Evaluation of the Implementation Effect of Ideological and Political Education in Economics Courses Based on FANP

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Abstract. In order to explore the implementation effect of ideological and political education（IPE） in economics courses, this paper constructs an index system for evaluating the implementation effect of ideological and political education in economics courses based on the Kirkpatrick Model, calculates the influence weight of ideological and political education in economics courses by using fuzzy network analysis method (FANP), considers the actual situation of course implementation, collects data by combining questionnaires, examination evaluation and teacher evaluation, and analyzes the specific effect of ideological and political education in economics courses. The research results show that the implementation effect of ideological and political education in economics courses is good in this semester, but in terms of teaching environment, teaching organization, course content and form, it can be further optimized; the design around students' learning application ability, ideological influence degree, learning planning and other aspects can be improved.

Keywords: Ideological and political education,economics courses, implementation effect evaluation, fuzzy network analysis method (FANP)

1 Introduction

With the continuous advancement of China's socialist modernization, the significance of ideological and political education (IPE) in higher education is increasingly prominent. As a subject with strong practical implications, economics plays a vital role in talent cultivation through the implementation of IPE design. Therefore, major academic institutions are actively promoting the integration of IPE elements into their economics courses. However, objectively and scientifically evaluating the implementation effect of such integration has always been a focal point for educators' attention.

Regarding the evaluation of IPE, Yang Binbin (2023) [1] developed an evaluation system for assessing the teaching effectiveness of IPE courses in colleges based on Kirkpatrick's model. The evaluation index system was designed based on four dimensions: reflective layer, learning layer, behavior layer, and result layer. Liu Cuimei (2023) [2] selected students from a university as research subjects for questionnaire surveys to build an evaluation index system for assessing the teaching effectiveness of IPE courses from aspects such as knowledge learning,

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value concepts, ability training and thinking innovation. Xiao Qing (2023) [3] discusses the importance of designing professional courses with IPE elements and proposes establishing a "multi-dimensional" evaluation system based on joint evaluations by teachers and students along with process assessment and ability evaluations. Wu Xiaoyan (2023)[4], from students' perspective establishes an evaluation model for assessing the effectivity level achieved by implementing IPE using fuzzy hierarchy method; sets index factors from two dimensions - student's teacher-evaluation & self-evaluation- to evaluate course-based integrated approach towards professional development . Li Zhijun (2023)[5] examines the influencing factors of the teaching effectiveness of IPE courses in universities, including teachers' full engagement, students' active participation in learning, and the quality of the teaching environment. Additionally, this study clarifies the characteristics of evaluating the impact of IPE in universities. Li Zheng (2023) [6] employs a scientific and rational approach using the Delphi method to select appropriate indices for analysis. The data is then analyzed using SPSS software, and an evaluation index system is constructed based on hierarchical analysis methods. Gao Zixuan (2023)[7] establishes an IPE element library specifically for histoembryology courses and evaluates its effectiveness. By comparing a control group with an intervention group, this study assesses the difference between traditional teaching methods and those integrated with IPE. Zhang Hao (2023)[8] analyzes teaching data from a Chinese medicine college since implementing IPE reforms. Using data envelopment analysis models to compare input-output ratios for related professional courses in traditional Chinese medicine, this research draws conclusions regarding the implementation effect of IPE construction within colleges. Existing research indicates that evaluating the teaching effectiveness of IPE should consider various factors such as student behavior, reflection, and outcomes; selecting evaluation methods should involve comprehensive consideration of practice; employing quantitative analysis methods to evaluate implementation effects is currently trending in research.

This paper attempts to construct a fuzzy network analysis model based on practical experiences with integrating IPE into economics courses. First-hand data will be collected through questionnaires, test scores, seminar performances etc., aiming to evaluate the implementation effect of IPE in economics courses, in order to provide theoretical support for improving the quality of IPE in economics courses.

2 Basic principles of fuzzy network analysis method

Fuzzy network analysis method(FANP) is proposed on the basis of fuzzy theory and network analysis method. It uses fuzzy trigonometric function to represent variables that cannot be clearly quantified,constructs network hierarchical relationship, and decomposes the research problem into various component factors, which form a system of mutual influence and mutual restriction [9-11]. This method is particularly suitable for dealing with uncertainty and fuzziness in the network[12]. Considering the teaching practice of IPE design of economics course, this paper adopts FANP to evaluate the application effect of IPE design of economics course.

