

Time series Analysis of Students' Ideological Changes in the Collaborative Education Model of Labor Education and Ideological and Political Education in Colleges and Universities

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Abstract: It is of great significance to analyze the change of students' ideological concepts to test the effectiveness and optimize the collaborative education model of labor education ideological and political education in colleges and universities. This paper constructs an evaluation index system for the ideological and moral quality of students in colleges and universities, and uses the hierarchical analysis method to assign weights to the indexes, and then constructs a success evaluation model based on the with the object meta-topologically tractable model, and uses the ARIMA model to conduct a time-series analysis on this basis, so as to explore the changes in the students' ideological concepts and the trend of the implementation of collaborative educating mode. The study shows that the level of students' ideological and moral quality in H colleges and universities in 2018-2022 is high. The selected optimal model AR(2) for predicting the change of students' ideological concepts in college H passed the inverse root detection and fitting detection, and the prediction effect was better, in which the predicted values of the political ideal belief indexes in the three periods of backward 2023-2025 were 34.62, 34.73, and 34.85, respectively. The prediction results show that the overall level of students' ideological and moral qualities in college H in 2018-2025 shows a year-by-year growth trend, but the growth rate is expected to slow down due to reaching the bottleneck, so it is necessary to continue to implement and optimize the synergistic parenting model of ideological and political education of labor education.

Keywords: hierarchical analysis; object element topable model; ARIMA model; time series analysis; collaborative parenting

1. Introduction

German scientist Hacken proposed the theory of synergy, which is an emerging comprehensive discipline to study the evolutionary law of synergistic systems from disorder to order, and is also widely used in the field of social sciences [1]. In the synergistic process, multiple energies that are originally unrelated or not closely enough related or with different directions and states are gathered in an orderly manner to form a synergistic effect that exceeds their respective capabilities and has the same goal, so as to accomplish the target task more effectively [2-4].

Focusing on the goal of moral education in colleges and universities, synergy and education are organically combined and integrated into innovative elements to form an effective mechanism, which brings together various educational subjects and various educational forces in colleges and universities to achieve resource sharing and co-creation, departmental interaction and optimization, and ultimately achieve the goal of unity of purpose to complete the moral education of the people [5-6]. As the main carrier for the implementation of the fundamental task of promoting moral education, ideological and political education in colleges and universities has an irreplaceable role in the process of "cultivating



socialist builders and successors who are all-rounded in morality, intelligence, physical fitness, aesthetics and labor” [7]. In recent years, in response to the lack of awareness of labor education in the higher education system, the implementation system is not complete, the evaluation mechanism is not sound and so on, the government issued a series of important documents, the new era of labor education to make the top design and systematic arrangements, and try to incorporate labor education into the whole process of talent cultivation [8-9]. In order to actively implement the education policy of the Party and the country, the model of collaborative education between labor education and ideological and political education has been widely used by colleges and universities, which promotes the “whole” with “labor” and “education” to make college students In order to promote the overall development of human beings, college students can master labor skills adapted to the development of society, cultivate creativity, and establish correct ideals and beliefs [10-11].

At present, although the collaborative education of labor education and ideological and political education in colleges and universities has achieved certain results, there is a common problem that there is a lack of dynamic evaluation system, which can not effectively quantify the temporal and sequential changes in the effect of collaborative education. In the synergistic parenting model, students' ideological concepts undergo constant changes, reflecting the important basis of whether the synergistic model is effective. Nowadays, the phenomena of irrational consumption, “lying equalitarianism” and exquisite egoism have emerged one after another, which have a drastic impact on the labor values of the new era, and the existence of the general concept that intellectual labor is higher than physical labor has a significant impact on the ideological concepts of the students, which is one of the focuses of the labor-ethics collaborative parenting model [12-14]. As education enters digital transformation, a variety of digital technologies are applied to the education system. Through big data, artificial intelligence and other technologies with long-term tracking function, we can obtain various students' labor and ideology-related data for a long time, providing data support for quantitative research on students' ideology [15-16]. And time series analysis, as an important statistical method, is used to study data over time [17]. It can understand the trend, periodicity and seasonality of the data, predict future trends and make decisions accordingly [18]. Through the time series analysis, the dynamic evolution of students' ideology can be accessed to capture the key points of the collaborative education model and contribute to the adjustment of the parenting model.

In this paper, we reflect the change of students' ideological concepts by quantitatively evaluating students' ideological and political literacy in colleges and universities, determining the index weights of the constructed evaluation system by combining the hierarchical analysis method, and evaluating the impact of the collaborative education model of labor education and ideological and political education on students' ideological concepts by means of the success model based on the theory of material elemental generalizability. On this basis, a time series analysis based on the ARIMA model is conducted to analyze the trend of students' ideological changes over time, and to provide an improvement direction for the optimization of the collaborative education model.

2. Time-Series Analysis Model of Changes in the Mindset of University Students

In order to explore the change of students' ideology and its related laws in the collaborative education model of labor education ideology and political education in colleges and universities, this paper firstly carries out the design of the quantitative evaluation index system of students' ideological and moral qualities, then constructs the evaluation model based on the hierarchical analysis method and the success degree method, and finally conducts the time-series analysis of the change of students' ideology by using the ARIMA model.

