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INDICATORS FOR SUSTAINABLE INNOVATION AND ENTREPRENEURSHIP COMPETENCIES AMONG VOCATIONAL ART STUDENTS IN CHINA

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Abstract:
The aim of this study is to construct indicators for assessing sustainable innovation and entrepreneurship competencies in vocational art education in China. Thirty recognised experts were divided equally into two panels, the first of which was required to evaluate and refine the indicators during two rounds of a modified Delphi survey. The second expert panel was required to analyse the relative importance of each indicator level, and based on their results, the indicator weights were determined using the analytical hierarchy process. The experts identified three first-level indicators and thirteen second-level indicators for assessing the sustainable innovation and entrepreneurship competencies of vocational art students in China. The results support the development of students' competencies in sustainable innovation and entrepreneurship education at vocational art colleges.

Keywords: vocational art students, sustainable development, sustainable innovation and entrepreneurship competencies, evaluation indicator system

1. Research Background and Motivation

University students' sustainable innovation and entrepreneurship competencies are key drivers of social and economic development (Rongpipi & Sharma, 2024), which is why the evaluation of these competencies in university students has become an important issue (Chen et al., 2024; Hendriana et al., 2025; Guo et al., 2022; Wang et al., 2023; Wang et al., 2022).

Universities worldwide have currently implemented policies to cultivate talents with innovative and entrepreneurial abilities (Hu Tao & Shen Li, 2013; Ge Hongxiang, 2017; Zhang Chao & Zhang Yuguang, 2017; Leceta & Könnölä, 2019; Medeiros et al., 2020; López-Muñoz et al., 2023). Researchers have demonstrated that the goal of implementing

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innovation and entrepreneurship education is to develop students' capabilities in these areas. This initiative has led to the significant transformation of worldwide traditional professional education and talent cultivation models, thereby promoting innovation and reform in higher education (Medeiros et al., 2020; Chen, 2024). According to current research, the global academic community has paid a considerable amount of attention to constructing evaluation systems for innovation and entrepreneurship education (Wang et al., 2023). As a result, improving the quality of innovation and entrepreneurship education has become a focal point of research, with constructive suggestions proposed in areas like curriculum design, faculty development and institutional support (Dai et al., 2019). However, this academic focus has often neglected the ultimate goal of innovation and entrepreneurship education, which entails the cultivation of students' innovation and entrepreneurship competencies. Due to the underdevelopment of research into the means of evaluating students' innovation and entrepreneurship abilities (Dai & Tang, 2022), issues related to the construction of an evaluation indicator system for the innovation and entrepreneurship competencies of students remain unsolved (Audretsch et al., 2024; Wang et al., 2023).

The theory of sustainable development has introduced a new direction for the development of university education. The growth of innovation and entrepreneurship education has caused an increasing number of scholars to link this topic to sustainable development and to present related research (Chen et al., 2024; Martin et al., 2019). Piccarozzi (2017) points out that the economic, social and environmental sustainability of entrepreneurship is closely related to social innovation. Meanwhile, Kamaludin et al. (2022) emphasise that innovation and entrepreneurship activities could be transformed during the COVID-19 pandemic, due to new collaborations, technological innovations and social innovations, thereby promoting sustainable innovation and entrepreneurship. Wei et al. (2024) propose a combined model for cultivating the sustainable innovation and entrepreneurship competencies of university students under the framework of sustainable education. Sustainable innovation and entrepreneurship are clearly influenced by various factors, all of which have a positive impact on the development of related competencies in students. However, the academic community has thus far only demonstrated the inherent correlation between sustainable innovation and entrepreneurship competencies and their influencing factors from a sustainability perspective. It has not fully addressed these competencies' cultivation and evaluation from the standpoint of innovation and entrepreneurship education.

In 2021, China dispensed the 'Guiding Opinions on Further Supporting College Students' Innovation and Entrepreneurship'. This policy promotes the development of innovation and entrepreneurship education and highlights the importance of reforming higher education to integrate innovation and entrepreneurship throughout all stages of talents' development (State Council Office, 2021). Its goal is to establish a new talent training model that is oriented toward innovation and entrepreneurship. With the support of national policies, innovation and entrepreneurship education has become an important component of China's vocational art education, with students' innovation and

entrepreneurship capabilities serving as critical indicators for evaluating the quality of education (Feng Hui et al., 2024; Yin Wei & Li Haiyan, 2023; Wang Hongcai & Zheng Yaqian, 2022; Luan Haiqing & Xue Xiaoyang, 2022). However, the current innovation and entrepreneurship education in China's vocational art colleges has not fully addressed the establishment of a comprehensive evaluation indicator system for students' sustainable innovation and entrepreneurship competencies (Guo et al., 2023). Although many of China's vocational colleges have implemented innovation and entrepreneurship education, the educational practices they have provided do not meet the specific needs of art students (Wang, 2023). With the rise of China's cultural and creative industries, universities must cultivate vocational art students' sustainable innovation and entrepreneurship capabilities to meet the long-term talent needs of the cultural and creative industries (Paulsen et al., 2024; Li et al., 2022). Therefore, the aim of this study is to construct an indicator system for these competencies, including the determination of indicator weights. On the basis of this research aim, the following research questions are proposed:

1) What are the sustainable innovation and entrepreneurship competencies of vocational art students in China?
2) What are the indicator weights for the sustainable innovation and entrepreneurship competencies of vocational art students in China?

