

# Design and Implementation of Evaluation System for Quality Construction of Teachers in Ethnic Minority Areas



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**Abstract.** In this paper, we did a research on the quality construction of teachers in ethnic minority areas. Towards evaluating the current situation of teachers in ethnic minority areas, we build a system dynamic model based on the principle of system dynamics with fully consideration of the mutual interaction among related elements. Key analytical approaches like causal relationship diagram, flow graph, system dynamics model are all utilized to aid our evaluation process. A comprehensive evaluation system has been built based on the model proposed. According to the actual situation of the teachers' quality construction in the ethnic minority areas, we further conducted a series of experiments including boundary test, mental test, extreme test and behavioral characterization test to validate the feasibility of our approach.

**Keywords:** ethnic minority areas, system dynamics, teachers' quality construction

## 1 Introduction

The quality evaluation for teachers in ethnic areas is a complex dynamic system influenced by the external environment and with specific demand on structure and function. System dynamics and ORACLE database are two effective approaches for analyzing complex systems, which can simplify and intuitively analyze complex systems, enable qualitative analysis and quantitative analysis to achieve dialectical unity.

The rest of this paper is organized as follows: In Section 2 we provide a brief survey on how existing research relates to our work. We provide an overview of quality evaluation practices on education. In Section 3 we describe the designed framework to evaluate the existing teachers' quality construction in ethnic minority areas, and further introduce an indicator set to explain how relating elements wage effects on the process of evaluation. The structure and realization of the system based on system dynamics model is introduced in Section 4, together with a series of simulations to validate the feasibility of the system. In our analysis, we choose actual data gather in Guangxi Autonomous Region to illustrate the validity of the system constructed.

## 2 Related Work

The quality evaluate system for teachers in ethnic areas is a complex dynamic system with specific demands on structure and function. System Dynamics is a discipline of analytical information feedback systems. It appeared in 1956 and was founded by Professor Jay W. Forrester of the Massachusetts Institute of Technology [1]. After decades of development, its theoretical and applied research involves a large number of system types [2-4], and is also an effective tool for research and simulation analysis in the field of education [5-7]. At the same time, the assessment of the existing education system construction is a complex project. The researchers conducted in-depth research and analysis and practical research, and obtained a large amount of statistical data [8-11]. In the evaluation of the existing education and teaching system, Shen and Zan [12] were inspired by the MOOC wave, introduced the evaluation

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indicators in detail with the actual data, and proposed a three-dimensional comprehensive evaluation model based on the actual needs of the teaching management department. A unified index scoring algorithm, and using AHP to determine the weight of each evaluation index. Hao et al. [13] proposed an online course evaluation system using fuzzy mathematics method, and introduced the design concept and basic functions of the network-based evaluation platform, and verified the proposed mathematical model through experiments. Li and Jia [14] constructed a comprehensive evaluation system for teachers' quality construction in ethnic areas based on multi-level model and fuzzy mathematics theory according to the region, and evaluated the status quo of junior high school teachers' quality construction in ethnic areas.

Combined with the structure and application of different comprehensive evaluation systems, the relating algorithms of teachers' quality construction evaluation based on dynamic model are studied, and further build the evaluation system of teacher quality construction in minority areas. The system combines various factors to comprehensively evaluate the proportion of highly educated teachers in ethnic areas. The analytical result of actual case indicates that the comprehensive evaluation system proposed worked well.

### 3 The Evaluation Model of Teachers' Quality Construction

#### 3.1 Overall Design

In this paper, we choose the proportion of highly educated teachers to evaluate the quality construction of teachers in ethnic areas. Based on thoroughly investigations and related researches, the main causal relationships of the dynamics model of the quality evaluation system for teachers in ethnic regions are:

(1) The quality construction of teachers in ethnic areas is influenced by policy support, economic and social foundation, and talent basis. These three factors are key driven forces who wage their influence in terms of greater assistance, strong talent attraction, and provision of outstanding talents.

(2) The government has given direct support to strengthening the construction of the teaching staff in ethnic areas through policy support. According to the society's urgency of raising the proportion of highly educated teachers, the government has given certain support to the quality of teachers in ethnic areas (the degree of support is related not only to the degree of urgency that the society believes, but also to the degree of urgency of government departments that support policies. It should be related to the extent to which support is supported. The government's understanding and judgment are characterized by the strength of policy support. With the support of the government, such as financial support, education support, etc., in ethnic areas, the growth rate of highly-educated teachers has been greatly promoted, which means the growth of highly-educated teachers.

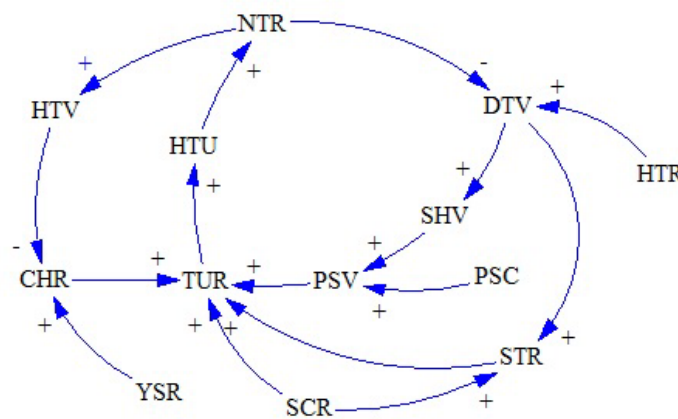
(3) Economic and social foundations through the attractive role of highly educated teachers, the construction of teachers in ethnic areas is actively promoted. With the development of the local economy and society and the growth of GDP, the local can provide higher salary, better working conditions, more learning and training outlines and education plans, enhance the attraction of highly educated teachers and in-service teachers. The ability to improve academic qualifications will give positive promotion to the quality construction of teachers in ethnic areas.

