

# *Visual Evaluation of the Integration Mechanism of Sports Development and Ecological Environmental Protection in the Era of Artificial Intelligence*

Cheng Chen\*

*College of Profession Tennis, Wuhan City Polytechnic, Wuhan, Hubei 430064, China*

*\*corresponding author*

**Keywords:** Sports and Ecological Environment, Visual Analysis, Artificial Intelligence, Artificial Neural Networks

**Abstract:** The development of sports is closely related to the ecological environment. The development of any sports requires a good sports ecological environment. Sports activities are inseparable from the carrier of the ecological environment. Without the ecological environment, there would be no sports activities. However, the problem of ecological environment pollution that people face in sports activities is very serious. Sports ecological environment pollution posed a huge threat to people's physical and mental health, and also greatly restricted people's enthusiasm and interest in participating in sports activities, and also greatly hindered the development of sports. The improvement of people's awareness of environmental pollution protection in sports is bound to further curb and alleviate many environmental pollution problems such as air pollution and garbage pollution. In a certain sense, it is helpful to solve and control the problem of ecological environment pollution, and promote the harmonious and sustainable development of society and ecological environment. Therefore, this paper would conduct a visual analysis of the integration mechanism of sports development and ecological environmental protection based on artificial intelligence. After analysis, China's research in related fields, sports and environmental engineering disciplines accounted for the largest proportion of 74.46%, and with the development of sports events and environmental protection, the number of international publications in 2017 reached a maximum of 134. To a certain extent, this is related to the Rio Olympics in Brazil the previous year. However, in the international research in this field, the number of published papers in the United States reached a maximum of 159, which opened a large gap with other countries.

## 1. Introduction

At the moment when people pay more and more attention to physical and mental development, sports activities are closely related to the ecological environment. The development of any sports

requires a good ecological environment. The ecological environment is the basis and carrier for people to carry out sports. Without the ecological environment, there would be no sports and sports culture. When people carry out daily physical exercise and outdoor activities, they must rely on the surrounding sports ecological environment and social environment, and are affected and restricted by the surrounding ecological environment throughout the process. An important factor for the success of the application city for hosting the Modern Olympic Games is the quality of the ecological environment of the applicant city. The basis and premise of people's exercise and sports is a good sports ecological environment. A good sports ecological environment can effectively help people to enjoy sports and improve their health in the usual physical exercise. However, at present, many physical exercises are seriously polluted by the ecological environment. People's participation in normal campus physical exercise is not only greatly restricted and restricted, but also poses serious challenges and threats to physical and mental health, which has caused huge obstacles to the development of sports. It is imminent to solve and deal with the problem of ecological environment pollution in the development of sports.

With the continuous development and innovation of science and technology, many intelligent technologies are used in all aspects of life. This paper would use artificial intelligence technology to integrate sports development and ecological environmental protection. Because visual analysis can convey and communicate effective information clearly and intuitively, the technology that data is finally presented in the form of graphics by means of visualization is currently widely used in various fields of knowledge. Therefore, this paper used the visualization method to systematically analyze the integration mechanism, so as to promote the harmonious development of sports development and ecological environment protection.

## 2. Literature Review

In the research of sports development and ecological environmental protection, many scholars have organically integrated the two. From the perspective of rural revitalization, Peng Y excavated all resources in the countryside. Relying on the rich local agricultural and sports and leisure resources, the construction of sports and leisure towns has been promoted [1]. Wu H J took Xi'an, a megacity with scarce water resources, as the research object. Through the construction of an evaluation system, the water resources carrying capacity and its existing problems were analyzed, and through the analysis of the water resources carrying capacity, countermeasures and suggestions for the development of water sports were put forward [2]. Rosevear R was based on an ecosystem development model to understand how character in the New Zealand Rugby (NZR) ecology is understood [3]. One of the proposed tour routes tested in the research reserve by Ilies D C was completed in four modes of walking, running, cycling and Nordic walking, and believed that the proposed tour route for physical activity and recreational activities in the reserve is suitable for ordinary People use [4]. These studies are all targeted and not rich enough in the connection between sports and ecology.

In the research of visual analysis, many scholars have various applications for it. Ming N used the Scientometric software CiteSpace to visually analyze the English test in China from 1995 to 2020 by drawing a map of keyword co-occurrence, time zone, scholar cooperation network, and scientific research institution cooperation network [5]. Lu B proposed TMNVis, an interactive visualization system for exploring the evolution of temporally multivariate networks [6]. Ben-Shalom U explored the "black box" of face-to-face violence during terrorist attacks, based on a visual analysis of a representative sample of terrorist attacks that took place in Israel between 2015 and 2016 [7]. Chen Y conducted a visual analysis of the state of application of network meta-analysis in the field of traditional Chinese medicine [8]. Gotz D proposed a new visual

analysis method for dynamic hierarchical dimensional aggregation. This method utilizes a predefined dimensional hierarchy to compute at runtime the amount of information for alternative grouping levels within the quantification hierarchy, relative to the metric of interest [9]. Based on collaborations with historians, linguists, and statisticians, Ha H proposed a method for creating and analyzing interpersonal visualizations using data from Kwon's family tree and the Joseon Dynasty yearbook [10]. Visual analysis can be used in various fields, but no one has carried out visual analysis of sports development and ecological environmental protection.

### 3. Introduction of Artificial Intelligence and the Visual Evaluation of the Integration Mechanism

#### 3.1. Introduction of Artificial Intelligence Technology

Aiming at the problems and deficiencies in the development of sports and the protection of ecological environment, this paper introduces various advanced artificial intelligence technologies, conducts the modeling research of the integrated decision support system, establishes the comprehensive model, and improves the existing methods. Various artificial intelligence technologies and methodologies are applied to solve practical problems one by one [11]. The methods of pre-processing, data outlier resolution and correlation coefficient analysis are used to evaluate the statistics, and relevant factors are screened. At the same time, the signal decomposition algorithm and clustering intelligent algorithm are used to improve the accuracy of the model [12].

(1) Artificial neural network

1) BP Neural Network (BPNN)

BPNN is a typical multi-layer feed-forward neural network, which is responsible for processing the information hidden sequentially from the input layer to the output layer [13]. If the predicted output value exceeds the expected output value, the inverter is executed and the network parameters are adjusted. The prediction error approximates the prediction output through an iterative process.

2) Radial basis function network

Radial Basis Function (RBF) is a local response function [14]. Its structure and calculation formula are as follows:

$$x_j = \sum_{i=1}^h u_{ij} \exp\left(-\frac{1}{2\sigma^2} \|y - c_i\|^2\right) \quad j = 1, 2, \dots, n \quad (1)$$

In the formula:  $x_j$  is the output;  $u_{ij}$  is the connection weight between the hidden layer and the output layer;  $\sigma$  is the variance of the basis function;  $y = (y_1, y_2, \dots, y_m)^T$  is the input sample;  $c_i$  is the center of the hidden layer node;  $m, h, n$  are the number of nodes in the input layer, hidden layer and output layer, respectively.

