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Article

Mathematical Modeling Study on the Effect of Educational Interaction in the Synergistic Model of Labor Education, Ideological and Political Education in Colleges and Universities

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Abstract: Labor education and ideological and political education of college students is related to personal growth, exploring the interactive effect of labor education and ideological and political education mathematical modeling can help educators to understand students comprehensively, carry out personalized guidance, and guide students to improve their literacy. The article firstly constructs the index system of labor education and ideological and political education, and measures the comprehensive development level of the interactive effect of labor education and ideological and political education of each region of Province A through entropy weight method. The article firstly constructs the indicator system of labor education and ideological and political education, and measures the comprehensive development level of the interaction between labor education and ideological and political education by entropy weighting method in each region of province A. The article constructs the dynamic equation model of labor education and ideological and political education, and establishes the threshold panel model, and carries out the comparative analysis of the dynamic relationship between labor education and ideological and political education in province A by stages and regions. In terms of regions, in the early stage of education, due to the influence of economic level and resource endowment and other factors, the interaction effect is better in the eastern region, and the influence of ideological and political education on labor education is greater, the influence of labor education on ideological and political education is greater in the western region, and labor education and ideological and political education in the central region are inhibiting each other.

Keywords: labor education; ideological and political education; entropy power method; threshold panel model; dynamic equation of association

1. Introduction

Facing the profound change of economic internationalization and informatization, the cultivation of talents in colleges and universities is undergoing the reexamination and reconstruction of concepts and modes [1-2]. The traditional single knowledge transmission mode is difficult to adapt to the social demand for comprehensive quality talents, students not only need a solid professional foundation, but also should have the correct values and practical ability [3-4]. The practical orientation of education and the value leadership of the Civics Organic combination, guiding students to pay and face the intensification of international competition and domestic reform in depth of the times, colleges and universities need to optimize the teaching structure from a high degree of the overall situation, will be labor dedication to perceive the social responsibility, in the thinking and judgment of the formation of the correct value orientation for the future of the society to continue to output high-quality talents with commitment, faith and ability [5-7].

Contemporary society is characterized by diverse values, and young people's value choices and identity often waver in the flood of information. Civic education is committed to establishing beliefs and correct value orientation for students, but without the support of practical links, its effectiveness is difficult to stabilize. Labor itself as a kind of education embodiment, the real work situation as a carrier, the value concept into the production, service, creation of the whole process, so that students in the specific labor activities to deepen the knowledge of the collective interests, social division of labor and public responsibility [8-9]. When the labor payment is understood and respected, the abstract concepts in the ideological education have also gained a foothold in the reality of the foundation, the significance of collaborative education can be embodied, so that the students not only recognize the language level, but also in the action of witnessing the power of value [10-11]. Thus, in the cycle of thought and practice, students gradually obtain a solid spiritual support, and face the future with a more determined attitude and clear direction [12]. Higher education through the mechanism of synergy of different disciplines to lay the foundation for the students' life, so that they can still maintain the quality of independent thinking, the enthusiasm to serve the society and the mission to serve the country after leaving the campus, which is precisely the indispensable requirement of higher education in the era of human development [13].

However, labor education and ideological education should be an important part of the education system, but in a long period of time failed to form an effective interaction, still presenting two courses, and it is difficult to quantify the assessment of practice and thought, resulting in a disconnect between the value of concepts and practical exercises in the education process [14-15]. In recent years, national policies have continuously emphasized the comprehensive development of morality, intelligence, physical fitness, aesthetics and labor, injecting institutional vitality into labor education. At the same time, ideological and political education in colleges and universities in the new era is also constantly exploring paths that are close to social reality and fit the proposition of the times [16-17]. The interaction effect, on the other hand, is the result of the interaction between different factors. This interaction can be an enhancement effect, i.e., the effect produced by multiple factors acting together exceeds the effect produced by each factor acting alone, or it can be a counteracting effect, i.e., the effect produced by multiple factors acting together is smaller than the effect produced by each factor acting alone [18-19]. In this context, by constructing an educational interaction effect model, we analyze and explain the synergistic parenting model of labor education and civic education, explore the mechanism of their action, and formulate a new synergistic parenting model.

The article first constructs the evaluation index system of labor education and ideological and political education in colleges and universities. Subsequently, labor education and ideological and political education are selected as explanatory variables, and a dynamic linkage equation model is established. Taking A province as the research object to carry out empirical analysis, the entropy weight method is used to measure the comprehensive development level of the interactive effect of labor education and ideological and political education in each region of A province. Then, the dynamic relationship between labor education and ideological and political education in Province A is tested for heterogeneity in stages and regions. Finally, the level of economic development and the level of technological innovation are respectively taken as threshold variables, and the existence of threshold effects is verified and the threshold values of threshold variables are calculated through the threshold regression model.

2. Construction and Methodology for Modeling the Effects of Educational Interactions

2.1. Evaluation Index System of Labor Education Ideological and Political Education in Colleges and Universities

2.1.1. Composition of Evaluation Indicators for Ideological and Political Education in Higher Education Institutions

This section constructs the evaluation index system of ideological and political education in colleges and universities composed of 4 first-level indicators and 20 second-level indicators, including technical means, nurturing environment, teaching links and value leadership, which can evaluate ideological and political education in colleges and universities in an objective and scientific way. The evaluation indexes of ideological and political education in colleges and universities are shown in Table 1.

Table 1. The evaluation index of ideological and political education.

