There are also many levels and perspectives to measure the effectiveness of education, and researchers use various terms such as impact, effect, result and role when they describe the effectiveness of entrepreneurship education in the literature [1, 3]. For over three decades, Kirkpatrick's framework for evaluating the effectiveness of education has been the reference for most studies [1]. Kirkpatrick's framework includes four hierarchical levels, each based on the previous level. The first level is *Reflection*, which presents the overall impression and satisfaction of the participants on all aspects of education, including scheduling, teachers, and topics. The second level is *Learning*, which measures the changes in participants' abilities, skills, and attitudes. The third level is called *Behavior*, which mainly examines whether the educational content is transformed into the behavior of the participants as manifested in their life and work. The final level is *Results*, which primarily assesses the relationship between changes in participant behavior and activity, performance, or productivity. In literature, most of the research is concentrated on the first two levels. This study focusses on the changes in entrepreneurial competencies, barriers and intention, that is, the measurement of learning. The use of these three indicators together to measure the effectiveness of entrepreneurship education is also one of the contributions of this study.

During the fast expansion of college level entrepreneurship education in the 1980s and 1990s, it was suggested to assess the impact of entrepreneurship education based on the number of businesses established by the participants or the number of jobs created. Typical cases such as Garavan and O'Connell [4] evaluated the effectiveness of the five entrepreneurship courses through the number of jobs created. According to their results, 755 participants created 2,665 jobs. They also used cost-benefit-calculation to find the cost per additional job. At the beginning of the new century, the method to evaluate the effectiveness of entrepreneurial education by the number of startup companies or job creation has been severely criticized at the macroeconomic level [5]. Because the effect of entrepreneurship education has a certain lag, the number of startups or the number of jobs created can only be measured after a few years, which is obviously not suitable for short-term improvement of entrepreneurship education [6]. Therefore, recent researchers have started paying more attention to participants themselves in the process of assessing the

effectiveness of entrepreneurial education. Especially, entrepreneurial competencies, barriers, and intention are the three most widely used indicators to measure the effectiveness of entrepreneurship education [2, 5, 7].

Entrepreneurial competencies can be identified as a specific group of competencies relevant to the exercise of successful entrepreneurship [8]. Gumusay and Bohne [9] collated and summarized the literature on entrepreneurial competencies. Based on their research, the main entrepreneurial competencies can be divided into five categories in the most widely cited literature. *Opportunity competencies* [10, 11] are related to the ability of entrepreneurs to search, create, develop and evaluate high-quality opportunities that are available in the market. *Relationship competencies* [8, 11] indicate the ability to deal with various relationships in entrepreneurship, of which leadership and management are important. *Innovating competencies* is the most frequently researched topic of all entrepreneurial competencies research, and it can be defined as one of the core competencies of entrepreneurship [12]. *Sponsoring competencies* [13] refers to sponsors helping entrepreneurs get the resources they need for their business [14], including but not limited to funds, places, and intellectual property. *Other competencies*, such as political competencies [10], strategic competencies [11], championing competencies [13, 15], conceptual competencies [11], flexibility competencies [16], and so on. Currently, the most widely used method to measure entrepreneurial competencies is based on the competency framework which is followed in the development of entrepreneurship education programs [10, 12].

Some studies have shown that barriers have a negative impact on entrepreneurial behavior [1]. In the literature, entrepreneurial barriers mainly include: *i*) lack of support, such as lack of available assistance in assessing business viability [7], lack of legal assistance or counseling [17], lack of formal help to start a business [18], lack of support from friends and family [19]; *ii*) lack of knowledge and experience, such as lack of experience in management or accounting [17], lack of knowledge of the business market [20]; *iii*) lack of self-confidence and willingness to take risks, such as fear of failure [18], irregular income [21], having to work too many hours [20], doubts about personal abilities [7]; *iv*) lack of resources, such as lack of start-up funding and venues [17], lack of employees [22]. Entrepreneurial barriers also include

economic development fiscal policies [23].

