Construction of Incentive Model for Young Teachers' Professional Development Based on Artificial Neural Network

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Abstract: - Because the traditional incentive model for young teachers' professional development does not combine incentive measures with independent professional development, the incentive effect is poor. And the relationship between external support measures and teachers' independent professional development has not been well connected. In order to solve the problem of poor effect of the incentive model, an incentive model for young teachers' professional development based on artificial neural network was designed., constructs an evaluation system of incentive measures for young teachers' professional development, divides incentive measures into three primary indicators and nine secondary indicators, evaluates nine secondary indicators by using artificial neural network model, and obtains that the secondary indicators are all good. According to the incentive measures in the secondary indicators and the target management theory, the incentive model of young teachers' professional development is constructed. The results show that the scores of robustness, incentive selection, scope of use and homomorphism of the model are 95.6, 96.7, 94.2 and 93.8 respectively; after using the model, the professional development perspectives of young teachers, such as learning aid, professional training and teacher-apprenticeship, have been improved by 47.80%, 52.00% and 53.20% respectively.

Key-Words: -Artificial neural network; Young teachers; Professional development; Incentive model; Incentive measures; Evaluation system.

Received: September 2, 2022. Accepted: September 28, 2022. Published: October 21, 2022.

1 Introduction

Since the 1990s, the professional development of teachers has become one of the important research topics in foreign academic circles [1]. Since the beginning of this century, domestic scholars have begun to carry out fruitful research on this topic. Scholars in China and abroad have reached a consensus on the important role of professional development of teachers in educational reform, and have recognized teaching. Teacher professional development is at the center of all educational reform strategies. It is the key to the success of school development and educational reform. It is also the center of all school improvement programs [2]. Young teachers are the new force of school-based management. The improvement of their professional quality directly determines the future development level of the school and the quality of students' training. As Lu put forward, young teachers are the starting point of teachers' professional development and have infinite potential. However, few scholars have explained and analyzed the role and motivation mechanism of teacher professional development, although Song has proposed that teachers' professional development should be emphasized. Zhu pointed out the significance of the research on the differences of teachers' professional development motivation, but there is still a lack of in-depth and systematic research in this area.

At present, there are abundant research results on teachers' professional development. Summarizing the existing research in China and abroad, it can be roughly divided into the following aspects according to the characteristics of the research contents:

Throughout the current research results, the academic community has noticed that the intrinsic motivation of teachers' independent development plays a key role in teachers' professional development, and put forward improvement strategies and management methods in combination with their respective professional knowledge. Ma's master dissertation on primary and secondary school teachers found that school system incentives and teachers' professional development initiative were significantly positively correlated. But generally speaking, external support measures and teachers' independent professional development were studied and discussed separately, and the two were not well connected.

Reference [3] proposed that there are two types of users in BSS: leisure travelers and commuters. Operators and the government are adopting a two-way incentive model (BIM) to improve their redistribution service level. In other words, BIM stimulates leisure travelers to actively respond to the

bicycle reset demand of the system; On the other hand, it guides commuters by encouraging them to avoid traveling during peak hours. This is conducive to reducing the scheduling pressure of bicycles during peak hours, and even achieving BSS self reset. Reference [4] proposed a feature extraction method based on empirical mode decomposition (EMD) energy entropy. The mathematical analysis for selecting the most important intrinsic mode function (IMF) is given. Therefore, the selected features are used to train the artificial neural network (ANN) to classify the bearing defects. The experimental results show that the method based on operation fault vibration signal can reliably classify bearing defects. Using the recommended Health Index (HI), REB degradation of different defect types and severity can be perfectly detected. The purpose of this study is to illustrate how school external management measures can motivate teachers' independent professional development, and to construct an incentive model for young teachers' professional development. According to the characteristics of the hierarchy, complexity and diversity of the incentive measure evaluation system, the weight is determined by the analytic hierarchy process. Establish BP neural network evaluation model, determine the network structure, training samples and network training, andconstruct the incentive mechanism model of young teachers' professional development according to the theory of management by objectives.