2. Literature Review

2.1 Theoretical Framework

The Triple bottom line (TBL) theory, proposed by Elkington (1997), provides a fundamental framework for achieving sustainability. Also known as the 'three pillars of sustainability' theory, it primarily consists of three aspects: social, environmental and economic bottom lines. The social bottom line is focused on ensuring the basic rights and needs of humanity, including—but not limited to—health, education and employment (Sitnikov, 2013). The achievement of this bottom line is considered to be a key priority for sustainability because it is only when people's fundamental rights and needs are secured that society can be said to maintain stability and sustainable development (Slaper & Hall, 2011). The environmental bottom line emphasises the importance of protecting the natural environment, including reducing pollution, safeguarding ecosystems and making sustainable use of resources. The goal of this bottom line is to ensure that the Earth continues to provide sufficient resources and a healthy ecological environment for future generations (Elkington, 1998). The economic bottom line highlights the need for economic growth and development without having to sacrifice social and environmental well-being. Its aim is to achieve sustainable economic development while meeting social and environmental thresholds (Waris & Ahmed, 2024; Shao et al., 2024). Specifically, the TBL framework emphasises sustainable development goals, advocating for high material living standards, while ensuring equity and integrity to achieve sustainability (Waris & Ahmed, 2024). These goals highlight the deep interconnection between social, economic

and environmental responsibilities, all of which are essential for addressing global environmental crises (Wu et al., 2024).

According to the TBL theory, it is vital to ensure social justice and environmental sustainability when pursuing economic prosperity to achieve overall sustainability This theory has been widely applied in various fields, particularly environmental protection, social welfare and corporate social responsibility (Wackernagel & Rees, 1996). Based on the TBL theory, the sustainable innovation and entrepreneurship competencies of vocational art students are divided in this study into three dimensions: social, economic and environmental, with the aim of exploring the components of these competencies from these three perspectives.

2.2 Sustainable Innovation and Entrepreneurship Competence Indicators

2.2.1 Social Indicators

2.2.1.1 Policy Understanding Ability

Policy understanding ability refers to the capacity to comprehend national policies. Kardos (2012) claims that sustainable innovation and entrepreneurship are integral components of the sustainability support system. For example, policy formulation is used to support sustainable innovation and entrepreneurship activities in European Union countries. Jilin University's micro-speciality in innovation and entrepreneurship management emphasises leveraging the advantages of national innovation and entrepreneurship policies to conduct sustainable innovation and entrepreneurship practices combined with specific academic disciplines (Turner & Gianiodis, 2018). Shkabatur et al. (2021) suggest that it is crucial to provide innovation policies and institutional support in order to foster a thriving ecosystem of innovation and entrepreneurship. Incentive measures that are established by national entrepreneurship institutions can enhance entrepreneurial enthusiasm (Cervelló-Royo et al., 2021). In this context, national policies play a directive role, serving as key factors in guiding national and socio-economic activities, as well as shaping innovation and entrepreneurial activities.

2.2.1.2 Understanding Social Trends

Understanding social trends refers to the ability to comprehend the innovation and entrepreneurship landscape and industry development trends. As highlighted by Khan et al. (2023), with the development of economic globalisation, fluctuations in the capital markets have increased the pressure on new enterprises to survive. Students pursuing sustainable innovation and entrepreneurship may experience significant pressure when faced with intense competition and challenges, which could lead them to fail (Alyahya et al., 2022). The success or failure of sustainable innovation and entrepreneurship is determined by students' ability to recognise the prevailing social circumstances (Fan, 2023). They need to understand the current financial, service and broader social conditions in order to navigate entrepreneurship successfully and ensure the sustainable development of their innovation and entrepreneurship activities.

2.2.1.3 Social Responsibility Ability

Social responsibility ability refers to the capacity to fulfil both profit-driven and legal obligations toward shareholders and employees, as well as the obligations toward consumers, communities and the environment (Lee et al., 2016; Ramos-Monge et al., 2021). In this context, corporate social responsibility underscores the need of enterprises to consider their contributions to the environment, consumers and society as important goals while continuously prioritising human values (Hanachor et al., 2021). Addressing employment issues, adhering to labour laws and providing employees with a positive working environment are critical objectives for activities based on innovation and entrepreneurship (Sreenivasan & Suresh, 2023). Bonfanti et al. (2023) emphasise that actively assuming social responsibility and regarding sustainable development as a strategic objective in business activities are core competencies for enterprises to resolve development issues (Aranibar et al., 2022).