Entrepreneurship intention can be defined as a conscious state of mind that directs attention, experience, and action toward a specific goal or path to that goal [24]. Entrepreneurship intention is another widely used indicator to measure and evaluate entrepreneurship education [1] and it is also treated as a key antecedent of venture creation in the literature [3]. Many factors may cause changes in entrepreneurial intention. Early research on the measurement of entrepreneurial intention focused on personal characteristics, such as self-confidence [25, 26], risk-taking [25, 27], achievement motivation [28, 29], family background [30], age and gender [31]. When some studies show that these variables are not closely related to entrepreneurial intention [32], the research on entrepreneurial intention has been broader and more diversified. In recent years, research on activities that may exert influence to change entrepreneurial intention is gaining more and more attention because such research results are more realistic and operative. Among them, entrepreneurship education, as one of the effective intervention methods, has quickly become an important focus of entrepreneurial intention research [33-35]. Therefore, how to scientifically measure entrepreneurial intention, especially for entrepreneurship education, is particularly important. For example, Bhaskar and Garimella used 6-items to measure entrepreneurial intention [36]. Some others measured entrepreneurial intention through a Likert-type scale with 5-items [30, 37]. Saeed et al. used a combination of 2-items and a categorical indicator to measure entrepreneurial intention [38].

2. Proposed measurement model

Based on the results of literature research, this study proposes the following three hypotheses to measure the effectiveness of entrepreneurship education:

H1: *Entrepreneurship education can improve the participants' entrepreneurial competencies.*

H2: *Entrepreneurship education can reduce the participants' entrepreneurial barriers.*

H3: *Entrepreneurship education can change the participants' entrepreneurial intention.*

According to these three hypotheses, we constructed a measurement model for the effectiveness of entrepreneurship education as shown in Figure 1. Since the three indicators in the model measure the effectiveness of

entrepreneurship education from three different perspectives, the model could be named 'Triangle Measurement Model for the Entrepreneurship Education Effectiveness' (TMM).

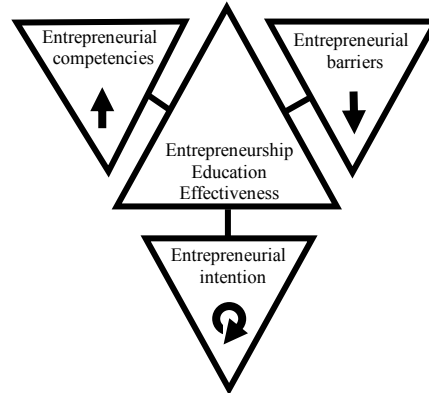


Figure 1. TMM for the entrepreneurship education effectiveness

3. Method

We developed a scale for measuring the effectiveness of entrepreneurship education across the proposed model's three indicators. In the literature, the studies of these three constructs are relatively independent. Therefore, independent and widely used scales were combined to form a unified framework by this study.

3.1 Scale design

In terms of the selection of entrepreneurial competencies subscale, this study used the Entrepreneurial Competencies Measurement Scale for College Students developed by Yang [39]. Yang's scale has been applied to Chinese college students, which is similar to the target population of this study. Yang's scale is composed of six factors, namely Innovation and creativity (4-items), Leadership and management (3-items), Opportunity identification (4-items), Strategic decision-making (3-items), Resource acquisition (4-items), and Pressure bearing (4-items). A total of 22 items operationalized on a 5-point Likert scale ranging from 1 (Strongly disagree) to 5 (Strongly agree).

The entrepreneurial barriers questionnaire designed by Karhunen for Russian students [21] was selected as the source of the entrepreneurial barriers subscale in this study. We fine-tuned Karhunen's questionnaire to obtain the subscale of entrepreneurship barriers in this study (for example, changing 'Russian tax' in the original questionnaire

to 'tax'). The entrepreneurship barriers subscale was composed of 5 factors, including Lack of support (6-items), Lack of knowledge (2-items), Lack of competencies (4-items), Lack of self-confidence (4-items), and Risk aversion (3-items). A total of 19 items operated on the five-point Likert scale, ranging from 1 (Very unimportant) to 5 (Very important).