2.1. Establishment of a Model for Evaluating the Ideological and Moral Qualities of Students in Higher Educational Institutions

2.1.1. Determination of Indicator Weights Based on the Hierarchical Analysis Approach

In this paper, the hierarchical analysis method (AHP) [19] was selected for the method of determining the weights of the indicators, and the object elemental topological model [20] and the success degree method were selected for evaluating the situation of students' ideological and moral quality. A total of 12 experts were invited to score the relative importance of the quantitative evaluation indexes of the ideological and moral quality of college students. By designing and distributing questionnaires, scoring was carried out in accordance with the scale method, and the hierarchical analysis scale of proportions is shown in Table 1.

The specific steps for determining the weights of indicators by hierarchical analysis method are:

- (1) Construct the evaluation relationship.
- (2) Construct hierarchical structure model.
- (3) Compare the factors two by two.
- (4) Weight calculation.
- (5) Consistency test.
- (6) Comprehensive judgment consistency indicator RI .

According to the specific calculation steps of indicator weights, the weights of indicators at all levels are calculated sequentially.

Table 1. Hierarchical analysis scale.

Serial number	Importance level	Measured value
1	The elements i and j are equally important	1
2	The element i is slightly more important than the element j	3
3	The element i is significantly more important than the element j	5
4	The element i is more strongly important than the element j	7
5	The element i is extremely important than the element j	9
6	The intermediate value between the above judgment values	2, 4, 6 8
7	The relative importance is the opposite of the above	Take the countdown

2.1.2. Successfulness Modeling Based on Object Element Topable Evaluation

The theory of object element topology can integrate multi-source information to solve the problems in the relationship between mutually incompatible factors in complex systems, evaluation, etc., and the evaluation results are more scientific and accurate and in line with reality.

- (1) Constructing topable object elements

The object element matrix R can be expressed as:

$$R = (N, c_i, v_i) = \begin{bmatrix} N & c_1 & v_1 \\ & c_2 & v_2 \\ & \dots & \dots \\ & c_n & v_n \end{bmatrix} = \begin{bmatrix} R_1 \\ R_2 \\ \dots \\ R_n \end{bmatrix} \quad (1)$$

In Eq. (1), N denotes the evaluation of students' ideological and moral quality after the implementation of the collaborative education model of labor education and ideological and political education in a university, whose characteristics are notated as $c_i (i = 1, 2, \dots, n)$, and v is the eigenvalue of N about c_i notated as $v_i (i = 1, 2, \dots, n)$.

- (2) Determine the success level domain and classical domain matrix

The overall success degree of the collaborative education model is judged according to the implementation of the collaborative education model of labor education and ideological and political education, while combining the relevant guidelines or goals of the system. On the basis of the determination of each evaluation index, the experts in the post-evaluation working group scored the corresponding fulfillment of the indexes according to the success level standard table of the collaborative parenting model, and finally obtained the comprehensive score of the collaborative parenting model.

Since there are five evaluation levels $N_j (j = 1, 2, \dots, 5)$ for the post-evaluation influencing factors, the classical domain object element matrix can be expressed as:

$$R_j = (N_j, c_i, v_i) = \begin{bmatrix} N_j & c_1 & \langle a_{j1}, b_{j1} \rangle \\ & c_2 & \langle a_{j2}, b_{j2} \rangle \\ & \dots & \dots \\ & c_n & \langle a_{jn}, b_{jn} \rangle \end{bmatrix} \quad (2)$$

In equation (2), N_j is the j th evaluation level in the success evaluation scale, V_{ji} is the quantitative value domain of all the post-evaluation indicators at the level N_j , and $\langle a_{jn}, b_{jn} \rangle$ denotes the range of

values of a specific indicator at a specific evaluation level.

(3) Construct the section domain matrix

The corresponding quantitative value range of each indicator c_i taken in the evaluation grade of students' ideological and moral quality after the implementation of the collaborative parenting model section domain R_p is:

$$R_p = (P, c_i, v_{pi}) = \begin{bmatrix} N_p & c_1 & \langle a_{p1}, b_{p1} \rangle \\ & c_2 & \langle a_{p2}, b_{p2} \rangle \\ & \dots & \dots \\ & c_n & \langle a_{pn}, b_{pn} \rangle \end{bmatrix} \quad (3)$$

In Eq. (3), N_p denotes the composition of the judgment level of evaluation success after the implementation of the collaborative education model, c_1, c_2, \dots, c_n are the evaluation indexes, and $\langle a_{pn}, b_{pn} \rangle$ denotes the range of the values of the section domain object elements about the eigenvalues.

(4) Construct the correlation function

According to the definition of topology about the distance between points and intervals, the correlation function can be constructed:

$$K_j(x_i) = \begin{cases} \frac{-\rho(x_i, x_{ji})}{|x_{ji}|} & x_i \in x_{ji} \\ \frac{\rho(x_i, x_{ji})}{\rho(x_i, x_{pi}) - \rho(x_i, x_{ji})} & x_i \notin x_{ji} \end{cases} \quad (4)$$

In Eq. (4), $K_j(x_i)$ is the degree to which the specific value of a university's collaborative education model P_0 on the characteristic parameter x_i belongs to the level of success of the goal level N_j , and $\rho(x_i, x_{ji})$ and $\rho(x_i, x_{pi})$ are the distances from a point x_i to interval $x_{ji} = [a_{ji}, b_{ji}]$ and from a point x_i to interval $x_i = [a_{pi}, b_{pi}]$ of the bounded interval, respectively.

(5) Determine the comprehensive correlation and evaluation grade

The correlation of the evaluation grade N_j after the implementation of the collaborative parenting model is:

$$K_j(P) = \sum_{i=1}^n w_i k_j(x_i) \quad (5)$$

In Eq. (5), $K_j(P)$ denotes that the level of success of this goal is ranked at the j th level, and w_i is the weight of evaluation factor c_i .