(4) Talent basis provides the basic premise for the quality construction of teachers in ethnic areas. The strengthening of the talent basis will actively promote the quality construction of teachers in ethnic areas. With the strengthening of the talent basis, such as the strengthening of higher teacher education, the implementation of policies such as special post teachers in ethnic areas, and the cultivation of more talents for ethnic areas, there may be more in the face of the continuous improvement of the quality standards of employers. High-quality talents that meet the requirements are an alternative to teacher recruitment, which is conducive to the positive promotion of the proportion of highly educated teachers.

(5) With the improvement of the quality of teachers in ethnic areas, the driving factors will gradually reduce the quality of the teaching staff. This reduction is due to the fact that with the improvement of the quality of teachers in ethnic areas, the urgency of the society to improve the quality of teachers in ethnic areas will be weakened, and thus the government's policy support will also weaken. It is the reduction of the quality of the teaching team; second, because there are imbalances in the development of various regions within the ethnic regions, and those with relatively good economic and social foundations are more likely to attract high-quality teachers, and with the high degree of teaching in ethnic areas. With the increase of teachers, those regions with better economic and social foundations that are more likely to

attract teachers are given priority to teachers, so that the areas that need to be supplemented with teachers are more difficult areas for economic and social development, making it more difficult for outstanding teachers to supplement. Reduce the speed of teacher quality. What needs to be pointed out here is that the degree of unbalanced development within the ethnic regions is also deep. The growth of GDP can make the economic and social development of the ethnic regions lagging behind, and the relatively developed regions of the economy and society simultaneously enhance the attraction of excellent teachers to a certain extent. However, this kind of GDP growth cannot make the economic and social development lag areas within the ethnic areas develop to a level close to the economically and socially developed areas of the ethnic areas in the short-term. Therefore, with the increase of GDP, the economic and social development areas within the ethnic areas Teachers are given priority to supplement. The remaining regions have limited economic and social development in the short term with the increase of GDP. Most of them still belong to the lagging regions of economic and social development, making teachers more and more difficult to supplement, and the quality of teachers is increasing. Third, with the improvement of the quality of teachers in ethnic areas, the quality requirements of teachers in ethnic areas will also increase. For example, the main emphasis is on academic qualifications, and now more emphasis on comprehensive quality, so that some can be considered as high-quality talents. The recruitment of faculty members is no longer in line with quality expectations, which reduces the number of hiring resources and reduces the speed of recruitment of highly educated teachers in ethnic areas.

Based on this, the causal relationship diagram of the evaluation system for the quality of teachers in ethnic areas is established, as shown in Fig. 1.



**Fig. 1.** The relationship diagram of regional teachers' quality construction evaluation system

### 3.2 Functional Module and Indicator Set

The quality construction of teachers in ethnic areas is influenced by several factors [15-18]. According to the characteristics of the quality construction of teachers in ethnic areas, this paper has established three functional modules: policy support module, economic and social foundation (GDP) module, and talent foundation (graduate) module. In this section, the three modules and related variable selections are analyzed respectively.

#### 3.2.1 Policy Support Module

Theoretically speaking, policy support has a significant impact on the quality of teachers in ethnic areas [19-20]. In order to further explore the impact of policy support on the quality of teachers in ethnic areas, this paper builds a policy support sub-module. Strengthening the policy support for the quality construction of teachers in ethnic areas is conducive to promoting the introduction of more highly educated teachers in schools in ethnic areas, and is also conducive to the increase in the proportion of highly educated teachers in the national minority teachers, thus improving the teachers in ethnic areas. The proportion of highly educated teachers in the middle. With the increase of highly-educated teachers in the minority teachers, the gap between their proportion and the proportion of policy expectations is getting smaller and smaller, which makes the urgency of the relevant departments and society to promote

the proportion of highly educated teachers in the minority teachers. Soothing, and thus the policy support to strengthen the quality of the teaching staff in ethnic areas has been weakened.

Causality diagrams are the basis for further analysis [21-22]. According to the above logic, the causal relationship of the policy support sub-module is shown in Fig. 2, and the related factors are shown in Table 1.