3) Generalized regression neural network

General Regression Neural Network (GRNN) is a distortion of the RBF network that combines radial basal and linear nerves [15]. The learning ability and speed of GRNN is better than that of RBF function, and the accuracy is better. The structure and calculation formula of GRNN are as follows:

$$q_i = \exp\left[-\frac{(y - y_i)^T (y - y_i)}{2\sigma^2}\right] \quad i = 1, 2, \dots, n \quad (2)$$

$$S_C = \sum_{i=1}^n q_i \quad (3)$$

$$S_{Nj} = \sum_{i=1}^n x_{ij} q_i \quad j = 1, 2, \dots, K, k \quad (4)$$

$$x_j = \frac{S_{Nj}}{S_C} \quad j = 1, 2, \dots, K, k \quad (5)$$

$q_i$  - pattern layer output;

$S_C, S_{Nj}$  - Summation layer output;

$x_{ij}$  - the  $j$  element of the  $i$  output sample;

$x_j$  - output the  $j$  element.

#### 4) Deep belief networks

Deep Belief Network (DBN) plays an important role in the development of deep learning [16]. The energy function of RBM is equal to Formula (6). After determining the modulus, the coupling distribution (7) can be obtained according to the energy function. The principle of DBN is to train in RBM to complete the initialization of BPNN factors, which overcomes the shortcomings of local optimization.

$$\varepsilon(u, l | \mathcal{G}) = - \sum_{i=1}^n \sum_{j=1}^m \omega_{ij} l_i u_j - \sum_{j=1}^m a_j u_j - \sum_{i=1}^n b_i l_i \quad (6)$$

$$q(u, l | \mathcal{G}) = \frac{1}{Z(\mathcal{G})} e^{-\varepsilon(u, l | \mathcal{G})} = \frac{1}{Z(\mathcal{G})} \exp(-\varepsilon(u, l | \mathcal{G})) \quad (7)$$

In the formula:  $u_j$  is the input of the visible node  $j$ ;  $l_i$  is the output of the hidden node  $i$ ;  $\omega_{ij}$  is the weight of both;  $a_j, b_i$  is the bias of  $u_j, l_i$ ;  $\mathcal{G} = \{\omega_{ij}, a_j, b_i\}$  is the parameter.

#### 5) Elman neural network

Elman neural network is a classic recurrent neural network [17]. Its structure is similar to the multilayer feedforward neural network, and its calculation formula is as follows.

$$h(x) = f(Vy(x) + Wh(x-1) + a) \quad (8)$$

$$o(x) = g(h(x)) = g(Uh(t) + b) \quad (9)$$

In the formula:  $h(x), o(x)$  are the input vector, the hidden vector and the output vector respectively;  $V, W, U$  are the connection weight of the input layer and the hidden layer, the connection weight of the hidden layer and the hidden layer, and the connection weight of the hidden layer and the output layer;  $f, g$  are the activation functions of the hidden layer (commonly used Tansig function) and the output layer (commonly used Purelin function).

#### (2) Correlation coefficient analysis method

The correlation coefficient generally uses the value range to judge the degree of correlation between the indicators, and the relationship is shown in Table 1:

Table 1. Value range and meaning of correlation coefficient

| The absolute value of the correlation coefficient | Relevance               |
|---|-------------------------|
| 0-0.1   | Very weak correlation   |
| 0.1-0.35  | Weak correlation        |
| 0.35-0.6  | Moderately relevant     |
| 0.6-0.85  | Strong correlation      |
| 0.85-1  | Very strong correlation |

Correlation coefficients have different forms according to the research variables. Three commonly used correlation coefficients are as follows:

1) Pearson correlation coefficient

The Pearson correlation coefficient was used to quantitatively analyze the linear relationship between two variables [18]. The formula for the calculation is as follows:

$$r = \frac{\sum_{j=1}^m (x_j - \bar{x})(y_j - \bar{y})}{\sqrt{\sum_{j=1}^m (x_j - \bar{x})^2} \sqrt{\sum_{j=1}^m (y_j - \bar{y})^2}} \quad (10)$$

In the formula:  $x_j$  and  $y_j$  are the correlated variables of the  $j$  sample pair;  $\bar{x}$  and  $\bar{y}$  are the mean values of  $x$  and  $y$ , respectively.

2) Spearman rank correlation coefficient

The Spearman's rank correlation coefficient uses the rank of variables instead of statistical values to calculate rank correlation coefficient, which can be said to be a special form of Pearson's correlation coefficient [19]. Features: non-statistical does not require data distribution and is more widely used than Pearson's correlation coefficient. The calculation is as follows:

$$r_s = \frac{\sum_{j=1}^m (a_j - \bar{a})(b_j - \bar{b})}{\sqrt{\sum_{j=1}^m (a_j - \bar{a})^2} \sqrt{\sum_{j=1}^m (b_j - \bar{b})^2}} = 1 - \frac{6 \sum_{j=1}^m d_j^2}{m(m^2 - 1)} \quad (11)$$

In the formula:  $a_j$  and  $b_j$  are the grades of the  $j$  sample on the relevant variables;  $\bar{a}$  and  $\bar{b}$  are the averages of  $a$  and  $b$ , respectively;  $d_j = a_j - b_j$  is the grade difference.

3) Kendall rank correlation coefficient

The Kendall rank correlation coefficient was used to reflect the correlation of categorical variables [20]. It is characterized by non-parametric test, and the requirements for data distribution are the same as Spearman's rank correlation coefficient; it is suitable for ordered categorical variables; it is not sensitive to extreme values. The formula for the calculation is as follows:

$$\lambda = \frac{m_c - m_d}{m(m-1)/2} \quad (12)$$

In the formula: for two sample pairs  $(x_i, y_i)$  and  $(x_j, y_j)$ , if  $x_i < y_i$  and  $x_j < y_j$ , or  $x_i > y_i$  and  $x_j > y_j$ , it is a homologous pair, otherwise it is a heterologous pair;  $m_c$  is the homologous log;  $m_d$  is the heterologous;  $m$  is the heterologous total logarithms.

(3) Whale optimization algorithm

1) The prey is surrounded

Humpback whales can identify and surround their prey. This behavior is represented by the following formula:

$$\vec{B} = \left| \vec{C} \cdot \vec{Y}(t) - \vec{Y}(t) \right| \quad (13)$$

$$\vec{Y}(t+1) = \vec{Y}^*(t) - \vec{A} \cdot \vec{B} \quad (14)$$

In the formula:  $t$  is the current iteration;  $\vec{Y}^*$  is the position vector that currently obtains the optimal solution, which needs to be updated in each iteration if there is a better solution;  $\vec{Y}$  is the position vector;  $\vec{A}$  and  $\vec{C}$  are the coefficient vectors, and the formula is as follows:

$$\vec{A} = 2\vec{a} \cdot \vec{x} - \vec{a} \quad (15)$$

$$\vec{C} = 2 \cdot \vec{x} \quad (16)$$

In the formula:  $\vec{x}$  is a random vector in  $[0, 1]$ ;  $\vec{a}$  decreases linearly from 2 to 0 in the iterative process (exploration, utilization).

