Empirical Research on Youth National Security Cognition Level Based on Cloud Model

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Abstract. Focusing on the development level, existing problems and cultivation path of the overall national security concept of young people has become an urgent issue of the times. In order to evaluate the national security cognition level of young people, this paper constructs a systematic evaluation system and improves the existing evaluation methods. Based on fuzzy comprehensive evaluation, grey relational analysis and the TOPSIS, a combined evaluation model based on cloud model is constructed, which takes into account the fuzziness and randomness in the evaluation process. Through the analysis of the examples and the verification of the mean square error, this new evaluation method has obvious superiority over the traditional evaluation method. The results show that the current national security awareness of young people is relatively weak, and the overall level of awareness is at a moderately low level.

1. Introduction

On April 7, 2020, the Ministry of Justice and the National Legal Affairs Office jointly issued a notice to launch a nationwide theme with the theme of "Adhere to the overall national security concept, coordinate traditional and non-traditional security, and provide a strong guarantee for the victory of a comprehensive well-off society." The National Security Education Day popularization campaign aims to raise the national awareness of national security and enhance the ability to resist risks. National security is a prerequisite and important guarantee for a country's stable development. At present, our country is in a high-speed and critical period of development. While facing many opportunities, it has received unprecedented tests in traditional security fields such as politics and military affairs and non-traditional fields such as economy and information. As the main force of the country's development and the successor of socialism, the contemporary youth has always been the main targets of the rivalry between enemies and ourselves. Therefore, the national security awareness level of contemporary youth is related to the security and stability of our country's development of the internal environment. Strengthening the national security awareness of the youth group is also a key content of ideological and political education in our country. Jiang Liping's survey of college students' non-traditional security awareness found that contemporary college students have problems with less contact with non-traditional security threats and ambiguous understanding [1]. Liu Yuqing investigated the national security awareness of college students in the Internet age, and found that the current colleges have defects in the form and content of national defense education [2]. Feng Qiankun surveyed the degree of cognition and concern of college students about national affairs from the perspective, depth, frequency and breadth of political attention, and the results were not satisfactory [3]. At present, the
theoretical basis of national security and psychological cognition has been relatively consolidated, but
the quantitative research on national security cognition has been slow, and there is no systematic
evaluation model for the national security cognition level of college students. This paper will construct
a combination evaluation method based on cloud model, taking into account the randomness and
ambiguity in the evaluation process, and make a quantitative study on the national security awareness
of the youth group.

2. Research methods

2.1. Cloud model
Academician Li Deyi of the Chinese Academy of Engineering proposed a new method for solving
uncertain problems based on fuzzy mathematics and probability theory----cloud model. The cloud
model organically combines the ambiguity and randomness in the uncertainty problem, and realizes
the bidirectional transformation of qualitative and quantitative cognition through forward Gaussian
cloud algorithm and reverse Gaussian cloud algorithm.

2.1.1. The concept of cloud
Definition 1: suppose that $U$ represents a quantitative theory field, and $C$ is a qualitative concept on $U$.
If the quantitative value $x \ (x \in U)$ is a random realization of concept $C$, and the determinability of $x$ to
$C \rightarrow \mu(x) \in [0,1]$ is a random number with a stable tendency, which is as follow:

$$\mu: \ U \in [0,1] \quad \forall x \in U, \ x \rightarrow \mu(x)$$

Then the distribution of $x$ on the domain $U$ becomes a cloud, denoted as $C(x)$. Each $x$ is called a
cloud drop.

2.1.2. Digital features of the cloud
The cloud model characterizes its characteristics through expectation, entropy and super-entropy, and
realizes the set of ambiguity and randomness. Expectation is the center value after concept
quantization, which is the most typical sample point. Entropy reflects the degree of dispersion of cloud
droplets. Super-entropy is a measure of the uncertainty of entropy and is reflected as the thickness of
the cloud droplets.