Thompson's Individual Entrepreneurial Intent Scale [40] was selected as the subscale of entrepreneurial intention in this study. Thompson's scale was based on a summary of studies on entrepreneurial intention over the past 20 years and had good international applicability. Thomas's scale consists of 10 items that were operationalized on a 6-point Likert scale ranging from 1 (Very untrue) to 6 (Very true).

3.2 Sample selection and data collection

The participants were 406 college students from China who had taken a semester-long comprehensive entrepreneurship education program called 'the foundation of entrepreneurship'. This program is the most popular and extensive entrepreneurship program offered for Chinese college students. The standards of this program are formulated by the China Education Ministry Higher Education Entrepreneurship Education Steering Committee.

The Qualtrics online survey system was used to collect data in class settings. At the beginning of each survey, the professors in the class explained to the students in detail the purpose of the survey and the importance of response with a free willingness of the participants. After data cleaning, a total of 298 participants completed all the items and met the requirements of this study. Overall, more of the participants were Female, 55.03%. In terms of class standing, sophomore, freshman and junior year were the main part of the sample, their proportion is 34.23%, 26.85%, and 26.17%, respectively. In terms of the academic majors of the participants, the business had the highest proportion (40.94%) followed by social sciences (31.21%) and engineering (27.85%).

3.3 Analysis

SPSS25 and AMOS25 were used to analyze the collected data. Statistical analyses first focused on establishing reliability and validity of these three subscales. Since the proposed model does not describe the relationship between the three main

measured indicators, the confirmatory factor analysis of each subscale was performed independently. Table 1 presents the fit indices of the three subscales, which indicated that the sampled data fitted the measurement models of the subscales.

Table 1. Fit indices of the three subscales (n=298)

Subscale	χ^2/df	GFI	NFI	IFI	CFI	RMSEA
EC	1.106	0.938	0.941	0.992	0.992	0.019
EB	1.141	0.945	0.957	0.994	0.994	0.022
EI	1.117	0.988	0.987	0.997	0.997	0.020
BV	<3	>0.90	>0.90	>0.90	>0.95	<0.05

EC: Entrepreneurial competencies, EB: Entrepreneurial barriers; EI: Entrepreneurial intention; BV: Benchmark Value

We also analyzed the standardized factor loadings for all items and computed the internal consistency metrics such as Composite Reliability (CR), Average Variance Extracted (AVE) and Cronbach's α for six factors (latent variables) of the entrepreneurial competencies subscale (see Table 2). The standardized factor loadings of all items, which are not provided due to the brevity of presentation, were greater than 0.7 and significant at a level of 0.001. All internal consistency coefficients (Cronbach's α) being greater than 0.7 and CR values greater than 0.6 indicated good internal consistency of the six factors. In addition, the AVE values of all factors were greater than 0.5, indicating the convergent validity of the factors.

Table 2. Composite Reliability (CR), Average Variance Extracted (AVE) and Cronbach's α for the entrepreneurial competencies subscale (n=298)

	CR	AVE	Cronbach's α
Innovation and creativity	0.865	0.618	0.862
Leadership and management	0.818	0.602	0.814
Opportunity identification	0.869	0.624	0.867
Strategic decision-making	0.809	0.586	0.814
Resource acquisition	0.880	0.649	0.878
Pressure bearing	0.856	0.602	0.854

We also studied the discriminant validity of the entrepreneurial competencies subscale. The correlation coefficients of the six factors of the entrepreneurial competencies subscale were smaller than the square roots of their corresponding AVE values. For example, the maximum correlation among the six factors of the entrepreneurial competencies subscale was 0.621 between Leadership/Management and Opportunity Identification, which was smaller than the square

root of the minimum AVE value in Table 2 (i.e., 0.775). Therefore, we could state that the subscale had good discriminant validity.

The statistical reliability and validity of the entrepreneurial barriers subscale were also analyzed in the same way. Table 3 shows CR, AVE and Cronbach's α values of the five factors of this subscale. All factor loadings were greater than 0.7 and significant at a level of 0.001. The results indicated the high internal consistency and convergent validity of the subscale. Moreover, the discriminant validity of these five factors was also very good based on the analysis of their square roots of AVE and the correlation matrix. The maximum correlation was between the factors Lack of Knowledge and Lack of Competencies with 0.587. The squared root of the minimum AVE value was much larger than 0.795. Therefore, the entrepreneurial barriers subscale also had good discriminant validity.

