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Research on the Influencing Factors of Kite Culture Inheritance Based on an Adversarial Interpretive Structure Modeling Method

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ABSTRACT The influencing factors of kite culture inheritance form a complex system that is influenced by many factors, such as the inheritance mode, audience preferences, communication mode and social environment, and the influencing factors are plentiful and nonlinear. In this paper, we use the literature search method and Delphi method to determine the set of influencing factors and clarify the direct binary relationships between each of them. Based on the results of these methods, the Adversarial Interpretive Structure Model (AISM) is modeled and used, and the AISM model with a cause-effect reachable hierarchy is obtained by comparing the directed topological diagram of a pair of up and down diagrams and conducting a comprehensive analysis of the influencing factors of kite culture inheritance. Finally, the validity of the model is proved through the project practice of talent training in the National Art Foundation of China. The results of this study show the following: policies and regulations and product characteristics are the root cause elements affecting the inheritance of intangible cultural heritage.

INDEX TERMS Kite culture, intangible cultural heritage, AISM, directed topology.

I. INTRODUCTION

Intangible cultural heritage (hereafter referred to as ICH) is defined by the UNESCO Convention. Intangible culture heritage refers to the various practices, performances, forms of expression, systems of knowledge and skills, as well as related tools, objects, crafts and cultural places that are regarded as their cultural heritage by various groups and sometimes even individuals. In the context of global economic integration in the 21st century, cultural homogenization and heterogeneity have led people to focus on the issue of preserving cultural diversity, and then the idea of "intangible cultural heritage preservation" has begun to spread. Under the strong advocacy and active promotion of UNESCO for the protection of ICH, China formally acceded to the convention for the safeguarding of Intangible cultural heritage in 2004, thus started a series of active exploration and practice of ICH, and made great significant progress in the reform of governmental institutions, the improvement of laws and regulations, the perfection of policies, and the deepening of concepts, and took a path of ICH protection with Chinese characteristics [1]. As of December 2013, the total number of items selected for UNESCO's Intangible Cultural Heritage List has reached 37, making China with the largest number of selected items in the world. Our country attaches great importance to the protection of intangible cultural heritage. On May 20, 2006, the kite making technique was approved by the State Council to be included in the first batch of national intangible cultural heritage list(Note: Kite making techniques (Weifang kite, Nantong board harrier kite, Lhasa kite), selected as national intangible cultural heritage list, No. VIII-88, Region: Jiangsu, Shandong, Tibet. The national

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FIGURE 1. Left: Kite wall painting and kite making craft studio in Beijing hutong; Right: Yangjiang ganoderma kite with rattan bow. Source of the picture: Photo by the author.

level is evaluated once every two years. Zhang's kite making skills" in Xi'an is listed as the second batch (2009) of intangible cultural heritage in Shaanxi Province; Beijing kite is the third batch (2011) of national intangible cultural heritage; Bianjing Song room kite is listed as the fourth batch (2015) of intangible cultural heritage in Henan Province;).Kites, as one of the objects of intangible cultural heritage protection in China, the characteristic kite making skills in different places are selected to be represented in the list of each level of protection. On the other hand, kites are also concerned by sports ICH because of their sporting characteristics of flying and running [2].

With the creation of industrial products and new toys, mechanized mass production and cheap kites flooding the market, the kite non-foreign heritage is facing the dilemma of losing traditional handicraft skills and the lack of inheritors. As a provincial intangible cultural heritage, the Yangjiang kite culture has great historical and cultural values, and how to inherit and innovate the traditional kite skills is a research topic worthy of in-depth exploration by intangible cultural heritage workers. At present, there are few studies on the influencing factors of kite culture inheritance, and these factors are typically systematically constructed into a hierarchical model to analyze the relationships among the influencing factors. The studies on this method are based on a large amount of questionnaire data used to derive the influencing factors of kite inheritance, such as inheritance mode, audience preference, dissemination mode, social environment, etc.; and then these data are used to construct an index evaluation system and fuzzy score for each evaluation factor to obtain comprehensive evaluation results [3]–[5]. To achieve this purpose, this paper uses the Adversarial Interpretive Structure Modeling Method (AISM), gradually forms a hierarchical structure model to understand the key factors and the hierarchical structure of the elements that influence kite culture heritage, and proposes ideas for the heritage and promotion of kite culture. In this way, we can understand the key factors and the hierarchical structure of kite culture and propose ideas and countermeasures to inherit and promote kite culture.

The interpretive structure model (ISM) was proposed by Professor J. Warfield in 1973 and is mainly used to analyze the constituent elements of complex systems and their interdependencies and interconstraint relationships [6], [7]. The basic principle of the ISM is to decompose the constituent elements of a complex system into several subelements. After a series of topological operations, a single hierarchical diagram is derived in a result-oriented manner, and the hierarchical diagram is arranged into a multilevel recursive structure from top to bottom; i.e., a cause-effect reachable sequence is obtained from the cause-effect approach and expressed in a hierarchical directed topological diagram. Huang [8] proposed various improved ISM methods and introduced the idea of game confrontation in game theory in the Game Interpretive Structure Modeling Method (GISM). Yingchun [9], when studying causality analysis, applied the Game Interpretive Structure Modeling Method (ISM) with game characteristics to the management concept of "simplifying complex problems". Xilin [10] stated that topological hierarchical diagrams (also called the Haas diagram technique) are a subset of the ISM. Topological hierarchy diagrams have many applications in comprehensive evaluations. Brüggemann *et al.* [11], [12] systematically introduced the principles of topological hierarchical graphs in his two books and gave a large number of application examples. Peng *et al.* [13] added a virtual sample based on objective criteria to a sample and then used topological hierarchical graphs to solve and refine the sample ranking. From the topological hierarchy diagram and its effectiveness in evaluating applications in related fields, it is feasible to apply the method to discuss the complex issue of cultural inheritance. This paper further explores the complex factors affecting kite inheritance that were previously fuzzy and disordered using this method and constructs an ordered, hierarchical, and causal topology for complex factors to provide a topological model for kite cultural inheritance.

