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Research on Sustainable Development Strategy for Teachers in Primary and Middle Schools of Sichuan Province: Based on the Forecast and Analysis of the Need for Teachers

RECHERCHE SUR LA STRATEGIE DE DEVELOPPEMENT DURABLE POUR LES ENSEIGNANTS DANS LES ECOLES PRIMAIRES ET SECONDAIRES DE LA PROVINCE DU SICHUAN SUR UNE BASE DE PREVISIONS ET ANALYSE DE LA NECESSITE POUR LES ENSEIGNANTS

WANG Shan[1,*]; PAN Yining[2]; GOU Bin'e[3]

[1]Sichuan Normal University, 5# Jing'an Road, Jinjiang District, Chengdu, Sichuan 610068, China
[2]PhD, Institute of mathematics and science department, Sichuan Normal University, 5# Jing'an Road, Jinjiang District, Chengdu, Sichuan 610068, China
Email: yining.pan@gmail.com
[3]Master, Institute of mathematics and science department, Sichuan Normal University, 5# Jing'an Road, Jinjiang District, Chengdu, Sichuan 610068, China
Email: bine341@163.com
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[*]Corresponding author.
Lecture, Institute of Teacher Educational Research.
Address: Sichuan Normal University, 5# Jing'an Road, Jinjiang District, Chengdu, Sichuan, 610068, China.
Email: wangshan77@126.com

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Abstract

Our study constructs mathematical model to predict the demands of teacher in primary school and middle school by analyzing education data of Sichuan Province, PRC, in years past. The study pointes out that, it is in urgent need to adjust the strategic layout of teacher development in Sichuan Province of China due to decrease in demand and increasingly fierce competition among teacher for compulsory education, shortage of teacher for senior high school, backward development of teacher for vocational education and serious structural contradiction. In order to keep teacher sustainable development, we must adhere to demand-oriented training orientation and mainly adopt mixed-type open training mode. Besides, establishing teacher development school, improving teacher certification system, strengthening teacher training in rural areas and minority areas and achieving all kinds of teachers' balanced development are basic countermeasures on bettering the quality of teacher training in Sichuan Province of China.

Key words: Sichuan province; Sustainable development of teachers; Strategy

Résumé

Notre étude construit un modèle mathématique afin de prédire les exigences de l'enseignant dans le primaire et le collège d'enseignement en analysant les données de la province du Sichuan, en Chine, dans les années passées. L'étude souligne que, il est urgent besoin d'ajuster la configuration stratégique du développement enseignant dans la province du Sichuan à cause de la baisse de la demande et la concurrence plus féroce parmi les enseignants de l'enseignement obligatoire, la pénurie d'enseignants pour le secondaire supérieur, en arrière de développement de la Chine enseignants pour l'éducation professionnelle et sérieuse contradiction structurelle. Afin de maintenir le développement durable enseignante, nous devons adhérer à l'orientation de formation orientée vers la demande et surtout d'adopter le mode de type mixte de formation ouverte. En outre, l'établissement de l'école de perfectionnement des enseignants, l'amélioration du système de certification des enseignants, le renforcement de la formation des enseignants dans les zones rurales et les régions des minorités et de réaliser toutes sortes de développement des enseignants sont équilibrés de base sur les contre-mesures améliorant la qualité de la formation des enseignants dans la province du Sichuan de la Chine.

Mots clés:

La province du Sichuan; Le développement durable des enseignants; Stratégie

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National Outline for Medium and Long-term Educational Reform and Development (2010-2020) indicates that, it is necessary to normalize teacher qualifications, improve teacher qualities, so as to make efforts to build a high-quality professional teacher group with noble mortality, reasonable structure and full of vitality. To realize sustainable development of teachers, accurate forecast of the need for teachers must be carried out.