Table 3. Standardized factor loadings (λ), composite reliability (CR), average variance extracted (AVE) and Cronbach's α for the entrepreneurial barriers subscale (n=298)

	CR	AVE	Cronbach's α
Lack of support	0.916	0.649	0.915
Lack of knowledge	0.882	0.791	0.883
Lack of competencies	0.936	0.784	0.936
Lack of self confidence	0.913	0.729	0.913
Risk aversion	0.839	0.637	0.836

Unlike the above two subscales with multiple factors, the entrepreneurial intention subscale consists of six items (directly measured variables).

Therefore, this study did not analyze its discriminant validity. However, analysis of its factor loadings, CR=0.883, AVE=0.562, and Cronbach's α =0.883 also indicated that the data fitted the measurement model very well. Again, all factor loadings were greater than 0.7 and significant at a level of 0.001 for this subscale.

4. Results

To complete the verification of our research hypotheses embodied in the TMM, we included a question in the questionnaire -- how many entrepreneurship education courses have you attended? Participants were divided into three groups based on their responses to 'once', 'twice' and 'three times or more'. These three groups of participants represent groups participating in entrepreneurship education at different degrees. We can analyze their differences in entrepreneurial competencies, barriers and intention to verify the hypotheses of the proposed model. This control variable is referred to as the number of times attended entrepreneurship education (NTAEE) hereinafter. The effect of the NTAEE on the three indicators of the model was investigated using ANOVA as shown in Table 4. The results showed that the NTAEE had a significant effect on participants' entrepreneurial competencies and barriers at the level of 0.001, and on their entrepreneurial intention at the level of 0.05. The effect of NTAEE as an independent variable on the entrepreneurial competencies, barrier and intention was consistent with the hypotheses of this study.

Table 4. Differences in entrepreneurial competencies, barriers and intention on NTAEE

	Once (n=106)		Twice (n=160)		Three times or more (n=32)		F	η^2
	Mean	SD	Mean	SD	Mean	SD		
Entrepreneurial competencies	3.040	0.286	3.951	0.480	3.976	0.425	174.031***	0.529
Innovation and creativity	2.994	0.575	3.940	0.683	3.913	0.644	75.395***	0.333
Leadership and management	3.129	0.601	4.029	0.651	4.041	0.648	72.121***	0.320
Opportunity identification	3.015	0.609	3.941	0.656	4.031	0.560	79.775***	0.344
Strategic decision-making	3.121	0.583	3.954	0.731	3.982	0.787	52.153***	0.253
Resource acquisition	3.051	0.579	3.938	0.731	4.124	0.737	65.912***	0.301
Pressure bearing	2.963	0.637	3.929	0.652	3.791	0.745	73.251***	0.323
Entrepreneurial barriers	3.078	0.354	2.894	0.430	2.151	0.512	65.973***	0.303
Lack of support	2.880	0.511	2.849	0.659	1.932	0.661	35.977***	0.190
Lack of knowledge	3.054	0.673	2.693	0.715	1.885	0.930	34.303***	0.185
Lack of competencies	3.108	0.697	2.664	0.724	1.966	0.955	33.123***	0.179
Lack of self confidence	3.017	0.523	2.869	0.643	2.213	0.704	22.828***	0.131
Risk aversion	3.533	0.675	3.451	0.685	2.942	0.731	10.050***	0.063
Entrepreneurial intention	3.386	1.309	3.632	1.429	4.161	1.277	4.286*	0.026

* $p < 0.05$, *** $p < 0.001$

In terms of entrepreneurial competencies, there was a significant difference among the three groups of participants with respect to the variable NTAEE. There were significant differences in the six factors of the entrepreneurial competencies subscale among the three groups at a level of 0.001. In addition, η^2 was 0.529, indicating a large effect. This result showed that the overall entrepreneurial ability of participants improved with their increasing exposure to the entrepreneurship courses. Thus, **H1** 'entrepreneurship education can improve the participants' entrepreneurial competencies' is supported.

