Research on the Capability Model of Innovation and Entrepreneurship Talents in the Background of Digital Transformation

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Abstract. With the increasing development of the digital economy, the internal and external environment of enterprises has undergone tremendous changes. In this context, innovative and entrepreneurial talents are crucial for the development of enterprises. This article summarizes relevant theories and compiles a questionnaire by capturing key indicator information. A survey was conducted on 340 employees, and a competency model was constructed through exploratory factor analysis. Through empirical research, four conclusions were drawn: men are higher in innovation and entrepreneurship abilities and digital awareness than women. This study can provide guidance for undergraduate colleges to cultivate innovative and entrepreneurial talents, in order to fill the talent gap in the talent market. On the other hand, it can provide reference for enterprises to identify or assess talents.

Keywords: Digital economy; Digital transformation; Innovative and entrepreneurial talents; Competency Model

1   Introduction

With the increasing development of the digital economy, innovative and entrepreneurial talents are crucial for the economic development of enterprises. Innovative and entrepreneurial talents not only play an important role in promoting economic development, employment growth, and the development of emerging industries, but also play an important role in promoting the development of the entire national economic system.

Both the country, society, and enterprises have changed their requirements for talent capabilities. With the deepening of domestic research on competency, research on different industries and positions has gradually increased, and competency has been more applied in practical applications. Bartram (2005) applied the competency theory in his research on entrepreneurial ability, dividing it into three dimensions, including 16 specific sub abilities, such as innovation, self-efficacy, interpersonal skills, and initiative[1]. Scholar Onstenk (2003) proposed a concept based on competency theory - the key skills of entrepreneurship, which are considered similar to key skills in vocational education and lifelong learning and suitable for a wide range of entrepreneurial activities[2]. Morris (2013) believes that innovation and entrepreneurship ability is the result of the continuous interaction between individuals and the

environment, and is measurable and developmental [3]. Jeffery (2006) believes that entrepreneurship is a series of uncertain and stressful activities that involve identifying opportunities, determining plans, acquiring resources, managing risks, and adjusting strategies[4]. Duan (2022) believes that entrepreneurship is a series of behaviors taken by individuals when interacting with the environment, and it is a process[5]. From the past case studies on the ability of innovative talents, which focused more on investigating the outstanding qualities of some successful entrepreneurs and less on the ability of innovative talents, to later research combining the characteristics of innovation and entrepreneurship [6], this undoubtedly adds to the research on innovative and entrepreneurial talents.

Gölzer et al. (2017) argue that digital transformation is the process by which enterprises strengthen the utilization of market information and utilize digital technology to improve or change existing services and production [7]. Taotao Wang and Wenhua Wang (2021) proposed that digital transformation refers to the widespread application of digital technology to change the way individuals live and work, the management and service models of government and social organizations, and the organization and operation methods of enterprises[8]. Zhang (2023) believes that digital transformation is the use of new digital technologies such as artificial intelligence, cloud computing, and blockchain to improve business efficiency, optimize processes and business models, and enhance customer experience[9]. Niu (2020) and others believe that digital transformation is achieved through the application of digital technology [10]. Zou and Wang (2020) proposed from the perspective of knowledge flow that the key to digital transformation lies in digital awareness [11], fully utilizing technologies such as cloud computing, the Internet of Things, and artificial intelligence to widely apply digitalization to enterprise production and operation activities (Wang Ying, 2022) [12].

With the rapid development of digitalization, enterprises are facing talent issues in the process of digital transformation. Xu (2021) mentioned that there is currently a considerable shortage of versatile talents who can flexibly apply information technology and are proficient in operational methods [13]. Jing (2020) believes that while pursuing quantity in talent cultivation, it neglects the systematic construction of comprehensive abilities, resulting in problems such as a bias towards science in talent cultivation and a lack of depth in integrated ability cultivation [14]. Yu (2017) believes that there are still problems such as insufficient talent in advanced fields, unequal talent quantity and enterprise demand, and a shortage of skilled craftsmen in major countries[15]. Dong Wei (2018) believes that the current demand for talent has changed. However, in terms of talent cultivation, the vocational education curriculum of undergraduate colleges still stays at the basic level, leading to the emergence of talent shortage issues [16]. Qin (2018) pointed out that in the context of the new era, the imbalance in the development of innovation and entrepreneurship education does not match the requirements for cultivating innovation and entrepreneurship talents [17].

