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Research on the Level of Innovation and Entrepreneurial Ability of University Students in Jilin Province

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Abstract: *This study collected relevant data through a questionnaire survey and used nonparametric testing methods, such as the Wilcoxon signed-rank test and the Kruskal-Wallis test, to examine the difference between innovation and entrepreneurial abilities among university students in Jilin Province. The analysis indicated a significant difference between the students' self-assessed innovation and entrepreneurial abilities. Particularly, their assessment of innovation ability was found to be significantly higher than their assessment of entrepreneurial ability. The study found no significant difference between male and female participants in assessments of their abilities in innovation and entrepreneurship. The analysis revealed significant differences in innovation and entrepreneurial abilities among the age groups represented in the sample. Specifically, the 17-22 age group had the lowest self-assessed scores in both innovation and entrepreneurship. The sample groups at different stages highlighted notable differences in these two areas, with graduates rating themselves higher in innovation and entrepreneurship compared to current students. This suggests that as students gain experience with age and work, their understanding of innovation and entrepreneurship deepens, leading to an increase in their level of innovation and entrepreneurial ability. The current employment picture is relatively grim. To alleviate the employment pressure, universities should strengthen innovation and entrepreneurship education for students, encourage students to innovate and start businesses, and continuously improve the level of innovation and entrepreneurship ability.*

Keywords: *Innovation and entrepreneurial ability; Questionnaire survey; Innovation and entrepreneurship education*

1. Introduction

Given the current context of 'mass entrepreneurship and innovation', it is an important objective of college personnel training to significantly enhance college students' ability to innovate and undertake entrepreneurial activities. Numerous scholars and experts have conducted research on this topic, which mainly covers the following two areas.

Several experts and scholars have investigated the level of innovation and entrepreneurship abilities of college students. Xu W G and Ai X Q (2021) conducted a survey on 972 college students from multiple universities in western China and carried out in-depth interviews with some of them to analyze the current state of college students' entrepreneurship and innovation abilities [1]. Cheng X L and An G (2020) analyzed the current situation of college students' innovation and entrepreneurship ability in Jiangxi Province and proposed to strengthen college students' opportunity recognition ability, improve their organization and coordination ability and management ability, and strengthen their frustration ability [2]. Liu Q and Liu D L (2020) used G University as a sample to investigate the status of innovation and entrepreneurship abilities in college students. They did so by examining five dimensions: professional knowledge, entrepreneurial consciousness, innovative thinking, practical experience, and entrepreneurial skills through a questionnaire survey [3]. A survey conducted by Chen G Z (2019) among college students at the Yancheng Institute of Technology identified that students had different levels of self-cognition about their potential in innovation and entrepreneurship, and they lacked awareness and practical experience, besides weak faculty support [4].

A number of scholars have conducted studies on the methods of cultivating innovation and entrepreneurial abilities in university students. Liu Chang, Xu Y N, and Zhou Y L (2023) analyzed the

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cultivation of innovation and entrepreneurship abilities in university students during the "Internet +" College Students' innovation and Entrepreneurship Competition. The analysis considered four aspects: innovation and entrepreneurship atmosphere as a premise, innovation and entrepreneurship projects as the core, innovation and entrepreneurship teams as the key, and innovation and entrepreneurship mentors as the pillar [5]. The study by Wu Zhantao, Li M, and Yang L F et al. (2022) analyzed how team building, complementarities of team members, leading display of team development, and instructor integration enhance innovation and entrepreneurship abilities of college students in the "Internet Plus" entrepreneurship competition [6]. Wei L G, CAI Q, and Wen J F (2021) suggested that adopting differentiated training strategies for college students based on the background of artificial intelligence can enhance the level of innovation and entrepreneurship among college students of different majors [7].

In summary, several scholars have researched college students' innovation and entrepreneurial skills in their respective universities or regions and have suggested their unique viewpoints and strategies to foster innovation and entrepreneurship abilities at various levels. Nonetheless, there has been little research on the innovation and entrepreneurship skills of Jilin Province university students. Consequently, this study explores the innovation and entrepreneurship abilities of university students in Jilin Province and aims to offer useful insights towards enhancing innovation and entrepreneurship education in universities of Jilin Province.