Similarly, the three NTAEE groups of participants also showed significant differences in the entrepreneurial barriers, but in opposite directions. There were significant differences in the five factors of entrepreneurial barriers among the three groups at the level of 0.001. Overall, the effect size of entrepreneurship barriers was large ($\eta^2=0.303$). Among the five factors of the entrepreneurial barriers subscale, the risk aversion had a small effect size ($\eta^2=0.063$). While the effect sizes of other factors were between medium and large. Consistently, despite differences in the mean of the five factors, participants who attended more entrepreneurship courses were less likely than the other group to perceive the entrepreneurial barriers. It showed that the effectiveness of entrepreneurship education can be reflected in the degree to which participants perceive the entrepreneurial barriers. Therefore, **H2** 'entrepreneurship education can reduce the participants' entrepreneurial barriers' is supported.

The entrepreneurial intention, as an indicator closely related to entrepreneurial behavior, was also significantly different among the three NTAEE groups. The mean of participants who attended the entrepreneurship course once was 3.386, twice was 3.632 and three times or more was 4.16. These mean differences were significant at a level of 0.05 but with a small effect size ($\eta^2=0.026$). The uniqueness of entrepreneurial intention will be discussed in detail later in this study. However, **H3** 'Entrepreneurship education can change the participants' entrepreneurial intentions' is also accepted.

5. Discussions

Among the three indicators of the TMM model, the direction of a possible change in entrepreneurial competencies and entrepreneurial barriers is straightforward to explain because effective

entrepreneurship education may improve the entrepreneurial competencies and reduce the entrepreneurship barriers of participants, which is consistent with the common view and most research conclusions. However, the direction of transformation in entrepreneurial intention requires more attention because we describe entrepreneurial intention in terms of 'change' rather than 'increase' or 'reduce'. In addition, the process through which entrepreneurship education affects participants' entrepreneurial intentions is more complex. Contrary to the research conclusions of most scholars, several researchers also showed that the positive effect of entrepreneurship education on entrepreneurial intention is not obvious [1, 41, 42]. Some scholars use entrepreneurship education as a mediating variable to explain this situation [43]. Some scholars believe that entrepreneurship education and other factors, such as self-efficacy [44, 45], cultural background [46], entrepreneurship cognition [47], and entrepreneurship role models [3], work together to influence entrepreneurial intentions.

In this study, we realized that some of participants' entrepreneurial intention was reduced. On one hand, we believe that clarifying participants' wrong perceptions of entrepreneurship through entrepreneurship courses is also valuable for education because it prevents participants' impulsive and irrational entrepreneurial behaviors. On the other hand, the increase and decrease of entrepreneurial intention among the participants partially offset each other, which may be one of the reasons that the mean difference among the three groups of entrepreneurs' entrepreneurial intentions is less than the entrepreneurial competencies and entrepreneurial barriers. Although the entrepreneurial intention was measured on a six-point scale, which in theory should have made the difference between groups greater, the other two were measured on a five-point scale. Similarly, it is one of the reasons for the small effect size of entrepreneurial intention in this study. Based on the above two considerations, this study uses the 'change' of entrepreneurial intention to express the effectiveness of entrepreneurship education. We believe that it is more accurate to analyze the data using the absolute value of the change in entrepreneurial intention rather than the average. Therefore, this point is one of the limitations of this study, which is also a future research topic.

Another important aspect of the TMM is the relationship among the three indicators. In fact, most of the research on the entrepreneurship

education revolves around entrepreneurial competencies, barriers and intention, but only a few have also explored their relationship [35, 43, 48]. What needs to be emphasized in this study is that the measurement model we developed pays more attention to the differences among the three indicators rather than the connections among them. Some studies aim to find out the mechanism between entrepreneurship education and some related elements. Whether it is factor analysis or regression equation, the application of research methods is to simplify the complex problems and explain the relationship between them with the simplest model by discarding some so-called minor components. We classify such research as

‘subtraction’. Different from them, the purpose of this study is to comprehensively measure the effectiveness of entrepreneurship education. For this purpose, we are more inclined to do ‘addition’, that is, to measure the same concepts with as many independent indicators as possible, to more realistically reflect different aspects of the measured concepts. The so-called minor components discarded in the previous type of research are likely to be a special manifestation of the effectiveness of entrepreneurship education and play a vital role in improving and improving education. Table 5 shows the Pearson correlation coefficients for all variables in this study.