In order to build a large team of high-quality innovation and entrepreneurship talents, maximize the talents of innovation and entrepreneurship talents, and promote the comprehensive development of the country, this article studies the ability model of innovation and entrepreneurship talents in the context of digital transformation. On the one hand, it can provide guidance for undergraduate colleges to cultivate innovation and entrepreneurship talents, and fill the talent gap in the talent market, On the other hand, it provides reference for enterprises to identify or assess talents.

2 Methods

2.1 Research Tools

Through a dialogue with innovative entrepreneurs, we will discuss their entrepreneurial abilities, innovation, and how to embrace digital transformation. The description of innovative entrepreneurs will form an interview content table, as shown in Table 1:

Table 1. Interview Content Table

Serial number	1	2	3
Problem	entrepreneurship ability	digital awareness	innovation ability
Description	Risk prediction ability Problem solving ability The courage to overcome difficulties Interpersonal communication skills c.Decision making ability	Learning ability Digital Technology Skills Ability to analyze data Resource integration capability Digital Technology Knowledge	Market sensitivity Be good at seizing opportunities Timely collection of information Solid professional foundation Rich experience and knowledge

Based on the above interview content, the "Innovation and Entrepreneurship Talent Ability Survey Questionnaire" (Appendix) was developed. The questionnaire designed three ability element indicators, each with a clear definition. There were a total of 29 questions, including 4 questions about basic information collection and 25 questions about subjectivity. The topics mainly involve understanding digital knowledge, adventurous spirit, ability to overcome difficulties, and innovative awareness. The question items adopt Likert's five point scale method. '1' represents complete non conformity, '2' represents relatively non conformity, '3' represents general conformity, '4' represents relatively conformity, and '5' represents complete conformity.

Firstly, invalid questionnaires were removed from the collected questionnaires and analyzed using Excel and SPSS software. Sum up the scores of the scale and rank them in descending order. Take the top 27% and bottom 27% of the total score as the high and low groups of the questionnaire, with the high group marked as number 1 and the low group marked as number 2. Then, perform independent sample t-tests on the high and low groups. If the same question cannot distinguish between high and low scores, it indicates that the validity of the question is not high. The question is not deleted here, indicating that the questions in the questionnaire can distinguish outstanding performers from average performers. Next, perform a correlation analysis between all items in the questionnaire and the total score, and delete items with an absolute value of correlation less than 0.3.

2.2 Research Procedure

Based on the previous literature review and sorting, some relevant indicators were extracted to design a questionnaire. Through online and offline distribution, a survey was conducted on innovation and entrepreneurship personnel in Chongqing and Guizhou, and factor analysis was conducted on the data to obtain a capability model. Finally, the various dimensions and

elements of the innovation and entrepreneurship capability model in the context of digital transformation were determined. SPSS 26.0 software was used to organize the obtained data, and reliability and validity tests were conducted. The test results reached consistency and reliability. Through descriptive analysis, factor analysis, and other mathematical statistical methods, the final result of the innovation and entrepreneurship talent ability model in the context of digital transformation was obtained.

2.3 Composition of subjects

This questionnaire mainly focuses on innovative and entrepreneurial talents as the research object, mainly conducted through electronic questionnaires, including two parts: basic information collection and subjective questions. The tested talents are innovative entrepreneurs from different fields and perspectives, mainly from Guizhou and Chongqing. They are 180 employees from different industries, 100 Taobao store owners, 30 small store owners, 12 real estate sales supervisors, 7 corporate legal persons, 6 real estate sales managers, and 5 entrepreneurs, respectively. Out of the 340 questionnaires collected, 32 were discarded, leaving 308 valid questionnaires with an effective rate of 91%.

2.4 Analysis Tools

This study used principal component analysis and exploratory factor analysis to determine and construct a competency model. Cronbach's Alpha coefficient and Alpha reliability coefficient were used to validate the model structure. Independent sample T-test and one-way ANOVA were used to compare the differences in the abilities of innovative and creative talents due to factors such as age and education. Due to significant industry differences, no analysis and segmentation of job role differences was conducted, The final results were identified by experts and scholars and conclusions and suggestions were obtained.