2.1.3. The basic algorithms of the cloud
The two most basic algorithms in the cloud are the forward Gaussian cloud algorithm and the reverse
Gaussian cloud algorithm [4]. Through these two algorithms, two-way conversion between qualitative
and quantitative cognition can be achieved.
Algorithm 1: Forward Gaussian Cloud Algorithm
Input: $(Ex, En, He)$; the number of cloud drops is $N$.
Output: $N$ cloud drops $x_i$; certainty $\mu$.
The specific steps are as follows:
(1) Generate Gaussian random numbers $En'_i$: $En'_i = NORM(En, He^2)$; (1)
(2) Generate Gaussian random numbers $x_i$: $x_i = NORM(Ex, En'_i^2)$; (2)
(3) Calculate certainty: $\mu_i = \exp \left(-\frac{(x_i-Ex)^2}{2En_i^2}\right)$; (3)
(4) $x_i$ with certainty $\mu_i$ is a cloud drop in the number field;
(5) Repeat steps (1)-(4) until $N$ cloud drops are generated.
Algorithm 2: Uncertain reverse Gaussian cloud algorithm
Input: $n$ sample points $x_i (i = 1, 2, ..., n)$.
Output: digital features $(Ex, En, He)$.
The specific steps are as follows:
(1) Calculate the sample mean: $\bar{E}x = \frac{1}{n} \sum_{i=1}^{n} x_i$; (4)
(2) Calculate the second-order central moment: \[ S = \frac{1}{n} \sum_{i=1}^{n} (x_i - \bar{E}x)^2; \] (5)

(3) Calculate sample entropy: \[ \hat{E}n = \sqrt{\frac{\pi}{2}} \times \frac{1}{n} \sum_{i=1}^{n} |x_i - \bar{E}x|; \] (6)

(4) Calculate sample super-entropy: \[ \hat{He} = \sqrt{S - \hat{E}n^2}. \] (7)

2.2. Combination evaluation method based on cloud model

Based on the cloud model [5] and the evaluation principles of fuzzy comprehensive evaluation method, grey comprehensive evaluation method and the TOPSIS, this paper integrates their advantages and complements their disadvantages to construct a new comprehensive evaluation cloud model. Its evaluation process is as follows:

(1) Construct a hierarchical index system structure: classify the indexes and determine the target layer, criterion layer and factor layer [6]. And determine the evaluation factor \( U = \{u_1, u_2, \cdots, u_n\} \) and evaluation level \( V = \{v_1, v_2, \cdots, v_n\} \).

(2) Determination of weights: In order to take into account the subjective experience of people and the objective information of data, subjective weighting is adopted by AHP, objective weighting is performed by entropy weighting method, and subjective and objective combination is made using game theory ideas [7]. The index weight vector determined by the \( i \) weighting method is \( w_i = \{w_{i1}, w_{i2}, \cdots, w_{in}\} \) (\( i = 1,2 \)), then the combination of the two weights can be expressed as: \( w = \beta w_1 + \beta_2 w_2 \), where \( \beta \) is the combination coefficient, satisfying \( \beta_1, \beta_2 > 0 \). Based on the optimal strategy, the dispersion is minimized according to (8), and the optimal combination coefficient is solved.

\[
\min \left| \sum_{i=1}^{2} \beta_i w_i^T - w_j^T \right|^2 \quad (j = 1,2) \tag{8}
\]

(3) Conversion of the original data to the cloud model digital feature parameters: using the indeterminate reverse Gaussian cloud algorithm [8], the three digital features of the cloud model are obtained to obtain the factor layer cloud, called the base cloud.

