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# Conceptual Analysis of Environmental Protection for Higher Education Population

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**Abstract.** Higher education population as the main force of social development, analysis of their degree of environmental protection, can effectively understand the relevant population's attitude towards environmental protection targeted. In this paper, 1400 people from BeiJing Jiaotong University and other universities in chemical engineering, engineering, liberal arts, chemical engineering and environment were investigated. At the same time, using conceptual analysis method, 20 terms including ecosystem, eutrophication and environmental carrying capacity were grouped and scored by correlation. Through the analysis of the quadrants of the samples of each major category, the relationship between related terms and the degree of difference of environmental protection awareness among higher education groups caused by different professional reasons are obtained. At the same time, the investigation and analysis can lay a solid foundation for the future higher education of environmental protection education and inject more energy into the cause of mitigation and protection.

**Keywords:** Multi-dimensional analysis, environmental protection, higher education, environmental planning, investigation and research.

## 1. Introduction

A total of 1400 college students from BeiJing Jiaotong University and other relevant schools were selected in this study. A total of 1400 questionnaires were sent out. In the end, 1400 questionnaires were collected, among which 1388 were valid, with an effective rate of 98%. The research samples involve different grades and majors. The samples are randomly selected, and the samples are divided into engineering, liberal arts, chemical engineering and environment according to the types of majors.[1][2]

Table 1 Proportion table of different types of others

| Category | Number | Percentage（%） |
|---|---|---|
| Engineering | 290 | 21.01 |
| Liberal arts | 400 | 28.99 |
| Chemical engineering | 300 | 21.74 |
| Environment | 390 | 28.26 |

As can be seen from the proportions in Table 1, there is little difference in the number of people in different categories. The subjects we investigated are concentrated in these four major categories. This can be roughly divided into four categories for comparative analysis: little correlation with the environment, a little correlation with the environment, and a lot of correlation with the environment. At the same time, through the calculation of reliability, we found that $\alpha$ is greater than 0.9, indicating that this study is effective.

$$\alpha = \frac{N}{N-1}(1-\frac{\sum S_j^2}{S^2}) = 0.933$$

## 2. Environmental protection consciousness analysis of experimental materials

The determination of concepts related to environmental protection goes through two processes: (a) Through literature analysis and reading related materials, select the concepts that appear most; (b) Through questionnaire survey, college students' views on environment-related concepts were collected. Finally, a total of 20 environment-related nouns were selected in this study, including: Biosphere, coordinated development, particle pollutants, electrical radiation, greenhouse effect, eutrophication, environmental carrying capacity, ecological pyramid, optimal market quantity, environmental quality prediction, food chain, red tide, acid rain, meteorological thermal factors, light pollution, information transmission, emission trading, sunspots, noise, material cycle.[3]

## 3. Experimental procedures

We asked the respondents to group the environmental terms we gave. There is no right or wrong conceptual grouping, which is mainly a multidimensional scaling method used to explore the knowledge representation of the respondents[4]. MDS multidimensional scaling analysis method assumes that research objects have similarities or spatial distances, which is used to reflect the relationship between research objects. The closer the relationship between the subjects, the closer their similarity or spatial distance will be. MDS is used to assess people's psychological perception of similarity or spatial distance between things, and it is used to study the conceptual structure of the knowledge given by each investigator. The more obvious the significant features of the concept, the easier it will be for students to learn. On the contrary, the more non-significant features involved, the easier it will be to confuse and learn. In terms of the concept of environmental protection, we should grasp the significant features of related concepts of environmental protection. The questionnaire was sent to the selected subjects. The questionnaire consisted of three questions.

### 3.1 Free classification

Participants can divide 20 relevant concept words into several groups. There is no limit to the number of groups. There is no right or wrong classification. This method of free classification has no specified criteria. According to their own considerations and ideas, the respondents divide multiple similar noun concepts into a group, and the nouns in the divided group are divided into two scores, each score 1, and the rest score 0. Given 20 nouns, each of which is regarded as a (1×m) -dimensional vector, a distance matrix in an m-dimensional space composed of n nouns can be calculated, and this matrix is composed of (n×n) data.