2.2 Time Series Analysis of Changes in Students' Mindset

In this paper, ARIMA model [21] is used to conduct time series analysis on the change of students' ideological concepts, and provide further optimization direction for the collaborative education model of labor education and civic and political education in colleges and universities by predicting the change of students' ideological and moral qualities.

2.2.1. ARIMA Model Definition and Properties

If a time series satisfies $\{x_t, t = 0, \pm 1, \pm 2, \dots\}$:

$$\begin{cases} \Phi(B)\nabla^d x_t = \Theta(B)\varepsilon_t \\ E(\varepsilon_t) = 0, \text{var}(\varepsilon_t) = \sigma_t^2 \\ E(\varepsilon_s \varepsilon_t) = 0, s \neq t \\ E(x_s \varepsilon_t) = 0, \forall s < t \end{cases} \quad (6)$$

Then the time series model is called an *ARIMA*(p, d, q) model.

where $\nabla^d = (1 - B)^d$. $\varepsilon_t \sim N(0, \sigma_t^2)$ is the white noise series. $\Phi(B) = 1 - \phi_1 B - \dots - \phi_p B^p$ is the *AR* (autoregressive) model and $\phi_p \neq 0$. $\Theta(B) = 1 - \theta_1 B - \dots - \theta_q B^q$ is the *MA* (moving average) model and $\theta_q \neq 0$.

By the definition of *ARIMA* :

$$\nabla^d x_t = \frac{\Theta(B)}{\Phi(B)} \varepsilon_t \quad (7)$$

From the above equation, it can be found that the *ARIMA* model is a *ARMA* model based on difference operations and satisfies:

When $p = 0$, the *ARIMA*(p, d, q) model is called a moving average model *MA*(q).

When $q = 0$, the *ARIMA*(p, d, q) model is called an autoregressive model *AR*(p).

When $d = 0$, the *ARIMA*(p, d, q) model is *ARMA*(p, q).

When $d = 1$ and $p = q = 0$, the *ARIMA*(p, d, q) model is *ARIMA*($0, 1, 0$) is a stochastic wandering model.

The *ARIMA* model has two properties:

(1) Smoothness. For the time series $\{x_t, t = 0, \pm 1, \pm 2, \dots\}$, it satisfies the *ARIMA* model, which can be obtained from the defining equation of the model:

$$\varphi(B) = \Phi(B)\nabla^d \quad (8)$$

From the above equation, the smoothness of the *ARIMA*(p, d, q) model can be judged by the root of $\varphi(B) = 0$.

(2) Reversibility. For the time series $\{x_t, t = 0, \pm 1, \pm 2, \dots\}$, which satisfies the *ARIMA* model, it can be obtained from the defining equation of the model:

$$\theta(B) = \Theta(B)\nabla^d \quad (9)$$

From the above equation, the invertibility of the *ARIMA*(p, d, q) model can be judged by the root of $\theta(B) = 0$.

2.2.2. Modeling Steps for ARIMA Models

The *ARIMA* model is actually to perform the difference operation on the data first to make the data become smooth, and then the *ARMA* modeling is carried out on this basis. The flow of the modeling steps of the *ARIMA* model is shown in Fig. 1, and the specific modeling steps are as follows:

(1) Determine whether the sequence is smooth. Commonly used methods to determine the smoothness of two categories, one is qualitative analysis, including two methods, the first is to draw a sequence of time series graph, through the observation of the sequence of time series graph over time whether to show a certain trend, roughly determine whether the smoothness. The second is to draw the autocorrelation and partial autocorrelation diagrams of the series, and judge the smoothness of the series roughly by the truncation and trailing of the two diagrams. The other type is quantitative analysis, i.e., unit root test, by calculating whether the root of $\varphi(B) = 0$ is within the unit circle, to conclude whether

the series is smooth or non-smooth.

(2) Perform a difference operation on the series. As a common means of turning an unsteady series into a smooth series, generally differencing an unsteady series by one order gives a smooth series.

(3) Fixed order on the model. After the second part of the smoothness test, you can model the series to determine the parameters in the ARIMA model, where d can be derived from the second step, p and q need to be obtained through other model evaluation criteria. Commonly used is to draw autocorrelation plots, partial autocorrelation plots, truncation and trailing observations, to get the approximate values of p and q , and then build all possible models, and according to the judgment criteria to get the best model.

(4) Test the model for significance. See whether the parameters pass the t test, whether the model as a whole passes the F test, and whether there is heteroskedasticity or clustering effects in the residuals of the model.

(5) Use the developed model to make price forecasts. Once the significance test of the model in step 4 is passed, the model can be used to make predictions. The data is divided into a training set and a test set to judge the predictive effectiveness of the model.

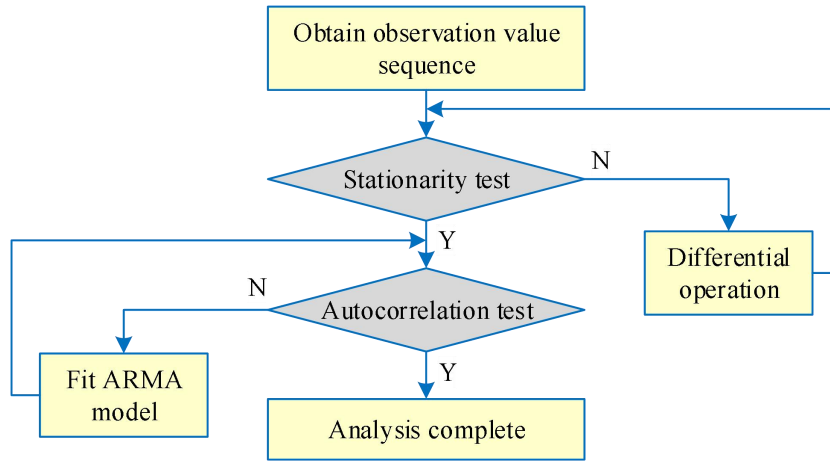


Figure 1. Modeling process of ARIMA.