II. INFLUENCING FACTORS IDENTIFICATION AND INDEX SYSTEM CONSTRUCTION

To construct the kite influence factor evaluation index system, the first step is to read and organize the related literature, the second step is to identify the word frequency clouds from the 267 collated documents using word frequency analysis, and the third step is to filter out the 16 main influencing factors from the 38 collated kite culture inheritance influencing factors using the Delphi method.

A. INVESTIGATION AND RESEARCH ON THE FACTORS INFLUENCING THE INHERITANCE OF KITE CULTURE

As mentioned above, the influencing factors of kite culture inheritance form a complex system, which is influenced by many factors such as inheritance methods, audience preferences for dissemination, the social environment, etc. The influencing factors are plentiful and nonlinear.

Using the literature search method, the relevant research results at home and abroad, and the Delphi method, the set of influencing factors is determined and the direct binary relationship between each influencing factor is clarified.

To select the influencing factors of kite culture inheritance, the author organized and extracted the relevant literature. For example, the representative study is Shunchang [14] that studied the concept and connotation of non-posthumous living state protection, historical laws and domestic and foreign practice. He summarized the influencing factors of cultural heritage: the technology and techniques of the ICH, the expression form of the ICH, the cross-border cooperation of the ICH, the social recognition of the ICH, the dissemination mode of the ICH, and the degree of connection between ICH and life. Zemei [15], based on the original "sports-like" study, took the obstruction of folk sports culture transmission, the convenience of the transmission site space, financial support, research enthusiasm, human resources, and people's consciousness of protection as the factors affecting the transmission of ICH culture. Zhenjun [16] believed that the main problem in the transmission of ICH is the transmission method. Hui [17] explored the development and utilization of intangible cultural heritage based on the perspective of the cultural industry and found that the materials of intangible heritage, design innovation and development, and the combination with modern scenes are the factors influencing the inheritance. Ling and Feng [18], by combing and summarizing the literature, concluded that the cultivation of social life, the power of school education, and the use of modern new media are important factors influencing the inheritance of cultural heritage and also stated that intangible cultural heritage inheritors are an important cultural factor to accomplish this mission. Li [19], [20] analyzed the industrial development, commercial operating awareness, inheritance laws, protection of inheritors, protection and management, and protection and development as important influencing factors that promote the inheritance of intangible cultural heritage from the perspective of the "invisible" hand of the market. Guoyong and Tao [21] analyzed the actual problems of sports intangible cultural heritage development based on the background of "national fitness" and concluded that a series of factors such as excessive commercialization, weak awareness of laws and regulations, the construction of a public sports culture service system, a lack of inheritors and related education, the protection of intellectual property rights, and the cultivation of inheritors are all important factors affecting intangible cultural heritage. Genetic heritage is an important factor. Bei [22] investigated and analyzed the protection, inheritance and development of intangible cultural heritage using a field survey and sorted and summarized the five major factors influencing the protection and development of intangible cultural heritage, which are regional culture, local management, the depth of knowledge of inheritors, communication media, and reasonable resource development.

FIGURE 2. The "Word Frequency Cloud" is generated from 267 research results on the inheritance of kite culture from the CNKI Archive from 2013 to 2020.

B. DETERMINATION OF THE EVALUATION INDEX SYSTEM OF THE INFLUENCING FACTORS OF KITE CULTURE INHERITANCE

1) COLLATION OF LITERATURE DATA TO IDENTIFY THE INITIAL LIST OF FACTORS INFLUENCING KITE CULTURE HERITAGE

In order to more comprehensively find out the influencing factors of kite culture inheritance, this paper mainly refers to the literature as above14-22 and a total of 267 research literature on kite culture inheritance at home and abroad from 2013 to 2020 using word frequency analysis [23], and statistically identifies a total of 38 possible influencing factors in kite inheritance, as shown in Table 1; Figure 2 shows the generated "word frequency cloud".

2) DELPHI METHOD

The Delphi method [24], which is a feedback anonymous correspondence method, was founded by the RAND Corporation in the United States in 1946. This method solicits experts' opinions in several rounds, collects statistical opinions, gives anonymous feedback to experts on the statistical results of the previous round in each round, and finally obtains unanimous opinions.

The four steps of the Delphi method.:

a: DETERMINE THE PURPOSE OF THE SURVEY AND PREPARE AN OUTLINE OF THE SURVEY

First, it is necessary to define the objectives and develop a detailed outline of the questions to be answered by the experts, and at the same time provide them with relevant background materials, including descriptions of the purpose and duration of the projection, the method of completing the questionnaire and other desired requirements.

b: A GROUP OF EXPERTS FAMILIAR WITH THIS ISSUE WAS SELECTED. 10 EXPERTS WERE SELECTED FOR THIS STUDY, INCLUDING EXPERTS IN VARIOUS ASPECTS OF THEORY AND PRACTICE

Above (Table 1) 38 influencing factors of kite culture inheritance, in order to further screen out the main influencing

TABLE 1. Statistics of the studied factors influencing kite culture heritage.

NO.	Factor name	NO.	Factor name	NO	Factor name
1	Internet Promotion	14	Literacy level of the heir	27	Geographical areas of transmission
2	Regional culture	15	Details and quality of products	28	Spatial accessibility of heritage sites
3	Public opinion	16	Conservation measures of the inheritors	29	Difficulty of research
4	Lack of education for heirs	17	The degree of connection between intangible cultural heritage and life	30	Lack of creative talent
5	Industrial development	18	Techniques and craftsmanship of intangible cultural heritage	31	Age of the audience
6	Ability to lead apprentices to pass on their skills	19	Platform construction	32	Ability to lead apprentices to pass on their skills
7	Expressions of Intangible Cultural Heritage	20	Radio and Film	33	Financial support
8	Cultural level of the audience	21	Impact of foreign cultures	34	Diversity of Intangible Cultural Heritage
9	Awareness of conservation	22	Human Geography	35	Lack of talent in traditional skills
10	Differences in cultural beliefs	23	Derivative Product Development	36	Social Adaptability of Intangible Cultural Heritage
11	Limitations to its own development	24	Market prospects	37	School Education
12	Museum displays	25	Differences in preferences	38	Scientific and technological innovation
13	Legal Policy	26	Practical skills of intangible cultural heritage inheritors		

factors, a total of 10 experts, including kite culture inheritance related research scholars, kite inheritors, government staff and university teachers, were organized, and the basic information of experts (Table 2).

c: SEND A QUESTIONNAIRE BY CORRESPONDENCE TO EACH SELECTED EXPERT FOR COMMENTS

A team of experts was formed to distribute the questionnaire (Table 3); the kite intangible cultural heritage impact correlation score was derived (Figure 3).

