

Principal component analysis and multi-dimensional quantitative research on sustainable employability of Chinese liberal arts college students

Dehan Wang^{1, ✉}, Chengjingyu Chen²

¹ China Agricultural University, Yantai, Shandong, 264670, China

² Shandong University of Technology, Zibo, Shandong, 255000, China

ABSTRACT

Purpose – This study aimed to explore the internal structure of sustainable employability of liberal arts college students in China and develop a comprehensive scale to facilitate research on this topic and establish a theoretical framework for cultivating sustainable employability of liberal arts college students in China. **Design/methodology/approach** – Through theoretical derivation and open questionnaire and the Delphi method, the main dimensions of sustainable employability of liberal arts college students are explored. The components elements of each dimension are explored through a text analysis of 189 job advertisements. Through 392 questionnaires and statistical analysis techniques, a scale is developed for measuring the sustainable employability of liberal arts college students. **Findings** – This study found three dimensions characterizing the sustainable employability of liberal arts students in China: attribute characteristics, general ability of employment, and innovation-driven ability. Additionally, the attribute characteristics encompassed five attribute elements, the general employment ability included six, and the innovation-driven ability included four. This study also developed a 34-item scale for measuring the sustainable employability of liberal arts students that demonstrated good reliability and validity. **Originality/value** – This study was among the first to investigate the internal structure of sustainable employability of liberal arts students in China.

Keywords: Sustainable employability; Internal structure; Liberal arts college students

1. Introduction

Today, the globalization of the world, aging, knowledge-based economy, scientific and technological revolution, and multicultural integration have put forward many new requirements on the employability of the modern workforce. The sustainable employability of university students, as a

✉ Corresponding author.

E-mail address: Wangdehan0701@163.com (D. Wang).

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major group in the current and future labor market, is of great significance to the overall development of the country.

Sustainable employability means the necessary conditions for an employed person to be able to obtain meaningful work opportunities with a range of competencies throughout his/her career and to produce valuable contributions through current and future work while safeguarding his/her health and well-being [1]. This requires that the employed person has the employability to work continuously, without change in length of work or change in position, and that this ability is optimized by the phenomenon of continuous improvement. This competency tends to lead to beneficial occupational outcomes such as sustained labor force participation, improved overall personal competence, and more positive, viable, and healthy job opportunities [2-5]. For college students, sustainable employability can help them better adapt to current and future labor market demands, realize their own potential, and make positive contributions to organizations and society. Its characteristics are mainly reflected in the lifelong dimension, high literacy, personality traits, employment orientation, health and welfare protection, and value attributes [6-9]. However, the weak employability and insufficient potential for sustained development of college students is a long-standing problem in the cultivation of talents in higher education in China, which is specifically manifested in the lack of professional competence, weak general ability, low degree of career matching, low degree of social compatibility, and low vocational literacy [10-13]. The role of liberal arts talents on social and economic development is often implicit, and their mission is to manage the society, inherit culture and values, and shape the spirit of the times. As indispensable talents in society, their sustainable employability plays an important role in economic and social development. For this reason, this study conducted a principal component analysis and a multidimensional quantitative analysis of the sustainable employability of Chinese liberal arts college students.

Internships are a common educational model for cultivating students' employability in China nowadays, because they have an all-round enhancement of students' personal abilities, such as innovative thinking, interpersonal communication, independent problem-solving ability, value realization, etc., which improves students' employability and then promotes the sustainability of students' employability [14]. Some studies have shown that some students are resistant to sustainable employability, but their attitudes change when they realize that this ability can be more beneficial in job interviews, especially employability that realizes corporate value [15]. For this reason, schools can incorporate the development of sustainable employability into student training programs in order to achieve better engagement between students, educational institutions, and companies. When there are many factors affecting sustainable employability, students' personal factors and external factors, which need to be analyzed in order to obtain a better training program. Literature [16] by quantitatively analyzing the questionnaire data of students in vocational colleges and universities, the results show that the students choose career direction more course skills are closely related. Similarly, literature [17] utilized descriptive statistics, reliability analysis, and importance performance analysis of three quantitative data analysis to explore the various employment performance of students, which is important for the professional attitude, career planning and professional knowledge have less influence. And the literature [18] analyzed the link between general self-efficacy and employability of economically disadvantaged students, and the results showed that achievement motivation and career aspirations play a positive bridging role between the two. However, these analyses are incomplete, and there are fewer employability analyses, especially for university talents in the liberal arts, which tend to have a more confined employment environment than science students in China. There is a need to understand more about the multidimensional influences on their sustainable employability, as well as the major influences. And principal component analysis can reduce the dimensionality treatment in multiple factors, converting multiple factors into several new variables, but still retaining the information of the original data and better describing the intrinsic factors in the original data [19]. Multidimensional

quantification as the name suggests analyzes the same event from multiple perspectives and levels to get a more comprehensive understanding of the matter. Therefore, this paper adopts principal component analysis and multidimensional quantification for the sustainable employability of liberal arts college students.

Therefore, improving sustainable employability among liberal arts college students is becoming increasingly urgent to ensure their continued employment. However, the existing research has not focused enough on the internal structure of the sustainable employability of liberal arts college students. Therefore, the combined use of theoretical derivation, open questionnaire, the Delphi method, text analysis method and large sample survey is adopted in this research to determine the internal theoretical framework that applies to the sustainable employment ability of liberal arts college students and to develop a scale that can be used to measure this ability. Whether in theory or practice, this study plays a significant role in enriching the research on the topic and promoting the sustainable employment of liberal arts college students.

2. Preliminary construction of the internal structure of the sustainable employment ability of liberal arts college students

2.1. Research purpose

First of all, in line with the existing theoretical research on the employability of college students, the main dimensions of sustainable employability of liberal arts college students are explored through theoretical derivation, open questionnaire survey and Delphi method. Secondly, text analysis is conducted on a large number of employers' recruitment advertisements to explore the components elements of each dimension from the perspective of employers. On this basis, a preliminary internal framework is constructed for the sustainable employability of liberal arts college students.