2.2.3. ARIMA Model Selection

There are many selection criteria for model optimization, but the most commonly used selection criteria for model optimization are the AIC criterion, SC criterion. the AIC criterion is defined as:

$$AIC = -2 \ln(L) + 2k \quad (10)$$

where L denotes the great likelihood function of the model, k denotes the number of unknown parameters in the model, usually in the absence of centrality, k takes the value of $p + q + 1$, and the smaller the value of AIC takes, the better the model is. Thereby, the AIC of the uncentered ARIMA model is calculated as:

$$AIC = n \ln(\sigma_w^2) + 2(p + q + 1) \quad (11)$$

where n denotes the capacity of the sample observation and σ_w^2 denotes the variance of the sample residuals.

The SBC criterion, also known as the BIC criterion, is the Bayesian Information Criterion. Its original defining equation is:

$$SBC = -2 \ln(L) + k \ln(n) \quad (12)$$

where L is the great likelihood function of the model, k denotes the number of parameters to be estimated in the model, which is usually taken as $p + q + 1$, and n is the sample capacity. From the

defining equation, the SBC criterion is an improvement of the AIC criterion, and the SBC criterion penalizes the newly added variables more strongly. In other words, the smaller the SBC criterion, the better the model. In the specific model, the SBC is calculated as:

$$SBC = n \ln(\sigma_w^2) + (p + q + 1) \ln(n) \quad (13)$$

3. Empirical Evidence of Quantitative Evaluation of Students' Ethical Quality in Civics and Politics in Universities and Colleges in H

In this paper, the undergraduate students of college H are selected as the research object, and the proposed evaluation model is used to quantitatively evaluate their ideological and moral qualities.

3.1. Quantitative Evaluation System for the Ideological and Moral Quality of Higher Education Students

3.1.1. Principles of Quantitative Evaluation System Design

(1) Operability. The evaluation system should be operable, easy to evaluate and operate the various aspects of students' ideological and moral qualities, and easy to obtain relevant information and data on students' ideological and moral qualities, as well as statistics and summaries.

(2) Simplicity. The design of the evaluation system should be able to operate easily, to ensure the quality of the evaluation while minimizing the workload of the management personnel and improve the efficiency of the evaluation.

(3) Comprehensiveness. The design of the evaluation system should strive to be comprehensive, as far as possible, including all aspects of students' learning, life, social practice, etc., to completely reflect the whole picture of students' quality.

3.1.2. Analysis of the composition of the Ideological and Moral Quality of Higher Education Students

Through the analysis of the ideological and moral quality objectives of students in colleges and universities and social needs, the content composition of the ideological and moral quality needed by students is clarified, and it is decomposed into a number of quality units, and then find out what knowledge, ability and practice requirements these quality units are made of, and then construct the evaluation system of students' ideological and moral quality in a targeted way, which is divided into four evaluation systems, namely, the political quality, the ideological quality, the moral quality, and the quality of law and discipline. Module. Each quality module is carried by the first, second and third classroom courses with education and training functions, party and group education activities, club activities, social contribution activities and other social practice activities to realize the purpose of education and training. Each quality module training content to "enough, practice, assessable" as the principle, according to the laws of education and the growth of talents to form a quantitative evaluation system of the ideological and moral quality of students in colleges and universities.

Among them, the political quality mainly includes four aspects: political ideals and beliefs, political knowledge, political character and political ability. Ideological quality mainly includes three aspects of ideological awareness, ideological methods and ideological cultivation. Moral quality mainly includes two aspects of social morality and family virtues. Legal quality mainly includes two aspects of legal literacy and disciplinary literacy.

3.1.3. Construction of the Indicator System

Based on the design principle of quantitative evaluation system and the analysis of the composition of ideological and moral quality of college students, this paper constructs the evaluation index system of ideological and moral quality of H college students as shown in Table 2.

Table 2. Evaluation index system of ideological and moral quality of college students.

Target layer	Criterion layer	Index layer	Code
Students' ideological and moral qualities (A)	Political quality (B1)	Political ideals and beliefs	C1
		Political knowledge	C2
		Political morality	C3
		Political ability	C4
	Ideological quality (B2)	Ideological understanding	C5
		Thought method	C6
		Ideological cultivation	C7
	Moral quality (B3)	Social morality	C8
		Family virtues	C9
	Legal and disciplinary quality (B4)	Legal literacy	C10
		Disciplinary quality	C11

3.1.4. Determination of Evaluation Criteria

In this paper, when setting the standard for the level of ideological and moral quality of college students, on the one hand, it is necessary to take into account the objective situation of the ideological and moral quality of college students and the identified ideal goal of parenting, and on the other hand, it is necessary to refer to the relevant literature. The level of ideological and moral quality of students in colleges and universities is divided into four grades: excellent, good, qualified and poor, and the specific criteria for the division of evaluation index grades are shown in Table 3.

Table 3. The specific classification criteria for the grades of evaluation indicators.