TABLE 2. Basic information of the research experts.

Work area	Number of people	Title, Education	Relevant field work years (years)
Kite culture researcher	2	1 professor, 1 doctor	8
Kite inheritors	3	1 bachelor's degree	20
Government workers	4	3 master's degrees, 1 bachelor's degrees	5
High school teachers	1	1 professor, 1 doctor	10

TABLE 3. Kite intangible cultural heritage impact relevance score (partial questionnaire statistics).

NO.	Factor name (Relevance)	0	1	2	3	4	5	6	7	8	9	10
1	Internet Promotion	○	○	○	○	○	○	○	○	○	○	○
2	Regional culture	○	○	○	○	○	○	○	○	○	○	○
3	Public opinion	○	○	○	○	○	○	○	○	○	○	○
4	Lack of education for heirs	○	○	○	○	○	○	○	○	○	○	○
5	Industrial development	○	○	○	○	○	○	○	○	○	○	○
6	Ability to lead apprentices to pass on their skills	○	○	○	○	○	○	○	○	○	○	○
…	…	..	…	…	…	…	…	…	…	…	..	…
36	Social Adaptability of Intangible Cultural Heritage	○	○	○	○	○	○	○	○	○	○	○
37	School Education	○	○	○	○	○	○	○	○	○	○	○
38	Scientific and technological innovation	○	○	○	○	○	○	○	○	○	○	○

d: THE RETURNED COMMENTS WERE SUMMARIZED AND SYNTHESIZED, QUANTITATIVELY STATISTICALLY ANALYZED AND THEN SENT TO THE EXPERTS CONCERNED, AND EACH MEMBER RECEIVED A COPY OF THE QUESTIONNAIRE RESULTS

After the 38 factors were extracted and discussed by the experts, the factors with the same meaning and context were deleted, merged and summarized into 16 factors; and the

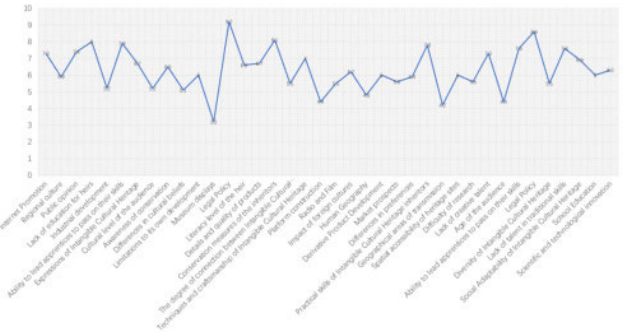

FIGURE 3. Kite intangible cultural heritage impact relevance score.

influencing indicators were divided into four categories: non-legacy, inheritance of human beings, audience and social environment (Table 5).

i) THE INTANGIBLE HERITAGE CATEGORY

Contains five specific indicators: the process, material and technical characteristics of intangible heritage skills; the developmental limits of intangible cultural heritage; the expression forms of intangible cultural heritage; the dissemination methods of intangible cultural heritage; and the value creation that intangible cultural heritage can bring.

ii) THE INHERITANCE OF HUMAN BEINGS

Includes four specific indicators: the lack of inheritors, the ability of inheritors themselves, the social status of inheritors, and the cultural adaptability of inheritors and society.

iii) THE AUDIENCE CATEGORY CONTAINS

Three specific indicators: the cultural level of the audience, the differences in the preferences of the audience, and the conservation awareness of the audience.

iv) THE SOCIAL ENVIRONMENT

Contains four specific indicators: the corresponding policies and regulations, the current level of social development, the cultural impact from internal and external sources, and the influence of the transmission area.

III. AISM MODELLING OF THE FACTORS INFLUENCING KITE CULTURAL HERITAGE

The core method of this paper is to introduce the adversarial idea on top of the result-oriented hierarchical ranking rules of the ISM, add the cause-oriented ranking rules that are opposite to the ISM ranking rules, and place the elements from the bottom to the top to find the cause-effect reachable sequence using results and causes to build a set of directed topological diagrams that are opposite of the ISM ranking rules. Compared with text, tables and mathematical symbols, the AISM is very intuitive and clear in its presentation of results. The AISM considers the influencing factors as nodes and identifies the nodes with causal relationships using directed line segments. In the directed topological hierarchy diagram, if an element can be in different topological levels, it is called an active element. A system with active elements is called an extension variable system, which is also called an active system or a topological active system; and a system without active elements is called a rigid system, which is also called a topological rigid system. In a directed graph, if there is at least one back path between two vertices, it is said that the two vertices are strongly connected. Strongly connected means that there is a path from v1 to v2 and a path from v2 to v1 between any two points v1 and v2 in a directed graph. If the AISM directed graph is strongly connected, then any two nodes are mutually reachable, so it must be possible to make a loop through all points in the graph [25]. The modeling rational of the AISM is the existence of at least one loop in the directed topological hierarchical graph, and this inverse solution sorting comparison process is called the AISM (Adversarial Interpretive Structure Modeling Method) [26]. The AISM may not be consistent with the internal relationships of factors and the directed topological hierarchy diagram obtained due to different ordering rules. By comparing a set of up and down diagrams of directed topological diagrams in a comprehensive manner, the influencing factors of kite culture inheritance are analyzed comprehensively to determine the correlation and hierarchy among the influencing factors and determine the influencing relationship among factors. The basic process of constructing the model according to this is shown as follows.

$$A \xrightarrow{A+I} B \Rightarrow R \Rightarrow \{UP \,|DOWN\,\} \Rightarrow An$$

A is the adjacency matrix, B is the multiplication matrix after joining the unit matrix ($B = A + I$), R is the reachable matrix, S is the skeleton matrix after reducing the edges, and UP/DOWN is a set of advisory directed topographies.

