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## Competency Model: A Study on the Cultivation of College Students' Innovation and Entrepreneurship Ability

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### Abstract

**Objectives:** This study was designed to analyze entrepreneurial competency and enhance college students' abilities in innovation and entrepreneurship. **Methods:** Ten relevant factors were summarized based on the interview records. Relevant data were collected through questionnaires and tested for reliability and validity. The effectiveness of the ten factors on entrepreneurial competency was tested using the regression analysis method. Then, an analytic hierarchy process model of entrepreneurial competency was established to calculate the relevant weights. **Findings:** The data collected from the survey questionnaire had sufficient reliability and validity. The ten relevant factors were effective in developing entrepreneurial competence. The weight distribution in the analytic hierarchy model indicated that entrepreneurial knowledge was most important, followed by entrepreneurial ability, and intrinsic potential was least significant. **Novelty:** The novelty of this article lies in not only verifying the effectiveness of relevant factors through regression analysis but also further analyzing the weight of these factors through an analytic hierarchy process.

**Keywords:** Competency; Entrepreneurship; Analytic Hierarchy Process Model; Regression Analysis.

## 1. Introduction

College students are a crucial component in social development, but with the development of the economy and society, the number of college students increases rapidly [1]. While this increase provides more talent reserves for societal progress, the job market is unable to provide suitable employment opportunities for a substantial number of recent graduates within a short timeframe due to its limited scale. Consequently, entrepreneurship has emerged as an alternative pathway for graduates to secure jobs. Successful entrepreneurial endeavors not only provide entrepreneurs with suitable jobs but also generate employment opportunities for other college students [2].

However, in a competitive market, entrepreneurship poses a formidable challenge. Given that college students devote most of their time to academic pursuits, they often lack practical experience in entrepreneurial endeavors. In order to improve the likelihood of success in entrepreneurship, colleges should not solely focus on imparting professional knowledge to college students. Entrepreneurial competency represents the proactive drive exhibited by college students during business ventures; the stronger this competency is, the more effective problem-solving abilities are in the entrepreneurial process, leading to a higher likelihood of success in entrepreneurship [3]. Hu [4] analyzed the composition, current status, and problems pertaining to the competencies of innovative teachers in Hebei province at both theoretical and empirical levels.

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Additionally, they proposed countermeasures and recommendations aimed at enhancing teachers' competitiveness. Vías et al. [5] proposed a novel framework for designing business education courses that integrates behavioral competencies with business skills. By incorporating experiential learning, this comprehensive framework equips students with the essential tools to excel in their professional endeavors and actively contribute to the economic and social advancement of diverse communities. Pranowo et al. [6] analyzed the impact of entrepreneurial competency and innovation competency on business success in the Indonesian footwear industry and tested these hypotheses through structural equation modeling. The results of hypothesis testing proved that entrepreneurial competencies affected innovation competencies. Bazyl et al. [7] proposed a scheme for modularized courses, which introduces future designers to entrepreneurship skills and provides practical examples of business plans and projects. Sergeeva et al. [8] emphasized the necessity of cultivating entrepreneurial abilities among university students and suggested a competitive approach to defending business projects under the supervision of mentors, with two stages: defending the business concept and defending the project itself.

Adeyemo et al. [9] investigated the extent to which entrepreneurship education influences students' entrepreneurial abilities and intentions. The results showed a significant impact. Previous studies have focused on aspects related to innovation and entrepreneurship capabilities, with some emphasizing innovation and entrepreneurship education while others focusing on the influence of entrepreneurial abilities on entrepreneurial outcomes. In contrast to these previous research efforts, this study places emphasis on entrepreneurial competency as a factor that can affect entrepreneurial abilities. It analyzes the components of entrepreneurial competency, validates their effectiveness, and performs an analytical hierarchy process on the weights of these components.