2) Attack method of "bubble net" (exploitation stage)

Shrink wrapping mechanism:

By reducing the value of  $\vec{a}$  in Formula (15) to achieve this behavior, the fluctuation range of  $\vec{A}$  is also reduced.

Spiral update position:

A spiral equation is created between the whale and prey positions to simulate the spiral movement of a humpback whale:

$$\vec{Y}(t+1) = \vec{B} \cdot e^{bl} \cdot \cos(2\pi l) + \vec{Y}^*(t) \quad (17)$$

In the formula:  $\vec{B} = \left| \vec{Y}^*(t) - \vec{Y}(t) \right|$  is the distance from the  $i$  whale to the prey (the current optimal solution is obtained);  $b$  is a constant that defines the shape of the logarithmic spiral;  $l$  is a random number in  $[-1, 1]$ .

Humpback whales circle their prey along a spiral path. In order to simulate simultaneous movement, the position of the whale is updated with a 50% probability, assuming a shrink-wound mechanism or a helical model is chosen during the optimization:

$$\vec{Y}(t+1) = \begin{cases} \vec{Y}^*(t) - \vec{A} \cdot \vec{D} & \text{if } p < 0.5 \\ \vec{B} \cdot e^{bl} \cdot \cos(2\pi l) + \vec{Y}^*(t) & \text{if } p \geq 0.5 \end{cases} \quad (18)$$

In the formula:  $p$  is a random number in  $[0, 1]$ .

3) Search of prey (exploration phase)

Humpback whales can search randomly according to each other's position. When  $\vec{A}$  is greater than 1 or less than -1, the search agent would move away from the reference search agent. The mathematical model is as follows:

$$\vec{B} = \left| \vec{C} \cdot \vec{Y}_{rand} - \vec{Y} \right| \quad (19)$$

$$\vec{Y}(t+1) = \vec{Y}_{rand} - \vec{A} \cdot \vec{B} \quad (20)$$

In the formula:  $\vec{Y}_{rand}$  is a random position vector in the current population.

The WOA algorithm starts with a set of random solutions, and during each iteration, the search agent updates its position based on the randomly selected search agent or the currently obtained optimal solution. The parameter  $a$  is reduced from 2 to 0 to ensure exploration and utilization, and the optimal solution is selected when  $|\vec{A}| < 1$ . According to the  $P$ -value WOA algorithm, it is possible to convert between spiral and circular movements. The iteration stops when the termination condition is met.

### 3.2. Integration Mechanism of Sports Development and Ecological Environment Protection

#### (1) Conflict between sports development and ecological environment

Sports play an important role in modern society. As an integral part of a healthy human lifestyle, it offers opportunities to increase human physical activity and social interactions, stimulating economic and social development. The contents of the ecological environment are shown in Figure 1.

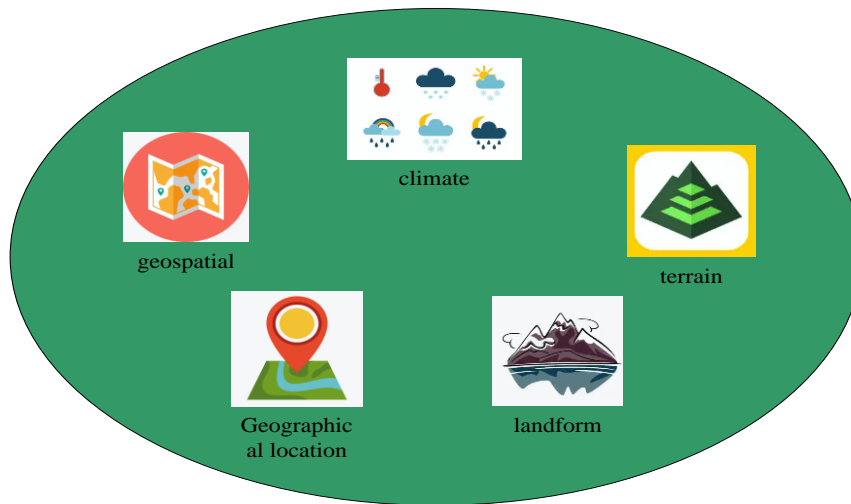


Figure 1. Contents of the ecological environment

The development of sports, especially the holding of large-scale sports events, has also had some negative impacts on the environment. The negative impacts of large-scale sports events on the environment are shown in Figure 2.

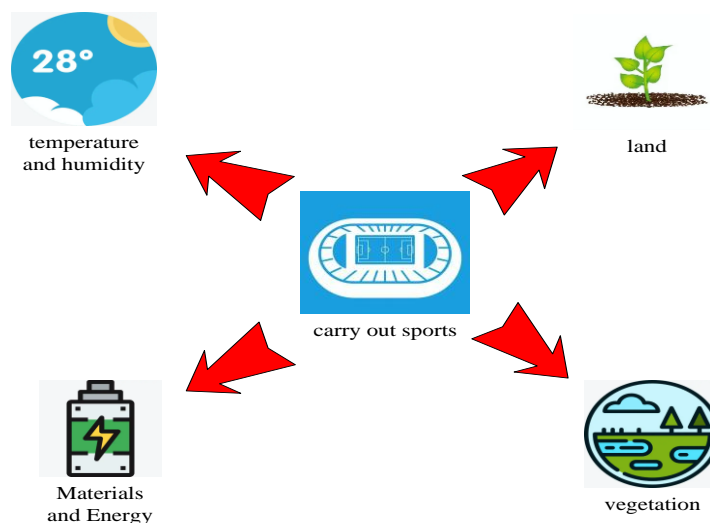


Figure 2. Various aspects of the environment affected by the development of sports

First, it is reflected in the extensive use of the natural environment. The construction of stadiums and their facilities requires a lot of land, and the existing natural environment is inevitably destroyed. New roads, parking lots and other facilities further pollute and damage the existing natural environment. Competition organizers often forgo existing venues and build large numbers of permanent venues, wasting a lot of material and energy. On the other hand, natural factors such as local vegetation and soil are also damaged, and this damage is long-term.

During competitions, a series of environmental problems still arise, such as car rally, motocross and powerboat racing, as shown in Figure 3.



(a) Motocross

(b) Powerboat racing

Figure 3. Motocross and powerboat racing scene

These items consume a lot of fuel during the race. This would rapidly increase exhaust emissions. Water sports such as water skiing and jet skiing can contaminate water bodies. Winter sports destroy vegetation, and natural landscapes destroy vegetation.