2. Research methods and research design

This study employs the questionnaire survey method, and the study participants are college students, including those who have already graduated, in Jilin Province. By purchasing the sampling service provided by "Wenjuanxing" platform and precisely collecting data from the study participants, a total of 315 questionnaires were collected, of which 295 were valid.

To examine the differences in innovation and entrepreneurial abilities among various types of sample groups, this paper implements the following research design(Table 1).

Table 1: Research design

No.	Research questions	Groups
1	Are there any differences in the ability of students to be innovative and entrepreneurial?	All samples
2	Are there differences in innovation and entrepreneurial ability between male and female students?	Male
		Female
3	Do students belonging to different age groups exhibit different levels of innovation and entrepreneurial ability?	Age 17 - 22
		Age 23 - 29
		Age 30 - 39
		Age >=40
4	Do differences exist in innovation and entrepreneurial abilities between students in school and graduates?	In school
		Graduates

3. Analysis of the difference between innovation and entrepreneurial ability of students

3.1. Normality Test

To examine the different innovation and entrepreneurial abilities of students, this paper conducted descriptive statistics and normality tests on two sets of survey data. The results are shown in Table 2.

Table 2: Descriptive statistics and normality test

	Mean±SD	Kolmogorov-Smirnov		
		Statistics	Degrees of Freedom	Salience
Self-assessment of innovative abilities	6.68±1.514	.173	295	.000
Self-assessment of entrepreneurial abilities	6.48±1.659	.148	295	.000

a. Rielly's significance correction

The Kolmogonov-Smirnoff (K-S) test in the normality test is applicable to large samples (n > 50),

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and the valid sample size of this survey is 295, so the results of the K-S test are selected. The outcomes reveal that the significance of the normal test is 0.000, which is less than 0.05 for both datasets. Thus, the null hypothesis is rejected, and we contend that assessing the innovation and entrepreneurial skills of students in both datasets does not adhere to a normal distribution. Therefore, the paper employs the Wilcoxon signed-rank test to examine if there is any substantial variance between the two datasets.

3.2. Wilcoxon signed-rank test

Table 3 displays the results of the Wilcoxon signed-rank test, which is utilized by students to assess their personal entrepreneurial and innovation-related aptitudes.

Table 3: Wilcoxon signed-rank test

	Z	P
Self-assessment of entrepreneurial abilities -- Self-assessment of innovative abilities	- 2.659	0.008 **

Table 3 shows that the P-value of the Wilcoxon signed-rank test is 0.008, which is less than 0.01. Thus, rejecting the null hypothesis shows that there's a substantial difference between students' self-assessments of their entrepreneurial and innovational abilities. Table 2 reveals that the students' mean self-assessment of their innovational ability is 6.68, which is higher than their entrepreneurial ability, whose mean value is 6.48.

4. Analysis of differences in innovation and entrepreneurial ability across groups of students

Since the survey data on student assessments of their own innovation and entrepreneurial abilities do not follow a normal distribution, the Kruskal-Wallis test is used in this paper to investigate whether there are significant differences in student assessments of innovation and entrepreneurial ability across groups.

4.1. Grouping by gender

The survey data in the questionnaire were classified by gender and the results are shown in Table 4.

Table 4: Descriptive statistics (by gender)

	Gender (Mean±SD)	
	Male (n = 127)	Female (n = 168)
Self-assessment of innovative abilities	6.76±1.49	6.51±1.61
Self-assessment of entrepreneurial abilities	6.49±1.63	6.27±1.68

Table 4 shows that men assessed their innovation and entrepreneurial abilities higher than women. Additionally, both genders evaluated their innovation skills better than their entrepreneurship skills. Further investigation of whether significant differences exist between the male and female sample populations in evaluating innovation and entrepreneurial abilities is conducted in this paper using the Kruskal-Wallis test. Table 5 displays the results.