	Primary indicator	Secondary indicator
The evaluation index of ideological and political education	Technical means(A)	Information communication channel(A1)
		Interactive communication tool(A2)
		Thinking of political teaching(A3)
		Sound prevention and control system(A4)
		Classroom teaching software(A5)
	Childbearing environment(B)	Equipment protection(B1)
		Teacher-student relationship(B2)
		Working degree(B3)
		Financial support(B4)
		Classroom instruction(B5)
	Teaching link(C)	Teaching target(C1)
		Teaching content(C2)
		Teaching method(C3)
		Teaching design(C4)
		Teaching evaluation(C5)
	Value lead(D)	Identification ability(D1)
		Ideological culture(D2)
		Communication spirit(D3)
		Discourse specification(D4)
		Behavior habit(D5)

2.1.2. Composition of the Evaluation Index System for Labor Education in Colleges and Universities

This section determines the evaluation index system with labor concept, labor ability, labor attitude and labor spirit as the first-level elements, which helps to motivate college students to improve their labor literacy. The evaluation index system of labor education in colleges and universities is shown in Table 2.

Table 2. The education evaluation index system of college labor education.

	Primary indicator	Secondary indicator
The education evaluation index system of college labor education	Labor concept(E)	Labor values(E1)
		Labor emotion(E2)
	Working capacity(F)	Labor knowledge(F1)
		Labor skill(F2)
		Innovative working ability(F3)
	Labor attitude(G)	Honest labor(G1)
		Be willing to work(G2)
	Labor spirit(H)	Innovate(H1)
		Dedication(H2)

2.2. Research Methodology

2.2.1. Entropy Method

On the basis of the evaluation index system of labor education and ideological and political education in colleges and universities, the entropy value method is used to assign corresponding weights to each index, so as to reflect the importance of each index. Combined with the actual situation, this is used to calculate the weight of each indicator [20]. Specifically divided into the following steps:

(a) Standardization (dimensionless) processing

According to the objective reality of the positive and negative attributes of the indicators, based on the construction of different indicators of the standardization formula. Positive/negative indicators standardization formula:

$$y_{ij} = \frac{x_{ij} - \min x_{ij}}{\max x_{ij} - \min x_{ij}} / \; y_{ij} = \frac{\max x_{ij} - x_{ij}}{\max x_{ij} - \min x_{ij}} \tag{1}$$

(b) Translation

Translate the value of y_{ij} by 0.001 units to obtain Y_{ij}:

$$Y_{ij} = y_{ij} + 0.001 \tag{2}$$

(c) Calculation of the weight of the indicator P_{ij}:

$$P_{ij} = \frac{Y_{ij}}{\sum_{i=1}^{m} Y_{ij}} \tag{3}$$

(d) Calculate the entropy value of the indicator E_j:

$$E_j = -\frac{1}{\ln k} \sum_{i=1}^{m} P_{ij} \ln \tag{4}$$

(e) Calculate the coefficient of variation G_j:

$$G_j = 1 - E_j \tag{5}$$

(f) Calculate weight W_j:

$$W_j = \frac{G_j}{\sum_{j}^{n}} j = 1 \; G_j, j = 1, 2, 3 \ldots n \tag{6}$$

2.2.2. Linear Weighting Methodology and Comprehensive Development Evaluation Index Analysis

On the basis of the results of entropy value method, the comprehensive development evaluation index of labor education in colleges and universities and ideological and political education in colleges and universities was established by linear weighting method.

$$Z_x = \sum_{j=1}^{n} W_j \times y_{ij} \tag{7}$$

2.2.3. Modeling of Interaction Effects

In the past, the research on the relationship between labor education and ideological and political

education in colleges and universities is mainly based on the preset theoretical model using the ordinary single equation model for testing, but in the process of model setting and testing, it may be due to the endogeneity of endogenous problems such as mutual causality between the explanatory variables and the explanatory variables, which leads to the model estimation results are prone to error. The establishment of dynamic equation model, this paper constructs a dynamic equation model with college labor education and college ideological and political education as the explanatory variables to carry out empirical research on the relationship of educational interaction effect between the two, and the econometric model of this paper can be expressed as follows:

$$\begin{aligned} EQU_{it} &= \alpha_0 + \alpha_1 EQU_{it-1} + \alpha_2 SOP_{it} + \alpha_3 EFF_{it} \\ &\quad + \alpha_4 GDP_{it} + \alpha_5 CUN_{it} + \alpha_6 CUL_i t + \eta_i + \varepsilon \end{aligned} \tag{8}$$

$$\begin{aligned} SUP_{it} &= \beta_0 + \beta_1 SUP_{it-1} + \beta_2 EQU_{it} + \beta_3 EFF_{it} \\ &\quad + \beta_4 GDP_{it} + \beta_5 CUN_{it} + \beta_6 CUL_{it} + \eta_{it} + \varepsilon_{it} \end{aligned} \tag{9}$$

where EQU denotes labor education, SUP denotes ideological and political education, EFF denotes educational efficiency, GDP represents the level of economic development, CUN denotes the local level of education, CUL represents campus culture, subscripts i and t denote region and time, respectively, η_i is the individual effect and ε_{it} is the residual term.

In order to overcome the estimation errors caused by the endogeneity problem, this paper proposes the generalized method of moments estimation (system GMM) to estimate the model, and then conducts the Sargan test and Arellano-Bond test to determine whether the instrumental variables of the model are valid or not, and whether the model has the second-order autocorrelation of the residual term or not, in order to enhance the reliability of the model test results. In order to enhance the reliability of the model test results.

2.2.4. Threshold Panel Model

Threshold effect, also known as threshold effect, its research significance lies in breaking through the assumption of linear relationship between variables. The traditional research on threshold effect is usually based on the method of exogenous sample separation, the defects are mainly manifested in the sample separation point and the divergence interval are arbitrarily given and divided by human beings, rather than based on the intrinsic operation mechanism of the economy itself, the threshold value of this method is given by human beings, and thus it is impossible to determine the confidence interval of the threshold value [21]. In addition, the model parameter estimates determined according to this method are quite sensitive to the threshold value and lack validity and reliability.