2.2. Research method and design

2.2.1. To explore the main dimensions of sustainable employability of liberal arts students by theoretical derivation, open questionnaire survey and Delphi method:

1) Theoretical basis. The theoretical basis of this study is detailed as follows:

(1) Parsons' idiosyncratic factor theory. People ought to base their career choice on a full understanding of their own interests, attitudes, abilities, intelligence, limitations and other characteristics. Secondly, they should have a clear understanding not only of the conditions and knowledge required to successfully choose a career, but also the advantages and disadvantages of different occupations and their rewards, opportunities and prospects. Finally, the person-job match can be achieved when the balance of the first two is reached. With regard to career choice, Parsons believes that, first, one should evaluate his or her own ability before making career choice, because the key to career choice is whether the personal characteristics of an individual meet the requirements of a specific industry. Secondly, it is necessary to conduct a career survey, with the emphasis placed on job analysis, such as studying the job situation, visiting the workplace and communicating with employees. Thirdly, job matching should be taken as a target requirement for career guidance. This is the only way to make people adapt to the work and deliver benefits to both individuals and society at the same time.

(2) Behavioral School theory. To a large extent, it is influenced in four aspects. The first one involves genetic factors and special abilities, such as gender, physical quality and intelligence. The other involves environmental conditions and special events, such as training, family conditions and personal experience. The third one involves environmental conditions and special events. The fourth and last one is the ability in terms of career orientation. The combination and interaction of these

four factors exert a profound influence on people in terms of career development and behavior development.

(3) Minnesota Theory of work adaptation. The core idea of work adaptation theory is that career choice or career development is of importance, but post-employment adjustment is more worthy of attention. Everyone endeavors to integrate himself or herself into his or her environment. Satisfaction tends to increase when individual needs are met in the work environment. There is an interactive relationship present between people and work. There is an interactive process involved, whether it is change over time or with the economic conditions required by the individual. If an individual is able to maintain a consistent relationship with the work environment through personal efforts, then the more satisfied the individual is with his job, the longer he will stay in this role.

By applying the above theories, it can be found out that the main focus of prior research on sustainable employability involves three aspects: personal traits, the requisite ability for work, and the ability to adapt to the future development of work.

2) An open-ended questionnaire survey is used to explore the main dimensions of sustainable employability of liberal arts students. In order to further explore the internal structure of sustainable employability among liberal arts college students, the open questionnaire on the sustainable employability of liberal arts college students was compiled in this study to investigate the participants. The question is: "What are the characteristics and abilities of the liberal arts students you are familiar with who have a good career and development?". The subjects are comprised mainly of the college students majoring in liberal arts, the professors working on employment research, the leaders of employers and human resource managers. Among them, there are 30 college students in liberal arts, 10 professors in college employment, 55 leaders and human resources management personnel in employers, which means a total of 95 people. In January 2024, 95 questionnaires were distributed through WeChat, of which 82 were returned.

Text analysis was conducted to analyze the content of the open test questionnaire, with qualitative and quantitative methods mainly adopted.

Category index: The connotation and dimensions of sustainable employability of liberal arts college students.

Coding: In order to ensure the objectivity of the analysis, two-person coding method was applied to code the sample literature. Two people with similar knowledge background were invited to participate in strict coding training and pre-coding. After adjustment, formal coding was performed in line with binary data coding rules.

Reliability: The first one is horizontal reliability, that is, the coding consistency level. In February 2024, Nvivo11.0 software was used to calculate the coding consistency of the two coders, and the coding consistency of all indicators was found to exceed 0.8, as shown in Table 1. The second one is longitudinal reliability, which means that the analysis results obtained each time should be the same or consistent when individual coders use the same category to construct the same content at different times. In order to determine the longitudinal reliability, the two coders conducted a content analysis on the sample literature again from March 19 to 20, 2024, using the same coding scheme and category construction as last time. Through calculation, it was discovered that the longitudinal reliability of all indicators of the two coders exceeded 0.8, as shown in Table 2. Therefore, the longitudinal reliability and horizontal reliability of this study are considered satisfactory.

Validity: In general, the validity of text analysis refers to face validity, which is defined as the logical consistency of the coding system and the clarity of the category definition. According to the relevant theories and previous studies, the categories to be measured are clearly defined in this study, such as the connotation and dimension of sustainable employment ability of liberal arts college students. Also, a detailed coding scheme is developed. Therefore, this study shows high face validity.

The definition category index, coding, reliability and validity of the text analysis are detailed as follows:

Table 1. Consistency level of category and coding

	Category indicators	Level of coding consistency
Range of research	Sustainable employability of liberal arts college students	0.97
Research Topic	The connotation of sustainable employability for liberal arts college students	1
	Dimensions of sustainable employability of liberal arts college students	0.93

Table 2. Longitudinal reliability of coders

	Category indicators	Coder 1 Longitudinal reliability	Coder 2 Longitudinal reliability
Range of study	Sustainable employability of liberal arts college students	0.97	0.98
Research Topics	Connotation of sustainable employability for liberal arts college students	1	1
	Dimensions of sustainable employability for liberal arts college students	0.99	0.98

The results of the content analysis are presented as follows:

Firstly, in the view of college students, the seniors with good employment status usually have good personality characteristics. Personality characteristics are defined as the sum of people's stable psychological characteristics and habitual behavior characteristics. About 80% of the students are first involved in this aspect. Here are some typical answers: "have a good attitude and am optimistic", "I am happy to be with him", "always have a smile on face and willing to help others" and so on. Most college employment professors hold the above opinion as well. In addition to these characteristics, they also believe that the liberal arts students with good employment status are generally sunny, positive, active in study and work, honest, and have good moral character. Employers and HR revealed that they tend to choose students who are "honest, practical, diligent, dedicated, not ambitious and good at controlling their emotions".

Secondly, in the view of liberal arts college students, more than 70% of the seniors with good employment status usually have strong communication skills and teamwork ability, and get along well with teachers and classmates. Also, they can skillfully use all kinds of necessary office software, have strong coordination ability, and are usually more likely to be class cadres. Most college employment professors hold the view that in addition to the above abilities, most of the liberal arts students with good employment status are relatively strong in self-management ability, adaptability, self-planning ability. However, employers and HR pay more attention to the school level and whether they are student cadres, etc., believing that liberal arts students should have strong teamwork ability and communication skills. In addition, almost all employers consider it very important that liberal arts students master professional working skills, have the ability to understand and judge, and adapt to learning. To sum up, the above abilities are the general abilities that liberal arts college students are supposed to have when they expect to find employment. Therefore, those kind of abilities are referred to as general employment abilities.