This study briefly introduced entrepreneurial competency, summarized ten relevant factors based on interview records, collected relevant data through a questionnaire, and tested the reliability and validity of the data before a case study. The contribution of this article lies in the utilization of regression analysis and the analytic hierarchy process (AHP) to validate the factors related to entrepreneurial competency and their importance, providing valuable insights for entrepreneurship education. The main challenge of this study is how to select the relevant factors influencing entrepreneurial competency. The approach taken in this article involves conducting in-depth interviews with undergraduate students who are preparing for or have already engaged in entrepreneurship, as well as experts in the field, and summarizing the relevant factors from these interview records.

## 2. Competency Model

### 2.1. Factors Influencing Entrepreneurial Competency

Encouraging college students to engage in entrepreneurial activities is a viable solution for addressing the employment challenges faced by this demographic. However, the success of entrepreneurial activities depends not only on the current objective market environment but also on the subjective motivation of the entrepreneurs themselves. Entrepreneurial competency is a subjective motivation that influences entrepreneurial activities [10], which includes the entrepreneur's enthusiasm for entrepreneurship and their ability to solve challenges encountered during the entrepreneurial process. It can be said that entrepreneurial competency constitutes an essential prerequisite for the success of entrepreneurial endeavors [11] and serves as a vital skillset for entrepreneurs.

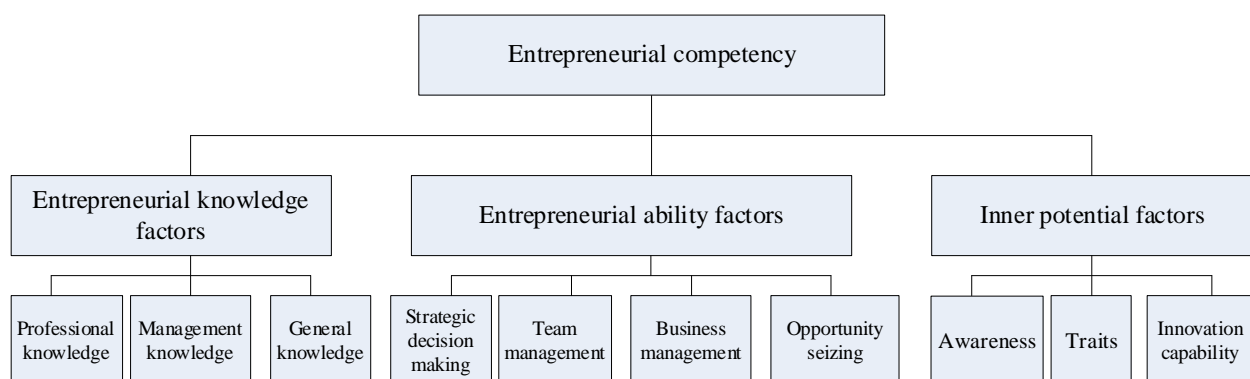


Figure 1. Factors influencing entrepreneurial competency

However, entrepreneurial competency is not solely reliant on talent; rather, talent only constitutes a fraction of it. The acquisition of experience and knowledge is crucial for developing entrepreneurial competency. Given that college students have predominantly been immersed in campus life [12], their limited exposure to the real world makes it challenging for them to embark on entrepreneurial ventures. Therefore, fostering the effective cultivation of entrepreneurial competency within colleges is beneficial to the entrepreneurial activities of college students [13].

Through in-depth interviews with college graduates who are either preparing to launch their own businesses or have already done so, as well as relevant experts, this paper summarized the factors influencing entrepreneurial competency, as shown in Figure 1. After summarizing, three main factors affecting entrepreneurial competency can be identified: entrepreneurial knowledge, entrepreneurial ability, and inner potential. Entrepreneurial knowledge includes professional knowledge, management knowledge, and general knowledge; entrepreneurial ability includes strategic decision-making, team management, business management, and opportunity grasping; and inner potential includes entrepreneurial consciousness, entrepreneurial traits, and innovation ability [14].