In two-institution threshold panel models, there is a single threshold value, where the choice of threshold variables is exogenously determined based on the theoretical model:

$$y_{it} = \mu_i + x_{it} I(q_{it} < \gamma)\beta_1 + x_{it} I(q_{it} \geq \gamma)\beta_2 + u_{it} \tag{10}$$

The above equation can also be expressed as:

$$y_{it} = \begin{cases} \mu_i + x_{it}\beta_1 + u_{it}, q_{it} < \gamma \\ \mu_i + x_{it}\beta_2 + u_{it}, q_{it} \geq \gamma \end{cases} \tag{11}$$

where the subscripts $i, t(1 \leq i \leq N, 1 \leq t \leq T)$ denote cross-section and time, respectively, y_{it} is the explanatory variable, X_{it} is the explanatory variable, u_{it} is the unobserved individual effect, and $u_i - N(0, \sigma^2)$ is the random interference term. If one makes:

$$x_{it}(\gamma) = \begin{cases} x_{it} I(q_{it} < \gamma) \\ x_{it} I(q_{it} \geq \gamma) \end{cases}, \beta = (\beta_i^{'}, \beta_i^{'}) \tag{12}$$

where $I(\cdot)$ is the schematic function, and the dummy variable $I = 1$ when $q_{it} < \gamma$ and $I = 0$ when $q_{it} > \gamma$. The final model can be succinctly expressed as:

$$u_{it} = \mu_i + x_{it}(\gamma)\beta + u_{it} \tag{13}$$

In order to estimate the parameters of the model, the effects of individuals need to be eliminated first, which is usually done by subtracting the corresponding within-group mean from each observation, so that the transformed model can be expressed as:

$$y_{it}^{*} = x_{it}^{*}(\gamma)\beta + u_{it}^{*} \tag{14}$$

Among them:

$$\begin{cases} y_{it}^{*} = y_{it} - \overline{y_i} = y_{it} - T^{-1}\sum_{t=1}^{T} y_{it} \\ x_{it}^{*}(\gamma) = x_{it}(\gamma) - \overline{x_i}(\gamma) = x_{it}(\gamma) - T^{-1}\sum_{t=1}^{T} x_{it}(\gamma) \\ u_{it}^{*} = u_{it} - \overline{u_i} = u_{it} - T^{-1}\sum_{t=1}^{T} u_{it} \end{cases} \tag{15}$$

For a given arbitrary threshold γ , OLS estimation can be used to obtain estimates of the corresponding parameters:

$$\hat{\beta}(\gamma) = (x_{it}^{*}(\gamma)' x_{it}^{*}(\gamma))^{-1} x_{it}^{*}(\gamma)' y_{it}^{*} \tag{16}$$

The corresponding residual sum of squares is:

$$S_1(\gamma) = u_{it}^{'} u_{it}^{*} = y_{it}^{*'}(I - x_{it}^{*}(\gamma)'(x_{it}^{*}(\gamma)' x_{it}^{*}(\gamma))^{-1} x_{it}^{*}(\gamma)')y_{it}^{*} \tag{17}$$

The optimal threshold should be such that the above equation is minimized in the sum of all residuals squared, i.e.,:

$$\hat{y} = argmin S_1(\gamma) \tag{18}$$

The observed value of each threshold variable may be the threshold value determined by the model, and the value that satisfies the above equation is taken as the threshold value, and once the threshold value is determined, the parameter estimates of the corresponding model are also determined at the same time. For the multi-threshold panel model, it can be followed, and multiple thresholds do not need to be re-estimated each time, and directly use the threshold estimates already obtained, that is, single-threshold and multi-threshold regression to obtain the threshold value is consistent. If the number of thresholds (γ_1 and γ_2 , respectively) in the model is set to be two, then the basic regression model can be expressed as:

$$y_{it} = \mu_i + x_{it} I(q_{it} < \gamma_1)\beta_1 + x_{it} I(\gamma_1 \le q_{it} < \gamma_2)\beta_2 + x_{it} I(q_{it} \ge \gamma_2)\beta_3 + u_{it} \tag{19}$$

The above equation can also be expressed using a more concise form:

$$y_{it} = \mu_i + x_{it}(\gamma)\beta + u_{it} \tag{20}$$

Among them:

$$x_{it}(\gamma) = \begin{cases} x_{it} I(q_{it} < \gamma_1) \\ x_{it} I(\gamma_1 \le q_{it} < \gamma_2), \beta = (\beta_1^{'}, \beta_2^{'}, \beta_3^{'}) \\ x_{it} I(q_{it} \ge \gamma_2) \end{cases} \tag{21}$$

The purpose of the significance test of the threshold panel regression model is to verify the existence of the threshold effect and the threshold value, and to conclude whether there is a nonlinear relationship between the variables due to mechanism transformation by testing whether the parameter estimates of the

model are significant enough for the sample data divided by the threshold value. Taking the single-threshold significance test as an example, the null hypothesis is that the variable parameter $\beta_1 = \beta_2$, that is, there is no threshold effect and threshold value, the null hypothesis is tested by constructing the LM statistic, and at the same time constructing the statistic:

$$F = n\frac{S_0 - S_n(\hat{\gamma})}{S_n(\hat{\gamma})} \tag{22}$$

where S_0 denotes the summed residual sum of squares without threshold effect (null hypothesis), and S_n denotes the summed residual sum of squares with threshold effect (alternative hypothesis). However, hypothesis testing of the above F statistic results in a large sample distribution of the statistic that does not follow the chi-square distribution, and is "non-standard and non-similar" due to the influence of the disturbance parameter, which $\hat{\gamma}$ is not able to recognize under the original null hypothesis. The large-sample asymptotic p-value is obtained by transforming the large-sample distribution function of the statistic itself. Under the null hypothesis, the large-sample distribution of the p-value statistic is uniformly distributed and can be derived by bootstrap (bootstrap method). The principle of this method is to simulate the generation of a set of sequences of dependent variables that satisfy $N(0,\hat{e}^2)$ given the threshold and explanatory variables, with $\hat{e}$ denoting the residual term, and for each sample of bootstrap obtained, a simulated LM value can be computed, and this process is repeated a number of times, with the number of times that the computed LM value is greater than the aforementioned F statistic As a percentage of the number of bootstraps is the estimated p-value, which is similar to the probability p-value derived from a general econometric analysis, e.g., if the p-value is less than 0.01, the LM test is considered to be passed at the 1% significance level.