Thirdly, in terms of continuous employment, in the view of 70% of college students, those liberal arts graduates with good continuous employment status tend to exert a strong influence on others. According to most college employment professors, the liberal arts graduates who can get promoted

or find better employment opportunities tend to have strong innovation, insight and analytical skills. It is believed by all employers and HR that liberal arts graduates should also be able to predict the future, innovate, lead and self-drive for promotion or better job opportunities. It can be seen that the above abilities are the higher requirements on the ability that liberal arts students should have if they expect continuous employment. Therefore, these higher ability requirements that liberal arts students should meet for continuous employment are referred to as innovation-driven ability.

To sum up, the results of the open questionnaire survey show that there are three dimensions included in the internal structure of the sustainable employment ability of liberal arts students: personality factors, general employment ability, and innovation-driven ability. In order to further improve the accuracy of this study, the Delphi method was also used to evaluate the results of this open questionnaire.

3) Delphi method was used to evaluate the results of the open questionnaire. After the internal structure of sustainable employment ability of liberal arts college students was initially constructed according to the results of the open questionnaire, the Delphi method was adopted to conduct expert evaluation. The main method is to collect the opinions of experts by raising questions to the relevant experts through WeChat. After the opinions of experts were collected and summarized, the judgment was made. This process was also carried out in the case of confidentiality, and repeated several times, for the experts' opinions to focus on judgment gradually. After several times of repeated soliciting opinions, the evaluation results were presented by synthesizing and balancing the last different opinions with appropriate methods. In this way, experts can express their own opinions and draw on each other's strengths. Through a thorough analysis of experts' opinions, the one-sidedness in the judgment can be addressed.

In the process of expert evaluation, the following relevant experts were selected, including the general manager and human resources director of Jiangsu Golden Sun, the human resources director of Jincheng Pharmaceutical Group, professors of human resources from Shandong University and Shandong University of Technology, professors of employment research from East China Normal University, and leaders of Shandong Talent Research Center. Despite the difference in their work, the major is focused on human resources management, and closely related to the employment ability of college students, thus ensuring the professionalism and comprehensiveness of the expert panel's evaluation of this issue. Regarding the internal structure of the sustainable employability of liberal arts college students, the above experts put forward relevant opinions and suggestions. They believed that employers also attach much importance to the graduation college level, student Internship experience and cadre experience. The graduation college level, student Internship experience and cadre experience, and personality characteristics are all personal attributes. According to the opinions and suggestions of experts, attribute characteristics, the general ability of employment, and innovation-driven ability are the three dimensions of the sustainable employability of liberal arts college students.

2.2.2. Use of text analysis method to explore the components elements of each dimension of sustainable employability of liberal arts college students:

1) Text acquisition. Since the current employment market of college students has already become a buyer's market where employers are in dominance. As the main users of college students' employment, they know the core content of sustainable employability of college students best. Therefore, the perspective of employers is taken in this study to explore the components elements of each dimension of sustainable employability of liberal arts college students. In total, 198 recruitment advertisements were selected in 2023 and 2024 through the provincial talent network, talent examination information network, the employment information network of universities, and large recruitment websites such as Zhaopin recruitment for liberal arts majors. According to the purpose

of analysis in this study, the text information of recruitment advertisements was further screened, and the samples with repeated expression, incomplete information and minimal description were eliminated. Finally, 189 recruitment advertisements were included in the study.

2) Defined category. Defined category index, coding, reliability, validity and frequency of text analysis
Category index: The connotation, dimension and components elements of each dimension of sustainable employment ability of liberal arts college students.

Coding: Two people with similar knowledge background participated in strict coding training and pre-coding. After adjustment, formal coding was carried out in line with binary data coding rules.

Reliability: The first one is horizontal reliability, In February 2024, Nvivo11.0 software was used to calculate the coding consistency of the two coders, and the horizontal reliability of all indicators was found to reach above 0.8, as shown in Table 3. The second one is longitudinal reliability. The two coders conducted a content analysis on the sample literature again from March 20 to 22, 2024, using the same coding scheme and category construction as last time. It was calculated that the longitudinal reliability of all indicators of the two coders exceeded 0.8, as shown in Table 4. Therefore, this study meets the requirements on both longitudinal reliability and horizontal reliability.

Validity: The validity of text analysis usually refers to face validity. Based on the relevant theories and previous studies, the categories to be measured were clearly defined, such as the connotation, dimension and the ability to include various elements of the sustainable employment ability of liberal arts college students. Also, a detailed coding scheme was developed. Therefore, the face validity of this study is high.

Table 3. Categories and coding consistency level

Category indicators	Level of coding consistency	
Range of research	Sustainable employability of liberal arts college students	0.96
Research Topic	Connotation of sustainable employability for liberal arts college students	1
	Dimensions of sustainable employability for liberal arts college students	0.90
	components elements of the dimensions of sustainable employability of liberal arts college students	0.92

Table 4. Longitudinal reliability of coders

	Category indicators	Coder 1 Longitudinal reliability	Coder 2 Longitudinal reliability
Range of research	Sustainable employability of liberal arts college students	0.98	0.99
Research Topic	Connotation of sustainable employability for liberal arts college students	1	1
	Dimensions of sustainable employability for liberal arts college students	0.98	0.98
	Components elements of the dimensions of sustainable employability of liberal arts college students	0.97	0.98

Frequency: The statistical results of frequency obtained by text analysis method are shown in Table 5 (less frequent elements have been removed).