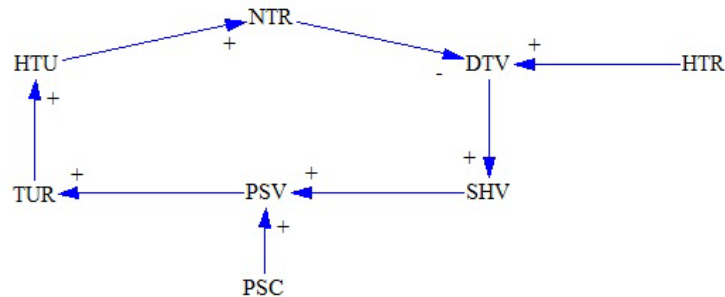


Fig. 2. Causality of policy support module

Table 1. Description of related factors of policy support module

Name	Symbol	Description
Ratio of highly-educated teachers	NTR	The proportion of highly educated teachers in the total number of teachers in ethnic areas.
Expecting ratio of highly-educated teachers	HTR	The expectation of society for the proportion of highly educated teachers in ethnic areas.
Difference between the actual and expected proportion of teachers with high education	DTV	The difference between the actual proportion of highly educated teachers and the proportion of highly educated teachers expected by society.
Social expectation to increase NTR	SHV	The urgency of the society to raise the expectation of highly-educated teachers in the teachers' team in ethnic areas.
Strength of policy support	PSV	The policy supports the extent of the construction of teachers in ethnic areas.
Policy support strength indicator	PSC	The degree of policy support is not only related to external factors such as the urgency of social expectations, but also to the extent to which the policy-making department believes that the role of external factors should be correspondingly responded. The proportion of the degree of external factors is the policy support strength coefficient, which indicates the government's willingness to support the policy under the influence of specific external factors.
Value of increase of highly-educated teachers	HTU	Highly educated teachers account for this increase in value.
Indicator of highly-educated teacher increase ratio	TUR	The influence factor of external driving factors on the growth of the number of teachers with high education in the minority areas.

### 3.2.2 Economic and Social Foundation (GDP) Module

The support of economic and social foundations and GDP for the quality of teachers in ethnic areas can be expressed in many ways [23-24]. In this paper, we focus on the direct impact of economic and social foundations and GDP on the growth rate of highly educated teachers. And indirect impact analysis.

The logic of indirect influence is: in the relatively low period of higher education teachers, the economic and social conditions are better, the areas where economic and social development lags behind, the areas lacking a large number of highly educated teachers, and the better economic and social conditions for higher education teachers. Attractive. Actively promote the growth of highly educated teachers in minority areas. On the contrary, in the period when the proportion of highly educated teachers reached a higher value, the proportion of teachers with higher education in areas with better economic and social conditions was higher. The lack of key highly-educated teachers is lagging behind in economic and social development, and it is more difficult to recruit highly educated teachers in areas with slow

economic and social development, thus reducing the growth rate of teachers with higher education of minority teachers. With the growth of GDP, the economic and social development of ethnic areas has developed. Many economic and social developments that are difficult to attract highly educated teachers develop in underdeveloped areas. It is easier to attract highly educated teachers than the original teachers, thus increasing the proportion of highly educated teachers. This ratio has led to positive promotions, which in turn has increased the proportion of highly educated teachers in minority areas. With the increase in the number of highly educated teachers in ethnic minority areas, the gap between their proportions and the expected ratio of policies is getting smaller and smaller, which makes the shortage of highly educated teachers in areas with better economic and social conditions account for the higher education teachers in various regions. The proportion is small (because areas with better economic and social conditions are more likely to attract highly educated teachers, so they give priority to supplementing. The gap is mainly due to the economic and social conditions behind the region. In areas with good economic and social conditions Higher education teachers are the total number of vacancies in all regions, which is smaller, which in turn reduces the overall growth rate of highly educated teachers in ethnic areas.

The logic is concluded as: With rapid growth in GDP, the region can offer higher salary, provide better working conditions and more learning and training to improve academic qualifications. Those factors mentioned above will further work on the rate of increase in the proportion of highly educated teachers as an incentive.

Accordingly, the causal relationship of the economic and social foundation (GDP) sub-module is shown in Fig. 3, and the relevant factors are shown in Table 2.

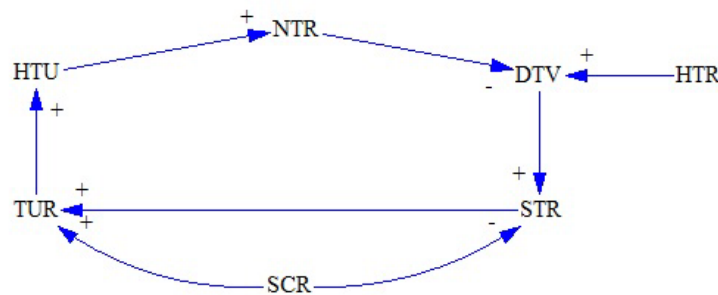


Fig. 3. Causality of economic and social foundation module

Table 2. Description of related factors of economic and social foundation (GDP) module

Name	Symbol	Description
Proportion of highly-educated teachers' vacancies in highly developed region accounted for the number of highly-educated teachers in all regions	STR	There are also serious imbalances in development within ethnic areas. In some areas, economic and social conditions are relatively good, and it is easier to attract outstanding teachers. This factor represents the proportion of the total vacancies of high-quality teachers in ethnic areas, and the proportion of vacancies in areas with relatively good economic and social conditions.
GDP growth rate	SCR	The increase in GDP in the ethnic areas studied accounts for the proportion of the original GDP.