After the threshold has been determined and passed the significance test, the confidence interval for the threshold should also be determined. For this purpose the LR (likelihood ratio) statistic can be constructed as follows:

$$LR_n(\gamma_0) = n\frac{S_n(\gamma) - S_n(\hat{\gamma})}{S_n(\hat{\gamma})} \tag{23}$$

If the significance level is α , the original null hypothesis $H0:\gamma = \gamma_0$ cannot be rejected when $LR,(\gamma_0) \le c(\alpha) = -2\ln\left[1-\sqrt{1-\alpha}\right]$. In a multiple threshold model, if the LM test is rejected, it indicates that at least one threshold exists, at which point the search for the 2nd threshold variable $\hat{\gamma}_1$ should be continued with the first threshold γ_2 identified and so on until the original null hypothesis cannot be rejected, and furthermore an LR trend plot for more visual analysis.

3. Empirical Analysis

3.1. Measurement Analysis

3.1.1. Results of the Analysis of Labor Education in Higher Education Institutions

The results of the analysis of labor education in colleges and universities are shown in Table 3. From the arithmetic results, the overall labor education level of colleges and universities a to o in 16 cities and towns in province A is high, and the gap between cities and towns is not significant. However, the level of labor education in colleges and universities in province A was 0.997 in 2016, which was the highest among the years, and the level of labor education was relatively high in 2017 and 2018, which was 0.991 and 0.978, respectively.

Table 3. The results of the education analysis of college labor.

	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	Mean
a	0.982	0.954	0.956	0.977	0.975	0.971	0.962	0.966	0.984	0.994	0.947	0.964	0.969	0.982
b	0.984	0.984	0.997	0.965	0.997	0.99	0.963	0.987	0.994	0.989	0.805	0.975	0.969	0.984
c	0.991	0.981	0.978	0.977	0.903	0.708	0.984	0.966	0.989	0.961	0.908	0.968	0.943	0.991
d	0.998	0.996	0.982	0.974	0.986	0.976	0.992	0.955	0.998	0.986	0.994	0.978	0.985	0.998
e	0.983	0.99	0.992	0.946	0.812	0.988	0.992	0.967	0.987	0.971	0.994	0.982	0.967	0.983
f	0.963	0.885	0.99	0.96	0.907	0.992	0.992	0.977	0.994	0.985	0.982	0.975	0.967	0.963
g	0.979	0.979	0.975	0.981	0.998	0.969	0.968	0.949	0.985	0.987	0.986	0.971	0.977	0.979
h	0.993	0.997	0.96	0.953	0.991	0.969	0.988	0.96	0.987	0.979	0.978	0.974	0.977	0.993
i	0.988	0.992	0.993	0.985	0.99	0.987	0.984	0.99	0.978	0.959	0.987	0.952	0.982	0.988
j	0.97	0.966	0.952	0.971	0.811	0.986	0.964	0.994	0.981	0.973	0.97	0.958	0.958	0.97
k	0.963	0.96	0.963	0.965	0.904	0.97	0.982	0.982	0.99	0.974	0.986	0.988	0.969	0.963
l	0.984	0.971	0.964	0.954	0.923	0.973	0.967	0.969	0.981	0.974	0.98	0.975	0.968	0.984
m	0.973	0.976	0.962	0.957	0.986	0.986	0.978	0.966	0.993	0.975	0.998	0.987	0.978	0.973
n	0.968	0.99	0.96	0.944	0.993	0.983	0.979	0.979	0.992	0.919	0.979	0.981	0.972	0.968
o	0.986	0.999	0.986	0.967	0.996	0.998	0.964	0.989	0.972	0.982	0.975	0.987	0.983	0.986
Mean	0.968	0.072	0.975	0.963	0.997	0.991	0.978	0.938	0.97	0.987	0.987	0.965	0.899	0.968

3.1.2. Results of the Analysis of Ideological and Political Education in Higher Educational Institutions

The results of the analysis of ideological and political education in colleges and universities are shown in Table 4. The operation results show that the operational efficiency of colleges and universities in 16 cities and towns in province A, a to o, is generally low, with large regional differences, and the educational efficiency of city a and city m is significantly higher than that of other regions.

Table 4. The results of the education analysis of university ideological and political education.

	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	Mean
a	1	1	1	1	1	1	1	0.998	1	0.991	1	1	1	0.999
b	0.69	0.684	0.575	0.898	0.734	0.668	0.818	0.746	0.624	0.875	0.849	0.666	0.587	0.724
c	0.673	0.994	0.526	0.757	0.928	0.643	0.562	0.864	0.624	0.882	0.788	0.772	0.965	0.768
d	0.867	0.846	0.697	0.923	1	0.608	0.521	0.621	0.489	0.815	0.775	0.57	0.760	0.730
e	1	0.829	0.903	0.834	1	0.604	0.552	0.892	0.692	0.686	0.71	0.662	0.800	0.782
f	0.99	0.919	0.666	0.967	0.867	0.804	0.997	0.85	0.672	0.43	0.769	0.935	0.888	0.827
g	0.52	0.525	0.699	0.892	0.637	1	1	0.794	0.744	0.963	0.751	0.794	0.851	0.782
h	0.738	0.829	0.706	0.807	0.632	0.753	0.942	0.412	0.528	0.847	0.728	0.885	0.924	0.749
i	0.87	0.956	0.59	0.934	0.568	0.859	0.861	0.828	0.433	0.998	0.723	0.799	0.935	0.796
j	0.46	0.738	0.687	0.984	0.883	0.686	0.797	0.931	0.654	0.804	0.769	0.643	0.660	0.746
k	0.773	0.591	0.755	0.882	0.742	0.612	0.818	0.991	0.454	0.899	0.81	0.867	0.632	0.756
l	0.845	0.773	0.717	0.994	0.77	0.531	0.712	0.265	0.605	0.964	0.745	0.71	0.730	0.720
m	0.996	0.996	1	0.996	0.999	0.996	1	0.998	0.999	0.999	0.976	0.748	1.000	0.977
n	0.464	0.557	0.507	0.984	0.821	0.787	0.996	1	0.831	0.973	0.994	1	1.000	0.840
o	0.724	0.882	0.595	0.791	0.56	0.534	0.918	0.997	0.983	1	1	0.987	1.000	0.844
Mean	0.986	1	0.597	0.828	0.681	0.738	0.93	0.802	1	0.639	0.718	0.769	0.637	0.794