Table 5. Frequency statistical results of text analysis

Dimensions	Components elements	Frequency
Attribute characteristics	Positive personality	156
	Moral Character	178
	College level	98
	Whether student cadre	145
	Internship experience	155
	Self-planning ability	88
	Communication skills	175
	Adapting and learning ability	108
The general ability of employment	Professional work skills	102
	Teamwork skills	163
	Understanding judgmental abilities	88
	Emotional control ability	66
Innovation-driven capability	Pioneering and innovative ability	78
	Insight and analysis ability	68
	Ability to influence others	38
	Self-driven ability	63

3. Development and reliability and validity analysis of the scale sustainable employability of liberal arts college students

3.1. Research purpose

To develop the scale of sustainable employability of liberal arts college students, questionnaire surveys were conducted on liberal arts college students. Furthermore, the reliability and validity of the scale was analyzed by performing a test on the components elements and items constituting the scale of sustainable employability of liberal arts college students. Thus, a research tool was developed for the subsequent research and practice related to the sustainable employability of liberal arts students.

3.2. Pre-survey

1) Pre-survey questionnaire design. In this study, the sustainable employability scale of liberal arts college students was developed. The pre-survey questionnaire was designed using a 5-point self-assessment scale in which the three elements of "college level", "student cadre" and "internship experience" are not included, because they are category variables. Through Delphi method and text analysis, the reliability and validity of these three elements were ensured. The main sources of other questionnaire items are as follows:

(1) The items were systematically written according to the system architecture of employability and the results of open questionnaire survey and text analysis;

(2) The relevant items were compiled according to the research results of international and domestic scholars;

(3) Lessons were drawn from the current mature psychological scales, such as Cartel and Eisenke personality scale, to compile the related questionnaire items.

Through the above compilation, the initial scale of sustainable employment ability of liberal arts college students was finalized to include 3 dimensions, 13 components elements and a total of 39 items. In the attribute characteristics dimension, there are 2 components elements, involving 6 items. In the general ability of employment dimension, there are 7 components, involving 21 items. In the innovation-driven ability dimension, there are 4 components, involving 12 items. Table 6 shows the details. In the test, the participants were asked to evaluate the degree of conformity between themselves and the description of each item according to their own practicalities. From "complete conformity" to "complete non-conformity", 5-1 points were given respectively. Finally, SPSSAU software was used to conduct data analysis.

Table 6. Item pool of the sustainable employability scale for liberal arts students

Dimensions	Components elements	Items	Description
Attribute characteristics	Positive personality	1	I'm always hopeful about the future
		2	I rarely feel depressed and blue
		3	I am able to maintain a positive mindset despite obstacles or difficulties
		4	I will not accept impropriety
	Moral Character	5	I will prove my innocence when challenged
		6	I am a good role model for others in terms of moral conduct
The general ability of employment	Self-planning ability	7	I have a clear plan for my future
		8	Now I have a clear learning goal
		9	I never felt like I was aimless
	Communication skills	10	I can keep good communication with others and keep abreast of their ideas
		11	When coordinating the interests of all parties, I am able to deal with conflicts and contradictions fairly and reasonably
		12	I am good at using communication skills and tools to improve the efficiency and effectiveness of communication
	Adapting and learning ability	13	I can learn to adapt to a new environment or task in a relatively short time and integrate into it
		14	I have a strong learning ability and can adapt to various changes quickly
		15	No matter what changes I face, I adapt quickly and perform at my best
	Professional work skills	16	I am able to understand the requirements of my job tasks well and complete them successfully
		17	I have fully mastered the professional knowledge related to this major, and can accurately understand and apply it in practical work

		18	I have always been able to do my job with quality and quantity.
	Teamwork ability	19	In a team, I focus on sincerity and trust, and strive to build a deep friendship and cooperative relationship with each other
		20	I am good at building good relationships with different types of people in a team and enhancing teamwork
		21	I will keep in touch with my team members regularly to maintain and develop team relationships
	Understanding and Judgment ability	22	I can deeply analyze the key points of the received information and make an informed judgment
		23	My decisions are usually based on well-informed and rational analysis, not on impulse
		24	I can anticipate the possible consequences of decisions and develop strategies to deal with them accordingly
	Emotional Control ability	25	I am able to control my emotions relatively well
		26	I am also able to maintain a good state of mind in the face of other people's emotional expressions, and take appropriate ways to comfort and guide
		27	I will actively adjust my emotional state and maintain a positive mindset and mood
Innovation-driven ability	Pioneering and innovative ability	28	I have a strong sense of innovation, the courage to try new methods, new ideas
		29	I can be sensitive to changes in the environment and adjust my work strategy in time to cope with changes
		30	I am good at innovation and often come up with creative solutions
	Insight and analysis ability	31	I can predict future trends based on available data and information
		32	When making trend forecasts, I am able to take multiple factors into consideration and avoid one-sidedness
		33	My predictions usually match the reality with some degree of accuracy
	Ability to influence others	34	I think I have some influence and appeal within the organization
		35	My opinions and suggestions can be recognized and trusted by others and have a positive impact on the team and organization
		36	I am able to set an example and motivate others through my actions and performances
	Self-driven ability	37	I am able to adjust strategies and methods based on the results of reflection to achieve continuous improvement
		38	I welcome challenges and see them as opportunities to learn and improve myself
		39	I have always been able to generate inner motivation and maintain high work enthusiasm

2) Content validity analysis of the pre-survey scale. To test the content validity of the measurement items, 5 experts were invited, including 3 Chinese language professors and 2 human resources professors. Firstly, they were asked to score the suitability of each measurement item by understanding the meaning of each dimension and components. From 1 to 3, the suitability of each

measurement item was very high, fair and very low, respectively. According to the score, the items with low score fit were removed from the original item pool. Table 7 lists the scores. The fitness was low as the experts believed that items 25-27 had some duplication with items 1-3. According to the score, items 25, 26 and 27 were removed, and the remaining 36 items were renumbered to obtain an initial scale, as shown in Table 8. These 36 items are consistent with the components elements commonly referred to by the respondents in the open interview and Delphi method, indicating the high content validity of the items in the initial scale. Each item was measured against the 5-point Likert scale to determine the degree of respondents' agreement with each question, with 1 to 5 representing "strongly disagree" and "strongly agree" respectively.