For example, in the question, participants regard biosphere, food chain and ecological pyramid as a category, then these three nouns get 1 point for each other, and the score between these three nouns and other nouns is 0 points, and so on, the matrix data of (20×20) is filled in and the data is analyzed for similarity.[5]

### 3.2 Establishment of conceptual framework

Twenty concepts affecting environmental factors were connected according to participants' own knowledge of environmental conceptual terms. The respondents were asked to draw concept maps for multiple conceptual nouns, and a connection was used to express a correlation between the two conceptual nouns. Constitute a concept map that can represent a certain connection and show the factors that affect each concept. It's still going to be a 20 by 20 matrix in m-dimensional space.

For example, in the survey paper, the participant connected the biosphere with the material cycle and the food chain, with the biosphere as its independent variable. However, his connection indicated that he believed both the material cycle and the food chain were closely related to the existence of the biosphere, and the connection between the two would not reflect the relationship between the material cycle and the food chain. So in the biosphere line only the material cycle and the food chain get 1 each, while the rest of the conceptual terms have nothing to do with the biosphere and get 0. The rectangular data obtained in this way will be conducive to the study of the individual subject to form different correlation to each concept.

### 3.3 Relevance of semantic evaluation

What needs to be studied is the "two pairs" principle for the correlation between concepts. Each concept pair is evaluated for its correlation. The more related the two concepts are, the higher the score will be. If the total number of concepts is N, the number of filling in is [N×(N-1)]/2 [6][7]. If the total number of concepts is 20, the number of filling in is 190. Use the resulting scores to form a (20×20) rectangular data graph.

The collected questionnaires are digitized with the above method, and each question will get a corresponding (20×20) rectangular data table in data processing. Then, the data matrix is processed with the multidimensional scaling method, and the data is obtained and analyzed.

## 4. Statistical analysis（The survey results of big data majors and environmental majors are taken as specific analysis objects）

The respondents are divided into four categories according to their professional characteristics. This method can express the relationship between concept groups and various categories in a more

specific and effective way, and can reflect how college students of different majors have different understandings of such concept groups. Due to the similarity of the majors of the respondents, we divided the investigated groups with great similarity in majors into four categories: engineering, chemical engineering, liberal arts and environment for MDS two-dimension statistical analysis.

### 4.1 Big data professional analysis results

4.1.1 Free classification reflects the aggregation of different characteristic concepts

The MDS two-dimensional solution obtains a two-dimensional plane with the origin (0,0) coordinate as the center. The plane is divided into four quadrants, and concept words are distributed in different quadrants. Figure 1 shows the MDS two-dimensional solution of free classification, i.e., the group conceptual structure. Stress=0.32168, RSQ=0.56086, the data fitting is normal[8]. The concepts are grouped into four concept groups. The overall distribution of these concepts is that six concepts, including emission trading rights, meteorological thermodynamics, optimal market quantity, environmental quality prediction, coordinated development and information transfer, are grouped in the first quadrant, while six concepts, including particle pollutants, red tide, noise, light pollution, eutrophication and greenhouse effect, are grouped in the second quadrant,the three concepts of electric radiation, sunspots and acid rain are clustered in the third quadrant, while the five concepts of environmental carrying, ecological pyramid, material cycle, biosphere and food chain are clustered in the fourth quadrant.

Figure 1 shows that the biosphere and the ecological pyramid coincide perfectly. And what this shows is that all subjects put these two into one concept group and it's a very related concept group. Each concept group has some common characteristic which is prominent and can be summarized directly. Among them, the concepts of environmental quality prediction in the first quadrant have the characteristics of environmental quality assessment; the concepts of eutrophication in the second quadrant have the similarity of severe environmental load; the concepts of electric radiation in the third quadrant have the similarity of air pollution; the concepts of environmental load bearing capacity in the fourth quadrant have the characteristics of ecological bearing degree. The close distance between the concept group of severe environmental load and the concept group of air pollution indicates the similarity between the concept group and the concept group of air pollution. However, the concept group of environmental quality assessment and ecological bearing degree are far away from other concept groups. There is a certain distance between different concept groups, and the distribution range of each concept group can be clearly divided. Generally, it presents the distribution trend of "environmental quality assessment--environmental load--air pollution--ecological bearing degree", reflecting the evolution of concepts from analyzing the source of environmental pollution to finding some conclusions. Therefore, the main feature of the group conceptual structure presented by free classification is that it can clearly present the different concept groups obtained from the common characteristics of concepts, but it cannot present the internal relations among the concepts in the concept group.