2.1 Fuzzy calculation rules

The index that cannot be described with exact numbers is expressed by triangular fuzzy numbers. The triangular fuzzy function is expressed by $M=(l,m,u)$, where $-\infty \prec l \le m \le u \prec +\infty$, parameters *l*,*m*,*u* represent the minimum value, median value and maximum value respectively.

Multiply M_1 and M_2 : $(l_1,m_1,u_1)\otimes(l_2,m_2,u_2)\approx(l_1l_2,m_1m_2,u_1u_2)$

The reciprocal of M_1 : $(l_1,m_1,u_1)^{-1}=(\frac{1}{u_1},\frac{1}{m_1},\frac{1}{l_1})$

2.2 Calculation of relative weight value

Assume that the object set for fuzzy network evaluation is and the target set is $A=(a_1,a_2,\cdots\cdots,a_n)$, the target set is $G=(u_1,u_2,\cdots\cdots,u_m)$ .Each object is analyzed by each target,M is the degree analysis value of each object,then:

$$M_{gi}^1,M_{gi}^2,\cdots\cdots,M_{gi}^m \quad i=1,2,\cdots\cdots,n$$

In the formula, all M_{gi}^m are triangular fuzzy functions.

(1) Fuzzy integrated degree value of the i-th object is defined

$$S_i=\sum_{j=1}^m M_{gi}^j\otimes(\sum_{i=1}^n\sum_{j=1}^m M_{gi}^j)^{-1} \tag{1}$$

Where,

$$\sum_{j=1}^m M_{gi}^j=(\sum_{j=1}^m l_j,\sum_{j=1}^m m_j,\sum_{j=1}^m u_j) \tag{2}$$

$$\sum_{i=1}^n\sum_{j=1}^m M_{gi}^j=(\sum_{j=1}^m l_i,\sum_{j=1}^m m_i,\sum_{j=1}^m u_i) \tag{3}$$

$$(\sum_{i=1}^n\sum_{j=1}^m M_{gi}^j)^{-1}=(\sum_{i=1}^n l_i,\sum_{i=1}^n m_i,\sum_{i=1}^n u_i)^{-1}=(\frac{1}{\sum_{i=1}^n u_i},\frac{1}{\sum_{i=1}^n m_i},\frac{1}{\sum_{i=1}^n l_i}) \tag{4}$$

(2) Let $M_1=(l_1,m_1,u_1),M_2=(l_2,m_2,u_2)$ be two triangular fuzzy numbers, then $M_1\ge M_2$ the possibility degree of is defined as

$$V(M_1\ge M_2)=\sup_{x\ge y}[\mu_{M_1}(x),\mu_{M_2}(y)] \tag{5}$$

$$V(M_1\ge M_2)=\begin{cases}1, m_1\ge m_2\\ \dfrac{l_2-u_1}{(m_1-u_1)-(m_2-l_2)}, m_1\prec m_2, u_1\ge u_2\\ 0, else\end{cases} \tag{6}$$

(3)The possibility degree of triangular fuzzy function M is greater than K triangular fuzzy numbers $M_i(i=1,2,3,\cdots\cdots,k)$ is defined as

$$V(M \geq M_1, M_2, \cdots\cdots M_k) = \min_{i=1,2,3,\cdots\cdots,k} V(M \geq M_i) \tag{7}$$

Assuming $P'(A_i) = \min V(M_i \geq M_k)$, then the weight vector $W' = [P'(A_1), P'(A_2)\cdots\cdots, P'(A_n)]^T$,after normalization is

$$W = [P(A_1), P(A_2)\cdots\cdots, P(A_n)]^T \tag{8}$$

3 Construction of evaluation index system for the implementation effect of IPE in economics courses

Kirkpatrick model was created by Professor Donald Kirkpatrick, which was initially applied to the evaluation of training effect, and then widely used in course evaluation. Kirkpatrick model includes reaction layer, learning layer, behavior layer and result layer, with the characteristics of diversification and dynamic, which fits the practical needs of the implementation effect of IPE in economics courses, so the evaluation index system is built on it. The model mainly includes the following:

First, the reaction layer is mainly to measure whether students are satisfied with learning, which reflects whether students are satisfied with learning, how they feel about learning, mainly from the dimensions of teaching organization, teacher evaluation, course content and form, teaching environment and so on.