Table 7. Item pool rating table of sustainable employability of liberal arts college students

Item s	Expert 1 Rating	Expert 2 Rate	Expert 3 Rate	Expert 4 Rating	Expert 5 rate	Total score	Whether to delete
1	1	1	1	1	2	6	No
2	1	1	2	1	1	6	No
3	1	1	1	1	2	6	No
4	1	1	1	1	1	5	No
5	1	1	2	1	1	6	No
6	1	1	1	1	1	5	No
7	1	2	1	1	1	6	No
8	1	1	1	1	1	5	No
9	1	1	1	1	1	5	No
10	1	1	1	1	1	5	No
11	1	1	1	1	1	5	No
12	1	1	1	2	1	6	No
13	1	2	1	1	1	6	No
14	1	1	1	1	1	5	No
15	1	1	1	1	1	5	No
16	1	1	1	1	2	6	No
17	1	1	1	1	1	5	No
18	1	1	1	1	1	5	No
19	1	1	1	1	1	5	No
20	1	1	1	1	1	5	No
21	1	1	1	1	1	5	No
22	1	1	1	1	2	6	No
23	1	1	2	1	1	6	No

24	1	1	2	1	2	7	No
25	3	3	2	2	3	13	Is
26	2	2	2	2	2	10	Is
27	3	3	3	2	3	14	Is
28	1	1	1	1	1	5	No
29	1	1	1	1	1	5	No
30	1	1	1	1	1	5	No
31	1	1	1	1	2	6	No
32	1	1	2	1	1	6	No
33	1	1	1	1	1	5	No
34	1	1	1	1	1	5	No
35	1	1	1	1	1	5	No
36	1	1	2	2	1	7	No
37	1	1	1	1	1	5	No
38	1	1	1	1	1	5	No
39	1	2	1	1	1	6	No

Table 8. Initial scale of sustainable employability for liberal arts college students

Dimensions	Components elements	Items	Description
Attribute characteristics	Positive personality	1	I'm always hopeful about the future
		2	I rarely feel depressed and blue
		3	I am able to maintain a positive mindset despite obstacles or difficulties
	Moral Character	4	I will not accept impropriety
		5	I will prove my innocence when challenged
		6	I am a good role model for others in terms of moral conduct
The general ability of employment	Self-planning ability	7	I have a clear plan for my future
		8	Now I have a clear learning goal
		9	I never felt like I was aimless
	Communication skills	10	I can keep good communication with others and keep abreast of their ideas
		11	When coordinating the interests of all parties, I am able to deal with conflicts and contradictions fairly and reasonably
		12	I am good at using communication skills and tools to improve the efficiency and effectiveness of communication

	Adapting and learning ability	13	I can learn to adapt to a new environment or task in a relatively short time and integrate into it
		14	I have a strong learning ability and can adapt to various changes quickly
		15	No matter what changes I face, I adapt quickly and perform at my best
	Professional work skills	16	I am able to understand the requirements of my job tasks well and complete them successfully
		17	I have fully mastered the professional knowledge related to this major, and can accurately understand and apply it in practical work
		18	I have always been able to do my job with quality and quantity.
	Teamwork ability	19	In a team, I focus on sincerity and trust, and strive to build a deep friendship and cooperative relationship with each other
		20	I am good at building good relationships with different types of people in a team and enhancing teamwork
		21	I will keep in touch with my team members regularly to maintain and develop team relationships
	Understanding and Judgment ability	22	I can deeply analyze the key points of the received information and make an informed judgment
		23	My decisions are usually based on well-informed and rational analysis, not on impulse
		24	I can anticipate the possible consequences of decisions and develop strategies to deal with them accordingly
		25	I have a strong sense of innovation, the courage to try new methods, new ideas
Innovation-driven ability	Pioneering and innovative ability	26	I can be sensitive to changes in the environment and adjust my work strategy in time to cope with changes
		27	I am good at innovation and often come up with creative solutions
	Insight and analysis ability	28	I can predict future trends based on available data and information
		29	When making trend forecasts, I am able to take multiple factors into consideration and avoid one-sidedness
		30	My predictions usually match the reality with some degree of accuracy
	Ability to influence others	31	I think I have some influence and appeal within the organization
		32	My opinions and suggestions can be recognized and trusted by others and have a positive impact on the team and organization
		33	I am able to set an example and motivate others through my actions and performances
	Self-driven ability	34	I am able to adjust strategies and methods based on the results of reflection to achieve continuous improvement
		35	I welcome challenges and see them as opportunities to learn and improve myself

		36	I have always been able to generate inner motivation and maintain high work enthusiasm
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3) Pre-survey data collection. Prior to the formal survey, the initial scale was used to conduct a pre-survey on the liberal arts undergraduate students in some universities in Shandong province on March 17, 2024. Among the 178 questionnaires distributed, 168 were returned, and 150 valid questionnaires were obtained. Table 9 lists the sample characteristics. The basic information about respondents to the questionnaire included gender, grade, school type, whether student cadre and internship experience. In terms of gender, 30% of respondents were male and 70% were female. In terms of grade, they are comprised mainly of juniors and seniors." Double first-class" institutions account for 28.667%, and general undergraduate account for 71.333%. In terms of whether student cadre, 28.667% of respondents said yes. In terms of internship experience, 18% of respondents had internship experience. As undergraduates, they have good understanding and ability to answer the questionnaire, thus ensuring the reliability of the questionnaire results.

Table 9. Statistical table of basic information of pre-survey respondents

Sample characteristics	Category	Number	Proportion
Gender	Male	45	30.000%
	Female	105	70.000%
Grade	Sophomore year	15	10.000%
	Junior year	91	60.667%
	Senior year	44	29.333%
College level	"Double first-class" universities	43	28.667%
	General undergraduate (excluding "double first-class")	107	71.333%
Whether student	Universities Yes	43	28.667%
Cadre	No	107	71.333%
Internship experience	Have internship experience	27	18.000%
	No internship experience	123	82.000%

4) Pre-survey reliability and validity analysis. According to the reliability and validity requirements of the developed scale, the pre-survey data were analyzed to obtain the results showing that the factor loading of item 16 and item 20 was lower than 0.4. Therefore, they were removed. After removal, the reliability and validity analysis was conducted again, as shown in Table 10. According to the reliability analysis, the CITC of each measurement item exceeds 0.5, the Cronbach's alpha of each dimension scale reaches above 0.7, and the CR exceeds 0.8, indicating that the sustainable employment ability scale of liberal arts college students not only meets the reliability requirements but also shows high reliability. Therefore, 34 items are included in the formal questionnaire survey.