4.1.2 Concept composition Random scoring method presents different concept distribution

Figure 2 shows the MDS two-dimensional solution of conceptual composition in the second-level scoring, namely, the group conceptual structure. Stress=0.30494, RSQ=0.56609, poor data fitting. In contrast to Figure 1, the concept group is more closely distributed around the origin, forming a circle. The concepts are scattered in four quadrants.In Figure 1, the concepts of each

concept group are closely related in each quadrant and in a cluster. In Figure 2, the concepts of each concept group are distributed in a circular manner, connecting each concept group with the origin.

4.1.3 Semantic relevance evaluation reflects the deep relationship between concepts

Figure 3 shows the MDS two-dimensional solution of semantic relevance evaluation, i.e., group conceptual structure. Stress=0.36121, RSQ=0.50607, showing poor data fitting. Similar to Figure 1 and Figure 2, there is still no concept distribution near the origin of Figure 3, and the concept is mainly in the horizontal axis of dimension 1 in the figure[9], and the distribution of the concept in each quadrant is also significantly different from other graphs. It's not very scattered anymore. The special distribution of concepts in Figure 3 is that the distance between the concept of acid rain and the concept group in the first quadrant is close, which indicates that the subjects think that the concept is slightly close to the concept group in the first quadrant in this study.

## 4.2 Environmental professional analysis results

4.2.1 Free classification reflects the aggregation of different characteristic concepts

The MDS two-dimensional solution obtains a two-dimensional plane centered on the origin (0,0) coordinates. The plane is divided into four quadrants, and the concepts are distributed in different quadrants. Figure 4 shows the MDS two-dimensional solution of free classification, i.e., the group conceptual structure. Stress=0.01882, RSQ=0.99868.According to the Stress coefficient of the fitting degree index 0.2 or above, it is not good, between 0.1 and 0.05 means good effect, and 0.025 or below means very good. The lower the Stress value is, the better it is, and the larger the RSQ value is, the better it is.

4.2.2 Concept composition random scoring method presents different concept distribution

Figure 5 shows the MDS two-dimensional solution of the concept map, that is, the population conceptual structure. Stress=0.00790, RSQ=0.99978. The smaller the Stress coefficient of the fitting index, the better, and the larger the RSQ, the better, which shows that the degree of data fitting is highly correlated.Different from Figure 4, the concepts are closely distributed, especially the concepts in the first and second quadrants, which not only increase in number, but also are close to each other. The concepts of market optimal quantity and red tide are around the origin, and the concepts are closer to the number line of dimension 1 in the figure. Other concepts are scattered in each quadrant, surrounding the concepts of market optimal quantity.After checking the samples, it was not found that students majoring in environment tried the concepts of optimal quantity in connected market and red tide. The aggregation of these two concepts in Figure 4 is the potential structure of the concept map extracted by MDS after comprehensive consideration of the directly connected concepts in each concept map, which reflects the deeper potential understanding of the tested to some extent.

4.2.3 Semantic relevance evaluation reflects the deep relationship between concepts

Figure 6 shows the semantically dependent MDS two-dimensional solution, the group conceptual structure. Stress=0.12541, RSQ=0.93120. The smaller the Stress coefficient of the fitting degree index, the better, and the larger the RSQ, the better, which indicates that the fitting range of the data is good. Different from Figure 5, there is only one concept of meteorological thermal factor around the origin, and the concept is closer to the number line of dimension 2 in the figure. The overall distribution of concepts is that four concepts, emission trading, eutrophication, environmental

carrying capacity and coordinated development, are distributed in the first quadrant. The four concepts of material cycle, greenhouse effect, sunspots and particle pollution are distributed in the second quadrant. Seven concepts, including electrical radiation, information transmission, noise, meteorological thermal factor, light pollution, red tide and market optimal quantity, are distributed in the third quadrant. The four concepts of environmental quality prediction, ecological pyramid, food chain and biosphere are distributed in the fourth quadrant. According to the distribution of concepts, it can be seen that the distribution is relatively average.Secondly, the distance between food chain and ecological pyramid, light pollution and meteorological thermal factors in Figure 6 is relatively close, which indicates that subjects believe that concepts related to ecological cycle are closely related to those related to atmospheric environment. This phenomenon may be caused by the fact that many subjects only consider the most obvious and direct relationships between concepts when drawing concept maps, especially the generic relationships between concepts, and rarely reflect the less important relationships between concepts and the horizontal generic relationships between different concepts.[10][11]