Secondly, the learning layer is to evaluate the learning effect of students, that is, whether students can improve knowledge, skills and attitude through learning. It is mainly reflected in learning interest, learning desire, learning initiative, learning application ability and other indicators.

Thirdly, the behavior layer is mainly to reflect the effect through the change of students' behavior habits after learning, such as the change of students' learning habits through learning. Mainly manifested as learning planning, learning communication and communication ability, learning innovation, ideological influence degree, etc.

Finally, the result layer evaluates the implementation effect of the course through the final scores or results of the students.In combination with the practice, this paper evaluates the multi-dimensional and multi-stage from the final examination scores, seminar performance and classroom performance.

4 Evaluation of iPE design of economics courses based on FANP

4.1 Weight calculation

The first step: determine the evaluation index system and construct the fuzzy network structure. Among them, the target layer is the target of evaluation, and evaluates the IPE effect of economics courses based on unconscious teaching method. The control layer is mainly divided into four aspects, namely the reaction level, learning level, behavior level and result level. The reaction level mainly includes teaching organization, teacher level, classroom

content and form, teaching environment, learning level mainly includes learning interest, learning desire, learning initiative, learning application ability, etc., behavior level mainly includes learning planning, learning communication and communication ability, learning innovation, ideological influence degree, etc., result level mainly includes final examination scores, seminar performance and classroom performance. The specific indicators and expressions are in Table 1.

The second step is to set up an expert evaluation team and determine the evaluation criteria. The expert evaluation team is composed of four senior teaching experts in economics related courses. The specification divides the evaluation into six levels, which are equally important, ordinary important, slightly important, very important, very important and absolutely important, respectively, expressed by positive and negative triangular fuzzy numbers (1,1,1), (1/2, 1,3/2), (1,3/2,2), (3/2, 2,5/2), (2,5/2,3) and (5/2,3,7/2) according to the importance from low to high. The positive and negative triangular fuzzy numbers are obtained according to the calculation rules described above. Then the score is calculated by judging the influence relationship between factors.

Table 1. Indicator setting of evaluation system.

Control layer	Symbol	Network layer	Symbol	Control layer	Symbol	Network layer	Symbol
Response level	*R*	Teaching organization	R_1	Behavior level	*B*	Learning plannin	B_1
		Teacher level	R_2			Learning communication and communication ability	B_2
		Course content and form	R_3			Learning innovation	B_3
		Teaching environment	R_4			Ideological influence degree	B_4
Learning level	*L*	Learning interest	L_1	Results level	*S*	Final assessment score	S_1
		Learning desire	L_2			Seminar performance	S_2
		Learning initiative	L_3			Classroom performance	S_3
		Learning application ability	L_4				

The third step is to construct a pairwise comparison fuzzy matrix based on the expert scores. These matrices are divided into three forms: the control layer(Table 2), the control layer to the network layer(Table 3) and the triangular fuzzy comparison matrix of the network layer.

Table 2. Triangular fuzzy contrast matrix of the control layer (R as the criterion).

R	*R*	*L*	*B*	*S*
R	(1,1,1)	(1/2,2/3,1)	(1/2,2/3,1)	(1/3,2/5,1/2)
L	(1,3/2,2)	(1,1,1)	(1,1,1)	(2/3,1,2)
B	(1,3/2,2)	(1,1,1)	(1,1,1)	(2/3,1,2)
S	(2,5/2,3)	(1/2,1,3/2)	(1/2,1,3/2)	(1,1,1)

The fourth step is to calculate the local weight of the three matrices. Based on the fuzzy calculation rules and the calculation method of relative weight value (formula 1-6), the local weight of the comparison matrix is calculated in Excel.

The fifth step is to calculate the super matrix, the weighted super matrix and the comprehensive weight. By calculating the weights in the previous paragraphs, the super decision software is used to calculate the super matrix, weighted super matrix and comprehensive weight.

Table 3. Triangular fuzzy contrast matrix of the control layer to the network layer(R1 as the criterion).

