The Evaluation System and Model of Students' Ideological and Political Education in Colleges and Universities Based on the Grey System Theory

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Based on the present problems and flaws in the evaluation of students' ideological and political education in colleges and universities, this paper analyses the evaluation system and methods of students' ideological and political education in colleges and universities, and brings up a new evaluation system of students' ideological and political education in colleges and universities and an improved evaluation model of students' ideological and political education in colleges and universities based on grey system theory. After analysing the principles for the selection of evaluation indicators of college ideological and political education under the new situation, the system of evaluation indicators is set up. Based on the grey system theory and grey correlation analysis, the multi-attribute and multi-variant calculation model and analytical model are built to acquire the grey correlation coefficient and grey correlation degree between the evaluation scheme and standard scheme of college ideological and political education, so that the grey comprehensive correlation degree between the evaluation scheme and standard scheme is obtained, based on which the quality of the college ideological and political education schemes can be assessed. Last, through the contrastive analysis of ideological and political education plans in several colleges, the validity of the system and the models are proved.

1. Introduction

College ideological and political education has always been an important component and a crucial part of implementation in higher education. Many scholars have conducted research and analysis on this topic from different perspectives and levels [Dong (2011), Xu(2010), Zhang et al (2011) and Huang et al (2013) reported], the attention of whom is especially paid to the performance of ideological and political education in colleges and universities as well as the evaluation system and the evaluation model. Theoretical achievement has been made to a certain degree, contributing to the practical guidance in college ideological and political education [Heng et al (2014), Li et al (2011), Lv et al (2014) and Yang et al (2010) reported]. However, there still remain some limitations and flaws in the present study on evaluation system and model of college ideological and political education. For instance, (1) the object the evaluation system aims at is unclear, and the evaluation framework and methods are not very scientific; (2) the evaluation content and evaluation models are not complete, leading to the diversified evaluation standard; (3) the evaluation approaches and methods are not consolidated and don't keep pace with the time; (4) evaluation model cannot deal with the fuzzy information during evaluation process, resulting in imprecise results. Therefore, this paper processes the fuzzy information based on the grey system theory [J.B et al (2014), Liu et al (2012), R et al (2014) and Victor et al (2010) reported] and sets up an improved evaluation model of college ideological and political education after providing a new evaluation system of college ideological and political education.

Evaluation index system of college ideological and political education.

This paper will set up the evaluation system of college ideological and political education from four aspects, namely subjective factors, objective factors, process factors and result factors, as is shown in Table 1.

Table 1: Evaluation system of college ideological and political education

System layer	criterion layer	indicator layer
evaluation system of college ideological and political education U	subjective factors U_1	investment and infrastructure u_{11}
		professional skills of teaching staff u_{12}
		scientific organization structuring u_{13}
		development planning ability u_{14}
		Education management ability u_{15}
		Course design u_{16}
	objective factors U_2	improvement of students' ideological and political quality u_{21}
		students' ideological and political proficiency u_{22}
		Education environment u_{23}
		Social satisfaction u_{24}
		integrate theory with practice u_{25}
		Social service awareness and ability u_{26}
	process factors U_3	contemporaneity of ideological and political education u_{31}
		Scientific nature of ideological and political education u_{32}
		Systematic nature of ideological and political education u_{33}
		Advancement of ideological and political education u_{34}
		Variety of ideological and political education u_{35}
		Rationality of ideological and political education u_{36}
		Talent team of ideological and political education u_{37}
		Integration of teaching and research of ideological and political education u_{38}
	result factors U_4	teaching efficiency of ideological and political education u_{41}
		Number of reform projects of ideological and political education u_{42}
		Number of awards of ideological and political education u_{43}
		Number of papers published on ideological and political education u_{44}
		Training activities of ideological and political education u_{45}
		industry-university-research results of ideological and political education u_{46}
		input-output ratio of ideological and political education u_{47}

2. Evaluation system of college ideological and political education

2.1 Multi-attribute and multi-variant qualitative analysis

According to the evaluation system of college ideological and political education shown in Table 1, some of the indicators need qualitative descriptions, which are likely to be fuzzy. In order to provide unified descriptions and to deal with the fuzzy information, the qualitative description of the evaluation indicators should be standardized. This study adopts 0-1 ratio scale to conduct qualitative analysis of the evaluation index, as is shown in Table 2.

