Exploring the Evaluation of the Construction Work of Student Party Branches in Colleges and Universities Based on Hierarchical Analysis Method

Yuncong Zeng[1(✉)] and Yifan Han[2]

[1] School of Life Science and Technology, University of Electronic Science and Technology of China, Chengdu, Sichuan, China
life_zengyc@uestc.edu.cn

[2] School of Public Affairs and Administration, University of Electronic Science and Technology of China, Chengdu, Sichuan, China

Abstract. Student party branches in colleges and universities are the basic units for managing, supervising, and serving student party members. The article establishes the "Student Party Branch Control System" by combining the control of typical complex systems, considering the student party construction work in colleges and universities as a whole system, as well as evaluating the quality of the student party branch construction work by building a hierarchical analysis and evaluation model. Firstly, the four evaluation indexes based on the hierarchical model are established through The Analytic Hierarchy Process (AHP), and the weight values of each index are determined by using the second-order evaluation method to reach the final evaluation results.

Keywords: The Analytic Hierarchy Process (AHP) · college party construction · student party branch

1 Introduction

Student Party branches in colleges and universities are the basic units for managing, supervising, and serving student Party members, the fighting bastion for implementing the Party's line and policy to the grassroots of colleges and universities, the bridge and link between the Party and the majority of young students, and the important support for running a good socialist university with Chinese characteristics.

Nowadays, there are many problems in some university student party branches: a shallow theoretical study, insufficient execution, weak organizational cohesion, and inaction of party branch members, resulting in the party branch "talking unheard and working unheard". In addition, the rapid development of the Internet era makes students pursue individuality, and the cognition of young college students is affected by the migration of grass-roots party branches in colleges and universities. To promote the creativity of the grass-roots student Party members and cadres to remember the mission,

X. Yuan et al. (Eds.): ICEKIM 2023, AHCS 13, pp. 1267–1275, 2023.
https://doi.org/10.2991/978-94-6463-172-2_134

take responsibility, study diligently, do practical things, do good things and solve difficulties for students so that the Party organization has a strong “magnetic force” and a lasting attraction that can talk with students, stand together, sit in one place as well as work with students. It aims that build a “suction stone” type party organization.

In the process of assessing the quality of student party branch construction work in higher education institutions, some evaluation factors or comments used have some degree of vagueness, do not have clear boundaries and clear extensions, and are difficult to be evaluated with absolute or precise affirmation or negation, so it is appropriate to use the fuzzy comprehensive evaluation method [1]. When applying the fuzzy comprehensive evaluation method, the weight of each index has an extremely important status, but when applying the fuzzy comprehensive evaluation method, the weight of each index is often proposed by experts according to their personal experience, which inevitably has a certain subjectivity [2]. Hierarchical analysis is a method that combines qualitative and quantitative evaluation, which can process and express personal subjective judgments in quantitative form, thus minimizing the possible unscientific evaluation due to personal subjective judgments and making the evaluation results more credible [3, 4].

2 Chromatographic Analysis Method

Given the different contribution values of each indicator to the previous level of indicators, AHP is used to determine the weights of each indicator [5]. Hierarchical analysis is a combined qualitative and quantitative evaluation method proposed in the mid-1970s by T.L. Satty, a famous American operations researcher and professor at the University of Pittsburgh [6]. The method simulates the basic features of the human thinking process in decision-making (i.e. decomposition, judgment and synthesis) for a hierarchical, quantitative and normative treatment of complex problems [7]. It is a system engineering method, which considers a complex multi-objective decision problem as a whole, decomposes the total objective into several sub-objectives or criteria, and then further decomposes it into several levels with multiple indicators or criteria and multiple constraints, thus decomposing it into orderly recursive hierarchical structure, i.e. hierarchical model, and calculates the single ranking (number of weights) and total ranking of each level by fuzzy quantification of the qualitative indicators [8]. (number of weights) and the total ranking, so as to optimize the multi-objective, multi-indicator multi-solution decision [9].

3 Evaluation Index System

Generally speaking, the modeling of AHP includes four steps: building a structural model of recursive hierarchy, constructing a two-by-two comparison judgment matrix, hierarchical single ranking and hierarchical total ranking [10, 11]. The following specific analysis is as follows.