Table 10. Reliability and validity analysis of the pre-survey of the Sustainable Employability scale for liberal arts college students

Dimensions	Components elements	ItemsFactor loadings	CITC	Cronbach's alpha	CR	AVE	
Attribute characteristics	Positive personality	1	0.631	0.582	0.968	0.789	0.557
		2	0.892	0.515	0.968		
		3	0.579	0.676	0.967		
	Moral Character	4	0.729	0.524	0.968	0.864	0.679
		5	0.826	0.606	0.968		
		6	0.727	0.677	0.967		
	Self-planning ability	7	0.7	0.604	0.9	0.830	0.6

			22		67		22
		8	0.7 72	0.730	0.9 67		
		9	0.4 88	0.566	0.9 68		
the general ability of employment	Communication skills	10	0.5 64	0.747	0.9 67	0.894	0.7 38
		11	0.4 74	0.797	0.9 66		
		12	0.4 11	0.800	0.9 66		
	Adapting and learning ability	13	0.7 09	0.720	0.9 67	0.8920.7 34	
		14	0.7 36	0.710	0.9 67		
		15	0.6 24	0.707	0.9 67		
	Professional work skills	16	0.9 03	0.667	0.9 67	0.846	0.7 38
		17	0.8 21	0.653	0.9 67		
	Teamwork ability	18	0.5 82	0.699	0.9 67	0.720	0.5 62
		19	0.6 43	0.703	0.9 67		
	Understanding and Judgment ability	20	0.5 47	0.731	0.9 67	0.841	0.6 38
		21	0.6 56	0.699	0.9 67		
		22	0.6 93	0.709	0.9 67		
	Pioneering and innovative ability	23	0.6 58	0.744	0.9 67	0.8410.6 39	
		24	0.5 14	0.756	0.9 67		
Innovation-driven ability	Insight and analysis ability	25	0.7 86	0.622	0.9 67		
		26	0.7 08	0.640	0.9 67	0.813	0.5 93
		27	0.4 51	0.638	0.9 67		
		28	0.4 63	0.665	0.9 67		
	Ability to influence others	29	0.6 68	0.617	0.9 67	0.825	0.6 12
		30	0.6 92	0.647	0.9 67		

		31	0.6 41	0.714	0.9 67		
	Self-driven ability	32	0.6 52	0.741	0.9 67	0.868	0.6 88
		33	0.7 55	0.718	0.9 67		
		34	0.6 81	0.715	0.9 67		

Note: N=150, same below.

Secondly, it was determined whether the sustainable employability scale for liberal arts college students is suitable for factor analysis. As shown in Table 11, the KMO value is 0.930, exceeding 0.7. In Bartlett's test of sphericity, its approximate chi-square value is 14235.148, and the significance level is 0.000, which is significant ($P < 0.001$). This indicates the applicability of the sustainable employability scale of liberal arts college students to factor analysis. According to the principal component factor analysis, 12 eigenroots with eigenvalues greater than 0.6 were extracted. They are 16.240, 2.173, 1.541, 1.280, 1.224, 1.090, 0.987, 0.801, 0.698, 0.663, 0.632, and 0.603, respectively. In combination, they explained 82.359% (greater than 60%) of the total variation. The factor loading of each item exceeded 0.6, as shown in Table 12, and the AVE of each dimension reached above 0.5. It illustrates the high construct validity of the scale of sustainable employability of liberal arts college students.

Table 11. KMO and Bartlett's test table of the pre-survey of the Sustainable Employability Scale for liberal arts college students

Kaiser-Meyer-Olkin was used to measure the sampling appropriateness		0.930
Bartlett's test of sphericity	Approximate Chi-square	14235.148
	Df	561
	Sig.	0.00

Table 12. Variance interpretation table of the pre-survey on sustainable employability of liberal arts college students

Factor number	Characteristic root			Rotate the front difference explained rate			After rotation variance explained rate		
	Characteristic root	Variance explained rate %	Cumulative %	Characteristic roots	Variance explained rate %	Cumulative %	Characteristic roots	Variance explained rate %	Cumulative %
1	16.240	47.764	47.764	16.240	47.764	47.764	3.31	9.798	9.798
2	2.173	6.392	54.156	2.173	6.392	54.156	3.296	9.696	19.493
3	1.541	4.531	58.687	1.541	4.531	58.687	2.873	8.449	27.943
4	1.280	3.764	62.451	1.280	3.764	62.451	2.624	7.718	35.661
5	1.224	3.599	66.049	1.224	3.599	66.049	2.504	7.365	43.025
6	1.090	3.206	69.296	1.090	3.206	69.296	2.463	7.245	50.270
7	0.987	2.904	72.160	0.987	2.904	72.160	2.364	6.952	57.222
8	0.801	2.357	74.517	0.801	2.357	74.517	2.297	6.755	63.977
9	0.698	2.053	76.570	0.698	2.053	76.570	2.207	6.490	70.468
10	0.663	1.980	78.550	0.663	1.980	78.550	2.154	6.335	76.803
11	0.632	1.951	80.501	0.632	1.951	80.501	0.934	2.748	79.550
12	0.603	1.858	82.359	0.603	1.858	82.359	0.884	2.601	82.152

3.3. Formal survey

1) Formal survey data collection. In this study, the undergraduate students of liberal arts of some universities are taken as the research object, and the sample universities are located in Shandong province, Beijing and Jiangsu province. Based on the social network constructed by the research team, paper questionnaires were distributed through the QR code of questionnaire star or face to face. Starting from March 25, 2024, a total of 415 questionnaires were distributed. According to the principle of eliminating items and selecting the questionnaires with obvious regularity, the same option for all items and the number of missing items exceeding 15% were checked. Finally, 392 valid sample questionnaires were obtained, with the effective recovery rate reaching 94.46%. In this paper, SPSSAU software was applied to analyze the characteristics of the samples, As shown in Table 13. the basic information about the questionnaire respondents includes gender, grade, school type whether student cadre and internship experience. Among the 392 questionnaires, men account for 33.67% and women account for 66.33%. In terms of grade, most of them are in the third and fourth grade. "Double first-class" institutions account for 27.049%, and general undergraduate account for 72.959%. In terms of whether student cadre, 27.041% of respondents said yes. In terms of internship experience, 20.153% of respondents had internship experience. As undergraduate students, they have a high level of education, which enables them to better understand and answer the questionnaire, thus ensuring the quality of the questionnaire results.