A. BUILDING AN ADJACENCY MATRIX

According to the 16, influencing factors for transmitting kite culture in Table 1, the internal relationship between the influencing factors is determined by expert scoring, Then an adjacency matrix is constructed, as shown in equation (1). Based on this assignment rule, an adjacency matrix is constructed, as shown in Table 4.

$$aij = \begin{Bmatrix} 0 & i \neq j \\ 1 & i = j \end{Bmatrix} \tag{1}$$

B. BUILDING AN REACHABLE MATRIX

The reachable matrix is a matrix format that describes the extent to which the path between the nodes of a directed connection diagram can be reached after a certain length of the passage. For an arbitrary original matrix, the reachability matrix is calculated as follows.

$$B = A + I \tag{2}$$

where B is the multiplication matrix, i.e., the diagonals all have 1 added to obtain their value; I is the unit matrix; and

TABLE 4. Adjacency matrix.

	S_1	S_2	S_3	S_4	S_5	S_6	S_7	S_8	S_9	S_{10}	S_{11}	S_{12}	S_{13}	S_{14}	S_{15}	S_{16}
S_1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1
S_2	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
S_3	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
S_4	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0
S_5	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0
S_6	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
S_7	0	1	1	1	1	1	0	1	0	0	0	0	0	0	0	0
A= S_8	0	0	0	1	1	1	0	0	0	0	0	0	0	0	0	1
S_9	0	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0
S_{10}	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0
S_{11}	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0
S_{12}	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
S_{13}	0	0	1	1	1	0	0	1	1	1	0	1	0	1	0	1
S_{14}	0	0	1	1	1	0	0	1	1	1	0	1	1	0	0	0
S_{15}	0	0	0	1	0	0	0	0	1	0	0	0	0	1	0	0
S_{16}	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0

multiplying B together gives the reachable matrix.

$$B^{k-1} \neq B^{k-1} = R \tag{3}$$

From this, the reachable matrix R is shown in Table 6.

C. CALCULATION OF THE GENERAL SKELETON MATRIX

A reduction from the reachable matrix means that the loop in the reachable matrix is treated as a point and is called a reduction. This results in the reachable matrix R', R' is then used for the indentation operation, essentially removing duplicate paths.

$$S' = R' - (R' - I)^2 - I \tag{4}$$

R' is reduced to give S', the skeleton matrix; and the circuit elements are substituted back to give S. S is the general skeleton matrix shown in Table 7.

D. TIER EXTRACTION

For a reachable matrix, there is a reachable set R, a prior set Q, and a common set T, where $T = R \cap Q$. In the case of a relational matrix A, for example, for its element ei, the following exists:

① All the elements of an element that correspond to a row value of 1 are called reachable sets $R = (e_i)$.

② All the elements of an element with a corresponding column value of 1 are called the prior set $Q(e_i)$. The common set of the reachable set $R(e_i) \cap Q(e_i)$ and the prior set is called $T(e_i)$.

The extraction method is as follows:

TABLE 5. Evaluation index system of the influencing factors of kite culture heritage.

Indicator categories	Indicator names	Indicator symbols	Indicator contents
Intangible cultural heritage	Product characteristics	S_1	The identity of the heritage itself, including the detailed quality of the product, the technology and the craftsmanship
	Development limitations	S_2	Difficulty/heat of researching intangible cultural heritage and limitations of own development
	Content forms	S_3	Manifestations of intangible heritage
	Propagation methods	S_4	Cross-border cooperation and diverse means of dissemination of intangible cultural heritage
	Value creation	S_5	Industrialization/rational resource development of intangible cultural heritage and commercial operations
Heirs	Lack of heirs	S_6	Lack of creative design talent and endangered heritage
	inheritance capacity	S_7	Practical skills of heirs, apprentice capacity, and legacy approach
	Social status	S_8	Social status of heirs
	Cultural adaptability	S_9	Cultural adaptation of the heirs, lack of relevant education and depth of knowledge
Public	Cultural levels	S_{10}	Differences in social awareness, the public's cultural level, and cultural beliefs of intangible cultural heritage
	Preferred differences	S_{11}	'live' experiences and preferred differences of the public
	Protective awareness	S_{12}	Protection awareness of the public
Social context	Policies and legislation	S_{13}	Concerned support, financial support, and guidance of government policy
	Social development	S_{14}	Modernity Transformation, Market Prospects, and Scientific and Technological Innovation
	Cultural shock	S_{15}	Social progress and the Western cultural impact
	Dissemination areas	S_{16}	Accessibility of heritage sites and geographical scope of dissemination

1) UP-TYPE TOPOLOGICAL HIERARCHY DIAGRAM

The up hierarchy is also known as result-first hierarchy extraction. The rule is as follows: $T(e_i) = R(e_i)$. The essence of this method is to extract the elements of the final result in the system, place them on the top layer, and then extract them by analogy.

2) DOWN TOPOLOGICAL HIERARCHY DIAGRAM

The hierarchy extraction rule method for cause is as follows: $T(e_i) = Q(e_i)$. The essence of this method is that the elements of the system that are the root causes are first extracted, placed at the bottom of the hierarchy, and then extracted by analogy. The hierarchy extraction process is shown in Table 8. The results are shown in Table 9.

TABLE 6. Reachable matrix.