3.1 Create a Recursive Hierarchy Based on Information

This paper set up the content and index system for evaluating the quality of party building work of student party branches from four aspects: policy system, specific measures and

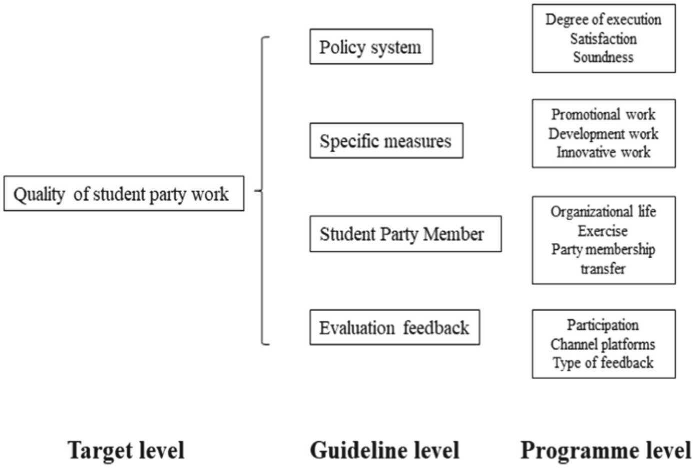

Fig. 1. Hierarchical structure model.

student party members as well as evaluation feedback. After clarifying the evaluation contents and the relationship, a hierarchical model consisting of the evaluation objects and evaluation index systems is established, which is shown in Fig. 1.

3.2 Constructing a Two-Comparison Judgment Matrix

A judgment matrix (also called pairwise comparison matrix) is constructed, and for factors of the same level, a two-by-two comparison is made according to their importance regarding a certain criterion of the previous level. Thus, a two-by-two comparison of the importance of all factors is shown on a scale of 1 to 9 in Table 1. Various scale in this table represents the importance of a two-by-two comparison, which is used to sort different factors with AHP.

The n-order two-by-two comparison judgment matrix is constructed, as shown in the following constructed judgment matrix. Where $A_i(i = 1, 2, 3, \ldots, n)$ is the evaluation index, and $a_{ij}(i, j = 1, 2, 3, \ldots, n)$ denotes the weight. This paper evaluates the importance of each level of evaluation indexes compared with other evaluation index at two levels by 10 Civic Science teachers of University of Electronic Science and Technology of China that are engaged in the work related to the party construction of college students.

$$A = \begin{bmatrix} A & A_1 & A_2 & A_3 & A_4 \\ A_1 & 1 & 5 & 3 & 7 \\ A_2 & 1/5 & 1 & 1/3 & 2 \\ A_3 & 1/3 & 3 & 1 & 1/5 \\ A_4 & 1/7 & 1/2 & 5 & 1 \end{bmatrix} \tag{1}$$

Table 1. Definition of judgment matrix scales

Scale a_{ij}	**Meaning**
1	Factor i factor j is equally important
3	Factor i is slightly more important than factor j
5	Factor i is significantly more important than factor j
7	Factor i is strongly more important than factor j
9	Factor i is extremely more important than factor j
2,4,6,8	The ratio of the effects of factor i over factor j is between the two adjacent levels above
Countdown	The ratio of the effects of factor i over factor j is the ratio of the above a_{ij} the reciprocal of. $a_{ij} = \frac{1}{a_{ji}}$

Based on the constructed judgment matrix, using the characteristic root method, the weight vector $\omega = (\omega_1, \omega_2, \omega_3, \ldots, \omega_n)^T$, right multiplying the weight ratio matrix A, we have.

$$A\omega = \lambda_{\max}\omega \quad (2)$$

where λ_{max} is the maximum eigenvalue of the judgment matrix, which exists and is unique, and in addition ω The components of the matrix are all positive components. Finally, the obtained weight vector is normalized and the normalized vector is the weight vector for sorting.

3.3 Hierarchical Single Sort and Hierarchical Total Sort

The first is the hierarchical single ranking. After the aforementioned judgment matrix is constructed, the maximum eigenvalue of this judgment matrix and its corresponding orthogonal eigenvector are found, and the weight value of the relative importance of each factor in each level with respect to a factor in the previous level and its ranking is calculated.

The main methods for solving the feature vectors are sum-product method, square root method, power method, least squares method, etc. The importance calculation is the most fundamental computational task of AHP decision analysis. In this paper, the sum-product method is used for calculation. Let the judgment matrix $A = (a_{ij})_{n \times n}$, whose specific steps include.