### 3.2.3 Talent Foundation (Graduate) Module

The talent basis is an important guarantee to meet the quality construction of teachers in ethnic areas [25-26]. With the increase in the proportion of highly educated teachers, the recruiting unit and the society will pay more attention to the comprehensiveness of the teachers while paying attention to the teacher's academic qualifications. Some teachers with high academic qualifications are not hired. The higher the expectation value of teachers' comprehensive quality, the fewer people who meet the quality expectations among the groups that can be recruited as teachers, and play a negative role in their proportion. Can be recruited as a group of teachers, and includes face-to-face undergraduate and above

graduates, as well as people of all ages accumulated in the early years. Graduates with bachelor degree or above have received good formal education from high-quality universities, and the proportion of highly qualified personnel is higher. Therefore, with the annual increase rate of undergraduate and above graduates (i.e., the annual increase rate of highly-educated graduates), It will increase the proportion of people who can be recruited as teachers and meet the expectations of quality, and thus increase the proportion of highly educated teachers in the minority teachers. With the increase in the number of highly educated teachers in the minority areas, the quality expectations of recruiting teachers will be further increased.

Thus, the description of related factors is shown as Fig. 4 and causality of talent foundation module is shown as Table 3.

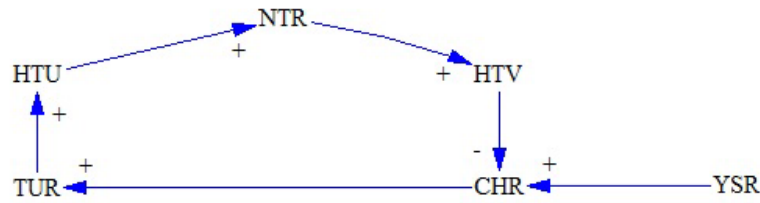


Fig. 4. Causality of talent foundation module

Table 3. Description of related factors of talent foundation module

Name	Symbol	Description
Expectation of the quality of the teachers recruited	HTV	In addition to the academic requirements, the recruitment unit's expectations for other comprehensive qualities of the recruiters.
The proportion of candidates who meet the quality expectations	CHR	Among the candidates who meet the requirements of academic qualifications, the proportion of those who meet the additional requirements of the recruiting unit.
Annual increase rate of highly educated graduates	YSR	The annual increase in the number of highly-educated graduates compared to the previous year, accounting for the proportion of the total number of highly-educated graduates in the previous year.

### 3.3 System Dynamics Model

According to the system dynamics modeling norm, on the basis of constructing the causal relationship graph, the system flow graph is also constructed to further describe the system, which lays a foundation for system simulation and quantitative analysis [27]. The system dynamics flow diagram is a flow chart shape that reflects the changes in state variables by various components of system dynamics. The flow graph is of great significance in system dynamics simulation: it is the basis for collecting data for quantifying the model, is the basis for setting up the system dynamic simulation test, is the basis for providing the system dynamics quantitative model, and the system simulation, and provides the system analysis. Mathematical model blueprint and analysis basis. A flow chart of the simulation model of the quality construction of the teachers in the ethnic minority areas is constructed accordingly. We choose simulation tool Vensim PLE to construct a system flow diagram of the “National Region Teacher Team Quality Construction Evaluation System Dynamics Model”, as shown in Fig. 5.

Using the system dynamics method, the design and construction of the quality construction model of the teachers in the minority areas is designed [28-29]. The model equation is as follows:

- (1)  $NTR = INTEG (HTU, initial\_NTR)$
- (2)  $HTU = TUR * NTR * DTV$
- (3)  $PSV = SHV * PSC$
- (4)  $STR = DTV * (1 + SCR)$
- (5)  $CHR = (1 + YSR) * (1 - HTV)$
- (6)  $SHV = DTV$
- (7)  $HTV = NTR$
- (8)  $TUR = 0.6 * (1 + SCR) * (STR * PSV * CHR)^{(1/2)}$
- (9)  $DTV = HTR - NTR$