R=

	S_1	S_2	S_3	S_4	S_5	S_6	S_7	S_8	S_9	S_{10}	S_{11}	S_{12}	S_{13}	S_{14}	S_{15}	S_{16}
S_1	1	1	1	1	1	1	1	1	1	0	1	0	0	1	1	1
S_2	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0
S_3	0	1	1	0	0	1	0	0	0	0	1	0	0	0	0	0
S_4	0	1	1	1	1	1	0	0	0	0	1	0	0	0	0	0
S_5	0	1	1	0	1	1	0	0	0	0	1	0	0	0	0	0
S_6	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0
S_7	0	1	1	1	1	1	1	1	1	0	1	0	0	1	1	1
S_8	0	1	1	1	1	1	1	1	1	0	1	0	0	1	1	1
S_9	0	1	1	1	1	1	1	1	1	0	1	0	0	1	1	1
S_{10}	0	1	1	0	1	1	0	0	0	1	1	1	0	0	0	0
S_{11}	0	1	0	0	0	1	0	0	0	0	1	0	0	0	0	0
S_{12}	0	1	1	0	1	1	0	0	0	0	1	1	0	0	0	0
S_{13}	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
S_{14}	0	1	1	1	1	1	0	0	0	0	1	0	0	1	0	0
S_{15}	0	1	1	1	1	1	1	1	1	0	1	0	0	1	1	1
S_{16}	0	1	1	1	1	1	1	1	1	0	1	0	0	1	1	1

TABLE 7. General skeleton matrix.

S=

	S_1	S_2	S_3	S_4	S_5	S_6	S_7	S_8	S_9	S_{10}	S_{11}	S_{12}	S_{13}	S_{14}	S_{15}	S_{16}
S_1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
S_2	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
S_3	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
S_4	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
S_5	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
S_6	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
S_7	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
S_8	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
S_9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
S_{10}	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
S_{11}	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
S_{12}	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
S_{13}	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0
S_{14}	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
S_{15}	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
S_{16}	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0

TABLE 8. Adversarial hierarchy extraction process.

Up type topology hierarchy extraction process			Down type topology hierarchy extraction process		
i	$R(Si)$	$T(Si)$	i	$Q(Si)$	$T(Si)$
S_1	1, 2, 3, 4, 5, 6, 7, 8, 9, 11, 14, 15, 16,	1, 7, 8, 9, 15, 16	S_1	1	1
S_2	2, 6	2, 6	S_2	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16	2, 6
S_3	2, 3, 6, 11	3	S_3	1, 3, 4, 5, 7, 8, 9, 10, 12, 13, 14, 15, 16	3
S_4	2, 3, 4, 5, 6, 11	4	S_4	1, 4, 7, 8, 9, 13, 14, 15, 16	4
S_5	2, 3, 5, 6, 11	5	S_5	1, 4, 5, 7, 8, 9, 13, 14, 15, 16	5
S_6	2, 6	2, 6	S_6	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16	2, 6
S_7	2, 3, 4, 5, 6, 7, 8, 9, 11, 14, 15, 16	7, 8, 9, 15, 16	S_7	1, 7, 8, 9, 13, 15, 16	7, 8, 9, 15, 16
S_8	2, 3, 4, 5, 6, 7, 8, 9, 11, 14, 15, 16	7, 8, 9, 15, 16	S_8	1, 7, 8, 9, 13, 15, 16	7, 8, 9, 15, 16
S_9	2, 3, 4, 5, 6, 7, 8, 9, 11, 14, 15, 16	7, 8, 9, 15, 16	S_9	1, 7, 8, 9, 13, 15, 16	7, 8, 9, 15, 16
S_{10}	2, 3, 5, 6, 10, 11, 12	10	S_{10}	10, 13	10
S_{11}	2, 6, 11	11	S_{11}	1, 3, 4, 5, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16	11
S_{12}	2, 3, 5, 6, 11, 12	12	S_{12}	10, 12, 13	12
S_{13}	2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16	13	S_{13}	13	13

TABLE 8. *(Continued.)* **Adversarial hierarchy extraction process.**

S_{14}	2, 3, 4, 5, 6, 11, 14	14	S_{14}	1, 7, 8, 9, 13, 14, 15, 16	14
S_{15}	2, 3, 4, 5, 6, 7, 8, 9, 11, 14, 15, 16	1, 7, 8, 9, 15, 16	S_{15}	1, 7, 8, 9, 13, 15, 16	1, 7, 8, 9, 15, 16
S_{16}	2, 3, 4, 5, 6, 7, 8, 9, 11, 14, 15, 16	1, 7, 8, 9, 15, 16	S_{16}	1, 7, 8, 9, 13, 15, 16	1, 7, 8, 9, 15, 16
Extract 2 and 6, place the upper layer and continue to extract after deleting			Extract 1and 13, place the lower layer and continue to extract after deleting		
	Draw step by step			Draw step by step	
Extract 7, 8, 9, 15, and 16, place the upper layer and continue to extract after deleting			Extract 11, place the lower layer and delete it and continue to extract		
S_1	1	1	S_2	2, 6	2, 6
S_{13}	13	13	S_6	2, 6	2, 6
Extract 1and 13, all elements are extracted			Extract 2 and 6, and all elements are extracted		

TABLE 9. **Adversarial hierarchy extraction results.**

LEVELS	Results First - Type UP	Reason First - type DOWN
LEVEL1	S_2、S_6	S_2、S_6
LEVEL2	S_{11}	S_{11}
LEVEL3	S_3	S_3
LEVEL4	S_5	S_5
LEVEL5	S_4、S_{12}	S_4
LEVEL6	S_{10}、S_{14}	S_{12}、S_{14}
LEVEL7	S_7、S_8、S_9、S_{15}、S_{16}	S_7、S_8、S_9、S_{10}、S_{15}、S_{16}
LEVEL8	S_1、S_{13}	S_1、S_{13}

E. MAPPING THE DIRECTED TOPOLOGICAL HIERARCHY

According to the relationship between elements and the result of confrontation hierarchy extraction, the directed topological hierarchy diagram can be drawn. The reachable relationship between the influencing factors of kite inheritance culture is represented by the directed line segment, and the two-way arrows in the diagram indicate the formation of a circuit, that is, the mutual reachable relationship, Furthermore, the lower layer indicates that the influencing factors have a root, and the upper layer factors indicate the result. the UP type and DOWN type directed topological hierarchy diagram is shown in Figure 4.