3 Results

3.1 Exploratory Factor Analysis

Table 2. Explanation of Total Variance

ingredient	Initial eigenvalue			The sum of the load squares was extracted			Rotary square sum loading		
	total	variance%	accumulate%	total	variance %	accumulate %	total	variance %	accumulate %
1	16.783	45.359	45.359	16.783	45.359	45.359	6.308	17.049	17.049
2	3.072	8.302	53.661	3.072	8.302	53.661	6.251	16.894	33.943
3	1.783	4.819	58.480	1.783	4.819	58.480	5.015	13.553	47.496

Extraction method: Principal Component Analysis

Conduct exploratory factor analysis on the content of this survey questionnaire. Firstly, exploratory factor analysis is conducted on the question items, and the statistic KMO is used to test whether the bias relationship between variables is small enough. Its value ranges from 0 to 1, and the larger the value, the better the effect of factor analysis. Kaiser provided commonly used metrics for KMO, and when KMO>0.9, factor analysis was the most effective; When KMO>0.7, factor analysis is suitable; When KMO<0.5, factor analysis is not suitable. The KMO of this questionnaire is 0.899, which is greater than the minimum standard of 0.5 and has

a high correlation. It is suitable for factor analysis. The approximate chi square value of Bartlett's sphericity test is 5539 and the degree of freedom is 300, ρ= 0.000<0.001 also indicates that the data is suitable for factor analysis.

Secondly, exploratory factor analysis was conducted on the data of the Innovation and Entrepreneurship Talent Capability Element Scale. The results are shown in Table 2. Principal component analysis was used to extract three factors from the Innovation and Entrepreneurship Talent Capability Element Scale. After rotating using the maximum variance method, the cumulative variance interpretation reached 68.144%, indicating that the factor analysis extraction effect was good. However, due to the large number of scales, a cumulative percentage of 47% was used as the cutoff point in the selection process. Therefore, this article selects the first three factors to construct the model.

The conclusion of factor analysis using SPSS 26.0 is shown in Figure 1 for the factor crushed stone diagram. When reaching the fourth principal component, if 25 questions can explain 58.210% of the total variable, then 6 factors with eigenvalues greater than 1 can be determined. It can also be seen from the gravel plot that selecting these 3 factors is also reasonable.
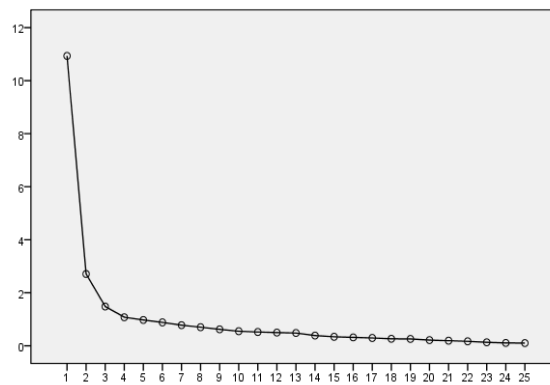

Fig. 1. Gravel Map

3.2   Overall Results

3.2.1 Overall characteristics

Table 3. Overall characteristics of the ability of innovative and entrepreneurial talents

	Entrepreneurship ability		Digitization consciousness		innovation ability	
	M	SD	M	SD	M	SD
Man	4.0179	0.77199	3.7639	0.89390	3.9017	0.69087
Woman	3.9711	0.72274	3.5833	0.66700	3.5979	0.62291
Total	4.019	0.735	3.694	0.732	3.738	0.715
t	0.715		0.005		0.107***	

According to Table 3, it can be seen that the average score ranking of innovation and entrepreneurship talents in each dimension is ranked from high to low in the context of digital transformation: entrepreneurial ability, innovation ability, and digital awareness.