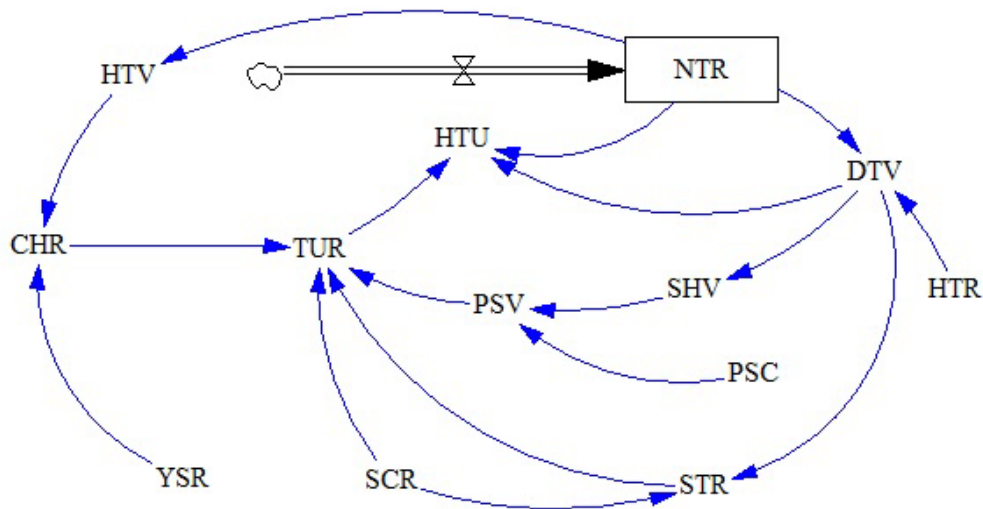


Fig. 5. Flow chart of quality evaluation system for teachers in ethnic areas

## 4 System Design

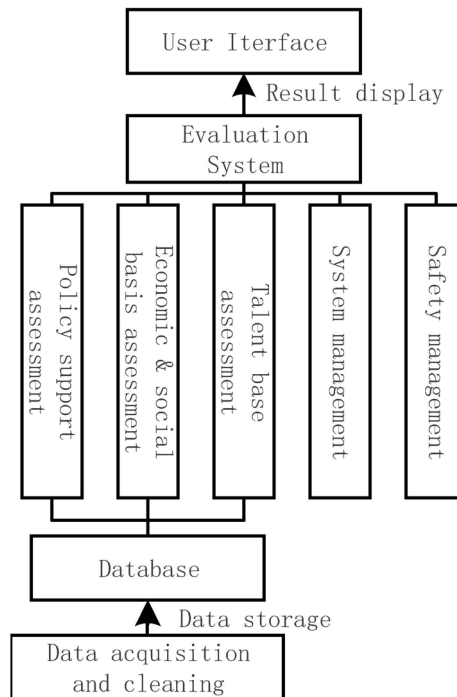
This paper is dedicated to the problem of development trend of the quality construction of teachers in ethnic areas under different driving factors, which can provide strong support for the research on the quality construction of teachers in the corresponding regions and the formulation of relevant policies. Based on the method constructed in the previous chapter, this paper designs a detailed system framework and a set of completed business realization processes for the teacher team quality construction forecasting and evaluation model. At the same time, the trending of the reality system is the key to the construction of the system dynamics model. To this end, this paper combines the example of Guangxi Zhuang Autonomous Region to test the established system dynamics model.

### 4.1 Requirements Analysis

The evaluation system for the quality of teachers in ethnic areas is based on the proportion of teachers with high academic qualifications in the teaching team. The system needs historical data based on the proportion of highly educated teachers in the ethnic minority teachers, combined with policy support, economic and social foundation, and talent basis. The influencing factors and importance of the three aspects predict and analyze the development trend of the proportion of highly educated teachers. In this way, we can comprehensively consider the impact of various factors, maximize the use of existing data, and improve the accuracy of prediction and evaluation.

### 4.2 System Design

Policy support, economic and social foundation, and talent foundation are the three main conditions that affect the quality of teachers in ethnic areas. Policy support plays a direct role in strengthening the construction of the teaching staff in ethnic areas. By giving certain support to the teachers in ethnic areas, the government has promoted the growth rate of highly-educated teachers in ethnic areas, and has promoted the growth of highly-educated teachers, which has increased the proportion of highly educated teachers; The economic and social foundation has a greater appeal to highly educated teachers and actively promotes the construction of teachers in ethnic areas. With the development of the local economy and society and the growth of GDP, the local community can raise the level of teaching with higher salary, better working conditions and more learning and training, and enhance the attraction of highly educated teachers and the ability of in-service teachers to improve their academic qualifications; The talent basis is the basic premise for the quality construction of the teachers in ethnic areas. With the enhancement of the talent basis, it is possible to cultivate more talents for ethnic areas, which is conducive to the positive promotion of the proportion of highly educated teachers. The three interact and interact with each other to build a simulation system. The overall structure of the system is shown in Fig. 6.



**Fig. 6.** Schematic diagram of the system

4.2.1 Data Structure

The database of the evaluation system is established based on the principle of Java and ORACLE database combined with the system framework diagram [30-31]. On the whole, the “teachers’ quality construction in ethnic areas” is determined by three main factors: policy support, economic and social foundation and talent basis. The parameters of each module are shown in Table 4, Table 5 and Table 6. The correspondence between the tables is as shown in Fig. 7.

**Table 4.** Parameters of policy support module

Field Name	Type	Description
NTR	DECIMAL(4, 3)	Ratio of highly-educated teachers
HTR	DECIMAL(4, 3)	Expecting ratio of highly-educated teachers
DTV	DECIMAL(4, 3)	Difference between the actual and expected proportion of teachers with high education
SHV	INTEGER	Social expectation to increase NTR
PSV	DECIMAL(4, 3)	Strength of policy support
PSC	INTEGER	Policy support strength indicator
HTU	DECIMAL(4, 3)	Value of increase of highly-educated teachers
TUR	DECIMAL(4, 3)	Indicator of highly-educated teacher increase ratio

**Table 5.** Parameters of economic and social foundation

Field Name	Type	Description
STR	DECIMAL(4, 3)	Proportion of highly-educated teachers’ vacancies in highly developed region accounted for the number of highly-educated teachers in all regions
SCR	DECIMAL(4, 3)	GDP growth rate

**Table 6.** Parameters of talent basis module

Field Name	Type	Description
HTV	INTEGER	Expectation of the quality of the teachers recruited
CHR	DECIMAL(4, 3)	The proportion of candidates who meet the quality expectations
YSR	DECIMAL(4, 3)	Annual increase rate of highly educated graduates