IV. AISM MODEL ANALYSIS AND SUMMARY

In the up and down pair of hierarchical topology diagrams (Figure 4, respectively), there is an orderly placement from

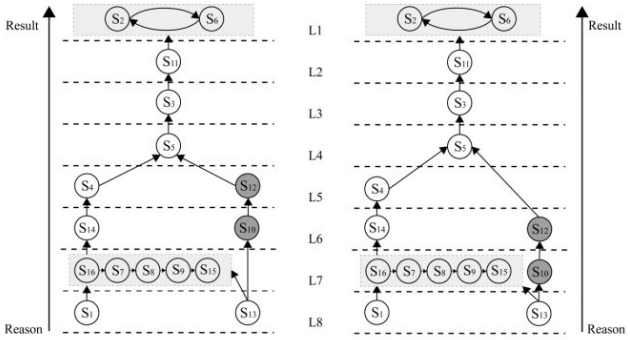

FIGURE 4. UP type (left) and DOWN type (right) directed topology hierarchy diagram.

cause to effect from bottom to top. The element of the root cause is the element for which only the emitting arrow exists. and it is calculated as the concatenation of the bottommost elements $\{S1, S13\} \cap \{S1, S13\} = \{S1, S13\}$. Similarly the final result element is the concatenation of the uppermost elements $\{S2, S6\} \cap \{S2, S6\} = \{S2, S6\}$. In the following, we will analyze 1) the root cause element set, 2) the intermediate element set, and 3) the result element set, respectively.

A. ANALYSIS OF THE ROOT CAUSE ELEMENT SET

As shown in Figures 4, the root cause element set of product characteristics (S1) and policies and regulations (S13), which are at the bottom of the system and are not affected by other factors, can directly or indirectly affect other factors within the system. The root cause factor is in the dominant position in the system, and its influence on kite culture inheritance is the most important. That is, the characteristics of nonlegacy products, related policies and regulations as the root cause will eventually lead to the top-level intangible cultural heritage development limitations (S2) and the lack of inheritors (S6) results.

B. ANALYSIS OF THE MIDDLE ELEMENT SET

The intermediate factor set, i.e., accepting the bottom-level cause factor set, sends upward arrows to influence the upper-level factors. As shown in Figures 3 and 4, this factor set spans 6 levels with a total of 12 factors. There are 2 points of particular concern.

First, there are 5 elements that belong to the same L7 level: transmission territory (S16), transmission ability (S7), social status (S8), cultural adaptability (S9), and cultural shock (S15). This indicates that these 5 elements have interrelated relationships.

By assessing the hierarchical abstraction process, it is found that 2 elements underwent a jump in hierarchy, cultural level (S10). and conservation awareness (S12); and their hierarchies jumped from L7 ➡ L6 and L6 ➡ L5, respectively. In addition, as mentioned earlier, these 2 elements are active elements, thus indicating that the system is an active system, i.e., a topologically variable system. Additionally, from the second table, it is clear that the system has unstable and variable characteristics influenced by the 2 elements of the cultural level and conservation awareness.

C. ANALYSIS OF THE OUTCOME FACTOR SET

As shown in Figures 4, it is clear that there are two loops here for the set of outcome factors located at the topmost level: development limitations (S2) and a lack of inheritors (S6). Loops are important indicators of the rationality of AISM modeling, and the fact that these two factors form loops in the directed topological hierarchy diagram indicates that the model is mutually reachable and rational. The mutual reachability relationship also indicates that the developmental limitation of the ICH and the lack of inheritors are mutually influencing relationships. I.e., the developmental limitation of the NRM will lead to the lack of inheritors; conversely, the lack of inheritors will affect the development of the NRM.

D. SUMMARY

Through the above modeling analysis, we derived a causal reachable model with an 8-level structure. The root cause element set at the bottom will eventually lead to the result of the top element set, the hierarchy from the bottom to the top indicates the importance of each element set in the causal system, and the element sets at the same level have interrelated relationships.

Kite culture heritage is the result of the interaction of many factors. Previous studies by scholars mainly focus on the influence of different inheritance and transmission methods on the inheritance effect, but they ignore the interrelationships and hierarchy among different factors; therefore, it is difficult to form an overall understanding of kite culture inheritance. Based on this, this paper uses the confrontation explanation structure model method to divide the 16 factors of 4 categories that affect kite culture heritage into 8 levels and then categorizes the factors of 8 levels into 3 element sets (root cause element set, intermediate element set and result element set). This is done to analyze the hierarchical relationship among the factors and the degree of influence on kite culture heritage.

The analysis of the root cause factor set is as follows: product characteristics (S1) and policies and regulations (S13) are the fundamental factors that lead to the limitation of the development of the ICH (S2) and the lack of inheritors (S6). When the root factors are effectively improved, they will lead and boost the factor sets at each level and lead to good results. At each level of intermediate factors, there are juxtapositions and leapfrogging relationships among the factor sets, indicating the interrelated effects and unstable relationships among complex factors. In other words, in the process of the decomposition and boosting of "causes", there is a need to have a state of "synergistic advancement" among the element sets to eventually lead to good "results". To check the validity of this model, the following will be demonstrated and discussed in the practical project led by the author.

V. PRACTICAL PROJECT JUSTIFICATION AND DISCUSSION

A. BACKGROUND OF THE PROJECT

The author launched an in-depth communication and exchange with the inheritors of Yangjiang kites in 2018. With the researcher of the NRM and the organization of the inheritors (Yangjiang Kite Association), applied to the National Art Foundation of China for the "ICH Talent Training" project and received project grants. The project broke the geographical boundaries of the inheritors' area and recruited students from neighboring provinces and cities, as well as other regions in China, with special kites. The program attracted 24 students from 7 provinces in China who are interested in kite flying and have higher education and an innovative spirit. The participants are all under 45 years old and have educational backgrounds in arts and crafts, design, physical education, and computers. Their occupations include cultural museum researchers; university, middle school and elementary school teachers; the inheritors of kite genres from other provinces and cities; sports kite enthusiasts; etc. The trainees left their jobs in July 2019 and converged from all over the country to complete a 50-day professional training course at the Kite Museum in Yangjiang, Guangdong Province. The teachers were taught by Yangjiang kite inheritors, teachers of nonheritage culture research, innovation design and other disciplines.

