Application of an Artificial Neural Network to Evaluate the Integration Effect of Quality Education and Skill Education

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Abstract—Quality education is the basis, driver, and inspirer of skill education. These two education models can complement and interact with each other. However, few scholars have discussed the current state and future trend of the integration between the two models, not to mention quantifying the integration effect. This paper applied the artificial neural network (ANN) to evaluate the integration effect of quality education and skill education, owing to the advantages of the ANN in processing nonlinear information adaptively. First, the subjects and motivation mechanisms of the integration between the two models were analyzed. Then, an evaluation index system was established for the integration effect. After that, an ANN model was created for the compatibility of evaluation indexes and used to predict the integration effect. Experimental results verified the reasonability of the proposed evaluation index system, and the effectiveness of the proposed model. Finally, the current state of the integration was analyzed based on the prediction results.

Keywords—Artificial neural network (ANN), quality education, skill education, evaluation of integration effect

1 Introduction

The purpose of quality education is to promote the comprehensive development of students in their virtue, intelligence, physical conditions, aesthetic perception, and laboring skills; it emphasizes on giving guidance to students in knowledge internalization, innovative spirit inspiration, and ideological and moral quality cultivation.

The purpose of skill education is to cultivate students to quickly acquire, master, and apply the vocational skills, experiences, and techniques they learnt to their work positions; skill education is highly professional and job-oriented [1-4].

Quality education focuses on accumulation and subtle influence, it's quite difficult to evaluate its effect; while skill education emphasizes more on implementation and practical operation, and its effect can be evaluated via the vocational skill tests [5-8]. Quality education is the basis, driver, and inspirer of skill education [9-11]; these two education models can complement and interact with each other, and they have a very close relationship [12].

In China, Beijing Institute of Graphic Communication is a college aiming at building a high-level and distinctive college engaged in the fields of publication and media; Luo Xueke, the president of Beijing Institute of Graphic Communication, had once said that higher education should be responsible for the lifelong career development of students [13]. Quality education ensures the sustainable development of students' careers, while skill education provides a basic guarantee for students to survive in society. The two complement each other and are closely related [11-14].

To investigate such correlations, scholars have carried out studies from the aspects of the compatibility of quality education and skill education integration, talent training mode, and integration mechanism, etc. [15-19]. For example, Wang [20] analyzed the social constraints, deficient conditions, incomplete management systems of quality education and skill education integration, and proposed two countermeasures for the said problems from the perspectives of school management, curriculum settings, campus activities, and cultural environment. Gavrilina et al. [21] constructed a joint training approach for quality training and skill training, which enriched the forms of ideological and political education and professional education, and promoted to cultivate professional ethics and occupational emotions through practice and training. Based on the definitions of the concepts of quality education and skill education, Aniskina and Lunina [22] summarized the problems existing in current higher vocational education such as ignoring the personality development of students, neglecting the cultivation of life-long learning awareness, and emphasizing professional education over humanistic education, etc., and they gave corresponding suggestions for the combination of the two. Aktepe [23] summarized the current situations of humanistic quality education in secondary vocational schools, and gave suggestions on the integration of humanistic quality education and skill training from the aspects of teaching, faculty level, evaluation system, and campus culture. Mulder-Nijkamp and Eggink [24] conducted an in-depth discussion on the talent training model based on the combination of quality cultivation and skill training; taking Chinese education as the starting point, their study proposed several operable and innovative talent cultivation strategies such as building cultural and educational communication platforms, emphasizing practical experience and academic training, carrying out training programs and theme activities, and organizing interest groups, etc.

Most existing researches on the integration of quality education and skill education are theoretical studies concerning problem thinking, countermeasure formulation, and integration mechanism analysis, and only a few of them employed quantitative methods to investigate the current status and development trends. As a technology built on brain processing mechanism, ANN is good at solving complex classification and prediction problems. Therefore, making use of ANN's advantages in non-linear and adaptive information processing, this paper applied ANN to the evaluation of the integration effect of quality education and skill education. The main content of this paper is arranged as follows: the second part analyzes the types of the subjects of quality education and skill education integration, and the integration motivation mechanisms; the third part builds an integration effect evaluation index system; the fourth part builds an ANN model for the compatibility of evaluation indexes, and achieves prediction of the integration effect of quality education and skill education; the fifth part uses experimental results to verify

the reasonability of the proposed evaluation index system, and the effectiveness of the proposed ANN model, and it gives an analysis on current state of the integration effect based on the prediction results.