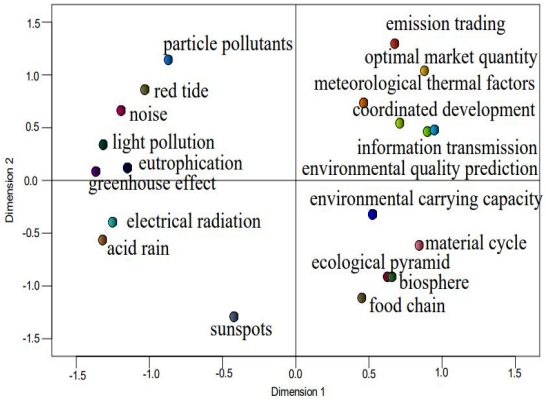


Fig.1MDS T-D solution of big data major free classified data

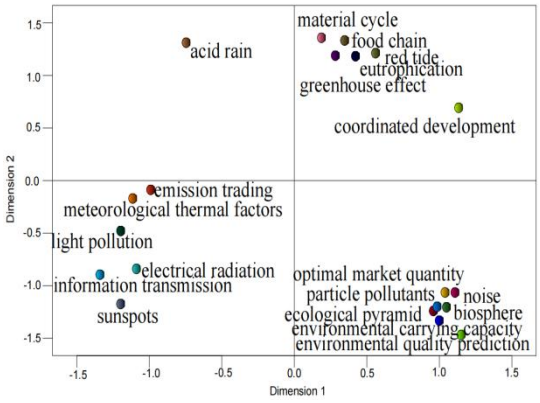


Fig.2MDS T-D solution of the conceptual composition (second-level score) data

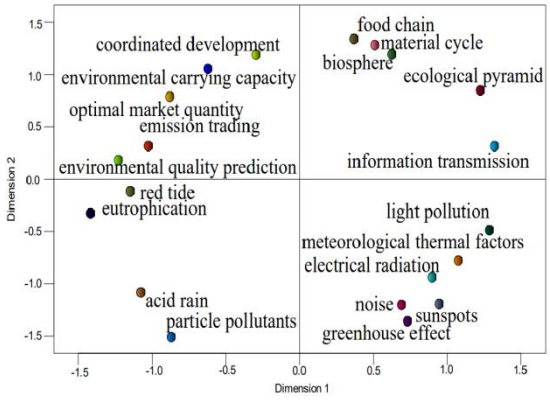


Fig.3MDS T-D solution of semantic relevance evaluation data of majors

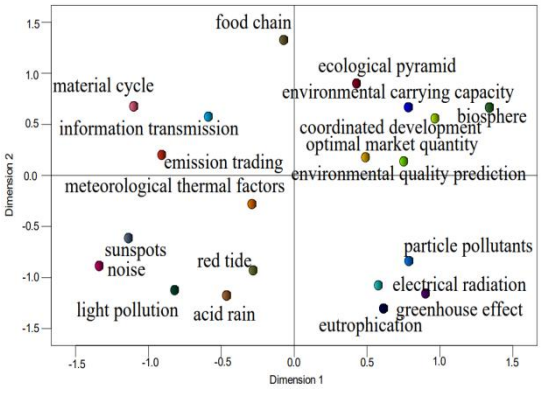


Fig.4 MDS T-D solution of free classified data of environment majors

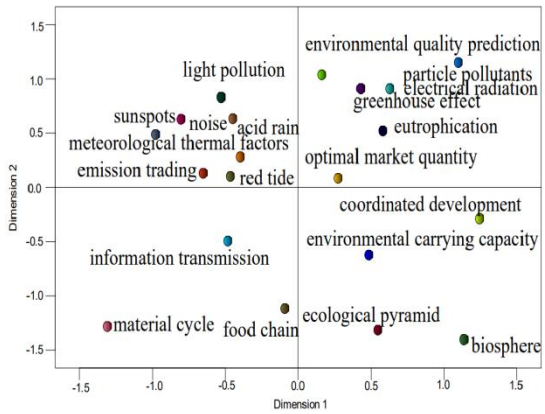


Fig.5MDS T-D solution of environment composition (second-level score) data

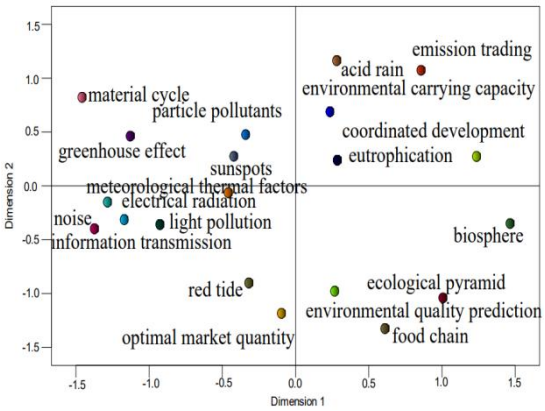


Fig.6MDS T-D solution of environment concept semantic relevance evaluation data

## 5. Summary

From the data analysis of the research object, we can see that the classification of nominal concepts of environment by college students is subjective classification, thus forming a variety of different classification methods. We have classified different majors of the same type, which are mainly divided into environmental majors and non-environmental majors, and there are four categories in total. Then big data major and environmental major are used as representatives for horizontal and vertical analysis.The MDS multidimensional scaling method derived from different specialty categories reflects the conceptual structure of different specialty groups. Among the three methods of free classification, concept diagram and semantic relevance evaluation, according to the characteristics of the three methods, the concept structure obtained from semantic relevance evaluation is more suitable for presenting the correlation relationship scientifically.

The concepts in the category of accounting are scattered in each quadrant, and the concepts related to pollutant pollution degree, physical pollution and ecological environment are classified in a specific way. They only pay attention to the classification of their respective properties among the concepts, and classify the concept groups based on their superficial meanings. When scoring the semantic correlation, they use the scores given by their superficial understandings. The environmental category believes that there are horizontal generic connections between different concepts. The upper part of the axis generally involves environmental pollution caused by elements and the influence of coordinated development, while the lower part of the axis is the concept of environmental pollution under physical influence to the biosphere, from which the professional terms of the environmental category are summarized.