Evaluation index	Evaluation level			
	Excellent	Good	Qualified	Poor
C1	28~35	20~28	12~20	0~12
C2	16~20	12~16	8~12	0~8
C3	20~25	16~20	8~16	0~8
C4	16~20	12~16	8~12	0~8
C5	32~40	24~32	16~24	0~16
C6	28~35	20~28	12~20	0~12
C7	20~25	16~20	8~16	0~8
C8	48~60	36~48	24~36	0~24
C9	32~40	24~32	16~24	0~16
C10	48~60	36~48	24~36	0~24
C11	32~40	24~32	16~24	0~16

3.2. Data Descriptive Statistics

The data used in the research of this paper come from the results of the questionnaire survey on the ideological and moral quality of undergraduate students in H colleges and universities from 2018 to 2022. According to the above index system, the descriptive statistics of relevant data in H colleges and universities are shown in Table 4. It can be seen that during the period of 2018-2022, the ideological and moral quality of undergraduate students in H colleges and universities has a wide range of fluctuations in the three indicators of C3 political character, C7 ideological cultivation and C10 legal literacy, with the extreme difference being above 10. In addition, the indicator value of C2 political knowledge is always at a low level, so these four indicators should be focused on in the process of collaborative education.

Table 4. Descriptive statistics of sample data.

Index	Minimum value	Maximum value	Mean value	Standard deviation
C1	27.58	34.62	32.85	1.36
C2	5.63	14.36	8.24	2.57
C3	10.45	23.76	18.41	1.45
C4	10.28	18.49	15.36	2.37
C5	31.53	39.41	36.97	1.39
C6	26.94	34.75	32.61	1.84

C7	11.32	24.81	19.64	1.52
C8	47.51	55.62	52.38	1.69
C9	32.61	39.54	37.02	1.72
C10	46.73	56.84	53.41	1.75
C11	30.49	39.27	36.54	1.83

3.3. Results of Empirical Analysis

3.3.1. Classical Domains, Section Domains, and Matrix Construction of Elements to Be Evaluated

The classical domain matrices for the four classes are constructed as follows:

$$R = \begin{bmatrix} P & C & P_1 & P_2 & P_3 & P_4 \\ C_1 & (28,35) & (20,28) & (12,20) & (0,12) \\ C_2 & (16,20) & (12,16) & (8,12) & (0,8) \\ C_3 & (20,25) & (16,20) & (8,16) & (0,8) \\ \dots & \dots & \dots & \dots & \dots \\ C_{11} & (32,40) & (24,32) & (16,24) & (0,16) \end{bmatrix} \quad (14)$$

The above R matrix is specified to obtain the new matrix R' :

$$R = \begin{bmatrix} P & C & P_1 & P_2 & P_3 & P_4 \\ C_1 & (0.8,1) & (0.571,0.8) & (0.343,0.571) & (0,0.343) \\ C_2 & (0.8,1) & (0.6,0.8) & (0.4,0.6) & (0,0.4) \\ C_3 & (0.8,1) & (0.64,0.8) & (0.32,0.64) & (0,0.64) \\ \dots & \dots & \dots & \dots & \dots \\ C_{11} & (0.8,1) & (0.6,0.8) & (0.4,0.6) & (0,0.4) \end{bmatrix} \quad (15)$$

Construct the section field matrix as follows:

$$R_{(P)} = \begin{bmatrix} P & C_1 & (0,35) \\ & C_2 & (0,20) \\ & C_3 & (0,25) \\ & \dots & \dots \\ & C_{11} & (0,40) \end{bmatrix} \quad (16)$$

3.3.2. Matrix of Elements to Be Evaluated

The year 2022 is selected for evaluation, and the matrix of to-be-evaluated elements R_{2022} and the matrix of specified to-be-evaluated elements R'_{2022} are constructed:

$$R_{(2022)} = \begin{bmatrix} P_{(2022)} & C_1 & 27.58 \\ & C_2 & 5.63 \\ & C_3 & 10.45 \\ & \dots & \dots \\ & C_{11} & 30.49 \end{bmatrix} \quad (17)$$

$$R_{(2022)} = \begin{bmatrix} P_{(2022)} & C_1 & 0.788 \\ & C_2 & 0.2815 \\ & C_3 & 0.3732 \\ & \dots & \dots \\ & C_{11} & 0.762 \end{bmatrix} \quad (18)$$

3.3.3. Indicator Relevance, Weights, Combined Relevance

Based on formula (4) above, the distance K_{ij} of the evaluation level is calculated:

$$K_{ij} = \begin{bmatrix} -0.047 & 0.047 & 0.296 & 0.547 \\ 0.274 & 0.219 & -0.018 & 0.018 \\ 0.175 & 0.076 & -0.076 & 0.192 \\ \dots & \dots & \dots & \dots \\ 0.503 & 0.335 & 0.167 & -0.008 \end{bmatrix} \quad (19)$$

Using the hierarchical analysis method, the weights of the indicators for evaluating students' ideological and moral quality are calculated as shown in Table 5. Among them, the largest weight in the first-level indicators is B1 political quality, followed by B3 moral quality, B2 ideological quality and B4 legal and disciplinary quality have the same weight. Among the second-level indicators, C1 political ideal belief, C8 social morality, C9 family virtues, C10 legal literacy have the greater weight, indicating that in the collaborative education model of labor education and ideological and political education, we should focus on the cultivation of students' political ideal belief, personal moral cultivation and legal literacy.