2 Methods

2.1 Construction of Evaluation System of Incentive Measures for Young Teachers' Professional Development

The evaluation of incentive measures for teacher professional development has different contents and purposes in different stages of teacher professional development. The commonly used evaluation models are CSE model, CIPP model, Taylor model, CIRO model, Kirkpatrick's four-tier model, Kaufman's five-tier model, Philips'five-tier ROI framework, wile Performance models and so on. The effectiveness of evaluation depends on a good evaluation model. This study adopts Wile performance model to evaluate.

While Performance Model is a performance factor analysis model proposed by American performance technology expert Wile in 1996. It combines professional development incentive measures with the process of incentive performance evaluation. It forms an evaluation system of teachers' professional development incentive measures. The composition of the system is mainly from the outside of the incentive performance. The analysis of the ministerial factors, mainly including incentive measures, incentive measures management, and incentive measures to support the three aspects.

The weight of incentive measures in the evaluation system has an important impact on the effectiveness of the evaluation [5, 6]. The commonly used weight determination methods are AHP, Delphi, compulsory scoring, ring comparison method, etc. AHP is the most widely used one. According to the characteristics of hierarchy, complexity and diversity of incentive measures evaluation system, this study uses AHP to determine the weight. The evaluation system of incentive measures is shown in Table 1. It can be seen from Table 1 that the weight of learning support in the first level indicators is large, and the weight of learning support is 0.14; In the secondary indicators, the weight of on-the-job research and teaching competition is relatively large, and the weight of on-the-job research and teaching competition is 0.22.

Table 1. Table Type Styles

First level index	Weight	Two level index	Weight
Learning support	0.14	In-service Study	0.22
		Visiting school in famous Schools	0.19
		academic activities	0.18
Professional training	0.11	Scientific research funding	0.21
		Paper reward	0.19
		Teaching competition	0.22
Teacher and apprenticeship	0.13	Teaching guidance	0.18
		Scientific research and help	0.19
		Management training	0.21

2.2 Establishment of BP Neural Network Evaluation Model

Neural network is a nonlinear adaptive dynamic system composed of a large number of processing units, which imitates the information processing mechanism of the brain at different levels. It has the functions of learning, memory, computing and intelligent processing, generalization ability and

strong fault tolerance. It can be used in signal processing, pattern recognition, combination optimization, knowledge engineering, process control and other data processing occasions [7]. Compared with the traditional data processing methods, it is more suitable for dealing with fuzzy, nonlinear and ambiguous mode characteristics.

2.2.1 BP Network Overview

BP network model is the core part of the forward neural network, which consists of three parts, including input layer, hidden layer (middle layer) and output layer. The input layer and output layer are usually only one layer, and the hidden layer may have one or more layers. Each node in the network represents a neuron, each layer of neurons distributed in parallel with no connection. There is only a connection between layer and layer neurons (nodes), and there is no connection between neurons in the layer. The evaluation model based on BP neural network not only has simple network structure and good objectivity, but also is convenient for computer programming.

2.2.2 Determination of Network Structure

The following steps are taken to establish the neural network model for evaluation of incentive measures for young teachers' professional development.

2.2.2.1 The Determination of the Input Layer Nodes

According to the specific requirements of the evaluation process for young teachers' professional development, a three-layer BP neural network is constructed. The evaluation indexes can be divided into three primary indicators and nine secondary indicators.9 of the secondary evaluation indexes are used as input nodes of neural network.

2.2.2.2 Determination of Output Layer Nodes

The ultimate goal of the comprehensive evaluation of incentive measures for young teachers' professional development is to get an objective and accurate quantitative value reflecting the incentive effect, namely the evaluation value [8]. Therefore, the quantitative value of the incentive effect of young teachers' professional development is taken as the output vector of BP neural network model, that is, the number of output layer nodes is determined as one, and the value range is [0,1].

2.2.3 Determination of Training Samples and Network Training

2.2.3.1 The Determination of Input Variables

The training sample data are obtained through the questionnaire, so this study is the evaluation of the survey results. Each teacher was asked to score 9 indicators with a total score of 0-100. The young teachers made a qualitative evaluation of the effect of professional development incentives in their own universities. The evaluation grade was set to five levels. Grade: excellent, good, medium, qualified and unqualified [9]. By analytic hierarchy process (AHP), the weight of each of the nine indicators is calculated, and the incentive score of each measure is calculated as the expected output value T of the model.

By comparison, the scores of teachers' incentive measures are consistent with the grade of teachers' qualitative evaluation.