B. PROJECT PRACTICE

In the project practice (Figure 5), the trainees sought to integrate new techniques (such as paper carving, embroidery, computer painting, LED lights, luminous materials, etc.) into the traditional craft production on top of learning the traditional techniques, which preserved the continuity of the ICH culture while enriching the expression and subject matter content of the traditional techniques. In addition, the participants combined the intangible cultural heritage with their own professional work. For example, those in the teaching profession combined the intangible cultural heritage culture with the school's art craft and design courses. Furthermore, the cultural museum researchers provided intangible cultural heritage experience courses to the community citizens and displayed the intangible cultural heritage publicity release activities to the public in multiple frequencies and scenes in their professional work so that more audiences could experience the cultural charm of intangible cultural heritage. The students from new media industry used micro-blog and WeChat public number as the communication platform to tell the history and culture of kites in China and Yangjiang with the title of "Mankind and the sky are connected by kite strings" by cartoon.

The project has not only received financial support from the National Arts Foundation of China, but has also received academic support from relevant nonheritage cultural research workers at the author's university and strong support from the provincial and municipal government departments, industry associations and inheritors where Yangjiang kites are located. The inheritance and collision between the inheritors of Yangjiang kites and the participants with good education and different professions from various places have created kite categories with the characteristics of the times. However, the 24 trainees have their own jobs and the 50 days of

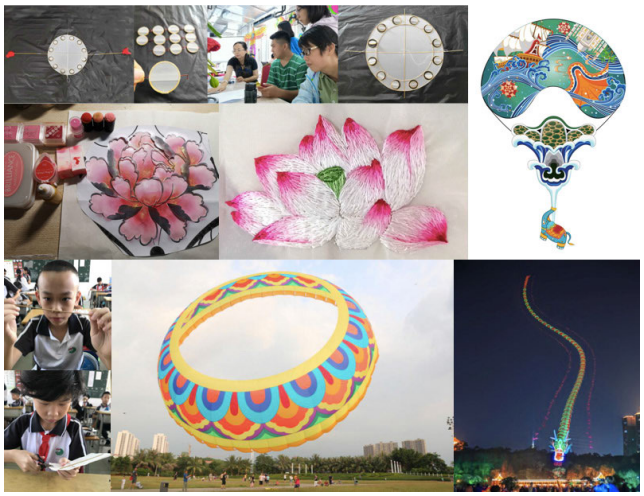

FIGURE 5. Works of the participants of the National Arts Foundation Yangjiang Kite Technique Inheritance and Innovation Talent Training Project conducted by Liu Zhiming, Huang Yongyang, Liu Haidan, Chen Yanfei, Kuang Yuan and Zhou Xiaoyi (organizers of the intangible cultural heritage in Schools).

training cannot fully grasp the essence of the intangible cultural heritage skills. Nevertheless, this kind of training project breaks the single way of family inheritance and broadens the audience of intangible cultural heritage. Students with professional backgrounds as teachers and cultural librarians can also spread out in wider fields in their daily work.

C. PROJECT PRACTICE AND THE EFFECTIVENESS OF THE AISM MODEL

The practice of this practical project reflects the validity of the AISM causality reachable hierarchy model. That is, with the support of national policy, the innovative intangible cultural heritage products generated through the collaboration of all parties will eventually break the limitation of intangible cultural heritage and will attract more people to join the team of the inheritors' study. In addition, when the state vigorously conducts activities to protect the ICH, it will attract more social forces to intervene, and the public will pay more attention to cultural heritage, thus enhancing the awareness of protecting the ICH.

As times change, the mission of cultural inheritance is to maintain cultural diversity, which is extremely different from commercial products. Thus, the attention of the state, government, and society to cultural heritage is a fundamental factor in whether the ICH culture can be passed on and carried forward. Under the external environment flooded with industrialized production and fashionable products, how to continue the vein of intangible cultural heritage with the help of new materials and technologies, how to integrate intangible cultural heritage into the lives of modern people, and how to prevent intangible cultural heritage from being eliminated are the fundamental factors to promote the development of intangible cultural heritage. However, traditional skills are the product of history and are influenced by many factors, such as the cultural impacts and cultural adaptability of the new era. Therefore, with the resources of all parties in society and continuous promotion, reform and innovation, we can inherit and carry forward the non-posthumous culture.

Therefore, in the AISM cause-effect reachable hierarchy, each element is interrelated and mutually promoted as a causal relationship.

VI. CONCLUSION

In this paper, using the many elements influencing kite culture heritage and on the basis of the ISM result-oriented hierarchical ranking rules, a pair of up and down hierarchical topology diagrams is established by adding the cause-oriented ranking rules opposite to the ISM ranking rules, and the AISM model of cause-effect reachable hierarchy is derived. The model shows the following: policies and regulations and product characteristics are the fundamental elements affecting intangible cultural heritage; and when the fundamental factors are effectively improved, they will lead and boost the set of elements at each level, leading to good results. This conclusion has also been demonstrated in the practice of the projects funded by China's National Arts Foundation.

However, an important prerequisite for the development of ICH is to treat ICH as a living development process in a specific space and time, and the development of living ICH still faces significant challenges in the new period. In addition, compared with the traditional ISM model, the AISM model can form the reverse sampling hierarchy map, which is more convincing. However, due to the limitations of the ISM model itself, the scope of the ISM model is still qualitative analysis, and further validation with quantitative decision laboratory-adversarial explanatory structural model association methods such as DEMATEL-AISM is needed in the future.