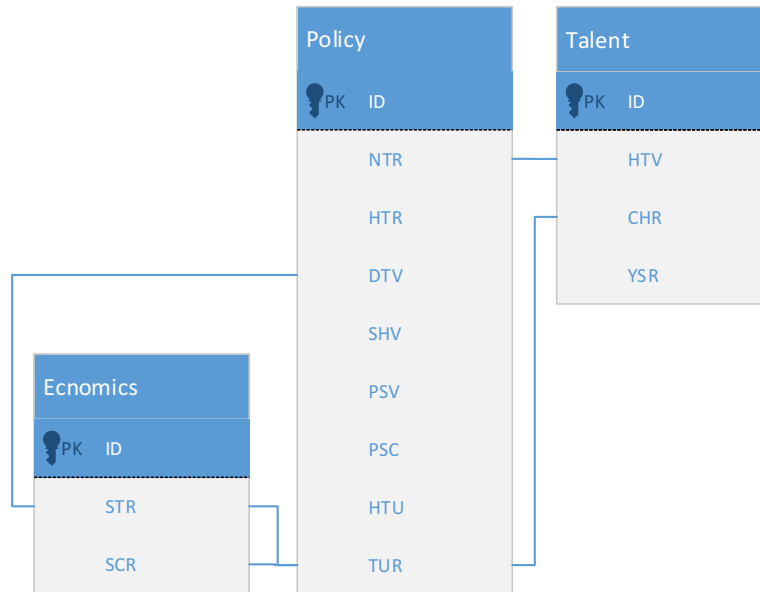


Fig. 7. Relationship of tables in the database

4.2.2 Parameter Assignment

Guangxi Autonomous Region is the most populous ethnic autonomous region in China with a population of 48.22 million, accounting for 48.5% of the total population of the five autonomous regions of 94.45 million. The research on the quality construction of the teachers in Guangxi Zhuang Autonomous Region is carried out, and it has outstanding representativeness to understand the quality construction of the teachers in ethnic areas. In the education of ethnic areas, compulsory education is the most important thing, and plays a foundation role. In compulsory education, junior high school education is in an important position. According to the “People’s Republic of China Teacher Law”, “the qualifications of junior high school teachers, junior vocational school culture, and professional class teachers shall be qualified for graduates of higher normal colleges or other colleges and above.” In recent years, the proportion of teachers with high academic qualifications (undergraduate and above) in the junior high school of compulsory education in Guangxi Zhuang Autonomous Region has been increasing, and has shown a good development trend [29, 32-35], as shown in Fig. 8.

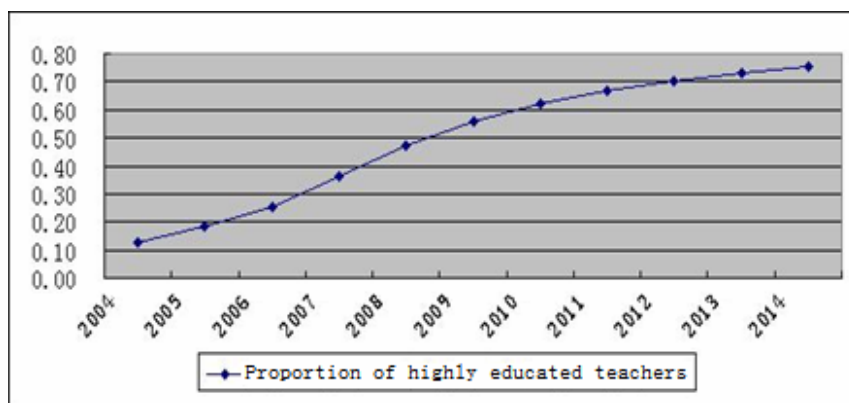


Fig. 8. Compulsory education in junior high school in Guangxi from 2004 to 2014  
Proportion of highly educated teachers

According to the system dynamics flow diagram constructed, combined with the status quo of the quality construction of teachers in Guangxi Zhuang Autonomous Region, this paper establishes the dynamics model of the evaluation system of the quality of teachers in Guangxi Zhuang Autonomous Region. In the model, the policy support strength coefficient indicates the willingness of government

policy support in the change of a certain society to promote the high hopes of highly educated teachers; the GDP growth rate, the annual growth rate of highly-educated graduates are averaged according to the actual data in recent years. According to the actual interview, it is expected that the proportion of teachers with high academic qualifications is 100%; the initial value of teachers with high education qualifications is the initial year of the above sample, that is, the value of teachers with high education in 2004. Equations for other variables can be derived from the flow graph of the system dynamics.

The mathematical model of the system and related parameters are as follows:

- (01)  $PSC = 1$
- (02)  $SCR = 13\%$
- (03)  $YSR = 8.4\%$
- (04)  $PSV = SHV * PSC$
- (05)  $STR = DTV * (1 + SCR)$
- (06)  $CHR = (1 + YSR) * (1 - HTV)$
- (07)  $SHV = DTV$
- (08)  $HTV = NTR$
- (09)  $TUR = 0.6 * (1 + SCR) * (STR * PSV * CHR)^{(1/2)}$
- (10)  $HTU = TUR * NTR * DTV$
- (11)  $NTR = INTEG (HTU, \text{initial NTR})$
- (12) Initial NTR = 13%
- (13) HTR = 100%
- (14)  $DTV = HTR - NTR$