3.2. Interactive Effects of Labor Education and Ideological and Political Education

3.2.1. Results and Analysis

The results of the test of the relationship between the interactive effect of labor education and ideological and political education in colleges and universities are shown in Table 5. Equation (1) describes the influence of labor education on ideological and political education, we can see that the regression coefficient of labor education is 2.976, which is significant at 1% confidence level, indicating that labor education can promote the positive development of ideological and political education and it is very significant, for every one percent of change in labor education, the ideological and political education will be changed positively by 2.976 percentage points. Equation (2) describes the influence of ideological and political education on labor education, the regression coefficient of ideological and political education is 0.623, which is significant at the confidence level of 1%, indicating that ideological and political education can promote the development of labor education and is very significant, for every one percent change in ideological and political education, the positive change in labor education will be 0.623 percentage points. By comparing the regression coefficients of the two equations 2.976 and 0.623, it is verified that there is a benign interactive effect between labor education and ideological-political education, both sides promote each other, and the promotion effect of labor education on ideological-political education is stronger.

According to the results of the interaction between labor education and ideological and political education in the middle and late stages, in the three-stage least squares estimation results, equation (1) describes the effect of labor education on ideological and political education, and it can be found that the regression coefficient of labor education is -0.314, which is significant at the 5% confidence level, indicating that the upgrading of labor education inhibits the development of ideological and political education, and that for every 1 percentage point of change in labor education, there will be an increase in labor education. For every 1 percentage point change in labor education, ideological and political education will change 0.314 percentage points negatively. Equation (2) describes the influence of ideological and political education on labor education, and the regression coefficient of ideological and political education is 0.557, which is significant at 1% confidence level, indicating that ideological and political education can promote the development of labor education, and for every 1 percentage point change in ideological and political education, the labor education will change positively by 0.557 percentage points.

Table 5. Education interaction effect test results.

Variable	Early stage		Midend	
	(1) *EQU*	(2) *SUP*	(1) *EQU*	(2) *SUP*
EQU	2.976***	0.623***	-0.314***	0.557***
SUP	-0.546***	0.195***	-0.128***	0.609***
EFF	-1.013***	2.716***	-0.075***	-0.08***
GDP	0.086***	0.076***	-0.037***	0.029***
CUN	0.044***	0.345***	0.07***	-0.334***
CUL	2.932***	0.144***	0.035***	0.302***
Constant term	0.234***	1.136***	-5.921***	-4.526***
N	500	500	500	500
R^2	0.219	0.131	0.544	0.456

3.2.2. Robustness Tests

The results of two-stage least squares estimation test are shown in Table 6. In the initial empirical results, the regression coefficients of labor education and ideological and political education are 2.149 and 0.736, respectively, and both of them are significant at the confidence level of 1%, which indicates that there is an interactive relationship between labor education and ideological and political education and labor education has a greater role, which is in line with the theoretical assumptions. In the middle and late periods, the regression coefficients of labor education and ideological and political education are -0.321 and 0.585 respectively, which are significant at 5% and 1% confidence level respectively, indicating that there is an interactive relationship between labor education and ideological and political education and ideological and political education plays a greater role.

Table 6. The least squares of the two stages are estimated.

Variable	Early stage		Midend	
	(1) *EQU*	(2) *SUP*	(1) *EQU*	(2) *SUP*
EQU	2.149***	0.736***	-0.321***	0.585***
SUP	-0.606***	0.182***	0.014***	0.591***
EFF	-0.633***	2.675***	0.226***	-0.083***
GDP	0.146***	0.062***	0.029***	-0.036***
CUN	0.068***	0.327***	0.078***	-0.337***
CUL	0.212***	0.311***	0.036***	0.029***
Constant term	-0.926***	0.539***	-5.821***	-4.633***
N	500	500	500	500
R^2	0.238	0.151	0.579	0.467

Secondly, this paper chooses to shrink all the indicator data, take the logarithm and then re-estimate the model using the 3SLS estimation method. The three-stage least squares estimation results after the shrinkage treatment are shown in Table 7. According to the estimation results of the table, the regression coefficients of labor education and ideological and political education in the early stage are 2.371 and 0.644 respectively, which are both significant at 1% confidence level, indicating that there is an interactive relationship between labor education and ideological and political education and that labor education plays a greater role. In the middle and late stages, the regression coefficients of labor education and ideological and political education are -0.436 and 0.528 respectively, which are both significant at 1% confidence level, indicating that there is an interactive relationship between labor education and ideological and political education and that ideological and political education has a greater effect.

Table 7. The least squares estimation results of the third phase of the treatment.