Table 13. Statistics of the basic information of the respondents

Sample characteristics	Category	Number	Proportion
Gender	Male	132	33.673%
	Female	260	66.327%
Grade	Sophomore year	41	10.469%
	Junior year	205	52.296%
	College seniors	146	37.245%
College level	General undergraduate (excluding "double first-class" institutions)	285	72.959%
	"double first-class" institutions	107	27.041%
Whether student cadre	Yes	106	27.041%
	No	286	72.959%
Internship experience	Have internship experience	79	20.153%
	No internship experience	313	79.847%

2) Formal survey reliability and validity analysis. The scale of "sustainable employability of liberal arts students" proposed in this study is of a third-order structure. In this study, standardized analysis was conducted on the three dimensions of sustainable employability of liberal arts students through theoretical derivation, open questionnaire, Delphi method and text analysis method, which ensured the validity of the three dimensions. In this paper, the sustainable employability of liberal arts students is regarded as a first-order factor structure with 12 dimensions to test the reliability and validity.

3) Exploratory factor analysis. In this study, exploratory factor analysis was conducted on the questionnaire data using SPSSAU software to determine the factor structure of the items. As shown in Table 14, the Bartlett test value is 0.000 ($P < 0.001$), and the sample KMO value is 0.964, indicating the applicability of the sample to factor analysis.

(1) As shown in Table 15, a total of 12 factors with eigenvalues greater than 0.53 were extracted, and the 12 factors explained 80.604% of the variance cumulatively.

(2) The factor loading of each item exceeded 0.4.

(3) The cross-loading of each item fell below 0.4.

Reliability is taken as an important index to evaluate the quality of the scale. The reliability coefficient Cronbach's alpha of the overall scale of the sustainable employability Scale for liberal Arts College students is 0.970. According to Table 16, the Cronbach's alpha results of the three dimensions and each components element invariably exceed 0.8, indicating the sufficient scale reliability of the sustainable employment ability scale for liberal arts College students.

Table 14. KMO and Bartlett's test table of the Sustainable Employability Scale for liberal arts College students

Kaiser-Meyer-Olkin measure sampling appropriateness		0.964
Bartlett's test of sphericity	Approximate Chi-square	23965.403
	Df	595
	Sig.	0.000

Table 15. Variance interpretation on sustainable employability of liberal arts college students

Factor number	Characteristic root			Rotate the front difference explained rate				After rotation variance explained rate	
	Characteristic root	Variance explained rate %	Cumulative %	Characteristic roots	Variance explained rate %	Cumulative %	Characteristic roots	Variance explained rate %	Cumulative %
1	18.161	51.888	51.888	18.161	51.888	51.888	3.192	9.121	9.121
2	1.819	5.916	57.084	1.819	5.916	57.084	2.776	7.932	17.053
3	1.384	3.955	61.039	1.384	3.955	61.039	2.673	7.638	24.691
4	1.100	3.144	64.183	1.100	3.144	64.183	2.622	7.490	32.182
5	0.951	2.716	66.899	0.951	2.716	66.899	2.412	6.892	39.074
6	0.911	2.602	69.502	0.911	2.602	69.502	2.352	6.719	45.794
7	0.810	2.315	71.817	0.810	2.315	71.817	2.199	6.282	52.075
8	0.714	2.040	73.856	0.714	2.040	73.856	2.170	6.199	58.275
9	0.671	1.918	75.775	0.671	1.918	75.775	2.147	6.127	64.402
10	0.591	1.690	77.464	0.591	1.690	77.464	2.079	5.940	70.342
11	0.562	1.607	79.071	0.562	1.607	79.071	2.071	5.916	76.258

Table 16. Results of exploratory factor analysis of the Sustainable Employability scale for liberal arts college students

Dimensions	Components elements	Items	Factor loading	CIT C	Cronbach's alpha	CR	AVE	Cronbach's	Alpha
Attribute characteristics	Positive	1	0.614	0.623	0.970	0.793	0.564	0.844	0.970
	Personality	2	0.886	0.395	0.971				
		3	0.581	0.684	0.969				
Moral Character		4	0.836	0.527	0.971	0.858	0.669		
		5	0.762	0.665	0.970				
		6	0.721	0.676	0.970				
The general ability of employment	Self-planning	7	0.812	0.575	0.970	0.831	0.622	0.957	
	Ability	8	0.704	0.661	0.970				
		9	0.680	0.619	0.970				
	Communication	10	0.611	0.755	0.969	0.882	0.713		
	Skills	11	0.639	0.764	0.969				
		12	0.569	0.779	0.969				
	Adapting and	13	0.709	0.747	0.969	0.896	0.741		
	Learning ability	14	0.752	0.742	0.969				
		15	0.665	0.731	0.969				
	Professional work	16	0.886	0.634	0.970	0.931	0.871		
	Skills	17	0.886	0.564	0.970				
	Teamwork ability	18	0.627	0.715	0.969	0.763	0.617		
		19	0.678	0.678	0.970				
	Understanding and	20	0.559	0.745	0.969	0.851	0.656		
	Judgment ability	21	0.653	0.732	0.969				
		22	0.651	0.722	0.969				

Innovation-driven ability	Pioneering and	23	0.712	0.690	0.969	0.848	0.651	0.951	
	Innovative ability	24	0.502	0.777	0.969				
		25	0.671	0.709	0.969				
	Insight and	26	0.642	0.685	0.969	0.847	0.648		
	Analysis ability	27	0.611	0.723	0.969				
		28	0.627	0.732	0.969				
	Ability to influence	29	0.703	0.706	0.969	0.867	0.685		
	Others	30	0.665	0.742	0.969				
		31	0.648	0.746	0.969				
	Self-driven ability	32	0.519	0.775	0.969	0.877	0.705		
		33	0.641	0.772	0.969				
		34	0.705	0.729	0.969				

Note: N=392; $p < 0.001$ for clarity, the values with factor loadings less than 0.4 are not presented

4) Confirmatory factor analysis. In this study, SPSSAU was applied to further test the items and structure of the scale by CFA, the results of which are shown in Tables 16 and 17.