2 Subjects of Quality Education and Skill Education Integration and the Motivation Mechanisms

Most domestic scholars' researches on the integration of quality education and skill education focus on the integration theory, mode, mechanism, path, and degree of the integration of related units or departments, their studies are mostly discussions on the integration effect from multiple aspects. While foreign scholars pay more attention to the teaching motivation of quality education and skill education integration, the students' perception, and the empowerment of government departments; their studies are mostly discussions on the various subjects of students, teachers, administrators, and society, etc. The roles of these subjects are clear: society promotes the talent demands; administrators conduct top-level planning and give guidance and support; teachers formulate and implement the strategies; and students participate in the classroom teaching and practice and give effect feedback.

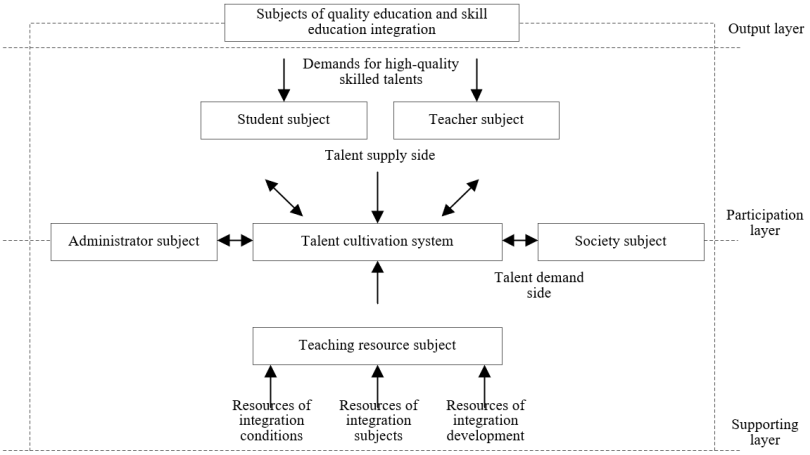

Fig. 1. Relationships of subjects of integration effect of quality education and skill education

Based on the above analysis, this paper defined five types of subjects of quality education and skill education integration, namely the teaching resource subject, the student subject, the teacher subject, the administrator subject, and the society subject. Figure 1 gives the relationships of the subjects, and clarifies the supporting role of each subject.

The development of quality education and skill education integration is not a simple teaching practice process. For higher vocational education, although the industry-school-research integration is an inevitable development path, its teaching philosophy

and talent cultivation ideas are driven by the social industry development and talent market demand. The attention from multiple parties, such as government, society and industries on the integration of quality education and skill education reflects that, they do have an appeal for such integration. By integrating quality education and skill education, college graduates' comprehensive qualities and skill level could be improved, and then, the high-quality skilled talents' influence could be enhanced as well. In this way, we could break the limits of the traditional vocational training mode and provide a new path for the improvement of the vocational and humanistic qualities of talents under the background of innovation and entrepreneurship.

According to above analysis, on the one hand, embedding the resources of quality education into skill education can achieve the transformation and upgrade of the teaching connotation, it can be regarded as a way to achieve the integration of quality education and skill education, and it is the short-term goal. On the other hand, enterprises can enhance their own hard power with the help of the high-quality skilled talents and the back-feeding effect of corporate development, also, it can be regarded as the ultimate appeal of the integration of quality education and skill education, and it is the long-term goal. Figure 2 gives a diagram of the motivation mechanisms of quality education and skill education integration based on the embedded integration theory.