## 2.2. The Process of Constructing an Entrepreneurial Competency Model

An entrepreneurial competency model can analyze the factors affecting entrepreneurial competency [15] in order to facilitate the cultivation of entrepreneurial competency among college students. Figure 2 shows the basic process of constructing the entrepreneurial competency model. The main principle is to utilize regression analysis to identify influential factors, subsequently construct an AHP model based on these factors, and perform an analysis of weight distribution [16]. The specific steps are demonstrated below.

- The records related to entrepreneurial competency were obtained from the in-depth interviews conducted with college students who possessed bachelor's degrees and exhibited readiness or had already initiated their own businesses, as well as relevant experts. Based on these records, the factors influencing entrepreneurial competency were summarized, as previously described.
- Entrepreneurial performance serves as a visual manifestation of entrepreneurial competency, and influencing factors are components of competency. Therefore, the validity of these influencing factors was examined through regression analysis on entrepreneurial performance and the factors that influence entrepreneurial competency [17].
- The framework of the AHP model was constructed based on the valid factors that influence entrepreneurial competency [18].
- Weights were calculated for indicators within the hierarchical analysis model of entrepreneurial competency across different dimensions to assess the importance of each influencing factor in the model. First, judgment matrices were constructed for each dimension [19]. At the highest level of the model lies entrepreneurial competency, while at the middle level (criterion level), three criteria are considered: entrepreneurial knowledge, entrepreneurial ability, and intrinsic potential. The target layer consists of indicators falling under these three criteria.

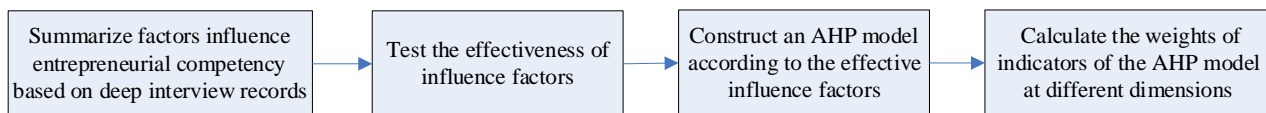


Figure 2. Basic process of building an entrepreneurial competency model

The judgment matrix was constructed based on the hierarchy of dimensions. For example, when constructing the judgment matrix of the middle layer, pairwise comparisons were made among the three criteria to form a  $3 \times 3$  judgment matrix. Similarly, when constructing the judgment matrix of the target layer, pairwise comparisons were made among indicators within each criterion, resulting in a judgment matrix formed by indicators under every criterion. As an illustration, a  $3 \times 3$  judgment matrix was formed by comparing indicators under the criterion of entrepreneurial knowledge. The element in the judgment matrix represented the ratio of the influence between the corresponding two indicators, and the influence scale was 1–9, with 1 for equally important and 9 for the most important. In case the judgment positions of the compared indicators are reversed, the scale is converted to its inverse value. Consequently, a consistency test was conducted [20]. The indicator weights were determined by calculating them using the tested judgment matrices; any elements that failed to pass the test were adjusted accordingly.

## 3. Case Study

### 3.1. Subjects

A questionnaire was used to collect data for testing the validity of factors influencing entrepreneurial competency. The questionnaire was generally divided into two parts. The first part was the conventional collection of information such as age, gender, entrepreneurial experience, and education level. The second part was the measurement questions, designed based on the ten influencing factors summarized from the interview records. Each influencing factor was assessed through five related measurement questions using the Likert scale [21]. In addition to the questions for testing the influencing factors, the second part of the questionnaire also included a measure of entrepreneurial performance, which was measured by the duration of continuous business operation.

The questionnaire was issued to small and medium-sized enterprises in the high-tech fields of Beijing, Shanghai, and Guangzhou. A total of 1,000 questionnaires were sent out, and 985 valid questionnaires were recycled.