2.2.1.4 Entrepreneurial Development Ability

Entrepreneurial development ability refers to the skills that are necessary to analyse and solve problems within the entrepreneurial process and enhance the value of entrepreneurial activities. Pennetta et al. (2024) link entrepreneurial skill types with entrepreneurial abilities to develop a framework for entrepreneurial capability development. Their research reveals the importance of aligning entrepreneurial skills with entrepreneurial capabilities to foster success. Tootoonchy and Sajadi (2024) propose that the key to entrepreneurial influence lies in the ability to explore innovative opportunities and the capacity for process learning. An entrepreneur addresses entrepreneurial problems, such as identifying opportunities and developing new abilities, in order to achieve entrepreneurial success. Venesaar et al. (2022) indicate that students' entrepreneurial development ability lies in their overall capabilities, problem-solving skills and lifelong learning capacity.

2.2.1.5 Social Practice Ability

Social practice ability refers to the capability to enhance personal hands-on abilities and operational competence. Entrepreneurship is a typical form of social practice, and vocational art students' social practice ability significantly influences their entrepreneurial capabilities (Kocot et al., 2024). Francesco et al. (2021) emphasises that social practice ability is a core competency in urban development roles. It is also one of the key skills being cultivated in the context of innovation and entrepreneurship education for vocational art students.

2.2.1.6 Social Relationship Ability

Social relationship ability refers to the capability to demonstrate interpersonal skills and qualities in social interactions. When individuals establish good relationships with powerful and financially capable organisations (e.g. governments and enterprises), they are likely to receive significant support for their entrepreneurial ventures, thereby

increasing the likelihood of success (Anwar et al., 2020). Middlemiss et al. (2019) also observe that social relationship skills are key competencies for addressing resource poverty.

2.2.2 Economic Indicators

2.2.2.1 Competitive Ability of Business Models

The competitive ability of business models refers to a firm's capacity to leverage a specific operational model to gain profitability and obtain a competitive advantage in the market. The business model holds significant value in a firm's development. Karimi and Walter (2016) assert that disruptive business models are an effective means to break away from traditional company models. Entrepreneurs, who are characterised by their adventurous spirit and proactivity, actively adopt disruptive business models to foster innovation in their firm and enhance their business performance. Similarly, Ghezzi and Cavallo (2020) argue that digital startups must focus on innovative value architecture and business models, particularly in their early stages. Business models are the driving force behind the development of startups and enable them to continuously sustain their entrepreneurial activities throughout a dynamic and changing developmental process (Hall et al., 2020)

2.2.2.2 Market Development Forecasting Ability

Market development forecasting ability refers to the capability to predict the potential for market development by analysing market trends and changes. The ability to understand the direction of market development has a significant impact on customer value and innovation entrepreneurship (Nasution et al., 2011). Dantas et al. (2022) argue that the ability to tap into the potential market is critical for startups. Art students in vocational colleges must possess the ability to forecast market development to better achieve sustainable innovation and entrepreneurship.

2.2.2.3 Marketing Agility

Marketing agility refers to the ability to quickly and keenly respond to changes in the market and marketing plans (Arslan et al., 2024). It is primarily concerned with making decisions in the marketing field, with the main goal of attracting and retaining customers, which has a direct impact on an entrepreneur's revenue (Arslan et al., 2024). Alghamdi and Agag (2023) contend that marketing agility is an important indicator that represents a company's ability to predict and respond to market changes, thereby enabling entrepreneurs to explore how they can seize opportunities and overcome existing challenges, even in resource-constrained situations. According to Sultana et al. (2021), marketing agility is a crucial ability to adapt to the dynamic environment required for innovation.

2.2.2.4 Risk Management and Control Ability

Risk management and control ability refers to the capability of a company to make decisions or control its actions when faced with business risks. Risk management has become one of the most critical abilities that determine the survival or demise of a firm. Rasheed et al. (2024) use the concept of ecological green development to argue that businesses face severe ecological and environmental pressures, and demonstrate how to deal with environmental risk pressure is a key factor in sustainable business development. Hoang and Nguyen (2024) assert that risk management becomes a crucial strategic capability to overcome risks and promote business expansion and operational excellence (Hoang & Nguyen, 2024). Scuotto et al. (2024) suggest that entrepreneurial failure is the result of an inability to identify and effectively manage risks in times of adversity. In the context of sustainable innovation and entrepreneurship, art students in vocational colleges must develop the risk identification ability in the face of various risks.

2.2.2.5 Market Potential Exploration Ability

Market potential exploration ability refers to the ability to identify and assess the market demand within a specific market environment (Berciano et al., 2022) Market competition is becoming increasingly fierce in the context of a global economy, and firms that excel at identifying potential markets are better able to withstand intense competition (Zemtsov et al., 2022). Therefore, art students in vocational colleges who have strong market potential exploration skills must be able to identify potential growth points in products or markets within the art industry in sustainable innovation and entrepreneurial activities.

2.2.3 Environmental Indicators

2.2.3.1 Environmentally-Friendly Production Capacity

Environmentally-Friendly production capacity refers to the ability to use principles of sustainability in order to achieve innovation-driven, low-carbon production (Staniškis, 2012). Sustainable production refers to the capability of an enterprise to manufacture products that meet environmental protection standards (Kumar, 2022). Hua et al. (2023) observe that firms should minimise waste emissions and air pollution during production, as this is one of the environmental responsibilities that firms need to address in their development. Hence, in the process of sustainable development and innovation entrepreneurship, art students in vocational colleges must actively respond to sustainable development and produce artworks that meet environmental standards for long-term growth.