1) Step 1

The elements in A are normalized by columns, i.e., to find

$$\bar{a}_{ij} = \frac{a_{ij}}{\sum_{k=1}^{n} a_{kj}}, i, j = 1, 2, 3, \ldots, n \quad (3)$$

2) Step 2

Table 2. Calculate the sum of the columns

Quality of work	Policy System	Specific measures	Student Party Members	Evaluation Feedback
Policy System	1	5	3	7
Specific measures	0.2	1	0.333	2
Student Party Members	0.333	3	1	0.2
Evaluation Feedback	0.1429	0.5	5	1
$\sum a_{ij}$	1.6759	9.5	9.333	10.2

The columns of the same row of the normalized matrix are summed, i.e.

$$\overline{\omega}_{\mathrm{i}} = \sum_{\mathrm{j}=1}^{\mathrm{n}} \overline{\mathrm{a}}_{\mathrm{ij}}, \mathrm{i} = 1, 2, 3, \ldots, \mathrm{n} \tag{4}$$

3) Step 3
The weight vector is obtained by dividing the summed vector by n, i.e.

$$\overline{\omega} = \overline{\omega}_{\mathrm{i}}/\mathrm{n} \tag{5}$$

4) Step 4.
The maximum characteristic root is calculated as

$$\lambda_{\max} = \frac{1}{\mathrm{n}} \sum_{\mathrm{i}=1}^{\mathrm{n}} \frac{(\mathrm{A}\omega)_{\mathrm{i}}}{\omega_{\mathrm{i}}} \tag{6}$$

where $(A\omega)_i$ denotes the vector $A\omega$ of i component of the vector.

The table below shows the calculation of the hierarchical single row and the hierarchical total row. Table 2 performs the sum of the columns of the matrix; Table 3 normalises the matrix by column; Table 4 is the matrix operation to calculate the sum of the rows; and Table 5 is the final step, calculating the weights of the elements.

3.4 Consistency Test

1) Calculate the consistency index CI (consistency index)

$$\mathrm{CI} = \frac{\lambda_{\max} - \mathrm{n}}{\mathrm{n} - 1} \tag{7}$$

where λ_{max} is the maximum eigenvalue of the judgment matrix.

2) Find consistency indicators RI (see Table 6)

Table 3. Normalization by column

Quality of work	Policy System	Specific measures	Student Party Members	Evaluation Feedback
Policy System	0.5967	0.5263	0.3214	0.6863
Specific measures	0.1193	0.1053	0.0357	0.1961
Student Party Members	0.1987	0.3158	0.1071	0.0196
Evaluation Feedback	0.0853	0.0526	0.5357	0.098

Table 4. Calculate the sum of the rows

Quality of work	Policy System	Specific measures	Student Party Members	Evaluation Feedback	ω_i'
Policy System	0.5967	0.5263	0.3214	0.6863	2.1307
Specific measures	0.1193	0.1053	0.0357	0.1961	0.4564
Student Party Members	0.1987	0.3158	0.1071	0.0196	0.6412
Evaluation Feedback	0.0853	0.0526	0.5358	0.098	0.7717
$\sum a_{ij}$	1	1	1	1	

Table 5. Calculate the weights of each element

Quality of work	Policy System	Specific measures	Student Party Members	Evaluation Feedback	ω_i
Policy System	0.5967	0.5263	0.3214	0.6863	0.5327
Specific measures	0.1193	0.1053	0.0357	0.1961	0.1141
Student Party Members	0.1987	0.3158	0.1071	0.0196	0.1603
Evaluation Feedback	0.0853	0.0526	0.5358	0.098	0.1929

3) Calculate the consistency ratio CR (consistency ratio)

$$CR = \frac{CI}{RI} \tag{8}$$

Table 6. Average random consistency index

n	1	2	3	4	5	6	7	8	9
RI	0	0	0.58	0.9	1.12	1.24	1.32	1.41	1.45

When $CR < 0.10$ When the consistency of the judgment matrix is considered acceptable, otherwise, the judgment matrix should be appropriately revised.