Table 5. Weight of evaluation indicators for students' ideological and moral qualities.

Target layer	Criterion layer	Weight	Index layer	Weight	Comprehensive weight
A	B1	0.35	C1	0.3412	0.1194
			C2	0.2003	0.0701
			C3	0.2514	0.088
			C4	0.2071	0.0725
	B2	0.20	C5	0.3956	0.0791
			C6	0.3512	0.0703
			C7	0.2532	0.0506
	B3	0.25	C8	0.5849	0.1462
			C9	0.4151	0.1038
	B4	0.20	C10	0.5924	0.1185
			C11	0.4076	0.0815

From the above formula, the composite correlation for the 2022 grade can be derived, and similarly the composite correlation for 2018-2021 is calculated. Summarizing the comprehensive correlation of 2018-2022 is shown in Table 6. It can be seen that the correlations of the moral and ethical qualities of students in college H in 2022 in the four evaluation grades of excellent, good, qualified, and poor are 0.872, 0.948, 0.976, and 0.825, respectively. The correlations of the qualified and good grades are significantly greater than those of the excellent and poor grades in the period of 2018-2022.

Table 6. Comprehensive correlation degree from 2018 to 2022.

Year	Excellent	Good	Qualified	Poor
2018	0.849	0.849	0.958	0.877
2019	0.851	0.927	0.953	0.859
2020	0.853	0.934	0.951	0.844
2021	0.861	0.952	0.907	0.846
2022	0.872	0.948	0.976	0.825

4. Forecasts of Changes in the Mindset of Students in H-Higher Education

In this chapter, we continue to take undergraduate students in college H as the research object, based on the evaluation model of Civic and Political Moral Quality, and use the ARIMA model to analyze the change of their ideological concepts in a time-series analysis.

4.1. Indicator Data Projections

In this section, taking the indicator of moral quality of Civics in college H as an example, the annual data from 2004 to 2022 are selected, and the EVIEW software is used to make ARIMA prediction, the specific steps are as follows.

4.1.1. Stability Testing and Processing

The results of the ADF test of the original series are shown in Table 7. The ADF test value is 2.173945 and the corresponding p-value is 0.9995, which is much larger than 0.05, indicating that the original hypothesis is accepted at the 5% significance level, i.e., there is a unit root in the series, which is a non-stationary series, and thus requires smoothing.

Table 7. ADF test of the original sequence.

		T-statistic	P value
Unit root test statistic		2.173945	0.9995
Detection critical value	At the 1% level	-3.968457	
	At the 5% level	-3.152473	
	At the 10% level	-2.781644	

The data are processed by first-order differencing, and then the processed series are tested again, and the results of the first-order differencing series test are shown in Table 8. After the first-order differencing, the ADF test value is -2.137654, corresponding to a P-value of 0.2863 > 0.05, which accepts the original hypothesis at the 5% significance level that the series is still a non-stationary series, and therefore continues to implement the second-order differencing.

Table 8. First-order difference sequence test.

		T-statistic	P value
Unit root test statistic		-2.137654	0.2863
Detection critical value	At the 1% level	-3.942631	
	At the 5% level	-3.138792	
	At the 10% level	-2.768275	

The results of the second-order difference series test are shown in Table 9. After the second-order difference treatment, the ADF test value is -3.548279, corresponding to a p-value of 0.0016 < 0.05, which rejects the original hypothesis at the 5% significance level, i.e., there is no unit root in the series, and the time-series data is a smooth series. At this point, the other orders in the ARIMA model need to be fixed.

Table 9. Second-order difference sequence test.

		T-statistic	P value
Unit root test statistic		-3.548279	0.0016
Detection critical value	At the 1% level	-2.817365	
	At the 5% level	-2.073624	
	At the 10% level	-1.718238	

4.1.2. ARIMA Model Ordering

After the above steps, it can be determined that the second-order difference sequence has smoothness and meets the requirements of ARIMA model prediction, i.e., the model order d is 2. Then the autocorrelation function and partial autocorrelation function after the second-order difference are analyzed, and the optimal prediction model for the time-series data is determined through the fixed order

of the ARIMA model based on the ACF and PACF plots.

And the research results show that in some cases, the correlation diagram does not have an obvious trend, that is, it is not possible to directly select the best prediction model parameter values based on the ACF and PACF diagrams. Therefore, the AR(2) model was finally selected as the optimal model for predicting the change of students' ideology in college H. The final results of the relevant data are shown in Table 10.

Table 10. Predict the order of the model.

Variable	Coefficient	Standard error	T-statistic	P value
C	39.52684	39.56792	0.998967	0.3429
AR(2)	-0.557695	0.238495	-2.506372	0.0291
SIGMASQ	56254.13	19624.83	2.958743	0.0093
Akaike info criterion	15.21963		Schwarz criterion	15.36874

4.1.3. ARIMA Model Testing and Forecasting

The ARIMA model test lies in determining whether the above ARIMA model meets the criteria for prediction through various tests.

Firstly, the inverse root test of polynomials is performed on the identified ARIMA prediction model. The results of the inverse root test of polynomials are shown in Figure 2, and the root values all fall within the unit circle, indicating that the final model passes the inverse root test and can be used as the final prediction model to predict the time series of the data of the index.