Variable	Early stage		Midend	
	(1) *EQU*	(2) *SUP*	(1) *EQU*	(2) *SUP*
EQU	2.371***	0.644***	-0.436***	0.528***
SUP	-0.433***	0.227***	0.185***	0.703***
EFF	-0.955***	2.746***	0.099***	-0.081***
GDP	0.275***	0.137***	-0.026***	-0.009*
CUN	0.01***	0.35***	0.048***	-0.42***
CUL	-0.005**	0.265***	0.066***	0.002**
Constant term	-1.286***	1.554***	-6.539***	-5.336***
N	500	500	500	500
R^2	0.12	0.097	0.491	0.461

3.2.3. Analysis of Regional Heterogeneity

(1) Eastern region

The results of the test of the interactive effect relationship between labor education and ideological and political education in colleges and universities in the eastern region are shown in Table 8. At the initial stage, equation (1) shows the regression results of labor education on ideological and political education, and it can be found that the regression coefficient of the indicator of labor education is 0.418, which is significant at the confidence level of 5%, indicating that every 1 percentage point change in the labor education will make the ideological and political education change by 0.418 percentage points, and the labor education has a significant positive effect on the ideological and political education. For equation (2), the regression coefficient of ideological and political education on labor education is 0.655, which is significant at 1% confidence level, indicating that every 1 percentage point change in ideological and political education will make labor education change by 0.655 percentage points, and ideological and political education also has positive effect on labor education. Comparing the regression coefficients of 0.418 and 0.655 of the two equations, there is a positive interaction between ideological and political education and labor education, but ideological and political education has a stronger effect

on labor education. In the middle and late stages, the regression coefficients of labor education and ideological-political education are -0.614 and 1.208 respectively, which are both significant at the 1% confidence level, indicating that there is an interactive relationship between labor education and ideological-political education in the eastern region and that ideological-political education has a greater influence in the interaction between the two.

Table 8. The results of the education interaction effect in the eastern region.

Variable	Early stage		Midend	
	(1) *EQU*	(2) *SUP*	(1) *EQU*	(2) *SUP*
EQU	0.418***	0.655***	-0.614***	1.208***
SUP	0.536***	0.379***	0.203***	-0.11***
EFF	1.662**	4.287***	-0.455***	-0.524***
GDP	0.253***	-0.141***	0.271***	-0.185***
CUN	-0.021***	0.503***	0.092***	-0.273***
CUL	-0.003***	0.85***	0.563***	-2.316***
Constant term	-6.952***	0.436***	-6.395***	3.502***
N	150	150	150	150
R^2	0.536	0.43	0.69	0.622

(2) Central region

At the initial stage, it can be found through the test that the regression coefficient of labor education in the central region is -1.696, which is significant at 1% confidence level, proving that labor education has an inhibitory effect on ideological and political education. The regression coefficient of ideological and political education is -0.887, which is significant at 1% confidence level, proving that ideological and political education also has an inhibitory effect on labor education. In the middle and late stages, the coefficient of labor education is -0.823, which is significant at 1% confidence level, and the coefficient of ideological and political education is 0.577, which is significant at 5% confidence level. The test results of the interaction effect relationship between labor education and ideological and political education in colleges and universities in the central region are shown in Table 9.

Table 9. The results of the study on the interaction effect of education in the central region.

Variable	Early stage		Midend	
	(1) *EQU*	(2) *SUP*	(1) *EQU*	(2) *SUP*
EQU	-1.696***	-0.887***	-0.823***	0.577***
SUP	0.331***	0.095***	-0.648***	0.493***
EFF	1.043***	5.011***	0.116***	-0.306***
GDP	-0.882***	0.17***	-0.005***	0.25***
CUN	0.026***	-0.07***	0.02***	-0.035***
CUL	0.036***	0.21***	0.21***	0.064***
Constant term	6.064***	5.162***	-12.654***	-2.863**
N	100	100	100	100
R^2	0.282	0.333	0.447	0.536

(3) Western region

The test results of the interactive effect relationship between labor education and ideological and political education in colleges and universities in the western region are shown in Table 10. In the early stage, the regression coefficients of labor education and ideological and political education are 1.241 and 0.432 respectively, which are both significant at 1% confidence level, indicating that there is a benign interaction between ideological and political education and labor education and labor education has a greater impetus to ideological and political education. In the middle and late stages, the regression coefficient of labor education is -0.622, and the regression coefficient of ideological and political education is -0.417, indicating that although there is an interactive effect between labor education and ideological and political education in the western region, they are in a kind of mutual inhibition, and the

inhibitory effect of labor education is greater than that of ideological and political education.

Table 10. The results of the study on the interaction effect of education in the western region.

Variable	Early stage		Midend	
	(1) *EQU*	(2) *SUP*	(1) *EQU*	(2) *SUP*
EQU	1.241	0.432	-0.622	-0.417
SUP	-0.092	0.174	-0.12	0.443
EFF	-0.522	1.107	-0.123	0.005
GDP	-0.073	0.169	0.019	0.038
CUN	0.11	-0.051	0.064	-0.181
CUL	0.203	0.162	0.023	0.011
Constant term	1.725**	1.362*	-4.521***	-4.362***
N	150	150	150	150
R^2	0.103	0.138	0.122	0.166

3.2.4. Analysis of empirical results

The results of the interaction effect relationship between labor education and ideological and political education in colleges and universities in each region are shown in Table 11. Through the establishment of panel equation model, the main empirical conclusions are: for the overall level of province A, labor education and ideological and political education form a benign interaction in the early stage and labor education has a greater effect, in the middle and late stages of education, labor education has an inhibitory effect on ideological and political education, and ideological and political education has a promotional effect on labor education.

Table 11. The relationship between high education and the interaction effect.