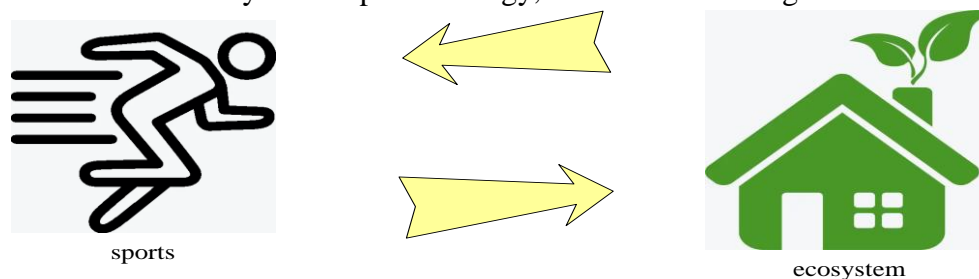
Sports would not only affect the natural environment, but also damage other ecological environments, such as the use of non-renewable resources, the discharge of harmful substances during the construction and operation of stadiums, etc. In order to solve the contradiction between sports and ecological environment, sports development and ecological protection must be combined.

(2) Integration of sports development and ecological environment

Sports and the ecological environment each exist as an independent and complete system, so the



construction goal of the integration mechanism of the two is first to enhance the coordinated operation and function of the system itself. On the other hand, as the existence of two different fields, the exchange and transmission of energy and information occur between the two, so the construction goal of integrating wit is secondly to maintain the stability of the system and promote the overall health and harmony of the sports ecology, as shown in the Figure 4.



*Figure 4. Integration of sports and ecological environment*

1) Exploration period: preparation for "idea point"

Thought is the guide of action, so it is necessary to lead in thought to lead in action, and to be prepared in thought to guide the implementation of action. The construction of an integration mechanism for sports development and ecological environmental protection requires a multi-angle grasp of this unprecedented complex ecological environment. Driven by the continuous development of technology and the continuous progress of society, there has never been a situation where such diverse forms coexist and are intertwined as today. Therefore, it is necessary to fully understand the close connection between sports and the ecological environment. According to the characteristics and trends of sports development, combined with the objective laws of the ecological environment, the preparation for the integration of the two cognitive transformations and the establishment and cultivation of scientific, correct and reasonable cognitive and thinking methods are the core tasks of the exploration stage of sports development and ecological environment integration.

2) Collision period: exclusion of "obstacle points"

At present, on the one hand, the two fields are intertwined with each other, and there are fierce conflicts in value orientation and ideological concept. At the same time, in order to win a larger living space, win a wider audience, and gain a stronger influence, they continue to absorb, learn from, exclude and resist each other; on the other hand, there are also contradictions or struggles between the components in the two systems. In order to maintain its constitutive position in the system and exist for a long time, it constantly transforms, replaces, and assimilates other heterogeneous elements. Therefore, it is a necessary measure in the stage of integration and collision to treat and optimize the diseases that affect the two systems themselves, and to continuously eliminate or even eliminate the key factors that hinder the integration.

3) Run-in period: the search for a "neutral point"

After monitoring and investigating the main obstacles to the integration of sports development and ecological environmental protection, it is necessary to actively seek the "neutral point" between the two fields, and to promote the continuous running-in and mutual recognition between the two fields through equal and conscious communication and dialogue. Based on these differences or distances, and guided by the principles of the unity of individuality and identity, as well as specificity and universality, mutual communicability and intelligibility are found, and a "common understanding" is found, so as to promote a good form of pluralistic coexistence and harmonious coexistence.

4) Expansion period: mating of "gene points"

Due to the differences in geographical environment, historical development, political economy and many other conditions, many ecological environments have formed their own unique and stable cultural genes during their long-term social evolution. The valuable and long-standing cultural genes inherent in various cultural forms are deeply dissected and explored. They meet and merge into the ecosystem in a certain way, and then form a new form. It is a major development and innovation process for the integration of the two in the multicultural field, and it is also the mission of the integration of sports development and ecological environment.

5) The whole process: avoidance of "risk points"

The development of sports and the ecological environment are complicated, and the integration of the two in this environment would inevitably have various risk points. In order to promote the smooth development of the integration of the two, and effectively achieve the goal and expectation of the integration, it is necessary to monitor the whole process of the integration from the exploration stage, to the collision stage, and to the running-in stage. Finally, in the whole process of integration in the expansion stage, the whole process of monitoring and risk avoidance is carried out, and the warning line is always grasped to prevent the serious consequences of system collapse and disintegration and ecological damage.

From the above construction scheme, this paper designs the corresponding specific mechanism, forming a relatively complete integration framework, as shown in Figure 5.

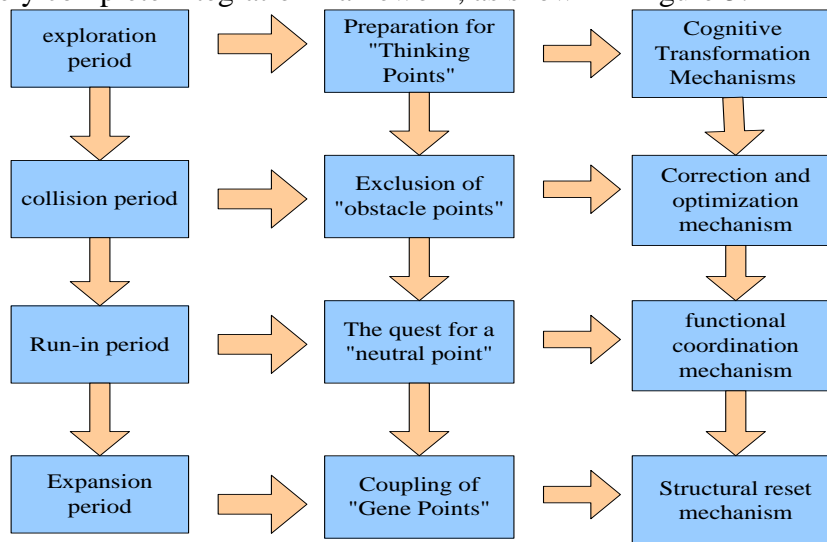


Figure 5. The basic framework of the administrative culture integration mechanism in the multicultural field

### 3.3. Design of Visual Evaluation System

(1) Demand analysis of visualization system

When an information platform has a large amount of data and visualization requirements, system users need to process different types of business data and visualize them. A very common visualization method at this time is the digital cockpit. When processing a certain data, the business process of the visual analysis engine is shown in Figure 6:

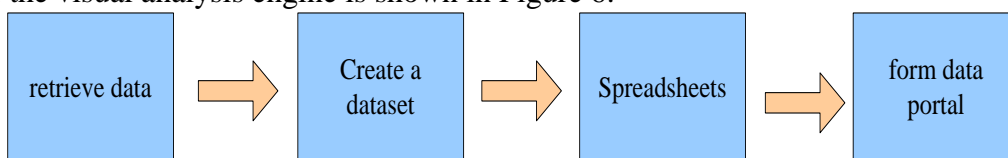


Figure 6. Visual analytics engine business process

The custom visual analysis engine includes three main functions. The first is the data management function corresponding to the steps of adding data sources and acquiring data, creating datasets. The second is the creation of the cockpit building function corresponding to the dashboard or spreadsheet step. The third one is to form the cockpit management function corresponding to the data portal or cockpit application steps. The business details of different businesses of the custom visual analysis engine are shown in Table 2.