3.2.2 Analysis of Differences

1. Gender Differences in the Ability of Innovation and Entrepreneurship Talents

According to the independent sample T-test results, the t-values of entrepreneurial ability, digital awareness, and innovation ability are 0.715, 0.005, and 0.1.7, respectively. There are significant differences in innovation ability between different genders, while there is no significant difference in entrepreneurial ability and digital awareness between gender

2. Age differences in innovative and entrepreneurial talents

Using one-way ANOVA test, the F-values of entrepreneurial ability, digital awareness, and innovation ability were 7.091, 8.179, and 9.405, respectively. The differences in age variables across all dimensions were extremely significant. Overall, the scores of various dimensions of innovation and entrepreneurship talent's ability elements show an increasing trend with age between the ages of 25 and 45, while those over 45 show a decreasing trend.

3.Differences in educational levels of innovative and entrepreneurial talents' abilities

Using one-way ANOVA test, the F-values of entrepreneurial ability, digital awareness, and innovation ability were 3.679, 4.113, and 5.589, respectively. The education level variable showed significant differences in the three dimensions of entrepreneurial ability, digital awareness, and innovation ability.

4. Differences in the working years of innovative and entrepreneurial talents' abilities

Using one-way ANOVA test, the F-values of entrepreneurial ability, digital awareness, and innovation ability were 11.192, 12.897, and 12.897, respectively. It can be seen that there are significant differences in the variables of work years in the dimensions of entrepreneurial ability, digital awareness, and innovation ability.

3.3   Reliability and validity testing

Table 4.   Reliability Statistics

Number of terms	Cloned Bach Alpha	Based on standardized terms Cloned Bach Alpha
25	0.945	0.945

This study designed a questionnaire reliability analysis using internal consistency reliability (Cronbach's Alpha coefficient). The closer the reliability coefficient is to 1, the higher the reliability of the questionnaire. The farther the reliability coefficient is from 1, and the closer it is to 0, the lower the reliability of the questionnaire. Table 4 shows the test results. Both the Clonbach Alpha values and the Clonbach Alpha values based on standardized terms are greater than 0.9, indicating the reliability of the questionnaire.To test the rationality of the dimension setting, it is necessary to test the internal consistency of the three innovation and entrepreneurship talent ability elements. From the data in Table 5, it can be seen that the reliability coefficients of entrepreneurial ability, digital awareness, and innovation ability are

0.926, 0.934, and 0.785, respectively, which have passed the test, indicating good internal consistency.

Table 5. Internal Consistency Inspection

Ability elements	Entrepreneurship ability	Digital awareness	Innovation ability
Number of items	13	8	4
Cloned Bach Alpha	0.926	0.934	0.785

This study used SPSS statistical analysis software and bivariate correlation analysis to explore the correlation between dimensions, their total scores, and various dimensions, and obtained the direction and strength of the correlation. The results are shown in Table 6.

Table6. Pearson correlation analysis

	Entrepreneurship ability	Digital awareness	Innovation ability	Total score
Entrepreneurship ability	1			
Digital awareness	.491**	1		
Innovation ability	.690**	.512**	1	
Total score	.501**	.555**	.543**	1

From Table 6, it can be seen that each variable is significantly correlated at the 99% significance level, and the correlation coefficients are all greater than 0, so they are all positively correlated. Overall, each variable is positively correlated with entrepreneurial ability, indicating that the higher the score level of each variable, the stronger the entrepreneurial ability.

4   Conclusion

Firstly, males have higher levels of innovation, entrepreneurship, and digital awareness than females. From an objective perspective, the physiological qualities of men are generally due to women; From a subjective perspective, most companies not only believe that women's digital thinking is not as good as men's. Secondly, people under the age of 45 have improved their professional skills as they age. While basic knowledge is applied in practice, they have also learned new knowledge, and their vision is no longer limited to the present. Therefore, innovation and entrepreneurship abilities are increasing with age. Thirdly, people with college or vocational education are all studying in vocational schools, and the cultivation of innovation and entrepreneurship abilities is more comprehensive and in line with social needs. Therefore, this group of people generally have strong innovation and entrepreneurship abilities. However, due to a lack of theoretical foundation, the overall population is still inferior to those with graduate or higher education. Fourthly, due to the increase in working years, stronger professional knowledge, richer work experience, and deeper understanding of the market, the ability to innovate and start a business is stronger.