Weight calculation steps:

1) The judgment matrix A is established. Through the experts' evaluation of the evaluation indicators, the two pairs are compared. Its initial weight forms the judgment matrix A. The element xij in the i-th and jth rows of the judgment matrix A represents the scale coefficient obtained after the comparison between the index xi and xj.

2) Calculate the geometric mean of each scale data in each row of the judgment matrix A, and record it as wi.

3) Carry out normalization. Normalization is to use $w_i' = w_i / \sum w_i$ formula calculation to determine the weight coefficient of each index according to the calculation results.

2.2.3.2 Network Training

Forty samples were taken as training data and normalized by Formula (1). Among them, x and x' were the values before and after sample data conversion, Max and Min were the maximum and minimum values of sample data respectively.

$$x' = (x - Min)/(Max - Min) \quad (1)$$

According to the above model, the maximum training frequency is 1000 and the error precision is 0.001. After training, the error curve of the network establishment process can be obtained. From this error curve, it can be seen that the network has reached the accuracy requirement after 98 steps of iteration.

2.3 Incentive Model for Young Teachers' Professional Development

According to the theory of goal management [10], this study constructs the incentive mechanism model of young teachers' professional development. Teachers' professional development goals are usually manifested in two aspects: professional titles and posts. Professional titles are divided into three levels: primary, intermediate and advanced [11-13]. After the implementation of the post-setting system, the employment of professional and technical posts is divided into 13 levels, with advanced level of 1-4, a deputy advanced level of 5-7, an intermediate level of 8-10, and a primary level of 11-13. Each level set the appropriate conditions of employment, and young teachers determine their own development goals according to their own development stages [14-17]. Because each level has a clear requirement on teachers' research achievements, number of papers and teaching achievements, young teachers should adopt appropriate organizational citizenship behaviors according to their own goals, and constantly improve their knowledge level through in-service education, visits to famous schools in China and abroad, and participation in frontier academic activities. Teachers' scientific research projects and hosting youth-funded scientific research projects can improve their scientific research ability, gradually improve their scientific research ability in the process of writing research reports and publishing scientific research papers under the support of the projects, and improve their teaching skills. In the process of mutual attendance and participation in teaching observation and competition, they improve their teaching skills and form a unique teaching style [18-20]. Young teachers' leadership ability is often neglected by researchers to improve their organizational coordination and leadership ability. In fact, the training of young teachers' leadership ability is indispensable for them to form a leading academic team and lead the development of disciplines, even if they do not take part-time management positions in the future.

3 Results

In this experiment, the incentive model of young teachers' professional development based on artificial neural network is used to evaluate the incentive measures of young teachers' professional development in 25 Chinese universities. In the experiment, MATLAB neural network toolbox was used for simulation. The original data of the experiment came from the Yearbook of Education Statistics in China. The sample selection considers generality and penalization, and tries to fully reflect the level of incentive measures for professional development of young teachers in different types of universities, while taking into account the differences between regions, as far as possible in different provinces and cities, reflecting the universality of the region.

In order to verify the effectiveness of the young teachers' professional development incentive model based on artificial neural network, this paper uses the young teachers' professional development model based on the analytic hierarchy process and the young teachers' professional development model based on the weighted sum as a comparison. The three models are compared under the same experimental environment. This paper analyzes the changes of young teachers' professional development before and after accepting the incentive measures designed in this paper from three angles of the apprenticeship. The results are shown in Table 2.

Table 2.Effects of different models on young teachers' professional development

		Young teachers' professional development index before young teachers' professional development incentives	Young teachers' professional development index after using young teachers' professional development incentives	Effect
Model of this paper	***Learning aid Perspective***	27.90%	75.70%	Promote 47.80%
	Professional training scheduling	31.60%	83.60%	Promote 52.00%
	Apprenticeship with angle	24.70%	77.90%	Promote 53.20%
Incentive model for young teachers' professional development based on Analytic Hierarchy Process	***Learning aid Perspective***	27.90%	55.40%	Promote 27.50%
	Professional training scheduling	31.60%	64.20%	Promote 32.60%
	Apprenticeship with angle	24.70%	58.80%	Promote 34.10%
Incentive model for young teachers' professional development based on weighted summation method	***Learning aid Perspective***	27.90%	62.10%	Promote 34.20%
	Professional training scheduling	31.60%	66.90%	Promote 35.30%
	Apprenticeship with angle	24.70%	54.8%	Promote 30.10%