2.2.3.2 Environmental Awareness

Environmental awareness refers to the conscious fulfilment of ecological and environmental protection responsibilities (Hsiao, 2023). It is a critical foundation for entrepreneurs to assume environmental responsibility. Zou (2022) emphasises that graphic design art plays an essential role in serving individuals, society and life. It is

important to integrate artistic concepts, art education, green environmental ideas and sustainable design principles in modern painting and graphic design. This effort should aim to change society and advocate for environmental protection based on the use of design ideas and design functions, thereby realising sustainable lifestyles. Blake and Cock (1987) maintain that there is an intrinsic connection between human beings and the environment, and environmental consciousness must be integrated into educational and practical models in higher education. In the context of art education, this implies embedding environmental consciousness in all aspects, including the creative process and entrepreneurial endeavours, in order to cultivate college students' environmental protection awareness in innovation and entrepreneurship, artistic creation and practices (Staples et al., 2019)

3. Research Design

3.1 Research Methodology

3.1.1.1 Modified Delphi Method

A modified Delphi method is used to obtain a consensus on a set of predictions or evaluations from a group of experts based on a structured iterative process to achieve the primary aim of this research to establish a set of innovation and entrepreneurship capability indicators for art students in vocational colleges (Mani & Bhattarai, 2024). The core of this method lies in gradually reaching an agreement on the key capability indicators through multiple rounds of expert consultations and feedback. In this study, the modified Delphi method is used to achieve consensus on art students' innovation and entrepreneurship capability indicators based on several rounds of expert consultations and feedback.

3.1.1.2 Analytic Hierarchy Process

In this study, the analytic hierarchy process (AHP) is used to construct a multi-criteria analysis model for evaluating the sustainable innovation and entrepreneurship capabilities of art students in vocational colleges. AHP is a multi-criteria decision-making method that is particularly suited for problems that cannot be entirely analysed quantitatively (Michael & Mario, 2022). It relies on the expert judgements of decision-makers to assess the relative importance of the criteria involved, assigning appropriate weights to each decision criterion. The weights are then used to determine the ranking of the alternatives (Michael & Mario, 2022).

3.2 Research Participants

This research is divided into two stages. The modified Delphi method is employed in the first stage, and the AHP is utilised in the second stage. 15 experts are invited to participate in each stage, making a total of 30 experts. The selection of experts and rationale for their numbers are described below.

In the first stage, purposive sampling is employed to form a team of 15 experts. According to Mani and Bhattarai (2024), the optimal number of consulting participants for the modified Delphi method is typically between 15 and 50, and the selected experts should be individuals with considerable experience in the industry. To ensure scientific rigor, the standards for selecting experts in this study are as follows: (1) experience in leading innovation and entrepreneurship education at the institutional level, (2) at least three years of research experience in innovation and entrepreneurship education and (3) experience in leading or substantially contributing to five or more provincial or above-level educational research projects.

The AHP, which is an effective method for constructing indicator weights (Wu et al., 2023) is utilised in the second stage when experts' opinions are crucial to determine the weights of indicators. Hence, when selecting experts, their knowledge, capabilities, and the objectivity of their evaluations should be fully considered. Purposive sampling is used in this study to form a team of 15 experts based on the following criteria: (1) an academic title of at least 'lecturer'; (2) a master's degree holder or higher; (3) expertise in the fields of cultural education, art education and entrepreneurship education, with practical experience in business; and (4) with published influential academic works or significant achievements in entrepreneurial innovation.

3.3 Data Collection and Analysis

3.3.1 First Stage: Research Procedures According to the Modified Delphi Method

In the first survey round, a questionnaire in relation to sustainable innovation and entrepreneurship capability indicators is sent to the experts, and they are invited to rate each indicator based on their professional judgement, with scores ranging from 1 (*very unimportant*) to 5 (*very important*). Next, the expert feedback is summarised, and the average score for each indicator is calculated. The differences in the expert opinions are analysed, paying particular attention to indicators with high consistency or significant divergence.

Following the first round of opinions and feedback, the indicators are adjusted, and a report is prepared, which includes the average scores of each indicator and any areas of disagreement. A second survey round is then conducted, and the revised questionnaire is sent to the same group of experts so that they can reconsider their evaluations after being informed of the others' opinions (Susan et al., 2020). After collecting the feedback from the second round, a data analysis is conducted to identify areas of consensus and divergence. Finally, the expert evaluations are used to construct a set of sustainable innovation and entrepreneurship capability indicators for art students in vocational colleges (Guo et al., 2008).

3.3.2 Second Stage: Research Procedures According to the AHP

Based on the results of the modified Delphi method, a hierarchical structure model for sustainable innovation and entrepreneurship capability is constructed, consisting of three primary indicators and thirteen secondary indicators.