Table 2. Visual analysis engine business function description

| Business name                | Business function description  |
|------------------------------|--|
| Data management function     | Realize adding and selecting data sources to obtain data, after having data sources, display all data in our data sources, provide field selection, filtering and other functions for users to choose, and create data sets through the selection of cockpit managers. |
| Cockpit management functions | Manage the construction information of the cockpit, and support the viewing, editing and deletion of the built cockpit view, and manage multiple cockpits  |
| Cockpit build features       | It mainly completes the view drawing work, selects and displays the data, and manages the interface style.   |

Data integration is the first step in data analysis. The data management function can easily and quickly centralize the required data to solve the problems of scattered data and different types. It simplifies the data acquisition process and helps users in data management and data analysis. The system provides a variety of flexible ways to help users complete data access, from the local MySQL database to the Hive database. The data management function mainly includes four functions: data source selection, data set creation, data source management, and data set management, as shown in Figure 7.

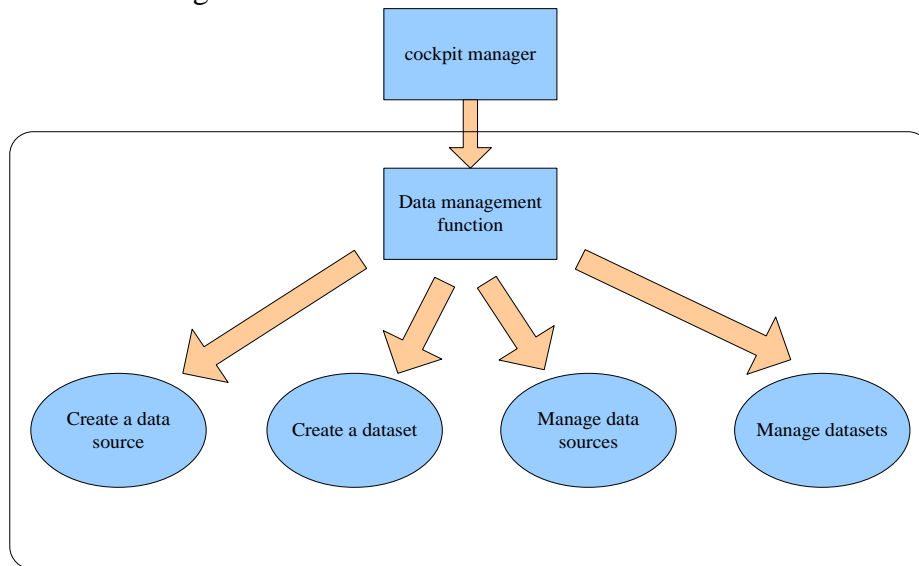


Figure 7. Data management function use case diagram

The function of creating data source would realize the creation of mysql database type data source, and the function of managing data source can realize the management of the obtained data

source list. This function includes operations such as editing, deleting, etc. The function of creating a data set is performed after the data source is obtained. The data source can be seen through the data source list, and after selecting the data source, the system matches all the data and fields of this table.

(2) Design of visual analysis system

According to the boundaries of different functions and actual business needs, the big data-based custom visual analysis engine is divided into data management modules, cockpit building modules, and cockpit functions. The module diagram is shown in Figure 8. These three modules not only perform their own functions and are responsible for the business and calculation of this module, but also share and transfer data with each other.

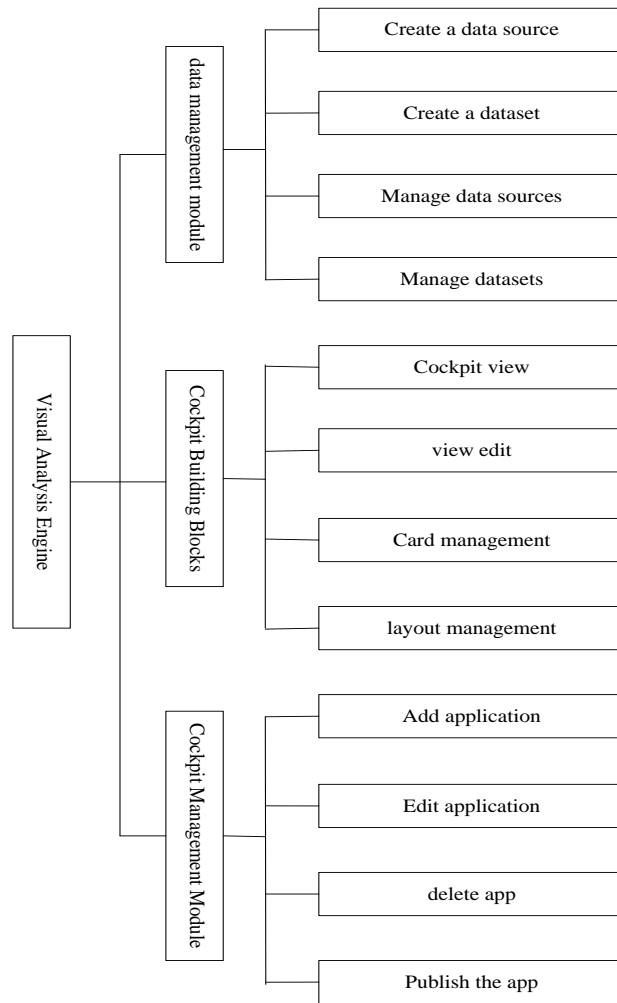


Figure 8. Visual analysis engine functional block diagram

The function of each module would be explained in detail below.

1) Data management module

The data management module is an important component of data analysis. The job of the data management module is to collect the data needed by the cockpit managers from different data sources into the system to solve the problems of scattered data and different types to form a data set. It simplifies the data acquisition process and saves a lot of time in integrating and cleaning data, and enables users to conveniently store and manage data and analyze data.

2) Cockpit building blocks

Cockpit building blocks are core modules for building visualization applications. The cockpit

consists of many cards. The position and size of each card in the cockpit can be freely set, and finally these cards together form the cockpit page. Users can adjust the position by dragging the header area of the chart, or set the chart size to zoom in or out through the small arrow in the lower right corner of the chart, or directly edit a card to control its data, style, and other attributes. The cockpit building module includes four parts: cockpit viewing, view editing, card management, and layout management.