### 3.2. Reliability and Validity Tests

Table 1 shows the results of the reliability and validity tests of the questionnaire indicator data. The Cronbach's alpha coefficient [15], the Kaiser-Meyer-Olkin (KMO) value, and the result of Bartlett's test of sphericity collectively supported the reliability of the indicator data, affirming its suitability for factor analysis.

**Table 1. Reliability and validity test results**

Variable	Cronbach's alpha	KMO value	Bartlett's test of sphericity		
			Chi-squared approximation	df	P value
Age	0.921	0.711	189.67	3	0.001
Gender	0.914	0.724	178.96	3	0.001
Entrepreneurial Experience	0.903	0.713	186.54	4	0.000
Academic Qualifications	0.915	0.710	198.75	5	0.001
Professional Knowledge	0.965	0.754	238.23	3	0.001
Management Knowledge	0.987	0.741	222.14	3	0.002
General Knowledge	0.966	0.784	198.65	5	0.001
Strategic Decision Making	0.948	0.756	215.36	6	0.001
Team Management	0.963	0.759	196.37	6	0.001
Business Management	0.945	0.789	203.69	3	0.000
Opportunity Seizing	0.968	0.769	187.95	3	0.001
Entrepreneurial Awareness	0.971	0.795	197.68	6	0.000
Entrepreneurial Traits	0.957	0.784	201.44	5	0.000
Innovation Capability	0.974	0.746	187.74	3	0.001
Duration Of Continuous Business Operation	0.983	0.775	189.67	7	0.001

### 3.3. Analysis of Results

After verifying the reliability and validity of the questionnaire data, the validity of the influencing factors of entrepreneurial competency in the questionnaire was verified using regression analysis. Table 2 shows the results of the regression analysis of the influencing factors. The regression analysis models were constructed separately according to the major categories of influencing factors, and there were four regression analysis models. Model 1 solely incorporated conventional information data as a control variable. In this model, the P values for the comparison between age and gender factors and the duration of continuous business operation were found to be greater than 0.05, which indicated a lack of statistical significance in these relationships; the P values for the comparison between entrepreneurial experience and academic qualifications factors and the duration of continuous business operation were observed to be less than 0.05, suggesting statistically significant relationships.

**Table 2. Regression analysis of the factors influencing entrepreneurial competency**

Variables		Duration of continuous business operation			
		Model No. 1	Model No. 2	Model No. 3	Model No. 4
Control variables (conventional information)	Age	0.032	0.023	0.031	0.024
	Gender	0.025	0.021	0.025	0.026
	Entrepreneurial experience	0.111 <sup>+</sup>	0.121 <sup>+</sup>	0.134 <sup>+</sup>	0.141 <sup>+</sup>
	Academic qualifications	0.121 <sup>+</sup>	0.124 <sup>+</sup>	0.113 <sup>+</sup>	0.132 <sup>+</sup>
Independent variables (entrepreneurial knowledge factors)	Professional knowledge		0.235 <sup>*</sup>		
	Management knowledge		0.326 <sup>*</sup>		
	General knowledge		0.412 <sup>*</sup>		
Independent variables (entrepreneurial ability factors)	Strategic decision making			0.236 <sup>*</sup>	
	Team management			0.365 <sup>*</sup>	
	Business management			0.287 <sup>*</sup>	
	Opportunity seizing			0.341 <sup>*</sup>	
Independent variables (intrinsic potential factors)	Entrepreneurial awareness				0.368 <sup>*</sup>
	Entrepreneurial traits				0.452 <sup>*</sup>
	Innovation capability				0.369 <sup>*</sup>
Statistical quantities	R <sup>2</sup>	0.082	0.198	0.187	0.213
	F-value	2.894	4.398	5.421	4.897

Note: + indicates the P value less than 0.05, and \* indicates the P value less than 0.01.