Table 5: Kruskal-Wallis test (by gender)

	Self-assessment of innovative abilities	Self-assessment of entrepreneurial abilities
Test statistics	0.449	1.104
Progressive significance (two-sided test)	0.503	0.293

The male and female sample populations showed no statistically significant differences in their entrepreneurial and innovation abilities, as indicated by the Kruskal-Wallis test with p-values of 0.503 and 0.293, respectively. The information is summarized in Table 5. Thus, the null hypothesis is accepted. The findings imply that both genders perceive their entrepreneurial and innovation capabilities similarly, without any noteworthy variations.

4.2. Grouping by age

The survey data has been categorized according to various age groups, and the findings are displayed in Table 6.

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Table 6: Descriptive statistics (by age groups)

	Age (Mean±SD)			
	17 - 22 years old (n = 93)	23 - 29 years old (n = 115)	30 - 39 years old (n = 81)	Age 40 and older (n = 6)
Self-assessment of innovative abilities	6.29±1.691	6.72±1.519	7.06±1.176	6.83±1.472
Self-assessment of entrepreneurial abilities	5.92±1.771	6.45±1.640	7.11±1.294	7.17±1.835

Table 6 shows that the highest score for innovation ability assessment was achieved by the 30-39 age group with an average of 7.06. The 40-plus age group and the 23-29 age group obtained average scores of 6.83 and 6.72, respectively. The lowest average score of 6.29 was recorded for the 17-22 age group. Regarding the evaluation of entrepreneurial ability, the sample groups over 40 and 30–39 years old scored higher, with an average of 7.17 and 7.11, respectively. The sample groups between 23 and 29 years old obtained an average score of 6.45, and groups between 17 and 22 years old ranked last with an average score of only 5.29.

To investigate significant differences in assessing innovation and entrepreneurial ability among sample groups of different ages, this paper uses the Kruskal-Wallis test for further analysis. Table 7 presents the results.

Table 7: Kruskal-Wallis test (by age groups)

	Self-assessment of innovative abilities	Self-assessment of entrepreneurial abilities
Test statistics	10.905	23.119
Progressive significance (two-sided test)	0.012	0.000

According to Table 7, the Kruskal-Wallis test shows a significance of 0.012 and 0.000 for evaluating the innovation and entrepreneurial abilities of the sample groups of different ages, both of which are less than 0.05. As a result, the null hypothesis is rejected, indicating that the sample groups of different ages are significantly different in the assessment of their own innovation and entrepreneurial abilities. Tables 8 and 9 present the results of the inter-group comparison.

Table 8: Inter-group comparison of innovation ability

Sample 1- Sample 2	Standard test statistics	Significance	Adjust significance
Age 17-22 – Age 23-29	-2.106	0.035	0.211
Age 17-22 – Age 30-39	-3.235	0.01	0.007
Age 17-22 – Age 40 and older	-0.984	0.325	1.000
Age 23-29 – Age 30-39	-1.364	0.172	1.000
Age 23-29 - Age 40 and older	-0.288	0.773	1.000
Age 30-39 - Age 40 and older	0.182	0.855	1.000

The Bonferroni correction has adjusted significance values for multiple tests.

From Table 8, it is evident that the only significant inter-group comparison between the sample groups aged 17-22 and 30-39 displayed an adjusted significance below 0.05. This suggests that the differences in innovation ability assessment between the sample groups are primarily apparent in these age groups. No important difference is evident in the results of the innovation ability assessment among the remaining age groups.

Table 9: Inter-group comparison of entrepreneurial ability

Sample 1- Sample 2	Standard test statistics	Significance	Adjust significance
Age 17-22 – Age 23-29	-2.262	0.024	0.142
Age 17-22 – Age 30-39	-4.671	0.000	0.000
Age 17-22 – Age 40 and older	-1.880	0.060	0.361
Age 23-29 – Age 30-39	-2.719	0.007	0.039
Age 23-29 - Age 40 and older	-1.137	0.255	1.000
Age 30-39 - Age 40 and older	-0.193	0.847	1.000

The Bonferroni correction has adjusted significance values for multiple tests.