		Total	Eastern Region	Central Region	Western Region
Early Stage	Interactive Relation	Exist	Exist	Exist	Exist
	Significance	Prominence	Prominence	Prominence	Prominence
	Effect Of Labor Education	Forward	Forward	Negative Direction	Forward
	The Impact Of Thinking On Education	Forward	Forward	Negative Direction	Forward
	Strength Of Force	Labor Education	Ideological And Political Education	Labor Education	Labor Education
Midend	Interactive Relation	Exist	Exist	Exist	Exist
	Significance	Prominence	Prominence	Prominence	Prominence
	Effect Of Labor Education	Negative Direction	Negative Direction	Negative Direction	Negative Direction
	The Impact Of Thinking On Education	Forward	Forward	Forward	Negative Direction
	Strength Of Force	Ideological And Political	Ideological And Political	Labor Education	Labor Education

		Education	Education		

3.3. Threshold Panel Model Regression Analysis

3.3.1. Threshold Variable Selection and Data Description

In this section, the level of economic development and the level of technological innovation are selected as threshold variables. Among them, the level of economic development is measured by GDP per capita, and the level of technological innovation is measured by the number of patents granted. The sample data mainly come from the China Statistical Yearbook and the statistical yearbooks of each province and city.

3.3.2. Analysis of Results

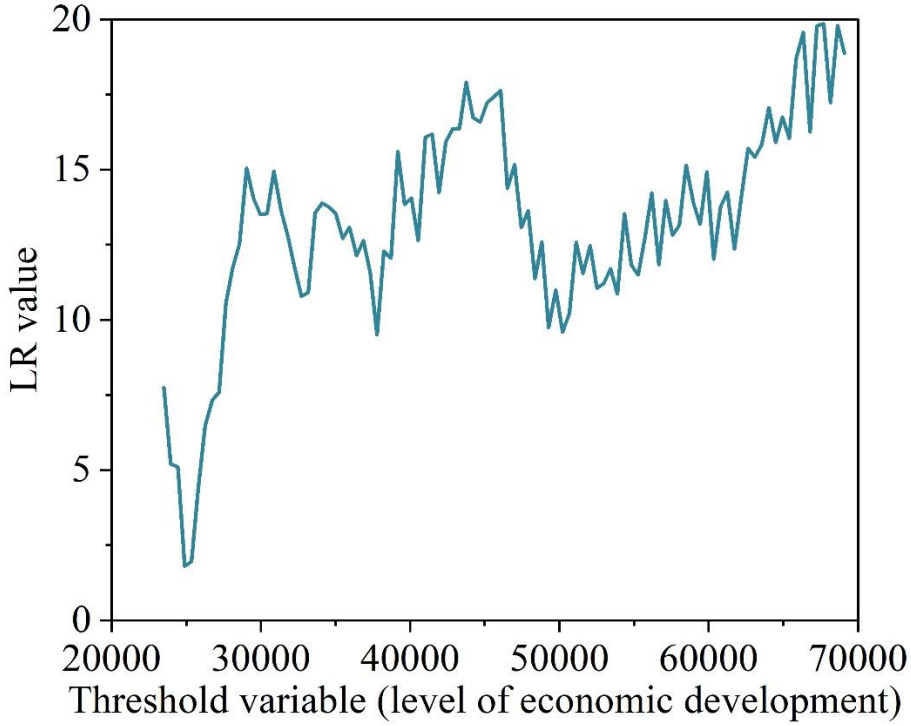
(1) Test of threshold effect and threshold value

Before the panel threshold model estimation, the first step is to verify the existence of the threshold effect, identify the threshold value and determine the confidence interval of the threshold value, in this paper, by sampling 600 times to determine the F-value and P. The results of the test of the significance of the threshold effect are shown in Table 12. According to the table, it can be seen that the comprehensive consideration of the judgment of the existence of a single threshold. When the level of economic development as a threshold variable, the model passed the single threshold, double threshold test.

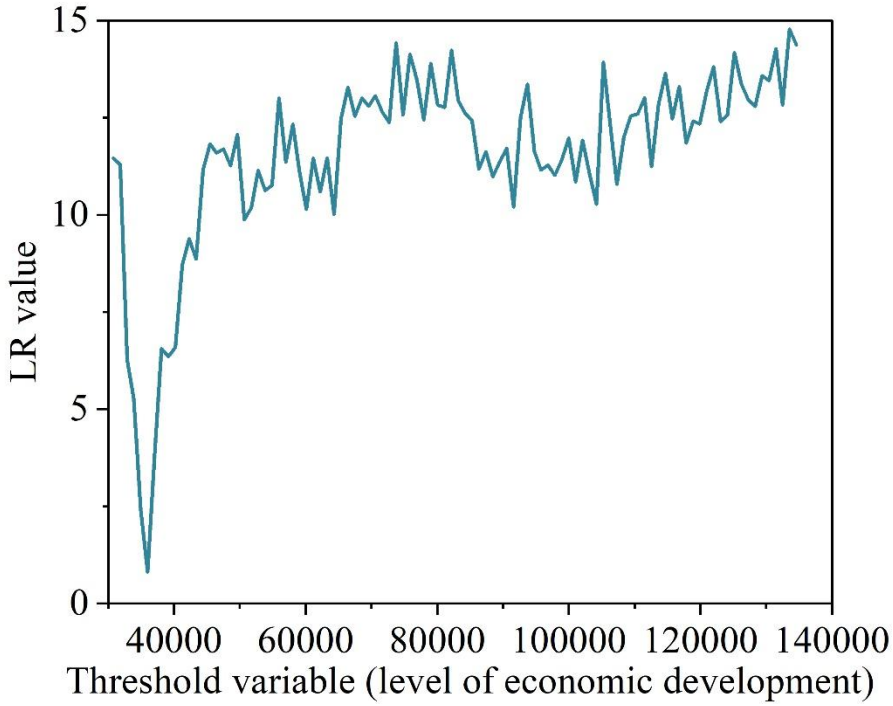
Table 12. Threshold effect significance test results.