## 5 Case Analysis

### 5.1 System Boundary Test

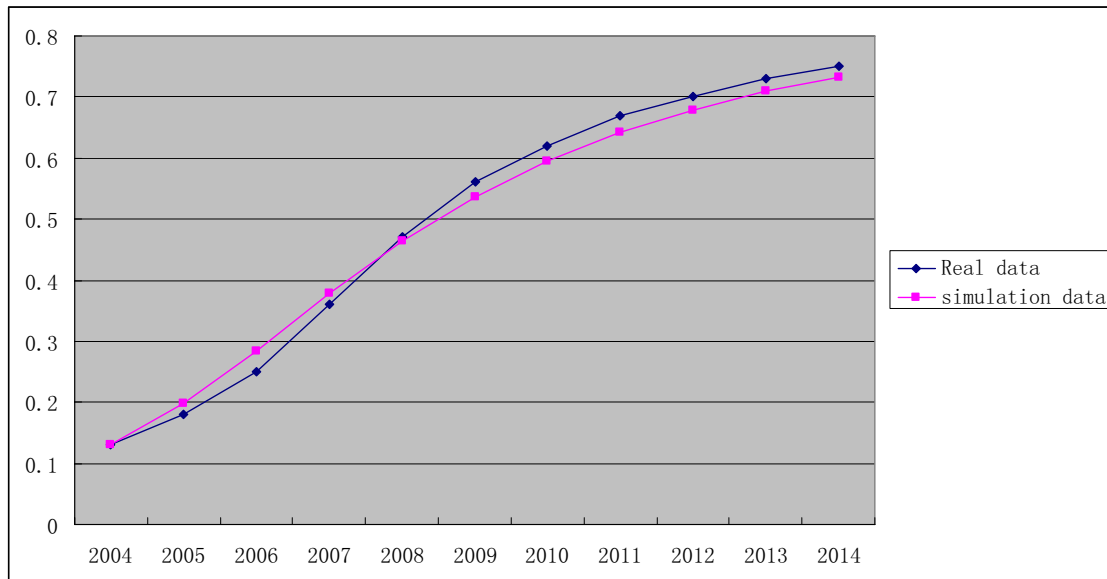
The boundaries of the system are primarily determined by the variables studied and valued and the span of time. The system boundary test mainly checks whether the important concepts and variables in the system are endogenous variables, and studies the sensitivity of the system behavior when the assumed system boundary changes.

After establishing the system dynamics model, this paper consulted relevant teachers and related field experts and organized a discussion. Based on the previous study of the absorption of teachers and experts, we further optimizes the model. In the definition of endogenous and exogenous variables, this paper fully considers the influence of psychological factors.

### 5.2 Mental Model Test

The mental model test detects whether the behavior of the system simulation fits the data provided by the case. For the case of replicating case data, there are two cases in which the absolute data match and the trend match. The agreement of the trend is more important, because the system dynamics model is a model based on the system microstructure, and the structure determines the behavior characteristics of the system. And the trend is a sign of behavioral characteristics.

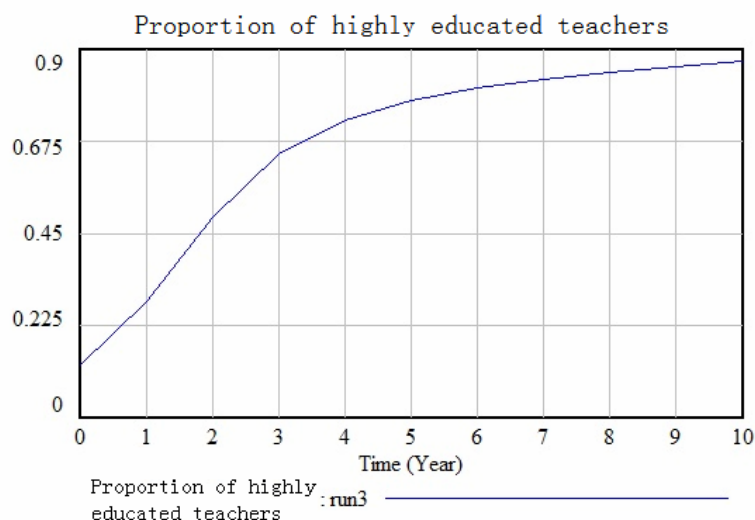
In this paper, the proportion of highly educated teachers is the core variable that represents the quality construction of the teaching staff. In this way, when testing the mental model, this paper compares the actual value of the highly-educated teacher ratio with the simulated analog value, and tests whether the trend is consistent. Fig. 9 is a simulation output of a highly-educated teacher and its comparison with the actual situation. After comparison, it can be concluded that the actual value of the highly-educated teachers and the simulated simulation values have a good fit in the trend, and the mental model test passes.



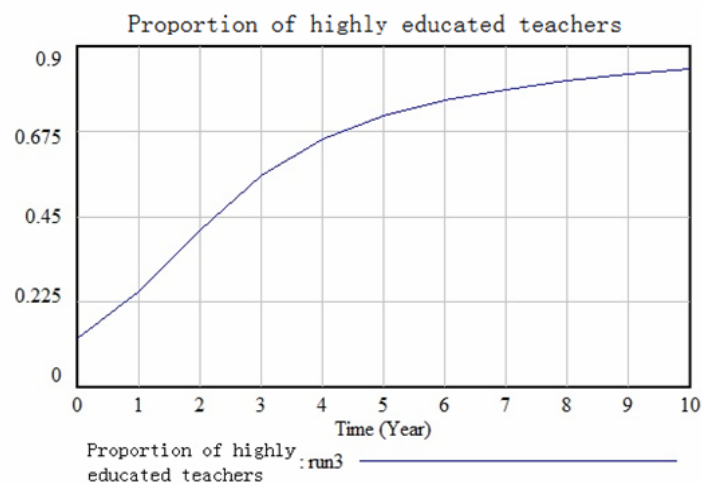
**Fig. 9.** Comparison of simulation results and actual situation of the teachers' quality construction in Guangxi Autonomous Region from 2004 to 2014