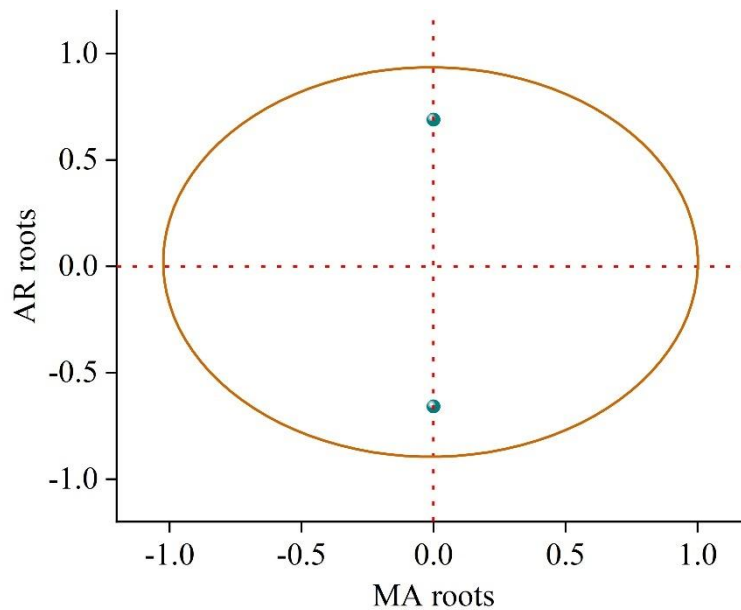


Figure 2. Inverse root test of AR/MA Polynomials.

Through the above test, it is found that the selected model meets the prediction criteria, and then the correlation plot Q-statistic of the residual term is tested, and it is found that all the values are greater than 0.05, i.e., this test is satisfied, so the reasonableness of the prediction model is further verified.

Finally, the effect of the predictive model is analyzed by testing the fit of the model. Among them, the actual values of the prediction model, the fitted values and the residuals are shown in Fig. 3, and the results further indicate that the selected model has a certain degree of feasibility in the prediction of the data of this indicator.

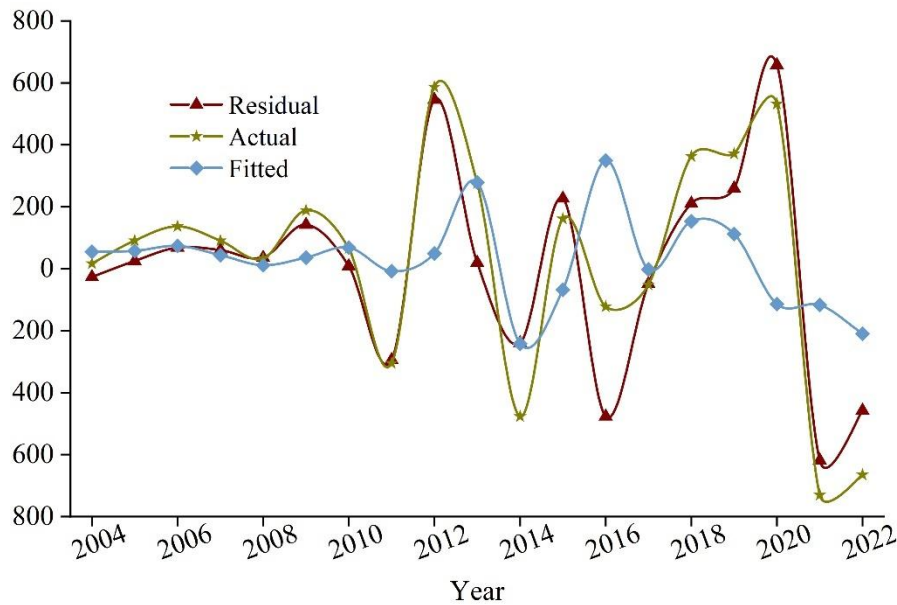


Figure 3. Actual values, fitted values and residual trends.

According to the above steps, the ARIMA model was used to predict the indicator data. Through the analysis, the ARIMA (2,2,0) model was finally chosen to predict the ideological and moral quality indicator data of H college students, and the predicted values of C1 of political ideals in the backward three periods were 34.45, 34.73, and 34.85, respectively, and ditto for the rest of the indicators, and the final predicted values of the indicators were obtained as shown in Table 11.

Table 11. Indicator predicted value.

Index		ARIMA(p,d,q) models	Predicted values for each year		
First-level indicator	Secondary indicators		2023	2024	2025
B1	C1	(2,2,0)	34.45	34.73	34.85
	C2	(1,2,0)	14.38	14.43	14.54
	C3	(4,1,0)	23.78	23.80	23.88
	C4	(2,2,1)	18.52	18.61	18.75
B2	C5	(2,2,0)	39.43	39.46	39.57
	C6	(4,2,0)	34.76	34.78	34.86
	C7	(1,2,0)	24.88	24.97	24.89
B3	C8	(1,2,0)	55.67	55.75	55.87
	C9	(1,2,0)	39.59	39.64	39.72
B4	C10	(1,2,0)	56.86	56.96	57.05
	C11	(2,2,0)	39.31	39.38	39.50

4.2. Development Projections

4.2.1. Data Processing

Based on the predicted values of the latter three years, the changes in the ideological concepts of students in H colleges and universities in 2018-2025 are further evaluated, and corresponding countermeasures and suggestions are put forward for the evaluation results. Firstly, the indicator data from 2014-2025 are processed as shown in Table 12.

Table 12. Data processing of indicators from 2018 to 2025.