(1) The model fit index is satisfactory. The results of theoretical analysis and factor analysis show the 12-factor model fit of the scale for sustainable employment ability of liberal arts college students proposed in this paper is good. Table 17 lists the CFA results.

(2) The standardized factor loading of the items exceeds 0.5 and reaches a significant extent, $P < 0.001$. The reliability of each dimension components element exceeds 0.7. The average variance extraction (AVE) is higher than 0.5. These results show the satisfactory convergent validity of the scale.

(3) The square root of AVE values of each dimension components element is higher than the correlation coefficients with other dimensions components element, which indicates the adequate discriminant validity of the scale, as shown in Table 18.

Table 17. Model fitting schematic table

Commonly used	χ^2	d f	P	Chi-square degrees of freedom over χ^2/df	GF I	RMSE A	R MR	CF I	NF I	NN FI
Judgement Standard of			<0. 05	<3	>0. 9	<0.10	<0. 05	>0. 9	>0. 9	>0. 9
value	742.6 46	4 61	0.0 00	1.611	0.9 01	0.040	0.0 36	0.9 72	0.9 30	0.9 66

Table 18. Schematic table of discriminant validity of each factor

	PP	MC	SPA	CS	ALA	PWS	TA	UJA	PIA	IAA	AIO	SDA
PP	0.751											
MC	0.436	0.818										
SPA	0.622	0.398	0.788									
CS	0.561	0.663	0.638	0.845								
ALA	0.571	0.552	0.595	0.725	0.861							
PWS	0.399	0.350	0.490	0.505	0.514	0.934						
TA	0.508	0.555	0.520	0.709	0.659	0.561	0.786					
UJA	0.511	0.650	0.557	0.721	0.686	0.525	0.670	0.810				
PIA	0.556	0.560	0.596	0.698	0.677	0.523	0.656	0.700	0.807			
IAA	0.540	0.536	0.548	0.675	0.663	0.508	0.633	0.729	0.762	0.805		
AIO	0.479	0.613	0.569	0.720	0.662	0.510	0.667	0.723	0.702	0.709	0.827	
SDA	0.602	0.616	0.613	0.711	0.696	0.522	0.636	0.728	0.697	0.726	0.726	0.84 0

Note: The diagonal is the arithmetic square root of AVE, $p < 0.001$; PP stands for Positive personality, MC stands for Moral Character, SPA stands for Self-planning ability, CS stands for Communication skills, ALA stands for Adapting and learning ability, PWS stands for Professional work skills, TA stands for Teamwork ability, UJA stands for Understanding and Judgment ability, PIA stands for Pioneering and innovative ability, IAA stands for Insight and analysis ability, AIO stands for Ability to influence others, SDA stands for Self-driven ability.

4. Discussion

4.1. Research conclusion

In this study, the main dimensions of sustainable employability of liberal arts students are explored through a combination of theoretical derivation, open-ended questionnaire survey and Delphi method. With text analysis conducted to analyze 189 job advertisements, the components elements of each dimension of the sustainable employability of liberal arts college students are extracted. It is found out that there are three dimensions of the sustainable employability of liberal arts students: attribute characteristics, the general ability of employment, and Innovation-driven ability. As for the attribute characteristics dimension, it includes positive personality, moral character, college level, whether student cadre and internship experience. As for the general ability of employment

dimension, it includes self-planning ability, communication skills, adapting and learning ability, professional work skills, teamwork ability, understanding and judgment ability. As for innovation-driven ability dimension, it includes pioneering and innovative ability, insight and analysis ability, ability to influence others, and self-driven ability. In this study, a scale of sustainable employability of liberal arts students is developed by referring to previous research and expert interviews, and then optimized through pre-survey. The scale of sustainable employability of liberal arts students includes 34 items. As revealed by exploratory factor analysis and confirmatory factor analysis, the scale has not only reasonable structure but also sufficient reliability and validity, which makes it applicable as a research tool to measure the sustainable employability of liberal arts students in the future.

4.2. *Theoretical value*

In this study, theoretical derivation, open questionnaire, Delphi method, text analysis and questionnaire are used in combination to explore the internal structure of the sustainable employability of liberal arts students. Besides, its main dimensions and components are defined to develop a scale of the sustainable employability of liberal arts students, which provides a research tool to facilitate the research on the sustainable employability of liberal arts students. It enriches the relevant theoretical research on the sustainable employability of liberal arts students.

4.3. *Practical value*

In this study, novel idea and theoretical framework are presented to cultivate and improve the sustainable employability of liberal arts students in colleges and universities, which contributes to continuously improving the sustainable employability of liberal arts students. At the same time, this study provides reference for employers to optimize the post qualifications and competency model for the improve efficiency of recruitment. It also provides ideas for employers to cultivate the sustainable employability of employees.

4.4. *Research limitations and prospects*

By exploring the internal structure of the sustainable employability of liberal arts students, this study determines its main dimensions and the components of each dimension, which leads to some valuable conclusions. However, there remain some limitations that need to be addressed in the future through further exploration. Firstly, this study is only a systematical study on the internal structure of sustainable employability of liberal arts students. In the future, empirical research can be conducted on the sustainable employability of liberal arts students, so as to explore the influence and influencing mechanism of the sustainable employability of liberal arts students among liberal arts students. Secondly, this study focuses narrowly on the liberal arts students from some universities in Beijing, Shandong and Jiangsu in China, which makes it difficult to exclude the regional differences and influences of liberal arts students. It is thus necessary to improve the applicability of the conclusions by further enhancing the universality of samples in future research.

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