According to our research, college students majoring in environment will combine the environmental knowledge they have learned with their own opinions to form their own environmental awareness. They will also often understand the current situation of the environment and consider the causes of problems. Therefore, through the questionnaire data of environmental investigators, they can obtain more comprehensive relevant or extended information about the environment. Compared with other non-environmental majors, I will pay attention to environmental issues and personal environmental development. To strengthen the cultivation of green

consciousness of college students and enrich the environmental knowledge of consumers is an important premise to ensure the formation of environmental protection consumption behavior.

## References

[1] Mansour Mahmoud M. et al. Evaluation of a Reliable Method for Flash Flood Hazard Mapping in Arid Regions: A Case Study of the Gulf of Suez, Egypt[M]. Springer Nature Singapore, 2023 : 103-117.

[2] Celia Renata Rosemberg et al. Nouns and verbs in the linguistic environment of Argentinian toddlers: Socioeconomic and context-related differences[J]. First

[3] Language, 2020, 40(2) : 192-217.

[4] Science - Linguistics; Reports Outline Linguistics Study Findings from National Council for Science and Technology (Nouns and Verbs In the Linguistic Environment of Argentinian Toddlers: Socioeconomic and Context-related Differences)[J]. Science Letter, 2020.

[5] Amorós Molina Ángela et al. Integrating the United Nations sustainable development goals into higher education globally: a scoping review.[J]. Global health action, 2023, 16(1) : 2190649-2190649.

[6] A Scandinavian Island in a Slavonic Linguistic Environment. The Dialect of Gammalsvenskby: Nouns[J]. Slovene, 2013, 2(1) : 60-110.

[7] Александр Евгеньевич Маньков. A Scandinavian Island in a Slavonic Linguistic Environment. The Dialect of Gammalsvenskby: Nouns[J]. Slovene, 2013, 2(1) : 60-110.

[8] Methods of Study[M]. The University of Alabama Press, 2088 : 20-37.

[9] The Social Context of Aging: Orientations to Aging and Age Peers[M]. The University of Alabama Press, 2088 : 124-161.

[10] Brenière Léa and Doyen Laurent and Bérenguer Christophe. Optimization of preventive replacements dates and covariate inspections for repairable systems in varying environments[J]. European Journal of Operational Research, 2023, 308(3) : 1126-1141.

[11] Zhang Shunqin and Zhu Xuege and Liu Xiaowei.A diffusive Lotka–Volterra model with Robin boundary condition and sign-changing growth rates in time-periodic environment[J].Nonlinear Analysis: Real World Applications, 2023, 72.

[12] Maria José Sousa and Andreia de Bem Machado and Gertrudes Aparecida Dandolin. Technologies for Sustainable Global Higher Education[M]. CRC Press, 2023.