Secondary indicators	2018	2019	2020	2021	2022	2023	2024	2025
C1	0.7880	0.8309	0.8737	0.9166	0.9891	0.9843	0.9923	0.9958
C2	0.2815	0.3565	0.4815	0.6065	0.7180	0.7190	0.7215	0.7270
C3	0.4180	0.5580	0.6580	0.7980	0.9504	0.9512	0.9520	0.9552

C4	0.5140	0.6390	0.7140	0.8390	0.9245	0.9260	0.9305	0.9375
C5	0.7883	0.8258	0.8883	0.9258	0.9853	0.9858	0.9865	0.9893
C6	0.7697	0.8126	0.8840	0.9269	0.9929	0.9931	0.9937	0.9960
C7	0.4528	0.5928	0.6928	0.8328	0.9924	0.9952	0.9988	0.9956
C8	0.7918	0.8235	0.8553	0.8835	0.9270	0.9278	0.9292	0.9312
C9	0.8153	0.8528	0.8903	0.9278	0.9885	0.9898	0.9910	0.9930
C10	0.7788	0.8038	0.8455	0.8872	0.9473	0.9477	0.9493	0.9508
C11	0.7623	0.8248	0.8873	0.9498	0.9818	0.9828	0.9845	0.9875

4.2.2. Analysis of Results

According to the weight of each index obtained by the hierarchical analysis method and the results of predictive data processing, the evaluation of the ideological and moral quality of students in H colleges and universities in 2018-2025 is carried out, and the predictive evaluation results in 2018-2025 are shown in Table 13, and the line graph of changes based on the data is shown in Figure 4.

The overall level of the ideological and moral quality of students in college H in 2018-2025 shows a trend of growth year by year, of which the next three years, i.e., 2023-2025, is expected to slow down due to reaching the bottleneck, but is still in the growth trend, i.e., it shows that the ideological concept of the students in college H is overall in a positive direction. Among them, in the dimension of moral quality, the next three years will likely show a gradual increase in the trend, that is, indicating that college administrators in the implementation of labor education and ideological and political education synergistic education model will take more appropriate measures to promote students' ideological concepts continue to be good, and the ideological and moral quality of the students continue to improve. At the level of political quality dimension, there is a brief decline between 2022 and 2023, but the amount of decline is very small, and the trend of steady growth resumes after 2023. At the level of the intellectual and legal quality dimensions, the future development situation will continue the previous growth.

Table 13. The prediction and evaluation results from 2018 to 2025.

Dimension	2018	2019	2020	2021	2022	2023	2024	2025
Political quality	0.5368	0.6275	0.7078	0.8086	0.9117	0.9108	0.9151	0.9197
Ideological quality	0.6968	0.7622	0.8373	0.9026	0.9898	0.9773	0.9921	0.9933
Moral quality	0.8016	0.8357	0.8698	0.9019	0.9525	0.9623	0.9549	0.9569
Legal and disciplinary quality	0.7721	0.8124	0.8625	0.9127	0.9614	0.9614	0.9637	0.9658
Overall evaluation	0.6820	0.7435	0.8052	0.8716	0.9475	0.9471	0.9502	0.9529

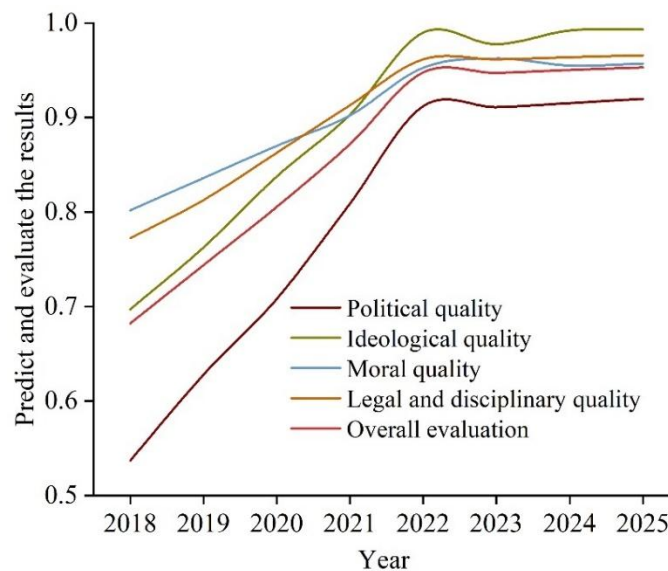


Figure 4. Predict and evaluate the results.

5. Conclusion

This paper constructs an evaluation model of ideological and moral quality of students in colleges and universities based on the hierarchical analysis method and the object element topable model, and uses the ARIMA model to analyze the time series of the change of students' ideological concepts.

The ideological and moral quality of students is specifically divided into four modules, namely political quality, ideological quality, moral quality and legal quality, as a way to reflect the change of students' ideological concepts, and the level of ideological and moral quality of H college students in 2018-2022 is calculated by the evaluation model, in which the correlation degree of the four evaluation standards, namely, excellent, good, qualified, and poor, at 2022 is 0.872, 0.948, 0.976, and 0.825. In addition, through time series analysis, the following conclusions are obtained:

(1) In 2018-2025, the overall trend of students' moral and ethical quality in college H shows a year-by-year growth, but in the next three years, i.e., 2023-2025, the growth rate is expected to slow down due to reaching the bottleneck.

(2) The level of moral quality will likely show a gradual increase trend in the next three years. It indicates that college administrators will take more corresponding measures to promote the continuous improvement of students' ideological concepts and moral quality when implementing the collaborative education model of labor education and ideological and political education.

(3) At the level of political quality, there is a brief decline between 2022 and 2023, but the trend of steady increase reappears after 2023.

(4) At the level of intellectual and legal qualities, the future development situation will continue the previous growth.

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