5 Proposal

Based on the above research conclusions, we propose the following suggestions:

Firstly, cultivating digital awareness to adapt to the development of the times requires a willingness to digitize, a comprehensive understanding of digitization, and the ability to discover opportunities that can be brought to individuals or businesses in the context of digitization. Secondly, cultivate innovation and entrepreneurship awareness and enhance innovation and entrepreneurship capabilities. According to the research results, talents who have been on campus and in the workplace for a period of time are at the pinnacle of innovation and entrepreneurship development. During the campus period, innovative and entrepreneurial talents are at the peak of their innovative and entrepreneurial abilities. For innovative and entrepreneurial talents who are new to society, improving their operational skills in work practice is an important way to transform innovative and entrepreneurial achievements. Thirdly, increase the role of ideological and political education in the cultivation of innovative and entrepreneurial talents. Course ideological and political education is the key to improving ideological and political abilities. Introducing course ideological and political content into university classrooms can cultivate students' overall perspective, enhance their understanding of society and love for the country, and thus stimulate their work enthusiasm and entrepreneurial enthusiasm. Integrating ideological and political education into the entire classroom can subtly change students' thinking, reduce the occurrence of flat thinking, and enable them to persist in the entrepreneurial process.

In addition, this article conducted research on the innovation and entrepreneurship talent capability model in the context of digital transformation through a questionnaire survey, and obtained relevant data, which has certain reference significance. However, due to the limitations of objective conditions and research level, as well as the limited personal abilities and resources of the author, there are inevitably certain limitations and deficiencies in the empirical research process. In subsequent research, we can improve our position to study the elements of innovation and entrepreneurship talent capabilities in the context of digital transformation from a global perspective, establish such talent capability models, provide guidance for undergraduate colleges to cultivate such talents, and provide reference for enterprises when recruiting or evaluating talents, in order to help enterprises improve their competitiveness in the context of digital transformation.

Appendix

Dear Madam / Sir,

Hello, thank you for taking time out of your busy schedule to participate in this survey. This survey will keep your information strictly confidential. The survey results are only used for the academic research on "the ability of innovative and entrepreneurial talents under the background of digital transformation". Please answer according to your actual situation. Thank you for your cooperation!

Part I: Basic Information survey

1.sex

A. male   B. female

2.age

A. Under 25 years old   B.25-35 years old   C.35-45 years old   D.45 years old and older

3.record of formal schooling

A. High school   B. junior or higher vocational   C. undergraduate   D. Master or above

4.working life

A. less than 1 year   B.1-3 years (excluding 3 years)   C.3-5 years (excluding 5 years)   D.5 years and more

partII:Basic information investigation

The following are some of the ability needed for innovative and entrepreneurial talents in the context of digital transformation. Please make a judgment on the importance of each ability factor according to your opinion, and tick the box in the corresponding position.

	Completely inconsistent	Not quite in line	General compliance	More in line	Full compliance
1. I am willing to do the challenging work.					
2. I will try to overcome the difficulties.					
3. I will adjust my goals according to the situation.					
4. I will listen to and absorb the appropriate criticism.					
5. I will create opportunities for myself at work.					
6. I often find my cognitive ability and professional level improving.					
7. I will anticipate the work affairs.					
8. I will prepare several plans to complete the work.					
9. I will summarize my work.					
10. I am good at adjusting the team atmosphere.					
11. I do more rationally.					
12. I often reflect on my past work.					
13. I have a very strong execution power.					
14. My recovery ability is good.					
15. My performance in the existing emergencies is calm.					
16. I will lead the team to review and reflect together.					
17. I can make effective decisions in complex environments.					
18. Digital transformation requires the continuous investment of human resources, material resources and financial resources.					
19. Digital transformation requires innovation ability and business innovation.					

	Completely inconsistent	Not quite in line	General compliance	More in line	Full compliance
20. A clear transformation strategy is the key to digital transformation.					
21. Digital transformation can improve the level of enterprise management and control.					
22. Digital transformation can bring about business innovation.					
23. Digital transformation can provide more opportunities for entrepreneurial enterprises.					
24. Data analysis can control the key touch points of the enterprise.					
25. Only the effective combination of internal and external data can play the data value.					