In this paper, we first calculate the maximum value of the eigenvectors of the judgment matrix A λ_{max}:

$$\lambda_{\max} = \frac{1}{n}\sum_{i=1}^{n}\left[\frac{\sum_{j=1}^{n} a_{ij}\omega_j}{\omega_i}\right] = \sum_{i=1}^{n}\left[\frac{\sum_{j=1}^{n} a_{ij}\omega_j}{n\omega_i}\right] \tag{9}$$

$$\lambda_{\max} = 4.1185 \tag{10}$$

Then its consistency index $CI = \frac{\lambda_{\max}-n}{n-1} = \frac{4.1185-4}{4-1} = 0.0395$ can be seen from the table that when the order of the judgment matrix $n = 4$ and the correction coefficient $RI = 0.90$. Thus the consistency ratio is $CR = CI/RI = 0.0395/0.90 = 0.0439$, $CR = 0.0439 < 0.10$ and the judgment matrix has consistency. Through the test, the resulting weight set.

$W = (0.5327, 0.1141, 0.1603, 0.1929)^T$ can reflect the importance of each factor, and thus the distribution of each weight value is more reasonable. It is possible to seen that the weight set $0.5327 > 0.1929 > 0.1603 > 0.1141$. It can be reflected that in the quality assessment of student party construction work in colleges and universities, the primary attention should be paid to the policy system, strengthening the organizational leadership, implementing the systems, and enhancing the cohesion and appeal of student party branches. Meanwhile, the supervision and evaluation feedback mechanism can become the cleaner of the political air in the party, and student party members and cadres can get used to making progress in reminding and supervising each other. It should be insisted on the combination of “self” feedback, feedback to “down” and feedback to “up” to optimize the feedback mechanism of supervision and evaluation.

4 Conclusions

This paper is based on the study of the factors that influences the evaluation of the construction work of university student party branches. The evaluation model is constructed by using AHP hierarchical analysis method comprehensively to evaluate the construction work of university student party branches and overcome the limitations of traditional methods. The content and index system of the quality evaluation of college student party branch construction work is established through AHP, and the weight value of each index is determined so as to conduct a comprehensive evaluation and improve the reliability and validity of the evaluation process and evaluation results.

The next work can be combined with fuzzy statistical analysis to obtain the affiliation degree of each factor, use a multi-level fuzzy comprehensive evaluation method to make a comprehensive evaluation of the quality of the construction work of student party branches in colleges and universities, and use the principle of maximum affiliation to analyze the fuzzy comprehensive evaluation results to come up with more contrasting and valid results.

Acknowledgment. This paper is the phased result of the 2021 grassroots Party building theoretical research project of University of Electronic Science and Technology of China (UESTC), "Research on Student Party Building Brand Construction" of "Three Real and Three Professional Life Sunshine" based on the Characteristics of Life Disciplines (Project number: DJYJ2021-17).

References

1. O'Neill M A, Palmer A. (2004) "Importance-performance analysis: a useful tool for directing continuous quality improvement in higher education[J]," Quality Assurance in Education, 12 (1), 39 –52.
2. Wang L, Ali Y, Nazir S. (2020) ISA evaluation framework for security of internet of health things system using AHP-TOPSIS methods[J]. IEEE Access, 8: 152316-152332.
3. Goyal T, Kaushal S. (2019) Handover optimization scheme for LTE-Advance networks based on AHP-TOPSIS and Q-learning [J]. Computer Communications, 133: 67-76.
4. Podgórski D. (2015) Measuring operational performance of OSH management system–A demonstration of AHP-based selection of leading key performance indicators. Safety Science, 73, 146–166. https://doi.org/10.1016/j.ssci.2014.11.018.
5. Rodriguez R. (2002) Models, methods, concepts and applications of the analytic hierarchy process.Interfaces, 32(6), 93.
6. Saaty T. (1980) The Analytic Hierarchy Process[M].McGraw-Hill lnc., New york.
7. Subramanian, Ramanathan. (2012) A review of applications of Analytic Hierarchy Process in operations managemen [J]. International Journal of Production Economics, v 138, p 215-241.
8. Vargas. (1990) An overview of the analytic hierarchy process and its applications[J]. European Journal of Operational Research, v 48, no.1, p 2-8.
9. Jimeno, Mokotoil. (2006) Another Potential Shortcoming of AHP[J]. Sociedad de EstadIstic a e Inves. Operative Top., v 14, no.1, p 99–111.
10. Saaty. (2008) Decision making with the analytic hierarchy process[J]. International Journal of Services Science, v 1, no.1, p 83–98.
11. Suryadi, K. (2007) Key performance indicators measurement model based on analytic hierarchy process and trend-comparative dimension in higher education institution. In International Symposium on the Analytic Hierarchy Process (ISAHP), Vina Del Mar, Chile (Vol. 3). https://doi.org/10.13033/isahp.y2007.030