The next step involves constructing a judgement matrix to evaluate the relative importance of each indicator at every level based on pairwise comparisons, quantifying the experts' judgements using a pairwise comparison matrix (Wu et al., 2023). The importance of the evaluation indicators is assigned using a nine-point scale, where 1 indicates equal importance and 9 indicates extreme importance. Each pair of indicators is evaluated to assign a numerical value that represents their relative importance (Lee et al., 2022). The weights are then determined by calculating the eigenvector and maximum eigenvalue of the judgement matrix. After the matrix has been established, its eigenvector and maximum eigenvalue are calculated (Lee et al., 2022) to determine the relative weights of all the indicators. Each element of the eigenvector represents the relative importance of the corresponding indicator in the overall objective. Finally, the comprehensive weight is calculated by aggregating the indicator weights at each level in order to derive the final overall weight.

4. Results and Discussion

4.1 Analysis of Results from Using the Modified Delphi Method

4.1.1 Results of the First Round of the Modified Delphi Survey

The analysis of the data collected from the first round of the expert panel revealed the following: the mode scores for the three first-level indicators of social dimension, economic dimension, and environmental dimension were 4, 4, and 5, respectively. The mean values were 4.27, 4.27, and 4.27, all of which were greater than 3.75; the standard deviations were .799, .799, and .799, all of which were less than 1; the coefficients of variation were .187, .187, and .187, all of which were less than .200; and the absolute differences between the mode and mean values (|M0 - M|) were .270, .270, and .730, all of which were less than 1 (as shown in Table 1). According to the data organised from the first round of the expert panel, no revisions were suggested for the three first-level indicators, and the experts unanimously emphasised the significant importance of these indicators. Therefore, the first-level indicators remain the same.

Table 1: Results of the Content Validity of the First-level Indicators by Expert Panel (First Round)

First-level indicators	M_0	M	SD	CV	$\lvert M_0-M \rvert$	Instructions
Social (A)	4	4.27	.799	.187	.270	reserve
Economic (B)	4	4.27	.799	.187	.270	reserve
Environmental (C)	5	4.27	.799	.187	.730	reserve

4.1.1.1 Second-Level Indicators for the Social Dimension

Based on the survey data from the first round of the expert panel, the second-level indicators identified for the social dimension include Policy Understanding Ability (A1), Situational Awareness Ability (A2), Social Responsibility Ability (A3) and Entrepreneurial Development Ability (A4). The mode scores for the four second-level indicators were 5, 4, 4, and 4, respectively. The mean values were 4.40, 4.20, 4.40, and 4.27,

all of which were greater than 3.75; the standard deviations were .910, .676, .507, and .458, all less than 1; the coefficients of variation were .207, .161, .115, and .107, all of which were less than .200; and the absolute differences between the mode and mean values (|M0 - M|) were .600, .200, .400, and .270, all of which were less than 1 (as shown in Table 2).

The data collected from the first round of the expert panel emphasises that the experts revised the secondary indicators within the social dimension. Expert D1 suggested that 'it is crucial to understand policy, to recognise its importance and possess practical social skills, not just theoretical knowledge'. This expert's comment highlights the importance of practical capabilities, leading to the inclusion of a Social Practice Ability indicator. Expert D11 proposed 'enhancing the observation of social relationships and social forms'. This expert opinion underlined the significance of social relationship abilities.

In summary, revisions to the second-level indicators within the social dimension include the addition of Social Practice Ability and Social Relationship Ability, while other secondary indicators remain unchanged (Table 2).

4.1.1.2 Second-Level Indicators for the Economic Dimension

Based on the survey data from the first round of the expert panel, secondary indicators identified for the economic dimension include Business Model Competitiveness (B1), Market Development Forecasting Ability (B2), Marketing Agility (B3) and Risk Management Ability (B4). The four second-level indicators were 5, 4, 5, and 5, respectively; their means were 4.60, 4.20, 4.40, and 4.60, all of which were greater than 3.75. The standard deviations were .632, .414, .632, and .507, all of which were less than 1. The coefficients of variation were .137, .099, .144, and .110, all of which were below .200. The absolute differences between the modes and the means, $|M_0 - M|$, were .400, .200, .600, and .400, all of which were less than 1 (see Table 2).

The data collected from the first round of the expert panel indicate that the experts had revised the secondary indicators within the economic dimension. Expert D9 suggested 'adjusting the Business Model Competitiveness indicator'. In response to this feedback, the Business Model Competitiveness indicator was revised to Business Development Competitiveness. Experts D13 and D14 proposed the addition of 'Market Potential Exploration Ability' and 'Market Insight' indicators, respectively. The Market Potential Exploration Ability indicator was added based on these suggestions.

Hence, the revisions to the secondary indicators within the economic dimension were as follows: Business Model Competitiveness (B1) was adjusted to Business Development Competitiveness, and a new Market Potential Exploration Ability indicator was added (Table 2).

4.1.1.3 Second-Level Indicators for the Environmental Dimension

Based on the survey data collected from the first round of expert consultations, the second-level indicators identified for the environmental dimension include Environmentally-Friendly Material Creation Ability (C1), Environmentally-Friendly

Production Ability (C2), Environmental Protection Awareness Ability (C3) and Renewable Resource Utilisation Ability (C4). The four secondary indicators were 5, 4, 5, and 4, respectively; the means were 4.53, 4.20, 4.47, and 4.20, all of which were greater than 3.75. The standard deviations were .640, .676, .640, and .561, all of which were less than 1. The coefficients of variation were .141, .161, .143, and .134, all of which were below .200. The absolute differences between the modes and the means, $|M_0 - M|$, were .470, .200, .530, and .200, all of which were less than 1 (see Table 2).