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REFERENCES

[1] X. Mu and L. Xi, "Exploration of the concept of intangible cultural heritage and development in China in the new era," *J. Beijing Union Univ.*, vol. 353, no. 1, pp. 57–63, 2021.
[2] C. Yafei, "On the study of the development of kite sport in Weifang," Liaoning Normal Univ., Dalian, Chian, Tech. Rep., 2016, vol. 4,no. 6, pp. 1–31.
[3] Y. Lai, "Analysis of factors influencing urban residents' participation in traditional ethnic sports-taking Yangjiang kite flying as an example," *Literary Sports Goods Technol.*, vol. 8, no. 4, pp. 50–52, 2018.
[4] W. Yuanyuan and Y. Jieli, "Research on the potential of cultural tourism development of national intangible cultural heritage in southern Jiangsu," *Geographical Res. Develop.*, vol. 32, no. 5, pp. 157–162, 2013.
[5] Z. Yuchao, "Research on the current situation and countermeasures of Weifang International Kite Flying Association from the perspective of tourists," Shanghai Inst. Sports, Shanghai, China, Tech. Rep., 2014, vol. 5, no. 1, pp. 1–44.
[6] J. N. Warfield, "Binary matrices in system modding," *IEEE Trans. Syst. Man Cybern.*, vol. 9, no. 4, pp. 441–449, 1973.
[7] R. W. Hawthorne and A. P. Sage, "On applications of interpretive structural modeling to higher education program planning," *Socio-Econ. Planning Sci.*, vol. 9, no. 1, pp. 31–43, Feb. 1975.

[8] W. Huang, "Methodological implications of hacking and anti-hacking thinking research—A new exploration of explanatory structural models," South China Normal Univ., Guangzhou, China, Tech. Rep., 2003, vol. 6, no. 3, pp. 2–120.
[9] L. Yingchun, "Research on countermeasures of secondary education development in Guangdong Province based on system theory and game explanation structure model," Guangdong Tech. Teachers' Univ., Dalian, Chian, Tech. Rep., 2019, vol. 6, no. 2, pp. 1–116.
[10] X. Xilin, "Research on the competitiveness of coastal smart ports based on adversarial explanatory structural modeling approach," Dept. Manage. Econ., Tianjin Univ., Sheng, China, Tech. Rep., 2019, vol. 6, no. 7, pp. 1–30.
[11] R. Brüggemann and L. Carlsen, *Partial Order in Environmental Sciences and Chemistry*. Berlin, Germany: Springer, Jan. 2006.
[12] R. Brüggemann, L. Carlsen, and J. Wittmann, *Multi-Indicator Systems and Modelling in Partial Order*. New York, NY, USA: Springer, Jan. 2014.
[13] Q. Peng, Q. Zhang, and Y. Zhang, "Application of objective criteria-based directed Hashtub technique in groundwater quality evaluation," *Water-Saving Irrigation*, vol. 1, no. 9, pp. 81–84, 2019.
[14] X. Shunchang, "Research on the transformation of intangible cultural heritage under the mode of living protection," Southeast Univ., Dhaka, Bangladesh, Tech. Rep., 2018, vol. 6, no. 5, pp. 1–100.
[15] L. Zemei, "Research on the protection and inheritance of the national intangible cultural heritage of original sports-like," Yunnan Normal Univ., Kunming, China, Tech. Rep., 2015, vol. 5, no. 1, pp. 1–81.
[16] W. Zhenjun, "Reflections on the value and inheritance of intangible cultural heritage in Henan," *Henan Social Sci.*, vol. 17, no. 1, pp. 1–2, 2009.
[17] F. Hui, "Research on the development strategy of intangible cultural heritage from the perspective of cultural and creative industry—Tie-dye art," Knowledge Bank, Gurgaon, Haryana, Tech. Rep., 2020, vol. 7, no. 14, pp. 9–12.
[18] Y. Ling and Y. Feng, "From inheritors to heirs: Innovative thinking of intangible cultural heritage protection," *Jiangxi Social Sci.*, vol. 12, pp. 185–190, Oct. 2008.
[19] Y. Li and G. Jun, "Industrial development and commercialization of intangible cultural heritage," *Henan Social Sci.*, vol. 17, no. 4, pp. 20–21, 2009, doi: 10.3969/j.issn.1007-905X.2009.04.005.
[20] Y. Li, "Several issues of scientific protection of intangible cultural heritage," *Jiangxi Social Sci.*, vol. 5, no. 9, pp. 20–25, 2010.
[21] W. G. Yong and K. Tao, "The practical difficulties and countermeasures for the development of sports intangible cultural heritage in the context of national fitness," *Guangxi Social Sci.*, vol. 2, no. 12, pp. 205–208, 2018.
[22] W. H. Bei, "Research on the protection and development of intangible cultural heritage of sports in Chengdu," Chengdu Inst. Phys. Educ., Chengdu, China, Tech. Rep., 2015, vol. 5, no. 5, pp. 1–43.
[23] L. Yisan, "Research on the application of word frequency analysis method to 'hot topics' articles," Northeast Normal Univ., Changchun, China, Tech. Rep., 2019, vol. 5, no. 9, pp. 1–60.
[24] *Delphi Method*. Accessed: Sep. 10, 2001. [Online]. Available: http://www.book888com.cn/study/means/02/02004htm
[25] J. Peng and Y. Xiang, "Data structures and algorithm: Data structures and algorithm," People's Post Telecommun. Publishing House, Dalian, Chian, Tech. Rep., 2013, vol. 1, no. 1, pp. 1–54.
[26] N. Biao and H. Wei, "A model for evaluating the generalizability of military training methods based on adversarial explanatory structure model," *Mil. Oper. Res. Syst. Eng.*, vol. 34, no. 02, pp. 46–51, 2020.

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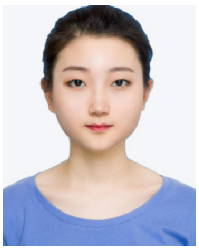

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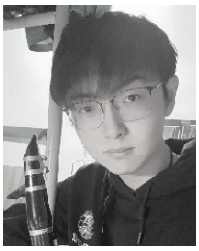

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