### 3) Cockpit management module

Cockpit management module includes cockpit application management and publishing application functions. The page structure of this module is similar to a directory, which is composed of folders and specific cockpits. The analysis framework of each business is formed through folders and cockpits. This module includes the four operation functions of adding, publishing, deleting and editing the cockpit application by the cockpit manager.

#### (3) Design and implementation of functional modules of visual analysis engine

##### 1) Detailed design and implementation of data source

The cockpit manager clicks data management in the system menu to enter the data management interface. The cockpit manager then clicks the new data source button. In the data source type list, the mysql database data source option is selected, and the createDataorigin method of the DataoriginService class is called, and a pop-up box prompts to input configuration items including server, port number, user name, password, database name, etc. The getConnection method of Java DataBase Connectivity (JDBC) connects to the database.

The connection is successful, and a data source data is added through the DataoriginCreate method of the Data Access Object (DAO) layer. Generator reads and displays the tables of the database for data preview. The parameters of the create data source method are shown in Table 3:

*Table 3. JDBC is used to create dataset method parameters*

| Parameter | Type             | Describe                | Note   |
|-----------|------------------|-------------------------|--|
| Id        | Int              | The data source id      |  |
| Name      | String           | Database name           |  |
| Tablename | String           | The name of the table   |  |
| Columns   | String           | Data source description |  |
| Amount    | Int              | Number of fields        | Field is the column name and type is the sort type. Asc and desc are supported |
| Baseinfo  | Map<string,list> | Field                   | The selected column, key is the table, vale is the table selected              |
| Address   | String           | Server address          |  |
| Port      | Int              | The port number         |  |
| Username  | String           | The user name           |  |
| Password  | String           | Password                |  |

##### 2) Detailed design and implementation of the dataset

The dataset function includes the following steps. The first step is to access the data source and obtain the data source list through the getDataoriginList method of the DataoriginService class, and display it on the front-end page DATA Management.vue for users to choose.

The definition of the indicator is determined and the indicator is added. In the worksheet list box, the worksheet to be processed is selected and the add field in the upper right corner is clicked, and

the field name and field type to be added are set. According to the needs of business and analysis, the corresponding indicators are formulated, and the Chinese naming operation is performed to facilitate the subsequent data analysis. This step is equivalent to defining the columns object of the interface on the front end. There is data selection. The selection of data is controlled by filtering columns, data volume restrictions, whether to join, etc. This step defines the filters attribute, orderby attribute, and amount attribute when passing parameters.

Finally, the data set is newly created through the createDataset method of the DataoriginService class, and the data is added through the DatasetCreate method of the DAO layer accessed through sqlGenerator. This step generates the data table and adds entries to the dataset table, where the dataset is generated. After the added fields are generated, the accuracy of the field values and whether they meet the expectations are previewed on the data verification page of the worksheet. The parameters of the method of creating a dataset are shown in Table 4:

*Table 4. Creation of dataset method parameters*

| Parameter       | Type             | Describe                         | Note   |
|-----------------|------------------|----------------------------------|--|
| Tablenames      | List             | Table name to read               |  |
| Tablenamescn    | List             | Contents in the table to be read |  |
| Targettablename | String           | Table name after importing mysql |  |
| Columns         | Map<string.list> | Field                            | The selected column, key is the table, vale is the table selected  |
| Amount          | Int              | Limit the amount of data         |  |
| Filters         | Map<string.list> | Filter conditions                | Where field is the column name, filter is the condition, which supports greater than, less than, equal to, included in, equal to, and val is the value |
| Orderby         | Orderby          | Sort columns                     | Where field is the column name, type is the sort type, and asc and desc are supported  |
| Baseinfo        | Baseinfo         | User data                        | Where id is the user id and token is the user token  |
| Joincol         | Map<string.list> | Join selected columns            | Where col is the join column name and table is the join table name   |

Among them, the concept of field type is defined for the columns parameter. The field can be simply understood as the row or column title when using the EXCEL table, and the value of each column or row below the title is the value of the field. Field is a concept introduced by database table, which is inherited here. There are three types of fields in the worksheet: date, text, and value. The following would introduce the three field types mentioned above:

Date type field: the field type is date, indicating that the value of the field is a date or time, and

an icon would be displayed in front of it. Date type fields support further processing using calculation functions and data analysis as dimensions or values in charts.

**Text type field:** the field type is text, indicating that the value of the field is a string and records some text information. For example, if an order data table is accessed, the receiving address of the order, the recipient and other field types are all text.

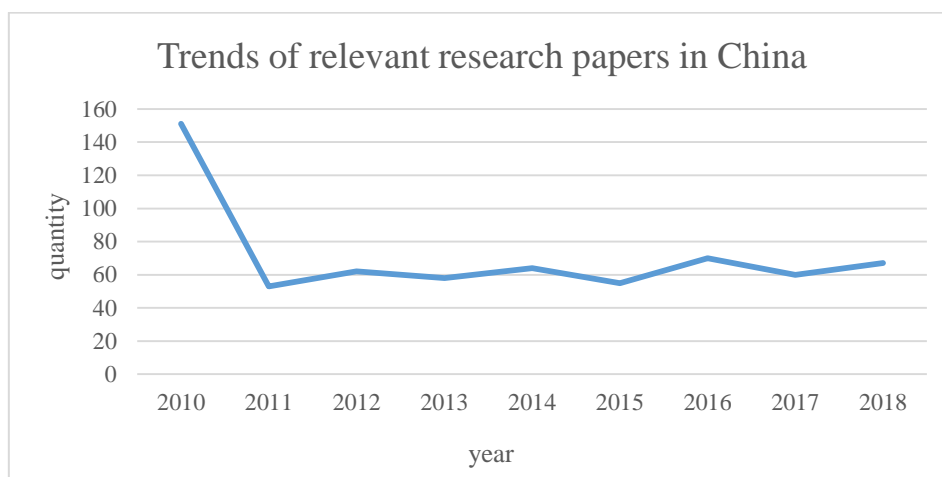
**Numeric type field:** the field type is numeric, indicating that the value of the field is a numeric value or a number, including INT, NUMERIC and other types. For example, a field type in a table in the database that stores business data in the enterprise is INT type, and then the system is directly connected to the database for synchronization. After synchronizing to the system, this field type corresponds to a value.

#### 4. Visual Experiment and Evaluation of the Integration Mechanism of Sports Development and Ecological Environment Protection

##### 4.1. Visualization Experiment of the Integration Mechanism of Sports Development and Ecological Environment Protection

(1) Visualization experiment of Chinese sports development and ecological environmental protection research

Generally speaking, the publication volume and changing trend of research literature in a certain field in different time periods can reflect the academic level or development trend of experts and scholars in this research field to some extent. The research object selected in this paper is the literature in China that conformed to all standard formats during the period from 2010 to 2018, and the valid data were screened and retained, with a total of 640 articles, and the change trend is shown in Figure 9.