(4) Fuzzy synthesis: fuzzy synthesis according to the fuzzy comprehensive evaluation method [9]. Here, cloud digital features are used to replace the fuzzy judgment matrix, and the numerical algorithm of cloud is (9) to (11). Finally, multiple base clouds synthesize a comprehensive cloud of target layer \( A \).

\[
E_x = \frac{E_{x1} \times W_1 + E_{x2} \times W_2 + \cdots + E_{xn} \times W_n}{W_1 + W_2 + \cdots + W_n} \tag{9}
\]

\[
E_n = \frac{w_{11} \times E_{n1} + w_{12} \times E_{n2} + \cdots + w_{1n} \times E_{nn}}{w_{11} + w_{12} + \cdots + w_{1n}} \tag{10}
\]

\[
H_e = \frac{w_{21} \times H_{e1} + w_{22} \times H_{e2} + \cdots + w_{2n} \times H_{en}}{w_{21} + w_{22} + \cdots + w_{2n}} \tag{11}
\]

(5) Calculate relevance: determine the optimal sequence \( Y^* = (\max E_x(i), \min E_n(i), \min H_e(i)) \) and the worst sequence \( Y^0 = (\min E_x(i), \max E_n(i), \max H_e(i)) \) from all the comprehensive cloud digital features, and based on the idea of gray correlation analysis [10], use the formulas (12) and (13) to calculate the correlation between each comprehensive cloud sample and the optimal cloud/the worst cloud.

\[
R_i^* = \frac{\min \{Y^* - Y_i\} + \rho \max \{Y^* - Y_i\}}{|Y^* - Y_i| + \rho \max \{Y^* - Y_i\}} \tag{12}
\]

\[
R_i^0 = \frac{\min \{Y^0 - Y_i\} + \rho \max \{Y^0 - Y_i\}}{|Y^0 - Y_i| + \rho \max \{Y^0 - Y_i\}} \tag{13}
\]

(6) Comprehensive evaluation value: use the proximity calculation formula in TOPSIS method, replace the Euclidean distance with the correlation degree, and calculate the gray correlation closeness \( Q \) as the comprehensive evaluation result, which is as follow: \( Q = \frac{R_i^*}{R_i^* + R_i^0}. \) (14)
3. Comprehensive Evaluation of National Security Cognition Level of Youth Group

3.1. Establishment of evaluation system

A total of 70 people were randomly selected in this survey, and 69 valid survey results were recovered, with a recovery rate of 98.6%. The questionnaire used in the study consisted of three parts: the general situation of the respondents, the questionnaire of the national security awareness level and other conditions of the respondents. Based on the theoretical conception of the security dimension by many scholars, a questionnaire framework is constructed, and based on the national security system, combined with the existing safety scale and relevant expert opinions, the questionnaire items are collected and compiled. Then, the traditional project analysis and IRT project analysis methods are used to screen out the items with poor quality, and finally form a formal questionnaire. The hierarchical structure of the formal questionnaire is shown in Fig.1. Among them, C1 contains 3 questions, mainly investigating how often people pay attention to national security through multimedia and social channels; C2 contains 3 questions, mainly understanding people's grasp of the time, background and related content of the overall national security concept; C3, C4, C5 set up questions based on eleven aspects of national security to understand the national security awareness, security attitudes and security behaviors of the respondents; C6 sets up six questions from the perspective of identity, emotional identity, cultural identity, and cultural identity to understand the national identity of the respondents.

![Fig.1 National security awareness level hierarchy](image)

This paper uses evaluation factor sets: the first-level index factor set is $A = \{B_1, B_2, B_3\}$; the second-level index factor set is $B_1 = \{C_1, C_2\}$, $B_2 = \{C_3, C_4, C_5\}$, $B_3 = \{C_6\}$; The three-level index factor set is $C_1 = \{x_{11}, \cdots, x_{13}\}, \cdots, C_6 = \{x_{61}, \cdots, x_{66}\}$. The evaluation adopts a five-level scaling method to determine the evaluation level domain $V = \{\text{Worse, Bad, Medium, Good, Better}\}$, and the value ranges they represent are as follows:

| Grade     | Worse | Bad  | Medium | Good  | Better |
|-----------|-------|------|--------|-------|--------|
| Interval  | [0,0.2)| [0.2,0.4) | [0.4,0.6) | (0.6,0.8] | (0.8,1] |