	R_1	R_2	R_3	R_4
R_1	(1,1,1)	(1/2,2/3,1)	(2/3,1,2)	(2/5, 1/2, 2/3)
R_2	(1,3/2,2)	(1,1,1)	(1/2,1,3/2)	(2/3,1,2)
R_3	(1/2,1,3/2)	(2/3,1,2)	(1,1,1)	(1/2,2/3,1)
R_4	(3/2,2,5/2)	(1/2,1,3/2)	(1,3/2,2)	(1,1,1)

4.2 Example analysis

FANP is used to analyze and evaluate the IPE design effect of the economics course, and get the weight of each factor. Then the questionnaire and comprehensive classroom performance score are used to evaluate the IPE design effect of the economics course, so as to improve the teaching design. The specific steps are as follows:

First, based on the fuzzy network structure constructed in the previous paragraphs, the fuzzy contrast matrix and weight of the control layer are calculated. On the basis of the evaluation of the questionnaire filled by experts, the factors of the control layer are compared in pairs, and then the weight of the control layer pair comparison matrix is calculated through the weight calculation rule(Table 4).

Table 4. Weight calculation of the fuzzy contrast matrix of the control layer (R as the criterion).

Element	Fuzzy comprehensive degree value $Si \geq Sk$（i≠k）			W’	W
R	$S_R \geq S_L$	$S_R \geq S_B$	$S_R \geq S_S$	0.33	0.11
	0.48	0.48	0.33		
L	$S_L \geq S_R$	$S_L \geq S_B$	$S_L \geq S_S$	0.82	0.28
	1	1	0.82		
B	$S_B \geq S_R$	$S_B \geq S_L$	$S_B \geq S_S$	0.82	0.28
	1	1	0.82		
S	$S_S \geq S_R$	$S_S \geq S_L$	$S_S \geq S_B$	1	0.34
	1	1	1		

Similarly, as is shown in Table 5,the weight of the four factors is calculated with L, B and S as the criterion.

Table 5. Weight under different criteria layer conditions.

Criterion layer	*R*	*L*	*B*	*S*
L	0.30	0.25	0.22	0.22
B	0.23	0.27	0.31	0.19
S	0.23	0.27	0.31	0.19

Again, similar to the weight calculation method of the control layer, the factors of the network layer are compared in pairs, and the weight of the network layer is calculated. According to formulas (1)-(6), the weight of the fuzzy contrast matrix of the control layer is calculated.

Taking R1 as the criterion, the calculation process of the weight of the elements of the network layer is shown in Table 6.

Table 6. The calculation process of the weight of the elements of the network layer (taking R1 as the criterion).

Element	Fuzzy comprehensive degree value Si≥Sk（i≠k）			W’	W
R_1	$S_1 \geq S_2$	$S_1 \geq S_3$	$S_1 \geq S_4$	0.60	0.19
	0.75	0.90	0.60		
R_2	$S_2 \geq S_1$	$S_2 \geq S_3$	$S_2 \geq S_4$	0.86	0.27
	1	1	0.86		
R_3	$S_3 \geq S_1$	$S_3 \geq S_2$	$S_3 \geq S_4$	0.72	0.23
	1	0.86	0.72		
R_4	$S_4 \geq S_1$	$S_4 \geq S_2$	$S_4 \geq S_3$	1	0.32
	1	1	1		

The relative weight of the elements in other cases can be calculated by the same method. The super matrix, weighted super matrix and limit matrix are obtained by using Super Decision software.

By calculating the comprehensive weight of the effect of the unconscious teaching method in the IPE design of the economics course, the results are shown in Figure 1.Based on the radar chart of the comprehensive weight, the sorting of the comprehensive weight from large to small is: classroom performance S3, learning communication B2, seminar performance S2, terminal assessment score S1, learning initiative L3, learning innovation B3, learning interest L1, teacher level R2, ideological influence degree B4, learning desire L2, learning planning B1, learning application ability L4, teaching organization R1, course content and form R3, teaching environment R4.

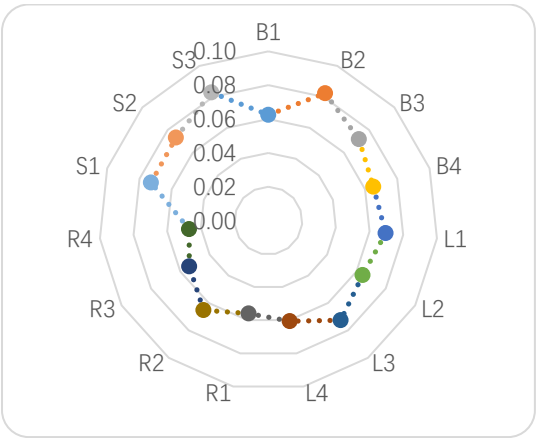

Figure 1. Comprehensive weight chart.