2.2 Multi-attribute and multi-variant quantitative analysis

Similarly, according to the evaluation system of college ideological and political education showed in Table 1, some evaluation index need quantitative descriptions. As the quantitative indicators are divided into benefit indicators and cost indicators, the processing should be separated.

Suppose the number of evaluation objects is m, then the value of indicator j about object i is $r_{ij} = \left[r_{ij}^a, r_{ij}^b \right]$. If the indicator is benefit indicator, then the standardized value $v_{ij} = \left[v_{ij}^a, v_{ij}^b \right]$ is:

$$v_{ij} = \left[v_{ij}^a, v_{ij}^b \right] = \left[\frac{r_{ij}^a - \inf_{\forall i}\left(r_{ij}^a \right)}{\sup_{\forall i}\left(v_{ij}^b \right) - \inf_{\forall i}\left(r_{ij}^a \right)}, \frac{r_{ij}^b - \inf_{\forall i}\left(r_{ij}^a \right)}{\sup_{\forall i}\left(v_{ij}^b \right) - \inf_{\forall i}\left(r_{ij}^a \right)} \right] \tag{1}$$

Considering the intervals between values, Formula (1) can also be written as:

$$v_{ij} = \left[v_{ij}^a, v_{ij}^b \right] = \left[\frac{r_{ij}^a - \inf_{\forall i}\left(r_{ij}^a \right)}{\sup_{\forall i}\left(v_{ij}^b \right) - \inf_{\forall i}\left(r_{ij}^a \right)}, \frac{r_{ij}^b - \inf_{\forall i}\left(r_{ij}^a \right)}{\sup_{\forall i}\left(v_{ij}^b \right) - \inf_{\forall i}\left(r_{ij}^a \right)} \right] \tag{2}$$

If the indicator is cost indicator, then the standardized value $v_{ij} = \left[v_{ij}^a, v_{ij}^b \right]$ is:

$$v_{ij} = \left[v_{ij}^a, v_{ij}^b \right] = \left[\frac{\sup_{\forall i}\left(v_{ij}^b \right) - r_{ij}^b}{\sup_{\forall i}\left(v_{ij}^b \right) - \inf_{\forall i}\left(r_{ij}^a \right)}, \frac{\sup_{\forall i}\left(v_{ij}^b \right) - r_{ij}^a}{\sup_{\forall i}\left(v_{ij}^b \right) - \inf_{\forall i}\left(r_{ij}^a \right)} \right] \tag{3}$$

Considering the intervals between values, Formula (3) can be also written as:

$$v_{ij} = \left[v_{ij}^a, v_{ij}^b \right] = \left[\frac{\sup_{\forall i}\left(v_{ij}^b \right) - r_{ij}^b}{\sup_{\forall i}\left(v_{ij}^b \right) - \inf_{\forall i}\left(r_{ij}^a \right)}, \frac{\sup_{\forall i}\left(v_{ij}^b \right) - r_{ij}^a}{\sup_{\forall i}\left(v_{ij}^b \right) - \inf_{\forall i}\left(r_{ij}^a \right)} \right] \tag{4}$$

2.3 Weighting of multi-indicators

According to Table 1, factors in different criterion layers and indicators in different indicator layers have different weight. In this study, 1-9 ratio scale is adopted to acquire indicator weight, as is shown in Table 3.

Based on Table 3, the evaluation analysis matrix Q can be obtained:

$$Q = \{ q_{ij} \}_{n \times n} \tag{5}$$

Among which p_{ij} refers to ratio scale value of the indicator while n refers to the number of evaluation indicators.

The largest eigenvalue of the matrix Q is λ_Q^{max}. According to the table R_{RI} is obtained, and then the unified indicator R_{CI} and the unified ratio R_{CR} are also gained:

$$R_{CI} = \left(\lambda_Q^{max} - n \right) / \left(n - 1 \right) \tag{6}$$

$$R_{CR} = R_{CI} / R_{RI} \tag{7}$$

If Formula (6) and (7) both meet the need of unified indicators, then the weight w_i of indicator i is:

$$w_i = \sum_{j=1}^{n} q_{ij} \Big/ \sum_{i=1}^{n} \sum_{j=1}^{n} q_{ij} \tag{8}$$