*Figure 9. Line chart of the publication trend of Chinese sports development and ecological environmental protection research literature from 2010 to 2018*

As can be seen from Figure 9, the trend of published articles fluctuated greatly during the period from 2010 to 2011. The reason is that before 2010, to a certain extent, it was related to the positive impact of the "Olympic Fever". Compared with previous years, the changes in the number of published papers from 2013 to 2018 showed a fluctuating trend. To a certain extent, the reason is related to factors such as the increase in the difficulty of reviewing academic journal publications and the increase in review thresholds in recent years.

However, there are many disciplines that study the development of sports and ecological

environmental protection in China, and relevant literature has made certain contributions to the progress and development of this direction. Figure 10 shows the classification proportions of China's sports development and ecological environment protection disciplines.

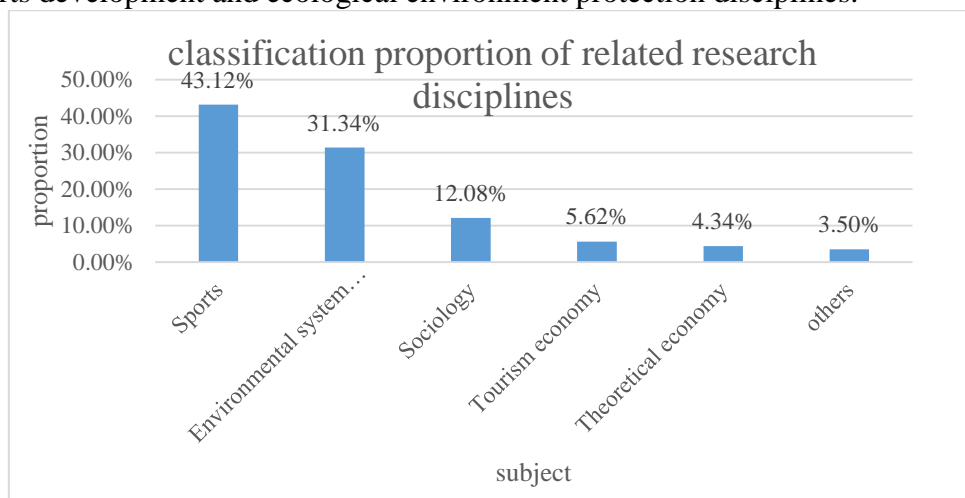


Figure 10. The proportion of China's sports development and ecological environmental protection disciplines

China has the largest proportion of the distribution of disciplines studied in this field, followed by environmental systems engineering. However, on the whole, it has jumped out of the two disciplines of sports and environment, and the scope of research has expanded, involving sociology, tourism economics, theoretical economics and other disciplines. At the same time, the development of sports and ecological environment protection, as an emerging interdisciplinary subject, has a certain role in enriching and improving the theoretical system by examining and understanding the application of multidisciplinary literature behind it.

(2) Visualization experiment of international sports development and ecological environmental protection research

The research object selected in this paper is the literature from countries other than China that conformed to all standard formats from 2010 to 2018. Valid data were screened and retained, with a total of 656 papers. The number of published papers from 2010 to 2018 is shown in Figure 11.



Figure 11. The number of international publications from 2010 to 2018

As can be seen from Figure 11, the overall trend of international sports development and



ecological environmental protection has fluctuated greatly. From 2010 to 2012, this stage belonged to the "small peak" of the number of publications; from 2013 to 2018, during the five-year period of this stage, the trend of publishing articles showed an obvious upward trend. Especially after 2015, the trend of publishing articles has reached a peak, and the number of published articles has increased year by year. The publication trend of relevant international research is related to the development of sports events and environmental protection, and is greatly influenced by factors such as the Olympic Games and large-scale events.

At the same time, according to statistics, the national distribution of international sports development and ecological environmental protection research is shown in Figure 12.

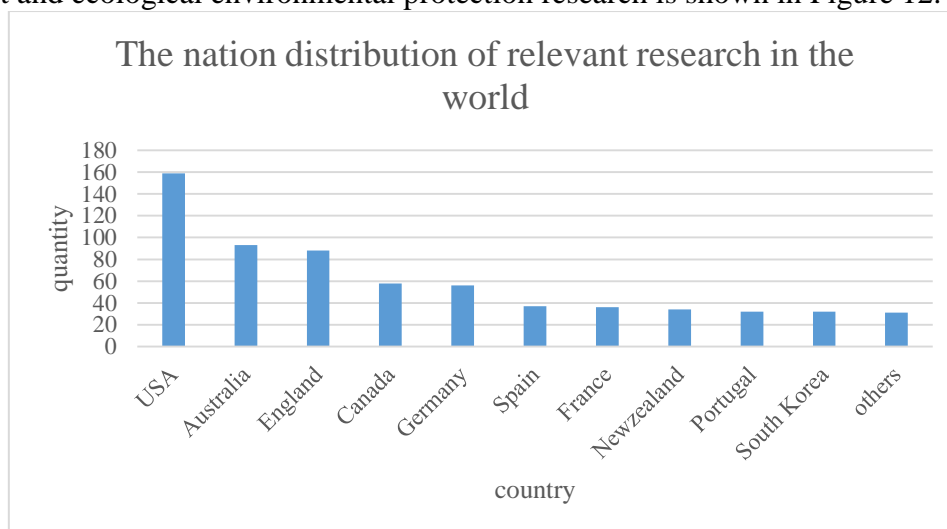


Figure 12. National distribution of international sports development and ecological environmental protection research

As can be seen from Figure 12, the USA (the United States), Australia, and England (the United Kingdom) are among the top three countries in which the international sports development and ecological environmental protection research literature is published. Among them, the United States has the largest number of publications, which has opened a large gap with Australia and the United Kingdom, showing strong research strength. It is worth mentioning that European countries represented by France, Germany and Spain and American countries dominated by Canada and Brazil are affected to a certain extent by national geographical conditions, sports resources and environment and other factors. A large number of papers have been published in this field of research, which has made a certain contribution to the development of sports tourism research.

#### 4.2. Visual Evaluation of Sports Development and Ecological Environmental Protection Evaluation

Through the data visualization analysis and comparison in the past ten years, the development of sports and related issues of ecological environmental protection have gradually attracted the attention and attention of the public. Scholars in various fields are very concerned about ecological environmental protection. Only by doing a good job in environmental protection can the sustainable development of human society be realized. The concept of sustainable development is being valued by more and more people, and there are more and more studies on this topic. Whether it is in the fields of sports, environment, sociology or economics, a large number of scholars have focused on research and discussion on its development. At the same time, relevant factual hotspots would also affect people's enthusiasm for the research, such as the holding of the Olympic Games and the

relevant policies promulgated by various countries. Under the visual analysis, a clear understanding and judgment of the relevant data and situations can be made. Due to the 2008 Beijing Olympic Games, the number of related studies in China has increased significantly in the following two years, and in the field of research, the proportion of sports and environmental engineering disciplines has reached as much as 70%, which has opened a large gap with other countries.