The data collected from the first round of the expert panel reveals that the experts revised the secondary indicators within the environmental dimension. Expert D9 suggested 'removing the Environmentally-Friendly Material Creation Ability'. Hence, the Environmentally-Friendly Material Creation Ability was removed based on this expert's revision. Expert D14 proposed 'merging Renewable Resource Utilisation Ability (C4) with Environmental Protection Production Ability (C2)', as a result of which Renewable Resource Utilisation Ability (C4) was merged with Environmental Protection Production Ability (C2).

In conclusion, the revisions to the secondary indicators within the environmental dimension are as follows: Environmentally-Friendly Material Creation Ability (C1) was removed, and Renewable Resource Utilisation Ability (C4) was integrated into Environmental Protection Production Ability (C2) (Table 2).

Table 2: Results of the Content Validity for Second-level Indicators Revisions by Expert Panel (First Round)

Second-level indicators	**Modified index**	**M_0**	**M**	**SD**	**CV**	**| M0-M|**
Policy Understanding (A1)	Policy Understanding (A1)	5	4.40	.910	.207	.600
Ability to grasp the situation (A2)	Ability to grasp the situation (A2)	4	4.20	.676	.161	.200
Social Responsibility Ability (A3)	Social Responsibility Ability (A3)	4	4.40	.507	.115	.400
Entrepreneurial Development Ability (A4)	Entrepreneurial Development Ability (A4)	4	4.27	.458	.107	.270
	Social Practice Ability (A5)					
	Social Competence (A6)					
Business model competitiveness (B1)	Business model competitiveness (B1)	5	4.60	.632	.137	.400
Market Development Forecasting ability (B2)	Market Development Forecasting ability (B2)	4	4.20	.414	.099	.200
Marketing Agility (B3)	Marketing Agility (B3)	5	4.40	.632	.144	.600
Management Risk control ability (B4)	Management Risk control ability (B4)	5	4.60	.507	.110	.400
	Market potential tapping ability (B5)					
Environmentally-Friendly material creation ability (C1)		4.20	.676	.161	.200	4.20
Environmental production capacity (C2)	Environmental production capacity (C2)	4.47	.640	.143	.530	4.47

Environmental awareness (C3)	Environmental awareness (C3)	4.20	.561	.134	.200	4.20
Renewable resource utilisation capacity (C4)		4.53	.640	.141	.470	4.53

4.1.2 Results of the Second Round of the Modified Delphi Survey

4.1.2.1 Statistical Analysis of the Survey Results

The revised opinions of the first-level indicators proposed by the experts are analysed according to the statistical method of the first round of expert panels. The results show that the scoring modes of the social dimension, economic dimension and environmental dimension are 5, 4 and 4, respectively. The average values were 4.53, 4.27 and 4.47, all greater than 3.75. The standard deviations were .516,.458 and .516, all of which were less than 1. The coefficients of variation were .114,.107 and .115, all of which were lower than .200. The absolute values of the difference between the mode and the mean | M0-M| were .470,.270 and .470, respectively, all of which were less than 1 (see Table 3). At the same time, the score of the second round of expert correspondence was higher than that of the first round. It can be seen that the overall recognition of the first-level indicator experts is very high, which can be higher than that of the first round; hence, the first-level indicator remains unchanged.

Table 3: Results of the Content Validity for First-level Indicators by Expert Panel (Second Round)

First-level indicators	M_0	M	SD	CV	$\lvert M_0-M \rvert$	Instructions
Social Dimension (A)	5	4.53	.516	.114	.470	reserve
Economic dimension (B)	4	4.27	.458	.107	.270	reserve
Environmental Dimension (C)	4	4.47	.516	.115	.470	reserve

4.1.2.2 Analysis of Second-Level Indicators

According to the results of the data presented in Table 4, the scores for the second-level indicators in the social dimension demonstrated high levels of expert agreement and consistency in terms of their opinions. As a result, all these indicators were retained. Similarly, the statistical scores for the secondary indicators in the economic dimension reflected high levels of expert approval and consistency in terms of their opinions, leading to the retention of all of these indicators. For the environmental dimension, the statistical scores also showed high levels of expert approval and consistency in terms of their opinions. Hence, all of these indicators were retained.