Table 5. Mean, SD, and correlation coefficients for each variable (n = 298)

	Mean	SD	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1) Entrepreneurial competencies	3.631	0.605	1.000													
2) Innovation and creativity	3.601	0.784	.786**	1.000												
3) Leadership and management	3.713	0.765	.725**	.507**	1.000											
4) Opportunity identification	3.623	0.774	.788**	.537**	.512**	1.000										
5) Strategic decision-making	3.662	0.798	.733**	.511**	.475**	.489**	1.000									
6) Resource acquisition	3.644	0.813	.775**	.494**	.495**	.520**	.499**	1.000								
7) Pressure bearing	3.572	0.799	.768**	.522**	.444**	.522**	.479**	.491**	1.000							
8) Entrepreneurial barriers	2.873	0.495	-.190**	-.121*	-.134*	-.178**	-.199**	-.151**	-.101	1.000						
9) Lack of support	2.755	0.676	0.022	0.018	-0.001	-0.003	-0.006	0.067	0.015	.772**	1.000					
10) Lack of knowledge	2.727	0.803	-.248**	-.168**	-.150**	-.199**	-.265**	-.200**	-.163**	.687**	.450**	1.000				
11) Lack of competencies	2.739	0.818	-.414**	-.281**	-.309**	-.351**	-.388**	-.337**	-.251**	.734**	.327**	.531**	1.000			
12) Lack of self confidence	2.845	0.654	-0.002	0.033	0.015	-0.058	-0.059	-0.014	0.066	.719**	.422**	.383**	.427**	1.000		
13) Risk aversion	3.421	0.707	-0.058	-0.049	-0.022	-0.019	0.000	-0.108	-0.048	.422**	.145*	.136*	.159**	.199**	1.000	
14) Entrepreneurial intention	3.605	1.384	0.088	0.021	.131*	.112*	.130*	0.103	-0.059	-.139*	-0.080	-0.065	-.154**	-.130*	-0.016	1.000

* $p < 0.05$, ** $p < 0.01$ (two tailed), the number of 1–14 at the first row represent the variables in the first column respectively

It can be concluded that entrepreneurial barriers are related to entrepreneurial competencies and intention, but there is no significant correlation between entrepreneurial competencies and intention. In addition, even if entrepreneurship competencies and entrepreneurial barriers are related in general, the factors of ‘Lack of support’, ‘Lack of self-confidence’ and ‘Risk aversion’ in entrepreneurial barriers have not shown significant correlation with entrepreneurial competencies. This is one of the principles that this study follows when selecting subscales, based on the intrinsic requirements of the TMM. This requirement comes from the theoretical basis of the construction of the models, namely the Triangulation approach widely used in qualitative research to ensure validity. Triangulation approach means using more than one method to collect data on the same topic. However, the purpose of triangulation is not necessarily to cross-validate data but rather to capture different dimensions of the same phenomenon [49]. Entrepreneurial competencies, barriers, and intention are three different

dimensions reflecting the effectiveness of entrepreneurial education. Based on this, we would like to see them independent of each other. Of course, due to the complexity of educational phenomena, their complete independence is difficult to achieve, as shown in this study. However, at least mutual independence is one of the principles to be followed in the selection of subscales under the framework of the TMM. Another way to think about the value of independence is that if there is a strong positive or negative correlation among the three indicators, why don't we use a single indicator to measure the effectiveness of entrepreneurship education? This way of thinking is certainly against the original intention of this study. Specifically, the subscales should be relatively independent of each other, and there should be no significant statistical correlation. In fact, one of the factors in the entrepreneurship barrier subscale is ‘Lack of Competencies’, which is contrary to the independence principle with the entrepreneurial competencies subscale. It can be easily concluded from the correlation analysis of

variables (see Table 5) that the Pearson correlation coefficient between ‘Lack of Competencies’ and ‘Entrepreneurial Competencies’ is -0.414, which is significantly correlated at the level of 0.01 and can't be ignored. This is one of the limitations of this study and the direction of future improvement.