## 5. Conclusion

Through the visual research on the integration mechanism of sports development and ecological environmental protection, it can be understood that the distribution trend of hotspots from surface to point and from the whole to the part is developmental. The emergence of hot spots in different periods is closely related to the development needs of the country and society. The evolution path of sports development and ecological environment protection mainly focused on development strategy research, sports tourism research, and sports environment research. From the perspective of economics, the research on the integrated development of sports culture and sports tourism was divided into four knowledge groups. This paper has the characteristics of multiple topics, multiple contents, multiple research perspectives, complex research methods, and refined research content. The stratification of research perspectives is becoming more and more prominent. The proportion of empirical and mixed research is increasing. Research hotspots in different periods are closely related to national macro policies and major social events. Through the comparative analysis of sports development and ecological environment research hotspots, it can be seen that there are still some deficiencies in related research, including a single disciplinary perspective, a lot of repetitive research, lack of comparative research, insufficient argumentation, less specific research, insufficient research depth and breadth, insufficient research content, lack of systematic research content, lack of systematic research methods, etc. Therefore, this field still needs in-depth research and discussion.

## Funding

This article is not supported by any foundation.

## Data Availability

Data sharing is not applicable to this article as no new data were created or analysed in this study.

## Conflict of Interest

The author states that this article has no conflict of interest.

## References

- [1] Peng Y. *Study on the Path of Building a Sports and Leisure Town with 10,000 Mu Ecological Tea Garden in Western Hunan under the Background of Rural Revitalization*. *Modern Economics & Management Forum*. (2022) 3(1): 1-5. <https://doi.org/10.32629/memf.v3i1.610>
- [2] Wu H J. *The research on under water resources supporting capacity restraint in Xi'an city of the water sports*. *Desalination & Water Treatment*. (2018) 121(JUL.): 208-212. <https://doi.org/10.5004/dwt.2018.22462>

- [3] Rosevear R, Cassidy T. *The role of character in talent identification and development in New Zealand rugby union. International Journal of Sports Science & Coaching.* (2019) 14(3): 406-418. <https://doi.org/10.1177/1747954119847172>
- [4] Iliés D C, Buhas R, Iliés M, Iliés A, Găceu O, et al. *Sport activities and leisure in nature 2000 protected area - Red Valley, Romania. Journal of environmental protection and ecology.* (2018) 19(1): 367-372.
- [5] Ming N. *Characteristics and Trends of English Testing Research in China: Visual Analysis Based on CiteSpace. Region - Educational Research and Reviews.* (2021) 3(3): 1-6. <https://doi.org/10.32629/rerr.v3i3.386>
- [6] Lu B, Zhu M, He Q, Li M, Jia R. *TMNV is: Visual Analysis of Evolution in Temporal Multivariate Network at Multiple Granularities. Journal of Visual Languages & Computing.* (2017) 43(dec.): 30-41. <https://doi.org/10.1016/j.jvlc.2017.03.003>
- [7] Ben-Shalom U, Moshe R, Mash R, Dvir A. *Micro-Sociology and New Wars: Visual Analysis of Terror Attacks During the 'Intifada of the Individuals'. Armed Forces & Society.* (2020) 46(2): 281-301. <https://doi.org/10.1177/0095327X18811382>
- [8] Chen Y, Zeng X Y, Yang F W, Sun F. *Visual analysis of knowledge map of network Meta-analysis in traditional Chinese medicine based on CiteSpace. Zhongguo Zhong yao za zhi = Zhongguo zhongyao zazhi = China journal of Chinese materia medica.* (2020) 45(18): 4500-4509.
- [9] Gotz D, Zhang J, Wang W, Shrestha J, Borland D. *Visual Analysis of High-Dimensional Event Sequence Data via Dynamic Hierarchical Aggregation. IEEE transactions on visualization and computer graphics.* (2020) 26(1): 440-450. <https://doi.org/10.1109/TVCG.2019.2934661>
- [10] Ha H, Mun S, Choi G, Hong E, Lee K. *Visual Analysis on the Political Orientation of Historical Characters in the Joseon Dynasty : Focusing on Seo, Geojeong. Archives of Design Research.* (2019) 32(1): 147-160. <https://doi.org/10.15187/adr.2019.02.32.1.147>
- [11] Medvedkov A, Nikanorova A, Shabalina N. *Functional zoning of Kirovsk town (the Murmansk region) in conditions of tourist and recreational development of its territory. InterCarto InterGIS.* (2019) 25(2): 429-436. <https://doi.org/10.35595/2414-9179-2019-2-25-429-436>
- [12] Youwen M. *Study on the cultural construction of sports universities based on the co-ecology of school and enterprise. Boletin Tecnico/Technical Bulletin.* (2017) 55(19): 137-143.
- [13] Mijin Kim, Masako Kobayashi. *Factors Facilitating the Continuous Exercise in the Adolescents. Japanese Journal of Health and Human Ecology.* (2019) 85(2): 67-79. [https://doi.org/10.3861/kenko.85.2\\_67](https://doi.org/10.3861/kenko.85.2_67)
- [14] Manuel J. Steinbauer, Juergen Kreyling, Carolin Stöhr, Volker Audorff. *Positive sport-biosphere interactions? - Cross-country skiing delays spring phenology of meadow vegetation. Basic and Applied Ecology.* (2018) 27: 30-40. <https://doi.org/10.1016/j.baae.2017.10.003>
- [15] Barovic G, Vujacic D, Spalevic V. *Cartography in Sports and Sports in Cartography. Sport Mont.* (2020) 19(2021): 1-6. <https://doi.org/10.26773/smj.210214>
- [16] Izov, N. *Sport Injuries And Stem Cells. Journal of environmental protection and ecology.* (2017) 18(2): 700-709.
- [17] Posthuma R A, Flores G L, Barlow M A, Dworkin J B. *Social signaling and interorganizational relationships: Lessons learned from the professional sports industry. Business Horizons.* (2018) 61(4): 521-531. <https://doi.org/10.1016/j.bushor.2018.03.001>
- [18] Turkay C, Kaya E, Balcisoy S, Hauser H. *Designing Progressive and Interactive Analytics Processes for High-Dimensional Data Analysis. IEEE transactions on visualization and computer graphics.* (2017) 23(1): 131-140. <https://doi.org/10.1109/TVCG.2016.2598470>

- [19] Yi C, Jian M, Liu Y. Knowledge mapping of social commerce research: a visual analysis using CiteSpace. *Electronic Commerce Research*. (2018) 18(4): 837-868. <https://doi.org/10.1007/s10660-018-9288-9>
- [20] Orakov A N, Sakenova N K, Sorokin A, Goryanin II. ASAR: visual analysis of metagenomes in R. *Bioinformatics*. (2018) 34(8): 1404-1405. <https://doi.org/10.1093/bioinformatics/btx775>