Based on the weight obtained by the above calculation, the evaluation is carried out in combination with the implementation effect of the IPE of the economics course in the spring semester of 2023.By designing the questionnaire and various achievements and other information, the obtained data are quantified in accordance with the 1-5 point scale of Letro to comprehensively evaluate the teaching effect. Among them, the data of final examination

scores, seminar performance and classroom performance come from the assessment scores of the course, and other data are obtained through questionnaires. The data obtained from the questionnaire take the average score of each question as the final score, and the final examination scores, seminar performance and classroom performance are converted according to the final scores in accordance with the 5-point system. By multiplying the comprehensive weight and scores, the final total score is 4.372 points (out of 5 points), indicating that the IPE design of economics courses in the spring semester of 2023 has a good effect. Specifically, for the teaching situation, the teaching environment, teaching organization, course content and form can be further optimized; for students, the learning application ability, ideological influence degree, learning planning and other aspects can be further improved. In the next course teaching process, it will be further optimized and improved.

5 Conclusion

Based on the Kirkpatrick model, this paper constructs an index system for the implementation effect evaluation of IPE in economics courses from the dimensions of reflective layer, learning layer, behavior layer and result layer, and evaluates the implementation effect of IPE in economics courses by using FANP. Combined with course practice, data is collected through questionnaires, classroom performance and exam scores, and the implementation of IPE in economics courses is evaluated through example analysis. Through the analysis of the evaluation results, it provides theoretical guidance for the subsequent optimization design of IPE courses.

References

[1] Yang B.Wang J. and Zong Y. 2023. Construction of ideological and political education teaching effect evaluation system of college courses based on Kirkpatrick model. Journal of Hubei Open Vocational College,36(09),94-96.

[2] Liu C. 2023.Establishment and optimization analysis of indicators for ideological and political education classroom effect evaluation in the new era. Heilongjiang Science, 14(17),70-72.

[3] Xiao Q.Zhang Y.and Wang X. 2023.Research on teaching organization and effect evaluation of ideological and political education in professional courses . Anhui Architecture, 30(05):114-5+36

[4] Xiaoyan W. Ye Z. 2023.Teaching effect evaluation of ideological and political education based on fuzzy analytic hierarchy process: taking engineering thermodynamics course as an example. Journal of Jiaxing University, 35(05),134-139.

[5] Zhijun L. Huanmin D. 2023. Influencing factors, evaluation orientation and promotion strategy of ideological and political education teaching effect in colleges and universities. Gansu Education Research, (08), 85-87.

[6] Li Zheng, Sun Feng. 2023.Construction of "micro ideological and political education" teaching effect evaluation index system of college physical education based on AHP. Sports World, (10),82-84.

[7] Gao Zixuan, Li Heng, Wei Jianfeng, et al. 2023.Preliminary construction and implementation effect evaluation of ideological and political education element library of histoembryology course. China Continuing Medical Education, 15(20),18-22.

[8] Zhang H. 2023.Research on teaching effect evaluation of ideological and political education courses in higher Chinese medical colleges and universities based on DEA model. Science and Education, (15),142-146.
[9] Zhang P. Qiao F. Wang J.et al. 2022.Novel Multi-Criteria Sustainable Evaluation for Production Scheduling Based on Fuzzy Analytic Network Process and Cumulative Prospect Theory-Enhanced VIKOR.IEEE Robotics and Automation Letters, 7(4),9969-9976.
[10] Feyz S.Khanmohammadi M.et al. 2019. Multi-criteria decision analysis FANP based on GIS for siting municipal solid waste incineration power plant in the north of Iran. Sustainable Cities and Society,47, 101513.
[11] Mokarram M, Negahban S,Abdeldjalil B.2021. GIS-based fuzzy-analytic network process (FAHP), fuzzy-analytic hierarchy process (FANP) methods and feature selection algorithm (FSA) to determine earthquake-prone areas in Kermanshah Province, Environmental Earth Sciences, 80 (18), 633.
[12] RazaviToosi SL,Samani JMV.2019. A Fuzzy Group Decision Making Framework Based on ISM-FANP-FTOPSIS for Evaluating Watershed Management Strategies, Water Resources Mangement,33 (15),5169-5190.