Model 2 incorporated entrepreneurial knowledge in comparison to Model 1, including professional knowledge, management knowledge, and general knowledge. In model 2, the P values for the comparison between entrepreneurial experience and academic qualifications factors and duration of operation were found to be less than 0.05, indicating a significant association. The P values for the comparison between the three newly added factors associated with entrepreneurial knowledge and the duration of continuous business operations were found to be less than 0.01, indicating an even more significant association. Additionally, after incorporating these three factors, the  $R^2$  value of the regression analysis model increased, i.e., the explanatory degree of the regression model increased.

Model 3 was similar to Model 2. This model included four factors associated with entrepreneurial ability compared to model 1. It was found that entrepreneurial experience and academic qualifications were significantly related to the duration of continuous business operations. Furthermore, the four newly added factors associated with entrepreneurial ability were also significantly related to the duration of continuous business operations. The  $R^2$  value of model 3 was larger than that of model No. 1, indicating an enhanced level of explanatory degree within the regression model.

Model 4 incorporated three factors associated with inner potential, in contrast to Model 1. It was found that entrepreneurial experience and academic qualifications were significantly associated with the duration of continuous business operation, and the three newly added intrinsic potential-associated factors were more significantly associated with the duration of continuous business operation. Compared to model 1, the  $R^2$  value for model 4 added with inner potential-related factors was larger, suggesting an improved level of explanatory power for the regression model.

A comparison of models 2, 3, and 4 with model 1 revealed that the categories of entrepreneurial knowledge, entrepreneurial competency, and inner potential were all more significantly associated with the duration of continuous business operation. Furthermore, the explanatory power of the regression model improved after the addition of these factors. These findings suggested that all of the above entrepreneurial competency influencing factors could effectively influence entrepreneurial performance, and the validity of the influencing factors has been verified.

After conducting the validity verification of the aforementioned influencing factors on entrepreneurial competency, an AHP model was constructed based on these factors. The weights were calculated using the judgment matrix given by ten invited experts, and the results are shown in Table 3. The consistency test confirmed that both the judgment matrix of the criterion layer and that of the target layer under each criterion passed successfully, thereby validating the weights computed through the judgment matrix.

**Table 3. The AHP model of entrepreneurial competency**

The highest level	Criteria layer	Weight	Maximum characteristic root	CR	The target layer	Weight	Maximum characteristic root	CR
Entrepreneurial competency	Entrepreneurial knowledge	0.4967	3.0647	0.0236	Professional knowledge	0.4258	3.0541	0.0325
					Management knowledge	0.1987		
					General knowledge	0.3755		
	Entrepreneurship	0.3257			Strategic decision making	0.3128	3.0458	0.0314
					Team management	0.2367		
					Business management	0.2589		
					Opportunity seizing	0.1916		
					Entrepreneurial awareness	0.2295		
	Inner potential	0.1776			Entrepreneurial traits	0.2216	3.0642	0.0298
					Innovation capability	0.5489		

## 4. Discussion

College students spend most of their time on campus and do not have enough entrepreneurial experience. In order to enhance the success rate of college students' entrepreneurship, colleges often cultivate the entrepreneurial competency of college students. Some relevant studies are reviewed as follows: Wang et al. [12] conducted a study by surveying senior students in experiential universities, collecting 400 data points. They used AMOS 23.0 and SPSS 26.0 as data analysis tools to explore the relationship between entrepreneurship knowledge literacy courses and entrepreneurial abilities among college students. The results indicated that entrepreneurship knowledge literacy courses directly and significantly influenced college students' entrepreneurial abilities, and entrepreneurial self-efficacy played a mediating role. Slišāne [23] conducted an online survey using the QuestionPro platform to collect data, aiming to explore the correlation between teaching methods and entrepreneurial abilities. The results indicated that students were well-prepared for further development of their entrepreneurial skills during remote learning.