Through the analysis of Table 2, it can be concluded that the incentive effect of young teachers' professional development has been improved by 47.80%, 52.00% and 53.20% respectively, and the incentive effect of young teachers' professional development has been improved by using this model. The angles of study aid, professional training and attempt to impart increased by 27.50%, 32.60% and 34.10% respectively; after using the incentive model of young teachers' professional development based on weighted summation, the incentive effect of young teachers' professional development was improved by 34.20%, 35.30% and 30.10%, respectively. By comprehensive analysis of these experimental data, we can see that the effect of professional development of young teachers has been greatly improved after using the proposed model. This is because the young teachers' professional development incentive model based on the artificial neural network has constructed an evaluation system for young teachers' professional development incentive measures. The incentive measures are divided into three first level indicators and nine second level indicators. The nine second level indicators are evaluated using the artificial neural network model, and the second level indicators are all good. According to the incentive measures and the theory of management by objectives in the secondary indicators, an incentive model for young teachers' professional development is constructed.

4 Disscusions

Both the educational administration department and the universities themselves have realized the importance of the professional development of young teachers, and have taken various measures to urge and encourage the professional development of young teachers. According to the training breadth of these measures in the professional development of young teachers, we classify these external measures into three categories in turn: study aid, professional training and teacher-apprenticeship.

1) Learning aid. From the perspective of teachers'initiative in professional development, learning aid mainly refers to the encouraging policies adopted to implement the idea of lifelong learning, encourage young teachers to broaden their horizons and continue learning. There are three common forms of in-service education, visiting schools in China and abroad, and attending academic conferences of the same profession. Universities generally encourage young teachers to study for master's and doctoral degrees in-service by reimbursing all or part of their tuition fees.

2) Professional training. In order to promote the ability of young teachers in scientific research, thesis writing and teaching, educational administration departments and universities have set up different levels of training policies to encourage young teachers to grow up through selection competition. The optimum incentives for scientific research are as follows: setting up a national fund for young doctoral teachers, provincial-level projects for young teachers'cultivation and school principals' funds, etc. to subsidize young teachers to

conduct scientific research and training through special scientific research projects.

3) Apprenticeship. The practice of traditional teacher-apprenticeship model has proved to be an effective way for young teachers to become an excellent and mature teaching and scientific researcher. Through the old academic band, the young teachers will grow up in an all-round way. In order to help young teachers get into the role of teachers as soon as possible, some universities have selected instructors for young teachers, asking young teachers and instructors to listen to each other, and directing young teachers to improve their teaching skills.

4) Combined with our own teaching work, we will try to reform information technology and various disciplines to adapt to the development of new teaching concepts. Actively participate in on-the-job learning and training. Actively participate in in-service learning and training; Diligent in thinking, improve the ability of education and teaching research; Conduct professional cooperation with other teachers, effectively develop the ability of cooperation and communication, and master modern information technology.

5 Conclusions

Teachers' professional development is the key to the success of school reform. The level of teachers' professional development directly determines the level of school development. As a young teacher in the school, the development level represents the future development of the school. This study designs an incentive model for young teachers' professional development based on artificial neural network. Firstly, the incentive measures for young teachers' professional development are divided into three primary indicators and nine secondary indicators, and the evaluation index system of incentive measures for young teachers' professional development is constructed. Then the artificial neural network model is used to evaluate the secondary indicators, and the secondary indicators are all above good. Finally, according to the incentive measures in the secondary indicators and the target management theory, the incentive model of young teachers' professional development is constructed. From the experimental results, the robustness, incentives, range of use and homomorphism scores of the model are 95.6, 96.7, 94.2 and 93.8 respectively, which shows that the model has better robustness, range of use and homomorphism. After using this model, the angles of learning aid, professional training and teacher-apprentice transmission of young teachers have increased by 47.80%, 52.00% and 53.20%, respectively. This shows that the professional development level of young teachers has gradually improved after using this model. In the future development, it is necessary to improve the classroom teaching art of young teachers, strengthen the teaching reflection ability, and make the original concept more perfect and scientific.

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