2.4 Grey correlation analysis of ideological and political education

After the standardization of evaluation indicators, the grey standard scheme V_o of the evaluation index can be obtained:

$$V_o^{\triangle} = \left(v_{o1}^{\triangle}, \cdots, v_{oj}^{\triangle}, \cdots, v_{on}^{\triangle} \right), \quad v_{oj}^{\triangle} = \left[\max_{1 \leq i \leq m}\left(v_{ij}^a \right), \max_{1 \leq i \leq m}\left(v_{ij}^b \right) \right] \tag{9}$$

$$V_o^{\nabla} = \left(v_{o1}^{\nabla}, \cdots, v_{oj}^{\nabla}, \cdots, v_{on}^{\nabla} \right), \quad v_{oj}^{\nabla} = \left[\min_{1 \leq i \leq m}\left(v_{ij}^a \right), \min_{1 \leq i \leq m}\left(v_{ij}^b \right) \right] \tag{10}$$

Therefore the grey correlation coefficient $\delta_{ij}^{\square}$ between college ideological and political education evaluation object i and grey standard scheme $V_o^{\square}$ concerning indicator j is:

$$\delta_{ij}^{\square} = \frac{\min_i \min_j \left\| v_{oj}^{\triangle} - v_{ij} \right\| + \beta \max_i \max_j \left\| v_{oj}^{\triangle} - v_{ij} \right\|}{\left\| v_{oj}^{\triangle} - v_{ij} \right\| + \beta \max_i \max_j \left\| v_{oj}^{\triangle} - v_{ij} \right\|} \tag{11}$$

In which β Is resolution ratio, usually assigned as 0.5.

The grey correlation degree $\varphi_i^{\square}$ between evaluation object i and grey standard scheme $V_o^{\square}$ is:

$$\varphi_i^{\square} = \sum_{j=1}^{n} \left(w_j * \delta_{ij}^{\square} \right) \tag{12}$$

Similarly, the grey correlation coefficient δ_{ij}^{∇} between evaluation i and grey standard scheme V_o^{∇} concerning indicator j is:

$$\delta_{ij}^{\nabla} = \frac{\min_i \min_j \|v_{oj}^{\nabla} - v_{ij}\| + \beta \max_i \max_j \|v_{oj}^{\nabla} - v_{ij}\|}{\|v_{oj}^{\nabla} - v_{ij}\| + \beta \max_i \max_j \|v_{oj}^{\nabla} - v_{ij}\|} \tag{13}$$

Among which β is resolution ratio, usually assigned as 0.5.

The grey correlation degree φ_i^{∇} between evaluation object i and grey standard scheme V_o^{∇} is:

$$\varphi_i^{\nabla} = \sum_{j=1}^{n} \left(w_j * \delta_{ij}^{\nabla} \right) \tag{14}$$

2.5 Model and algorithm implementation

According to the analysis above, the higher grey correlation degree $\varphi_i^{\square}$ is, the better object i is; the higher grey correlation degree φ_i^{∇} is, the worse object i is. Therefore, the quality of evaluation object i cannot be well reflected if grey correlation degree $\varphi_i^{\square}$ or grey correlation degree φ_i^{∇} is referred to singularly. The grey comprehensive correlation degree φ_i need to be built:

$$\varphi_i = \left(\varphi_i^{\nabla} \right)^2 / \left(\left(\varphi_i^{\nabla} \right)^2 + \left(\varphi_i^{\square} \right)^2 \right) \tag{15}$$

According to selective preference principle, if:

$$\varphi_o = \left(\varphi_1, \cdots, \varphi_i, \cdots, \varphi_m \right) = \varphi_k \tag{16}$$

Then the evaluation object k is the best.

Table 2: Qualitative analysis of evaluation index

Fuzzy value	Descriptions
1.0	excellent
0.8	good
0.6	qualified
Fuzzy value	Descriptions
0.4	Not so good
0.2	bad
0	Very bad
0.1,0.3,0.5,0.7,0.9	Between the adjacent descriptions

Table 3: AHP evaluation and analysis

scores	descriptions
9	Comparing the two, the former one is extremely important
7	Comparing the two, the former one is very important
5	Comparing the two, the former one is relatively important
3	Comparing the two, the former one is a little more important
1	Comparing the two, the former one is as important as the latter one
2,4,6,8	Between the adjacent descriptions
reciprocal	Comparing the two, the latter one is more important

3. Case validation and analysis

The college ideological and political education has always been an important part of the educational work of the education sector in X province. Periodical assessment of the college ideological and political education work is conducted in different types of colleges and universities. Through the field visit to those colleges and

universities and the consultation to educational experts, this research has acquired data of the college ideological and political education from three normal colleges and universities in X province. The performance of ideological and political education is assessed by the evaluation system and model given by this paper. The research data is shown in Table 4.