Table 4: Results of the Content Validity for Second-level Indicators by Expert Panel (Second Round)

Second-level indicators	M_0	M	SD	CV	$\lvert M_0-M \rvert$
Policy Understanding (A1)	4	4.27	.594	.139	.270
Ability to grasp the situation (A2)	4	4.07	.594	.146	.070
Social Responsibility Ability (A3)	4	4.07	.458	.113	.070
Entrepreneurial Development Ability (A4)	4	4.40	.507	.115	.400

Social Practice Ability (A5)	4	3.93	.458	.117	.070
Social Competence (A6)	4	4.07	.594	.146	.070
Business model competitiveness (B1)	5	4.47	.640	.143	.530
Market Development Forecasting ability (B2)	4	4.13	.516	.125	.130
Marketing Agility (B3)	4	4.13	.640	.155	.130
Management Risk control ability (B4)	4	4.07	.704	.173	.070
Market potential tapping ability (B5)	4	4.20	.561	.134	.200
Environmental production capacity (C2)	5	4.40	.737	.168	.600
Environmental awareness (C3)	4	4.07	.458	.113	.070

4.2 Analysis of Results of the Analytical Hierarchy Process

The survey of the AHP of Chinese art-related higher vocational students' sustainable development and innovative entrepreneurial abilities was based on the revisions summarised through two rounds of the Delphi method consultations. The developed AHP structure and judgement matrix formed the framework for the survey questions. A total of 15 questionnaires were distributed from August 15 to August 30, 2024, all of which were valid, yielding a response rate of 100%. The comprehensive judgement matrix was constructed using the YAAHP software, and the consistency was tested as shown in Table 5.

Table 5: Consistency Indicators of Each Dimension

First-level indicators	Consistency indicators of second-level indicators in each dimension（CI）	Consistency indicators of each dimension（CI）
Social dimension	0.04869	0.0187
Economic dimension	0.04308	
Environmental dimension	0.00000	

A total of 15 experts were invited to participate in this study. Based on the AHP framework for evaluating Chinese art-related higher vocational students' sustainable development and innovative entrepreneurial abilities, these experts analysed and evaluated the various indicators, calculating the corresponding weights. Firstly, the extreme judgement data from the individual judgement matrices of the experts were excluded: the arithmetic mean and standard deviation for each element in the individual judgement matrices of all the experts were calculated. Then, individual judgement information exceeding 2 standard deviations was removed from the arithmetic mean. After the arithmetic mean was recalculated, the revised data served as the expert group's collective judgement for that element, which was then integrated into the collective expert judgement matrix. Next, YAAHP software was used to calculate the maximum eigenvalue and corresponding normalised eigenvector (W) for the judgement matrix, and the consistency of the expert group's composite judgement matrix was tested. Lastly, YAAHP software was used to calculate the weight of each indicator. The results were integrated to form the weight table of the sustainable development and innovative entrepreneurial abilities evaluation indicators of Chinese art-related higher vocational students (Table 6).

Table 6: Indicator Weights and Ranking

First-level indicators	Weight	Sort	Second-level indicators	Weight	sort
Social dimension	0.4502	1	Policy Understanding	.1326	2
			Ability to grasp the situation	.1141	4
			Social Responsibility Ability	.0700	6
			Entrepreneurial Development Ability	.0689	7
			Social Practice Ability	.0403	10
			Social Competence	.0243	13
Economic dimension	0.3943	2	Business model competitiveness	.1518	1
			Market Development Forecasting ability	.1110	5
			Marketing Agility	.0629	8
			Management Risk control ability	.0441	9
			Market potential tapping ability	.0244	12
Environmental dimension	0.1555	3	Environmental production capacity	.1190	3
			Environmental awareness	.0365	11

5. Discussion

5.1 Objectives of Cultivating Chinese Art Higher Vocational Students' Sustainable Innovation and Entrepreneurship Ability

This paper initially constructs the index of Chinese art students in higher vocational colleges' sustainable innovation and entrepreneurship ability based on the literature review. After revising the Delphi Method questionnaire, the opinions of 15 experts are solicited and their suggestions are revised to form an index system of Chinese art higher vocational students' sustainable innovation and entrepreneurship ability. Finally, the AHP questionnaire is used to evaluate the weights of the first and second indices in the index system of Chinese art higher vocational students' sustainable innovation and entrepreneurship ability. They all passed the consistency test of hierarchical analysis and the weights of the indicators of sustainable innovation and entrepreneurship ability of Chinese art higher vocational students are clarified. The index system of Chinese art higher vocational students' sustainable innovation and entrepreneurship ability is then constructed, including 3 first-level indicators and 13 second-level indicators.

The social dimension of the first-level indicators includes six second-level indicators, namely, policy understanding ability, social situation grasp ability, social responsibility ability, entrepreneurial development ability, social practice ability and social relationship ability. According to the triple bottom line theory, the social dimension is a key practice for enterprises to fulfil their social responsibility and a key measure to promote the sustainable development of enterprises (Jha & Aggrawal, 2020). The embodiment of Chinese art higher vocational students' sustainable innovation and entrepreneurship ability is bound to realise entrepreneurial enterprises' goal of social responsibility, so that social responsibility can be better taken as one of the operational goals of enterprises (Lu et al., 2019). Entrepreneurial enterprises lack competitiveness in general; hence, entrepreneurs need to have a deep understanding of national policies and industry policies, an accurate grasp of the social development situation and industry

development trend, and the ability to maintain a good competitive relationship with the government and peer enterprises in order to promote the sustainable development of entrepreneurial enterprises (Amir et al., 2022).