### 5.3 Extreme Situation Test

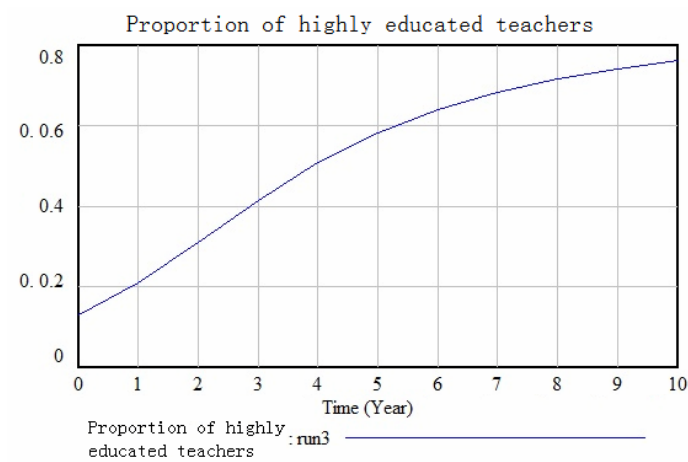
The extreme case is mainly used to test whether the rate equation in the model is stable and reliable, and whether it can reflect the changing law of the real system or the will of the decision maker in any extreme case. The extreme case test method is judged by the response of the model to the impact. In the test, when the three factors affecting the policy support coefficient, GDP growth rate, and annual growth rate of undergraduate and above graduates take the extreme value, that is, the increase is 5 times of the original, the proportion of highly educated teachers With faster growth, reasonable values can be obtained without exceeding the 100% limit, as shown in Fig. 10, Fig. 11, and Fig. 12. This shows that after the extreme values appear, the prediction function of the model will not be abnormal, which proves that the model has appropriate stability.



**Fig. 10.** Simulation result of compulsory education in junior high school in Guangxi from 2004 to 2014  
Highly educated teachers' ratio trend (PSC increased by 5 times)



**Fig. 11.** Simulation result of compulsory education in junior high school in Guangxi from 2004 to 2014 highly educated teachers' ratio trend (GDP growth rate)



**Fig. 12.** Simulation result of compulsory education in junior high school in Guangxi from 2004 to 2014 highly educated teachers' ratio trend (GDP growth rate)

### 5.3 Behavioral Characterization Test

To further test the effectiveness of the system simulation model, this paper uses the system dynamics model to simulate the proportion of highly-educated teachers in the junior high school compulsory education teachers in Guangxi Zhuang Autonomous Region from 2004 to 2014, and compare the simulated values with Actual values, the results are shown in Table 7.

**Table 7.** Compulsory education in junior high school in Guangxi from 2004 to 2014 Comparison between actual value and simulation result of proportion of teachers highly educated

Year	Actual	Simulation	Error
2004	0.13	0.130	0
2005	0.18	0.199	0.106
2006	0.25	0.285	0.140
2007	0.36	0.378	0.050
2008	0.47	0.464	0.013
2009	0.56	0.537	0.041
2010	0.62	0.596	0.039
2011	0.67	0.642	0.042
2012	0.70	0.679	0.030
2013	0.73	0.709	0.029
2014	0.75	0.733	0.023

In this paper, we choose following formula to calculate degree of error between the simulated and actual values:

$$e = \frac{|a-b|}{b}$$

Where a is the simulated value and b is the actual value.

The verification of the error rate shows that the vast majority of data error parameters are less than 0.05. Therefore, the dynamic model of the system is well fitted to the reality, and the modeling of the dynamic model of the system is effective.

## 6 Conclusion

In this paper, we focus on the quality evaluation schema of teachers in ethnic areas, and established a working system based on the proposed model. Key analytical approaches like causal relationship diagram, flow graph, system dynamics model are all used to support our analyzation. The result is concluded as follows:

(1) The quality construction of teachers in ethnic areas is a complex dynamic system, and systematical behavior can be simulated by system dynamics model.

(2) The simulation results indicates that the policy support, economic and social foundation and talent basis of ethnic regions have positively promoted the quality of teachers in ethnic areas.

(3) The model proposed fits well the actual situation of the quality construction of teachers in ethnic areas, and has a good predictive effect. It can be used to systematically analyze the behavioral characteristics and policies of the quality construction of teachers in ethnic areas.

The evaluation system of the quality construction of teachers in ethnic areas is an effective tool for simulating the teachers in ethnic areas, and plays a very positive role in research and trend prediction. Meanwhile, policy support is an important guarantee for the construction of teachers in ethnic areas. The economic and social foundation is an important foundation for the quality construction of teachers in ethnic areas. The talent basis is an important prerequisite for the construction of teachers in ethnic areas. Studying and analyzing the comprehensive impact of policy support, economic and social foundations, talent basis and other factors, and taking overall measures to accelerate the promotion of the quality of the teachers in ethnic areas is of great significance.

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