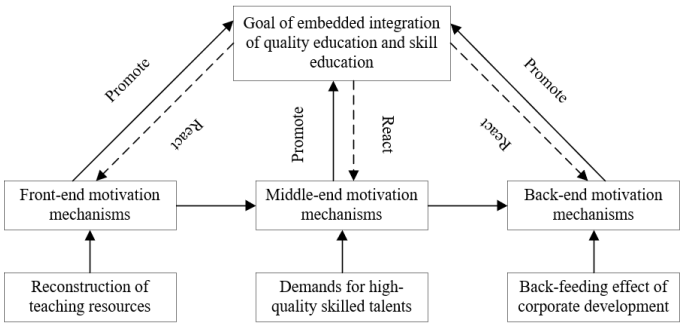

Fig. 2. Motivation mechanisms of quality education and skill education integration based on the embedded integration theory

3 Evaluation Index System for the Integration Effect of Quality Education and Skill Education

To better reflect the relationship between the influencing factors and the evaluation indexes, a three-stage model containing three influencing factors and nine indexes was adopted in the paper, and an evaluation model structure with a base layer, a core layer, and a development layer was constructed.

In the evaluation index system, the base layer consists of teaching resources that can promote the integration of quality education and skill education, wherein the basic teaching facilities have a great impact on the integration of the two; the comprehensive competence of the school, the geographic location, the school category, and the employment of graduates have a direct impact on the talent cultivation and the student

source. At the same time, as the material background of the development layer, these conditions play a hidden and stimulative role in promoting the talent cultivation of higher education schools.

The core layer consists of the resources of integration subjects. This layer connects the resources of base layer with the potential resources of the development layer. School-enterprise cooperation, and the planning and support of government departments must interact with each subject to achieve good integration effects. Wherein, the status of the integration of vocational education with industry (which represents the scale of skill education) and the status of the humanistic environment (which represents the effect of quality education) are the two manifestations of the resources of integration subjects.

The development layer consists of the potential resources of integration development. In theory, the resources in this paper are the most influencing resources for the coordinated development of the resources of quality education and skill education, and they are the reserve resources for the integration of quality education and skill education.

Based on the framework shown in Figure 4, this paper selected a few easily available, easily quantifiable, highly relevant, and significantly complementary evaluation indexes, and the indexes were selected according to the adaptable, systematic, and operable principles. Table 1 lists the evaluation indexes of the integration effect of quality education and skill education from the perspective of integration conditions.

Table 2 gives the evaluation indexes of the integration effect of quality education and skill education from the perspective of integration subjects.

Table 3 gives the evaluation indexes of the integration effect of quality education and skill education from the perspective of integration development.

Table 1. Evaluation indexes of integration effect from the perspective of integration conditions

Influencing factor	Criteria	Index code	Index details	Determined by
Integration conditions A1	Basic facilities B1	C1	Number of teaching venues	Expert revision
		C2	Number of labs	Expert revision
		C3	Number of school-level teaching and research centers	Expert consultation
		C4	Number of off-campus training bases	Expert consultation
		C5	Number of engineering and technological research centers at all levels	Expert consultation
	School attributes B2	C6	Rank of comprehensive competence	Expert consultation
		C7	Geographical location	Expert consultation
		C8	School category	Expert revision
		C9	Employment of graduates	Expert revision
		C10	Overall faculty level	Expert revision
		C11	Level of scientific research and social service	Expert consultation
		C12	Level of humanities disciplines	Expert revision
		C13	Number of apprenticeship cooperation programs	Expert revision

Table 2. Evaluation indexes of integration effect from the perspective of integration subjects

Influencing factor	Criteria	Index code	Index details	Determined by
Integration subjects A2	Student subject B3	C14	Class hours of vocational education	Expert consultation
		C15	Class hours of cultural lessons	Expert consultation
		C16	Class hours of innovation and entrepreneurial education	Expert consultation
		C17	Class hours of labor education	Expert consultation
		C18	Class hours of physical education	Expert consultation
		C19	Class hours of practice education	Expert consultation
		C20	Internship hours	Expert revision
	Teacher subject B4	C21	Number of trainings in enterprises and cultural and quality trainings	Expert consultation
		C22	Number of teachers having job titles in enterprises	Expert consultation
		C23	Number of teachers engaging in cultural and quality education	Expert consultation
		C24	Number of "double-position" teachers	Expert consultation
		C25	Number of assistant teachers engaging in quality developing activities	Expert consultation
	Administrator subject B5	C26	Number of supportive policies	Expert consultation
		C27	Number of instructive competitions	Expert consultation
		C28	Number of trainings of quality education held at all levels	Expert consultation
		C29	Number of trainings of skill education held at all levels	Expert consultation
		C30	Number of lectures of vocational education held	Expert consultation
	Society subject B6	C31	Demand for high-quality skilled talents	Expert consultation