The economic dimension of first-level indicators includes five second-level indicators: business model competitiveness, market development forecasting ability, marketing agility ability, management risk control ability and market potential mining ability. According to the triple bottom line theory, the economic dimension is an important manifestation of enterprises' internal governance (Shao et al., 2024). Enterprises' ability to develop internal governance is particularly important, which is why the economic dimension of the index of Chinese art higher vocational students' sustainable innovation and entrepreneurship ability is constructed in this study, with the aim of equipping the art higher vocational students with the internal governance ability of a sustainable enterprise by cultivating such internal governance abilities as the business model, market development, marketing, risk control and market mining.

The environmental dimension of the first-level index includes 2 second-level indicators: environmental protection production capacity and environmental awareness capacity. Environmental responsibility is an important embodiment of enterprises' sustainable development strategy, which not only involves the inevitable requirement of the green and sustainable development of the country, but also the internal driving force of the sustainable development of enterprises themselves. Entrepreneurial enterprises must actively fulfil their environmental responsibility to achieve sustainable development. (Maalouf, 2024) The triple bottom line theory emphasises that fulfilling environmental responsibility is a sustainable practice that is based on green value and is an important measure for enterprises to reduce risks and costs (Lotfi et al., 2018). Therefore, the environmental dimension of Chinese art higher vocational students' sustainable innovation and entrepreneurship ability index is constructed in this study. Art higher vocational students are equipped with environmental awareness, which enables them to fulfil their environmental responsibilities in terms of entrepreneurship activities and innovation by cultivating environmental awareness.

5.2 Establishment of Chinese Art Higher Vocational Students' Indicators of Sustainable Innovation and Entrepreneurship Ability

According to the research results, the weights of the first index of Chinese art higher vocational students' sustainable innovation and entrepreneurship ability are from high to low in the social dimension (.4502), economic dimension (.3943) and environmental dimension (.1555).

It can be seen that most of the experts believed that the sustainable innovation and entrepreneurship ability should take the social dimension as the main content, and that innovation and entrepreneurship time activities could only be better realised with high social ability. Zhang (2022) pointed out that innovation and entrepreneurship are a kind of socialisation behaviour of college students, and their ability to socialise has a positive impact on their entrepreneurial ability. This can reflect the core ability of the sustainable

innovation and entrepreneurship of art higher vocational students, including their social ability, that is, how to use their personal social ability to achieve sustainable innovation and entrepreneurship activities in the social process.

With the development of a social economy, Chinese art students will face more severe economic competition in terms of innovation and entrepreneurship. This also highlights the importance of Chinese art students' sustainable innovation and entrepreneurship ability in the economic dimension. Tao and Zhuang (2023) pointed out that the ability to withstand pressure and risk will affect entrepreneurs' decisions and activities. Chinese art higher vocational students will face huge risks when employing innovation and entrepreneurship in a severe economic situation, and their ability to withstand pressure and risk will determine their decision-making and the effectiveness of their sustainable innovation and entrepreneurship activities. Manea et al. (2021) observed in his study that the application of a circular economy and business model will have an impact on the support for sustainable innovation and entrepreneurship development and provide new learning opportunities.

Similarly, although the environmental dimension has a low weight value, it is also an important reflection of Chinese art vocational students' sustainable innovation and entrepreneurship ability. With the high-quality development and construction of an ecological civilisation, the world pursues a goal of coordinated governance of energy conservation, environmental protection, pollution reduction and carbon reduction, all of which require art sustainable innovation and entrepreneurship activities to pursue the principles required to develop an ecological civilisation. According to Peng (2022), the development of an ecological environment is currently the focus of governments and the high attention of society; hence, it is necessary to cultivate students' concept of developing an ecological environment in innovation and entrepreneurship education, and use innovative education to train innovative talents to solve ecological environment problems. College students' innovation and entrepreneurship activities have a huge role to play in the ecosystem, and a symbiotic relationship has been established between universities and ecosystem agents, emphasising the mutual effect of the coordination of environmental policy and innovation and the practice of entrepreneurship management strategies (Paola et al., 2021).

6. Conclusion

The intention of this study is to form an evaluation tool for Chinese art higher vocational students' sustainable development innovation, and entrepreneurship ability based on the evaluation index system of the Chinese art higher vocational students' sustainable development innovation, and entrepreneurship ability. The ability level test is conducted, and the Chinese art higher vocational students are classified according to their stage and relevant dimensions in order to provide feasible guidance for Chinese art students to undertake innovation and entrepreneurship education. The evaluation index system of Chinese art higher vocational students' innovation and entrepreneurship ability for

sustainable development generally builds and expands the connotation and standard knowledge system of students' innovation and entrepreneurship ability for sustainable development, thereby providing an operable tool for diagnosing the ability of art higher vocational students to use innovation and entrepreneurship for sustainable development.

7. Recommendations for Future Research

In future studies, the Chinese art higher vocational students' sustainable innovation and entrepreneurship ability index may be further divided into grades, and the evaluation index system of the sustainable innovation and entrepreneurship ability of Chinese art higher vocational students in different grades may be divided according to the course content, ability training objectives and professional skills training of different grades. This will achieve the assessment of students of different grades to have the ability to use sustainable innovation and entrepreneurship in order to solve the current ecological problems in the environment.

Conflict of Interest Statement

The authors declare no conflicts of interest.

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