1. FORECAST AND ANALYSIS OF THE NEED FOR TEACHERS

1.1 Mathematical Model and Forecast Result

The number of births and the gross enrollment rate are the significant factors influencing the number of students enrolled. To hypothesize all school-age children enter school on time and the gross enrollment rate for primary school and junior high school is 100% (After popularizing nine-year compulsory education, the gross enrollment rate is generally above 90%), likewise, not to be consideration of the number of outside the plan of bearing child, the natural deaths and the population movement, we could establish the birth population model and the gross enrollment rate model of senior high school to predict the number of the current students in primary schools and middle schools. Based on the analysis of the births data of 1988 to 2008 in Sichuan province, a combination model is established to predict the new-born population: $y_{0t}=0.27y_{1t}+0.73y_{2t}$ (y_{0t}: the predicted value of new-born population at time t). $y_{1t}=0.990652y_{1t-1}$ (t=n-1987, n: year) $y_{2t}=-0.0084t^4+0.4475t^3-7.4922t^2+35.5556^t+104.388$ (t=n-1990). Mathematical expression $y_{1t}=0.990652y_{1t-1}$, that is, the index regression-Auto Regressive (1) model of birth population, is established by non-stationary time series analysis and using Eviews6.0 and Matlab. The Adjusted R Square is 0.951561. AIC criterion (Akaike Information Criterion) and SC criterion (Schwarz Criterion) is -1.987287 and -1.937500 respectively. So the index regression- Auto Regressive (1) model fits better. Mathematical expression y2t=-0.0084t4+0.4475t3-7.4922t2+35.5556t+104.388, that is, the regression model of birth population, is established by regression analysis and using Matlab. The Adjusted R Square is 0.9697. The results of f-test and t-test are both significant. So the regression model also fits better. However, the index regression-Auto Regressive (1) model is better than the regression model in the short-term forecast, on the contrary, the regression model is better. Consequently, we use weighted average method to establish the combination model $y_{0t}= 0.27y_{1t} + 0.73y_{2t}$ and calculate its coefficient by the error variance minimum principle of the combination forecasting. Analyzing the gross enrollment rate date of senior high school from 1993 to 2008 in China, we establish the Logistic curve model to predict the senior high school's gross enrollment rate: y=100/[1+exp(-0.03236-0.07574t)]-24.3exp{-[(t-0.3974)/8.644]2}-21.03exp{-[(t-11.11)/4.054]2} (t = n-1992) The Adjusted R Square is 0.9945. The results of f-test and t-test are both significant and the residual are white noise. The model fits better. Finally, we use the birth population model and the gross enrollment rate model of senior high school to predict the number of the current students in primary schools and middle schools.

Table 1
The Total Number of Current Student of 2010 to 2020 in Sichuan Province

Year	2010	2011	2012	2013	2014	2015
Primary school	5,665,408	5,310,886	5,021,802	4,810,129	468,223	471,349
Junior high school	4,698,813	3,977,013	3,450,734	3,175,767	2,903,539	2,663,264
Senior high school	4,454,217	4,604,547	4,424,359	391.796	3,359,506	2,949,349
Year	2016	2017	2018	2019	2020	___
Primary school	4,779,718	4,827,559	4,940,769	5,010,594	4,965,811	___
Junior high school	2,489,641	240,347	2,358,358	2,320,488	2,274,883	___
Senior high school	274.3837	253.3962	234.6141	2,212,449	2,156,855	___

Forecast on the number of current students in primary schools and middle schools in Sichuan Province is as follows: (1) The number of current students in primary schools will decrease, sharply first and then slowly till steadily. It will decrease sharply in 2010-2014 with 245,800 students per year on average, and increase slowly from 2015, up to 4,965,811 students till 2020. (2) The number of current students in junior high schools will decrease in 2010-2020 with 242,393 students per year on average. (3) The number of current students in senior high schools will also decrease, but a slight rise first and then sharply drop. It will decrease in 2010-2020 with 229,736 students per year on average. In short, the number of current students in primary schools and middle schools in Sichuan Province will decrease in the next ten year.

1.2 Teachers Demand Forecast

The total demand of teacher is equal to the number of student divided by the student-teacher ratios (total students divided by total teachers). We take the mean value from student-teacher ratio for 2008 in China and that for 2002 in Sichuan Province to represent the student-teacher ratio

from 2009 to 2020 in Sichuan Province and obtain the result as follows: 21.26 in primary school, 18.06 in junior high school and 17.2 in senior high school. Then we can calculate the total demand of teacher from 2010 to 2020 in Sichuan Province.

Table 2
The Total Demand of Full-time Teacher of 2010 to 2020 in Sichuan Province

Year	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Primary school	306,500	266,482	249,806	236,209	226,252	220,237	221,707	224,822	227,072	232,397	235,682	233,575
Junior high school	202,300	260,178	220,211	191,071	175,845	160,772	147,467	137,854	133,297	130,594	128,488	125,962
Senior high school	124,100	258,966	267,706	257,230	227,788	195,320	171,474	159,525	147,323	136,403	128,631	125,398

The number of teacher recruitment is equal to the total demand of teacher minus the number of existing teacher then add the number of annual retirement. Then we can calculate the number of teacher recruitment from 2010 to 2020 in Sichuan Province.