Zhang et al. [24] proposed a mediating effect model and tested the hypotheses using hierarchical regression and a moderated mediation test with a sample of 200 Hong Kong university students. The results indicated that entrepreneurial



attitudes, subjective norms, and perceived behavioral control of entrepreneurship significantly mediated the positive relationship between entrepreneurial learning and entrepreneurial intention. In the aforementioned studies, which focused on students, various factors influencing entrepreneurial success, such as entrepreneurial knowledge, attitudes, and market perception, were analyzed. However, this study specifically examines entrepreneurial competency by first summarizing ten relevant factors based on interview records. Subsequently, data on these factors was collected from students through questionnaires, and their effectiveness was verified using regression analysis. Finally, the impact weights of these factors on entrepreneurial competency were determined using the AHP. The results of the case study were shown in the previous section. The regression analysis conducted on the ten correlated factors showed that all the competency-related factors were significantly associated with entrepreneurial performance, thereby confirming their validity in assessing entrepreneurial competency. Then, the corresponding weights were calculated based on the judgment matrix of the AHP model, which successfully passed consistency tests.

In the criterion layer of the competency model, the factor of entrepreneurial knowledge had the largest weight, followed by entrepreneurial ability and inner potential. The magnitude of the weight distribution indicated that it was very important to have sufficient entrepreneurial knowledge in the process of entrepreneurship, followed by sufficient entrepreneurial ability. Based on the constructed competency model and its weight distribution, the following suggestions are proposed for cultivating entrepreneurial competency among college students:

- Colleges need to pay attention to teaching college students enough theoretical knowledge in entrepreneurship education, especially focusing on the knowledge of the professional field in which they want to start their business.
- College students need to pay more attention to the changes in local market policies and develop their sensitivity to market opportunities in the process of entrepreneurship.
- Students should actively participate in practical activities inside and outside of school to improve their ability to analyze problems and practical management skills.
- Students should pay attention to communication when participating in practical activities with teams during school and pay the same attention to timely communication with peers when starting a business.
- When setting goals for the business process, not only short-term goals but also long-term goals should be set, and different operating policies should be set according to the goals. The policies should be adjusted and exchanged according to the actual situation in the process of implementation.

## 5. Conclusion

This paper briefly introduced entrepreneurial competency and summarized ten relevant factors based on the interview records, including professional knowledge, management knowledge, general knowledge, strategic decision-making, team management, business management, opportunity grasping, entrepreneurial consciousness, entrepreneurial traits, and innovation ability. Relevant data were collected through questionnaires. The reliability and validity of the data were tested using Cronbach's alpha [15], the KMO value, and the Bartlett's test of sphericity. Moreover, a case study was conducted. The effectiveness of the relevant factors was tested using regression analysis; an AHP model was constructed based on these factors, and their corresponding weights in the model were calculated. The following results were obtained: (1) The data obtained from the questionnaire survey were sufficiently reliable and valid, making them suitable for factor analysis. (2) The results of the regression analysis showed that all the ten factors were significantly related to entrepreneurial performance, thus confirming the validity of these factors in assessing entrepreneurial competency. (3) The weight distribution within the AHP model showed that entrepreneurial knowledge held the highest importance, followed by entrepreneurial ability and inner potential.

## 6. Declarations

### 6.1. Author Contributions

Conceptualization, Y.C. and Y.M.; methodology, Y.C.; validation, Y.C.; formal analysis, Y.C.; investigation, Y.C.; resources, Y.C.; data curation, Y.M.; writing—original draft preparation, Y.M.; writing—review and editing, Y.M.; visualization, Y.M.; supervision, Y.M.; project administration, Y.M.; funding acquisition, Y.M. All authors have read and agreed to the published version of the manuscript.

### 6.2. Data Availability Statement

The data presented in this study are available in the article.

### 6.3. Funding

The authors received no financial support for the research, authorship, and/or publication of this article.

#### 6.4. Institutional Review Board Statement

Not applicable.

#### 6.5. Informed Consent Statement

Not applicable.

#### 6.6. Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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