Threshold variable	Model	F value	P value	Number of BS	Critical value		
					1%	5%	10%
pgdp	Single threshold	11.154***	0.015	600	14.413	8.163	7.181
	Double threshold	2.362	0	600	8.727	4.604	3.991
	Triple threshold	10.542**	0.152	600	7.88	5.038	4.21
tec	Single threshold	19.652***	-0.001	600	11.035	8.844	3.867
	Double threshold	5.569	0.172	600	17.094	10.968	7.403
	Triple threshold	1.436	0.305	600	9.702	6.661	3.423

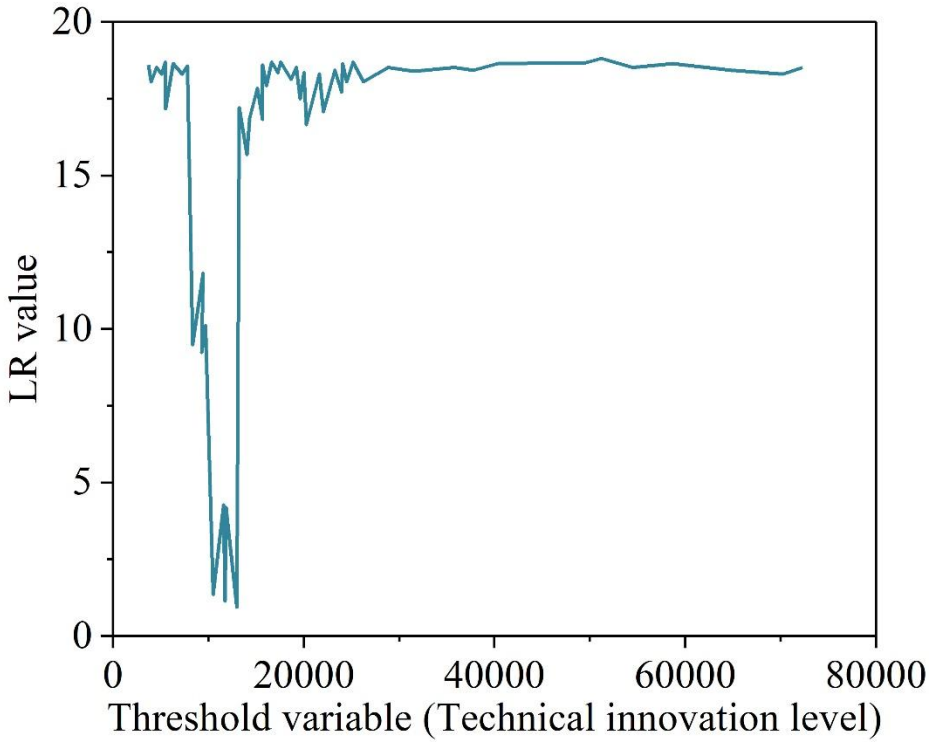
The results of the threshold effect test are shown in Figure 1 (Figures a to b show the graphs of threshold variables for the level of economic development, and Figure c shows the graphs of threshold variables for the level of technological innovation). Combined with the figure, it can be seen that the LR value corresponding to each threshold value is located below the critical value, therefore, it is judged that there is a triple threshold. When the level of technological innovation is used as a threshold variable, the model passes the single threshold test, and when a single threshold search is conducted, the LR value corresponding to the first threshold value is located below the critical value; therefore, a single threshold is judged to exist.



(a) The first threshold variable diagram of economic development level



(b) The second threshold variable diagram of economic development level



(c) Threshold variable diagram of technological innovation level

Figure 1. Threshold effect test results.

The results of the tests for the thresholds and their confidence intervals are shown in Table 13.

Table 13. Threshold estimate and confidence interval.

Threshold variable	Threshold 1		Threshold 2		Threshold 3	
	Estimated value	95% confidence interval	Estimated value	95% confidence interval	Estimated value	95% confidence interval
pgdp	26351	[23600,28220]	36500	[36000,43000]	53000	[40000,150000]
tec	11000	[8563,12000]	22000	[2800,360000]	4236	[2300,5650]

(2) Analysis of the estimation results of the threshold model

The estimation results of the threshold parameters are shown in Table 14. According to the estimation results of the threshold parameters of the table, it can be seen that when the level of economic development (gdp) and the level of technological innovation (tec) are used as the threshold variables, there is a double threshold for the level of economic development: 26,351, 36,500, and there is a single threshold for the level of technological innovation: 11,000. These two threshold variables respectively divide the research sample into different intervals, and the different threshold variables under the conditions of the labor education in colleges and universities with the ideological and political education have differentiated effects on educational interaction effects.

Table 14. Estimate of threshold parameters.

Variable	Threshold interval	tfp	
pgdp	pgdp≤26351	-0.233	
	26351<pgdp≤36500	0.155	
	pgdp>36500	0.336***	
tec	tec≤11000		0.095
	tec>11000		0.365***

Control variable		YES	YES
Constant term		0.988***	1.042***
Sample size		500	500
R^2		0.265	0.292

4. Conclusion

In this paper, by constructing the index system to measure the interactive effect of labor education and ideological and political education in colleges and universities, the interactive effect of education was measured using the dynamic linkage equation model. At the same time, a threshold panel model was established to empirically analyze the interaction effect of labor education and ideological and political education. The empirical evidence of this paper shows that:

In terms of the two single-dimension results of educational equity and educational efficiency, in the analysis of the results of college labor education, the level of labor education in colleges and universities in province A in 2016 was the highest among all years as 0.997. In the analysis of the results of ideological and political education in colleges and universities, the educational efficiency of city a and city m was significantly higher than that of other regions.

In the test of the interactive effect of labor education and ideological and political education in colleges and universities, the regression coefficients of labor education and ideological and political education are 2.976 and 0.623 respectively, which shows that there is indeed a benign interactive effect between labor education and ideological and political education, both sides promote each other, and labor education has a stronger role in the promotion of ideological and political education.

There is a single threshold effect of technological innovation level, when the technological innovation level of province A is lower than or equal to the first threshold value of 11000, the coefficient of the interaction effect of education is 0.095, but it is not significant, when the technological level of province A is higher than the first threshold value of 11000, the coefficient of the interaction effect of education is 0.365.

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