References

[1]   Bartram, D. (2005)The Great Eight competencies: a criterion-centric approach to validation. The Journal of applied psychology, 90(6). DOI:10.1037/0021-9010.90.6.1185

[2]   Jeroen O.(2003) Entrepreneurship and Vocational Education. European Educational Research Journal, 2(1):75-89.DOI: 10.2304/eerj.2003.2.1.12

[3]   Michael H.M, Justin W.Webb ,Jun F, Sujata S.(2013)A Competency-Based Perspective on Entrepreneurship Education: Conceptual and Empirical Insights. Journal of Small Business Management,51(3). DOI：10.1111/jsbm.12023

[4]   Jeffery S.M, Dean A.S.(2006) Entrepreneurial Action and the Role of Uncertainty in the Theory of the Entrepreneur. The Academy of Management Review,31(1). DOI：10.2307/20159189

[5]   Xiaoyang D.(2022) On the Model and Evaluation Index System Construction of Innovation and Entrepreneurship Ability. Research in Educational Development,42(01):60-67. DOI:10.14121/j.cnki.1008-3855.2022.01.010.

[6]   Li Q ,Xin L.(2019) Exploring the Online and Offline Hybrid Gold Course Teaching Model of Entrepreneurship Education in the Era of MOOC. Chinese & Foreign Entrepreneurs. 15:182-183. DOI:CNKI:SUN:ZWQY.0.2019-15-146

[7]   Philipp Gölzer,Albrecht Fritzsche.(2017)Data-driven operations management: organisational implications of the digital transformation in industrial practice. Production Planning & Control,28(16). DOI：10.1080/09537287.2017.1375148

[8]   Taotao J, Wenhua W. (2021)Cultivation of Business Innovation and Entrepreneurship Talents in the Context of Digital Transformation of Enterprises.Education and Vocation,03:98-102. DOI:10.13615/j.cnki.1004-3985.2021.03.016.

[9]   Xin Z, Zhu D.(2023)Digital Transformation and Enterprise Technology Innovation: Mechanism Identification, Analysis of Guarantee Conditions, and Heterogeneity Testing. Economic Review.01:3-18. DOI:10.19361/j.er.2023.01.01.

[10]   Sijia N, Lei S.(2020) Strategic analysis of clothing brand marketing channels under digital transformation.Wool Textile Journal,48(04):70-74. DOI:10.19333/j.mfkj.20190705005.

[11]   Bangshan Z, Liwen W, Chengli W.(2002) Discussion on Digital Management of Modern Enterprises.   Aeronautical   Manufacturing   Technology,08:40-46. DOI:10.3969/j.issn.1671-833X.2002.08.013

[12]   Ying W. (2022)Innovation in the Integration Model of Industry, University, and Research for the Cultivation of New Business Talents in the Digital Economy Era.Survey of Education,11(10):97-100. DOI:10.16070/j.cnki.cn45-1388/g4s.2022.10.028.

[13]   Hualiang X.(2021)Research on the High Quality Development of China's Manufacturing Industry: Theoretical Logic, Changing Trends, and Policy Guidance - Based on the Perspective of Value Chain Upgrading. Economist.11:52-61. DOI:10.16158/j.cnki.51-1312/f.2021.11.007.

[14]   Anlei J, Binglin Z.(2020) The Situation, Problems, and Paths of Cultivating First Class Engineering and Technical Talents. Journal of National Academy of Education Administration.03:65-70. DOI：CNKI:SUN:GJXZ.0.2020-03-010

[15]   Zhijing Y.(2017)Providing Solid Talent Support for Building a Strong Manufacturing Country - Learning Experience from the "Manufacturing Talent Development Planning Guide". Vocational and Technical Education.06:11-15. DOI:10.3969/j.issn.1008-3219.2017.06.008

[16]   Wei D, Mei Z, Shibin W, Jinhu T.(2018) Analysis and Research on the Matching between the Demand and Cultivation of Skilled Talents in the Intelligent Manufacturing Industry. Research in Higher Education of Engineering.06:131-138. DOI：CNKI:SUN:GDGJ.0.2018-06-024

[17]   Bo Q. (2018)Research on the Path of Innovation and Entrepreneurship Education for College Students from the Perspective of the New Era.Journal of Southwest China Normal University(Natural Science Edition,43(08):143-148. DOI:10.13718/j.cnki.xsxb.2018.08.024.