Since each factor in the factor layer (C) contains multiple problems, in order to fully integrate the index information, the inverse cloud algorithm with uncertainties is used to convert the digital features to form a blossoming base cloud.

| Tab.2 Sample cloud digital features |
|-------------------------------------|
| Student | Factor | $(Ex, En, He)$ |
|---------|--------|----------------|
| 1       | C1     | (3.000,0.836,0.549) |
| 1       | C2     | (1.250,1.060,0.100) |
3.2. Calculation of combined weight

(1) In the process of AHP, in order to reflect the subjective judgment of the decision maker and quantify it, this paper uses a commonly used 1-9 scale method to construct the judgment matrix, as shown in Tab.3.

Tab.3 Judgment matrix scale and its meaning

| Serial number | Importance level                                      | $C_{ij}$ |
|---------------|-------------------------------------------------------|----------|
| 1             | $i$ and $j$ are equally important                     | 1        |
| 2             | $i$ is slightly more important than $j$               | 3        |
| 3             | $i$ is more important than $j$                        | 5        |
| 4             | $i$ is significantly more important than $j$          | 7        |
| 5             | $i$ is extremely more important than $j$              | 9        |

According to the hierarchical structure of this article, combined with the opinions of relevant experts, the judgment matrix of the target layer to the criterion layer (denoted as $A$) and the judgment layer of the criterion layer to the factor layer (denoted as $B_1$ and $B_2$) are determined as follows:

$$B_1 = \begin{bmatrix} 1 & 1/3 \\ 1/3 & 1 \end{bmatrix}, \quad B_2 = \begin{bmatrix} 1 & 1/3 & 1/5 \\ 3 & 1 & 1/3 \\ 5 & 3 & 1 \end{bmatrix}, \quad A = \begin{bmatrix} 1 & 1/3 & 3 \\ 3 & 1 & 5 \\ 1/3 & 1/5 & 1 \end{bmatrix}$$

Through the calculation on the MATLAB platform, the above judgment matrix has passed the consistency test. The weights of each level are: $B_1: \omega_{c1} = 0.25, \omega_{c2} = 0.75$; $B_2: \omega_{c3} = 0.105, \omega_{c4} = 0.258, \omega_{c5} = 0.637$; $A: \omega_{B_1} = 0.258, \omega_{B_2} = 0.637, \omega_{B_3} = 0.105$.

Finally, the subjective weight of $C_1$-$C_6$ in $A$ is: $\omega_i = (0.064,0.194,0.067,0.164,0.406,0.105)$.

(2) The objective weights calculated by the entropy weight method in this paper are $\omega_2 = (0.136,0.592,0.040,0.056,0.088,0.088)$.

(3) Based on the theory of game theory, using MATLAB to solve the equation (8) can get $\beta_1 = 0.415, \beta_2 = 0.808$. After normalization, the combination coefficient is $\beta_1^* = 0.339, \beta_2^* = 0.661$.

Combine the subjective and objective weights, and finally get $\sum = (0.111,0.457,0.049,0.093,0.196,0.094)$.

3.3. Comprehensive evaluation results

Use cloud digital features instead of membership matrix and weights for synthesis, and operate according to the cloud computing rules of formulas (9) to (11) to obtain a comprehensive cloud.