Table 3
The Number of Teacher Recruitment of 2010 to 2020 in Sichuan Province

Year	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Primary school	306,500	-31,286	-47,961	-61,559	-71,515	-77,531	-77,351	-74,236	-71,985	-66,660	-63,376	-65,905
Junior high school	202,300	59,772	19,806	-09,334	-24,559	-39,633	-52,666	-62,280	-66,836	-69,539	-71,646	-72,739
Senior high school	124,100	135,381	144,121	133,645	104,203	71,735	48,041	36,092	23,890	12,970	5,198	2,821

Forecast on full-time teacher in primary schools and middle schools in Sichuan Province is as follows: (1) Teachers in primary schools will be surplus gradually, almost 65,000 redundant full-time teachers till 2020, therefore, a decrease of 2.5% per year is required; (2) Teachers in junior high schools will be surplus from 2012, almost 70,000 redundant teachers till 2020, although they are relatively in shortage, therefore, a decrease of 4% per year is required from 2013; (3) However, teachers in senior high schools will be in shortage from 2010 to 2020, particularly from 2010 to 2013 and 120,000 teachers shall be recruited each year on average. Then the situation will be improved from 2014 although the teacher demand is still in short supply.

2. PROBLEMS FACED BY THE TEACHER DEVELOPMENT IN WESTERN CHINA

Sichuan is a province in the central-western China with its capital at Chengdu. The territory of the province ranks fifth in China. Sichuan is the country's second largest population province, the second largest Tibetan areas, the largest Yi minority residential area and the only Qiang minority residential areas. Sichuan is a province that both have developed western cities, such as Chengdu, and a large number of backward western rural areas and complex ethnic minority areas. The problems that are reflected in the teachers demand forecast of Sichuan are the typical problems faced by the teacher development in the western regions. As the economical production and cultural education, Sichuan occupies a pivotal position in western China.

2.1 Decrease in Demand and Increasingly Fierce Competition Among Teachers for Compulsory Education

With the school-age population of compulsory education declines, the teacher demand also decrease, therefore, oversupply causes increasingly fierce competition among teachers. Especially, as compared with eastern China and central China, economic development of western China lags fairly far behind and the overall level of teacher development is also low. How to reform the personnel system of teacher, standardize the position structure management, dismiss unqualified teachers and raise the entry standard for teacher are the main problems faced by the western teacher development. Besides, the class size of compulsory education in China is significantly higher than that in the developed countries, for example, the average class size of junior high schools is 55 of 2006 in China but that in OECD countries is 23.4; the average class size of primary schools is 37 of 2007 in China but that in OECD countries is only 21.4. So small-class teaching for compulsory education and more balanced education resources are the trend due to the decrease of school-age population. It means that challenge and opportunity coexist for teachers of compulsory education.

2.2 Shortage of Teachers for Senior High School and Backward Development of Teachers for Vocational Education

It has been the urgent affaires to develop the education of senior high school for the education sector after universal nine-year compulsory education. With the rapid development of senior high school as well as the decline of teaching in big classes, the teacher demand for senior

high school is increasing, especially for the teachers of vocational education. National Outline for Medium and Long-term Educational Reform and Development (2010-2020) indicates that the enrollment scale of secondary vocational schools shall be approximately equivalent to that of regular senior high schools in the near future. To realize this goal, the enrollment scale of vocational education has achieved a historic breakthrough in recent years. However, vocational education fell far behind regular senior high school in teacher development. Take Sichuan Province as an example, the growth rate of full-time teachers for regular senior high schools and secondary vocational from 2001 to 2008 is 91% and 45% respectively. So the shortage of teachers for senior high school and backward development of teachers for vocational education will be the main factor to influence the sustainable development of teachers in western China.

2.3 Serious Structural Contradiction

Teacher development is the coordination among the quantity, quality, structure, benefits and so on. Teacher development needs not only the growth in number, but also the improvement of quality, structure optimization and efficiency improvement. However, the fact is that the current development of regional structure and subject structure for teachers in the western regions is extremely uneven. Illustrated by the case of Sichuan Province in 2008, rural primary school accounted for 81% of the total primary schools while its full-time teachers only occupied 51% of the total number; Ethnic minority primary school accounted for 15% of the total primary schools while ethnic minority full-time teacher in primary school are less than 7%; The ratio of number of primary schools in rural areas, counties and cities is 20:4:1, however, that of number of full-time teachers is 4.3:3.05:1; Rural regular middle school accounted for 46% of the total middle schools while its full-time teachers only occupied 22% of the total number; The ratio of number of middle school in rural areas, counties and cities is 4.96:4.73:1, however, that of number of full-time teacher is 1.18:3.17:1; Ethnic minority middle school accounted 2.55% of the total middle schools while ethnic minority full-time teacher in middle school are less than 3%; Full-time teachers in primary schools and middle schools in Ganzi, Aba and Liangshan Ethnic Autonomous Prefecture are less than 9% in Sichuan Province. Besides, these subjects such as foreign language, music, sports, art and information technology are difficult to open for lack of corresponding teachers. From the perspective of the teachers demand, it is in urgent need to adjust the strategic layout of teacher development in the western regions for the government, in other words, we can't block the entrance of the talented people because of oversupply in compulsory education and can't purchased quantity at the expensive quality of teachers in senior high school too. Otherwise, the structure of teacher group will be imbalance and the quality of that will be decrease. Consequently, the most important thing for teacher development in western China is to balance the relationship between long-time and short-time and adjust the strategic layout of teacher education, so as to realize the sustainable development of teachers.