Furthermore, entrepreneurial competencies, barriers, and intention are three separate assumptions under the TMM. Under the TMM, we can divide the measured entrepreneurship education into several different types according to the different presentation of the three indicators. We define entrepreneurship, barriers and intentions as three axes starting from the same starting point. The measured entrepreneurship program results of the three indicators are taken as the point on the axis, the value from the common starting point is the minimum, and the value from the point farther away is the larger. By connecting three points on three axes, we get a triangle as shown in Figure 2. If the corners of the triangle are on the entrepreneurial competencies axis (the triangle is biased to the left and connected by the dotted line), we call this entrepreneurial education a Competency-driven type, for example, a formal entrepreneurship education course offered by the university. These courses are based on the student competency structure model to design teaching content and modules, focusing on common knowledge with the popularization of entrepreneurship. If the corners of the triangle are on the axis of entrepreneurial barriers (the triangle is biased to the right and connected by the dashed line), we call this kind of entrepreneurship education Problem-driven, for example, a series of lectures or workshops on the topic of entrepreneurship clubs, incubators, and create space. This type of education aims to solve a specific problem in entrepreneurship, with a focus on meeting the individual needs of entrepreneurs. If the corners of the triangle are on the axis of entrepreneurial intention (the triangle is biased to the top and connected by the solid line), this kind of entrepreneurship education can be called Career-driven, for example, a course that combines career planning and entrepreneurship education widely established in Chinese universities. These courses focus on the enlightenment and awakening of entrepreneurship.

Of course, some entrepreneurial program may have outstanding performance on two or three indicators, they can be called versatile or comprehensive education. The purpose of discussing the classification of entrepreneurship education is to illustrate that the TMM constructed

in this study has a broad spectrum of applicability, and common types of entrepreneurship education are included.

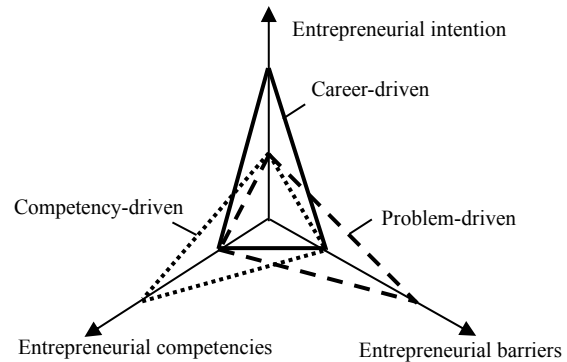


Figure 2. Triangle analysis of entrepreneurship education type based on TMM

6. Conclusion

The purpose of this study is to develop a scientific and comprehensive measurement model for the effectiveness of entrepreneurship education. Based on the literature review and data analysis, the following main conclusions are drawn:

The effectiveness of entrepreneurship education can be measured by the improvement of participants' entrepreneurial competencies, the reduction of entrepreneurial barriers and the change of entrepreneurial intention. On the theoretical basis of Triangulation, the TMM of the effectiveness of entrepreneurship education constructed with these three indicators in different directions in a relatively comprehensive and scientific way can measure Competency-driven, Problem-driven, Career-driven, versatile and comprehensive entrepreneurship programs. The model developed in this study provides entrepreneurial educators with powerful curriculum development and improvement tools and also provides a standard framework for entrepreneurial education researchers to achieve cross-cultural or cross-regional comparative research.

This is the first time that entrepreneurial competencies, barriers and intention have been used together to measure the effectiveness of entrepreneurship education program. On this basis, the establishment of the TMM of the effectiveness of entrepreneurship education is the biggest contribution of this paper. Future research will be carried out in the relationship between the three indicators. Especially based on relationship analysis, further adjustment and refinement of the scale selection strategy are more valuable.

7. References

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