Tab.4 Sample comprehensive cloud digital features

| Student | $Ex$   | $En$   | $He$   |
|---------|--------|--------|--------|
| 1       | 3.360  | 0.802  | 0.083  |
| 2       | 3.714  | 0.869  | 0.156  |
| 3       | 2.373  | 1.032  | 0.165  |
| 4       | 2.493  | 1.037  | 0.143  |

......
The optimal reference value $Y^*$ and the worst reference value $Y^0$ selected from the comprehensive cloud digital features of all samples are as follows:

$$Y^* = (\max E_x(i), \min E_h(i), \min H_e(i)) = (4.2638, 0.7985, 0.0796)$$

$$Y^0 = (\min E_x(i), \max E_h(i), \max H_e(i)) = (2.1918, 1.1391, 0.2134)$$

Obtain the correlation and closeness of each sample with the optimal reference value and the worst reference value, as shown in Tab.5.

| Student | $R^*$ | $R^0$ | $Q$   |
|---------|------|------|------|
| 1       | 0.8399 | 0.4579 | 0.6472 |
| 2       | 0.7461 | 0.4586 | 0.6193 |
| 3       | 0.4397 | 0.8780 | 0.3337 |
| 4       | 0.4459 | 0.8390 | 0.3470 |

Take Q value as the comprehensive evaluation value of students' national safety awareness level. As a comprehensive evaluation result, Q not only contains the accurate information of the expected value, but also incorporates the group of entropy and super-entropy parameter values that reflect the uncertain information. Therefore, compared with the traditional single comprehensive evaluation method and combined evaluation method, the results obtained by the combined evaluation method based on cloud model in this paper are more accurate, reasonable and comprehensive. Corresponding to the evaluation level specified in Tab.1 and combining with Figure 2, it can be seen that less than ten of the 69 surveyors have reached a good level, and the median and mode are in the "medium" interval, and the "bad" people were far more than the "good" people. Therefore, overall, the national security awareness level of college students in this survey is not ideal.

Fig. 2 Student comprehensive evaluation histogram

3.4. Results verification

In this paper, a new comprehensive evaluation method is used to evaluate the national safety awareness level of college students. In order to verify the accuracy of the method, gray correlation analysis method (method 1), TOPSIS method (method 2) and fuzzy comprehensive evaluation method (Method 3) were used for evaluation, select the average value of their rankings as a reference benchmark, and use the mean square error (MSE) to measure the pros and cons of each evaluation method.

$$MSE = \frac{1}{n} \sqrt{\sum_{i=1}^{n} (Y_i - \bar{Y})^2}$$

(15)
Only when the MSE is smaller, it shows that a certain evaluation method is superior to other methods. The MSE of the four evaluation methods calculated by equation (15) are listed in Tab.7. Obviously, the MSE of the cloud model comprehensive evaluation method is much smaller than the other three. Therefore, the accuracy of the above evaluation results is verified.

| Evaluation method | Cloud Model | M.1  | M.2  | M.3  |
|-------------------|-------------|------|------|------|
| MSE               | 0.9155      | 2.0382 | 1.4937 | 1.4071 |

4. Summary and outlook

Based on the overall national security concept architecture and the research of many scholars, this paper establishes a three-level and six-level indicator of national security cognitive evaluation system, and builds a combined evaluation model based on cloud model. The cloud model can realize the conversion of two-way cognition between qualitative and quantitative concepts, considering both ambiguity and randomness. By integrating the cloud model with multiple comprehensive evaluation methods, the shortcomings in the evaluation process of a single method are overcome, and the evaluation results are more comprehensive and accurate. According to the results, the survey group's awareness of national security is not ideal. The whole is only at the "medium" level, and more samples are below the "medium" level, which gives the ideological and political education carried out by colleges in China certain warnings------Should we implement corresponding reforms in the content and education forms?

Nowadays, colleges pay more and more attention to the development of national safety education, but it is still unknown how students learn and master. This article provides a comprehensive evaluation model for the national safety awareness assessment of the youth group, and it is expected that it will be compiled into corresponding software and applied to the national security awareness measurement of college students in the future, in order to better and more timely grasp the students' cognitive situation, so as to teach students according to their aptitude, and effectively lay a solid foundation for the ideology of contemporary youth.

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