Table 4: Evaluation data of ideological and political education

criterion layer	weight	indicator layer	weight	college A	B	C
U_1	0.200	u_{11}	0.224	0.6-0.7	0.8-0.9	0.8-0.9
		u_{12}	0.224	0.8-0.9	0.7-0.8	0.8-0.9
		u_{13}	0.107	0.8-0.9	0.7-0.8	0.6-0.7
		u_{14}	0.107	0.7-0.8	0.8-0.9	0.6-0.7
		u_{15}	0.179	0.7-0.8	0.8-0.9	0.7-0.8
		u_{16}	0.179	0.8-0.9	0.7-0.8	0.8-0.9
U_2	0.300	u_{21}	0.180	0.8-0.9	0.7-0.8	0.6-0.7
		u_{22}	0.180	0.95	0.95	0.90
		u_{23}	0.132	0.8-0.9	0.7-0.8	0.7-0.8
		u_{24}	0.186	0.7-0.8	0.6-0.7	0.8-0.9
		u_{25}	0.132	0.6-0.7	0.8-0.9	0.7-0.8
		u_{26}	0.187	0.8-0.9	0.6-0.7	0.6-0.7
U_3	0.350	u_{31}	0.125	0.8-0.9	0.8-0.9	0.6-0.7
		u_{32}	0.125	0.7-0.8	0.8-0.9	0.8-0.9
		u_{33}	0.125	0.8-0.9	0.7-0.8	0.7-0.8
		u_{34}	0.125	0.8-0.9	0.8-0.9	0.6-0.7
		u_{35}	0.125	0.7-0.8	0.8-0.9	0.8-0.9
		u_{36}	0.125	0.7-0.8	0.6-0.7	0.7-0.8
		u_{37}	0.125	0.8-0.9	0.6-0.7	0.8-0.9
		u_{38}	0.125	0.8-0.9	0.6-0.7	0.7-0.8
U_4	0.150	u_{41}	0.191	0.7-0.8	0.6-0.7	0.7-0.8
		u_{42}	0.070	20	17	14
		u_{43}	0.153	8	10	7
		u_{44}	0.070	95	100	81
		u_{45}	0.182	0.7-0.8	0.7-0.8	0.8-0.9
		u_{46}	0.153	0.8-0.9	0.8-0.9	0.7-0.8
		u_{47}	0.182	0.8-0.9	0.8-0.9	0.7-0.8

Assign the unified scale to the evaluation index based on the given evaluation index standardization model. Use the grey correlation coefficient models to get the grey correlation coefficient of the three colleges and universities. And based on the given model of weighted grey correlation degree and the grey comprehensive correlation degree model, the grey correlation degree of the three colleges and universities are obtained in Table 5.

From the results and analysis above, it can be seen that college A has the best performance and ability of ideological and political education among the three colleges and universities of the same kind.

Table 5: Grey correlation degree of three colleges

	A		B		C	
	$\varphi_i^{\square}$	φ_i^{∇}	$\varphi_i^{\square}$	φ_i^{∇}	$\varphi_i^{\square}$	φ_i^{∇}
U_1	0.728	0.694	0.767	0.656	0.676	0.669
	A		B		C	
	$\varphi_i^{\square}$	φ_i^{∇}	$\varphi_i^{\square}$	φ_i^{∇}	$\varphi_i^{\square}$	φ_i^{∇}
U_2	0.815	0.533	0.592	0.758	0.560	0.806
U_3	0.875	0.543	0.792	0.626	0.709	0.667
U_4	0.823	0.648	0.817	0.690	0.678	0.852
Weighted correlation degree of criterion layer	0.820	0.586	0.731	0.681	0.653	0.737
grey comprehensive correlation degree	0.662		0.535		0.470	

4. Conclusions

This paper studies the evaluation system and model of students' ideological and political education in colleges and universities, brings up a new evaluation system of students' ideological and political education in colleges and universities, and proposes an improved evaluation model of students' ideological and political education based on grey system theory. By analysing the differences between the evaluation object and the grey standard schemes, a comprehensive calculation model of grey correlation degree is set up, making the evaluation results more reliable, complete and accurate. In addition, based on grey system theory, the model has clear physical significance and computational process, which is helpful to the realization of the intellectualized design of college ideological and political education evaluation.

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