3. STRATEGIES OF THE TEACHER DEVELOPMENT IN WESTERN CHINA

3.1 Demand-oriented Training Orientation and Mixed-type Open Training Mode

Higher education as the source of national quality and science and technology is the core element to enhance regional competitiveness. To catch up with and surpass developed regions of China, western China is in urgent need to be provided intellectual support by higher education. Consequently, teacher colleges must adhere to demand-oriented training orientation. Not only to meet the demand for prominent teachers through improving teacher education curriculum system and innovation of the cultivable mode of the talent in normal universities, but also to guarantee teachers training in western rural areas and national areas due to consolidating achievements and improving quality of "Hou Pujiu" (the late period of popularizing nine-year compulsory education) in the western regions. Secondly, directed-type closed training mode to non-directed open training mode is the trend of teacher education mode in the world, but this trend is based on the premise that marketing economy developed rapidly and higher education has universal. Non-directed open training mode is more suitable for developed central-cites of China because this mode is favorable for widening undergraduates' knowledge, enhancing academic level and expanding employment opportunities. However, west region economy is backward and gross enrolment ratio of higher education is also low, exerting great effort to training teacher and keeping relative steadiness of teachers' team are still the long-term goal for teacher development in western China. So the teacher cultivation will mainly adopt mixed-type open training mode sponsored by normal universities and participated in by all comprehensive colleges and universities in western China for a long time.

3.2 The Effective Way of Teacher Education in Western China

Personnel system reform of teacher is a long-term dynamic process. The size of staff is oversupply in compulsory education but simply downsizing staff or limiting talent introduction is not feasible, likewise, simply increasing the number of teacher is not good for the development of senior high school education too. So personnel system reform of teachers must combine with the development of high-quality teacher resources. In other words, improving the quality of teacher training and carrying out

integration of teacher education is the foundation to solve the problems such as unbalanced development and low development level faced by teachers in western China and construction of the Teachers Development School (TDS) is the effective way. Enlightened from the theory and practice of the international teacher education reform, especially the Professional Development School (PDS) in United States, establishment of TDS is to fulfill the needs of the Chinese fundamental educational reform and teacher education reform and building college-elementary and secondary school education community.

3.3 The Basic Guarantee of the Quality of Teacher Training in Western China

With the specification in the development of teacher vocation, vocational accession becomes the basic standard and requirement and the establishment of teacher certification system becomes the important process of teacher professionalization. However, the facts appear to tell a different story in western China. Firstly, the course offering for pre-service teacher education can't satisfy teacher professional development. As long as normal school students pass the examination of pedagogy and psychology, they will take acquiring teacher certification for granted. Secondly, most students who are non-educational major acquire teacher certification through self-study examination, but the content, form and many other aspects of that are separated from educational practice of elementary and secondary schools. So they only need to grasp some examination skills through some training classes, then they can pass the self-study examination and easily acquire teacher certification. Lastly, with introducing competition mechanism and identifying teacher qualification by society, various teacher training institutions are pouring into the market. This leads to a large number of pre-service teachers who don't roundly accept teachers knowledge education, lack of teaching practice, know little about Chinese fundamental educational reform but have achieved the teacher certification. Of course, such pre-service teachers are overwhelmed by the duty to developing education in west China. Consequently, to standardize teacher training institutions and improve the teacher certification system are the basic guarantees of the quality of teacher training in western China.

3.4 Breaking Through the Teacher Development Bottleneck in Western China

The average schooling years of urban labor force is 9.38 years in the current period of China, however, that of rural labor force is 6.08 years. If the average schooling years of rural labor force increased to 12 years, that is to say if students in rural areas finished senior high school education, the benefit of education would increase 21.1%. In fact, there is a large number of rural population in western China. Therefore, it is necessary to continuously consolidate the achievements of popularizing nine-year compulsory education and strongly develop senior high school education and its teacher team in rural areas and minority areas, so as to break through the teacher development bottleneck in western China. The specific methods are as follows: the quality of teacher will be improved through optimization regrouping of schools and reasonable dispersion of substitute teachers in western countryside. On the other hand, perfecting the free normal students education is the most important measure due to the hematopoietic function of this measure, namely to cultivate new teachers satisfying the demand of teacher development in western China, especially for the countryside and minority areas. In addition, National Outline for Medium and Long-term Educational Reform and Development (2010-2020) indicates that we should regard strengthening vocational education as an important service in new rural construction and the satisfactory solution of the Three Rural Problems in China(Problems about Agriculture, Rural areas and Peasantry). So training double-qualified teachers and achieving all kinds of teachers' balance development will become a focal point of concern.

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