The adjusted significance of the inter-group comparison between the sample groups aged 17-22 and 30-39, as presented in Table 9, is still less than 0.05. Thus, it indicates that the assessment of entrepreneurial ability is significantly different between these two sample groups. In addition, as shown

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by Table 9, the adjusted significance of the group-to-group comparison between the 23-29 and 30-39-year-old sample populations was 0.039, which is less than 0.05. Therefore, there is a significant difference in the assessment of entrepreneurial ability between these two sample groups. Moreover, no significant difference in the assessment of entrepreneurial ability was observed among the samples of other age groups.

4.3. Group by current stage (in school or graduated)

The survey data is classified and statistically analyzed based on the current stage, and the results are presented in Table 10.

Table 10: Descriptive statistics (by the current stage)

	Current stage (Mean±SD)	
	In school (n=101)	Graduated (n=194)
Self-assessment of innovative abilities	6.36±1.628	6.85±1.426
Self-assessment of entrepreneurial abilities	5.96±1.667	6.75±1.594

Table 10 shows that, on average, graduates evaluate their innovation and entrepreneurial abilities higher than students in schools. Additionally, on average, students scored higher on their ability to innovate than on their ability to be entrepreneurial. The Kruskal-Wallis test was conducted separately on both sets of survey data to determine whether there was a significant difference between the assessment of innovation and entrepreneurial ability at different stages among the sample population. Table 11 presents the results.

Table 11: Kruskal-Wallis test (by the current stage)

	Self-assessment of innovative abilities	Self-assessment of entrepreneurial abilities
Test statistics	7.243	16.389
Progressive significance (two-sided test)	0.007	0.000

Table 11 shows that the Kruskal-Wallis test indicates significant differences in the innovation and entrepreneurial abilities of students at various stages, with p-values of 0.007 and 0.000, respectively, both below 0.05. Thus, we reject the null hypothesis. This indicates that there are significant differences in the self-assessment of innovation and entrepreneurial abilities between the students and graduates of the school.

5. Conclusion

This paper collected relevant data through a questionnaire survey and analyzed the differences in self-evaluation of innovation ability and entrepreneurial ability between paired samples and independent samples by using non-parametric test methods such as the Wilcoxon signed-rank test and the Kruskal-Wallis test, and reached the following conclusions: Through analysis of paired sample differences, we found a significant contrast between self-evaluation of entrepreneurial and innovation abilities in the sample population, with self-reported innovation ability scoring higher than entrepreneurial ability. Analyzing differences amid independent sample results revealed no significant gender-based contrast. Both males and females scored similarly in their self-evaluation of entrepreneurial and innovation abilities. Significant differences in innovation and entrepreneurial abilities were found between different age groups in the samples. Differences in innovation ability assessment were observed in the 17-22 and 30-39 age groups. The sample group aged 30-40 attained the highest mean score, while the 17-22-year-old sample group had the lowest mean score. There is a difference in the assessment of entrepreneurial ability in sample groups between two age ranges: 17-22 and 30-39, and 23-29 and 30-39, where 30-39 age group has the highest mean score. Significant differences were found in the assessment of innovation and entrepreneurial abilities between the students and graduates of the school. The scores of students on innovation and entrepreneurial ability were significantly lower than those of graduates, indicating that the graduates are more innovative and entrepreneurial than the current students. It is apparent that as students gain more age and work experience, they continuously enrich their knowledge and expertise of innovation and entrepreneurship, resulting in an increase in their level of innovation and entrepreneurial ability.

The present employment situation is somewhat challenging due to the influence of the global environment. To alleviate employment burdens for university students, colleges and universities should

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enhance students' innovation and entrepreneurship education. Improvements should focus on enhancing the program, teaching staff, and curriculum system. In addition, universities should incentivize college students to take part in innovation and entrepreneurship contests and community engagement. Successful entrepreneurs should also be invited to hold seminars and presentations on campus to enhance students' experience and augment their knowledge. Lastly, schools and social media should create widespread awareness of governmental policies and programs focused on fostering innovation and entrepreneurship among university students. Additionally, college students should be encouraged to engage in related activities and partake in the current trend of 'mass innovation and entrepreneurship'.

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