Table 3. Evaluation indexes of integration effect from the perspective of integration development

Influencing factor	Criteria	Index code	Index details	Determined by
Integration development A3	Responds and improvement B6	C32	Student satisfaction	Expert consultation
		C33	Teacher satisfaction	Expert consultation
		C34	Enterprise satisfaction	Expert supplement
	Learning evaluation B7	C35	Evaluation of students' vocational qualities	Expert consultation
		C36	Evaluation of students' vocational skills	Expert consultation
		C37	Behavioral evaluation of graduates in work positions	Expert consultation
		C38	Performance of graduates and the enterprises they work for	Expert consultation
	Innovation resource B9	C39	Number of patents granted to students	Expert consultation
		C40	Number of student papers published by journals	Expert consultation
		C41	Number of awards in discipline competitions received by students	Expert consultation
		C42	Number of awards in humanistic knowledge competitions received by students	Expert supplement
		C43	Number of awards in skill competitions received by students	Expert supplement

4 Prediction of Integration Effect Using ANN

Based on the evaluation index system proposed above, this paper built an ANN to predict the integration effect and explore the correlations among the index data of the integration effect. Figure 3 gives the structure of the ANN.

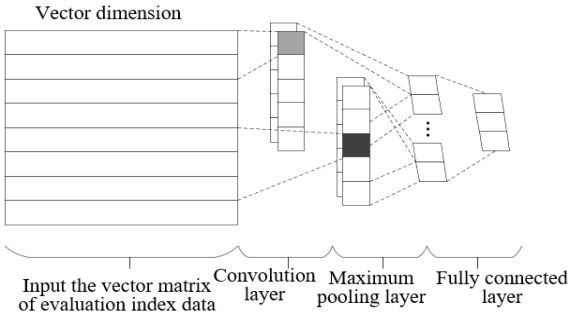

Fig. 3. Structure of ANN

First, the compatibility between individual evaluation indexes was modeled. Since individual evaluation indexes are quite different in terms of level, quantification unit, and quantification form, it was assumed that there's a potential compatibility space that can make up for these quantification differences, and the highly compatible evaluation indexes had certain similarities in the compatibility space. Figure 4 gives the structures of the autoencoders of an unsupervised deep neural network.

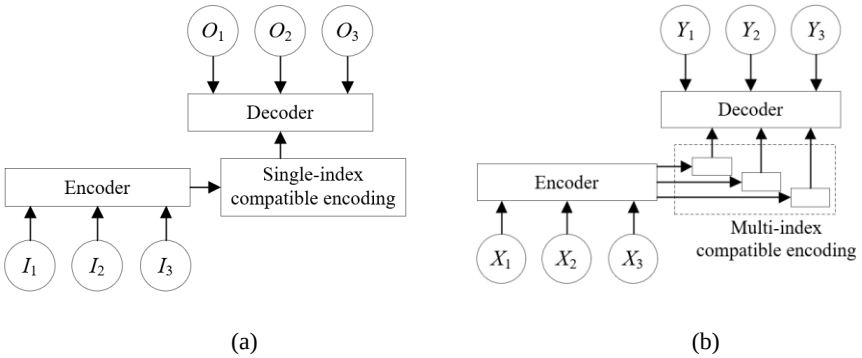

Fig. 4. Structures of autoencoders in case of single-index and multi-index compatible encoding

According to the figure, the autoencoder was composed of two parts: the encoder that maps the input evaluation index data to the implicit representation space, and the decoder that maps the evaluation index data from the implicit representation space to

the reconstructed representation space; and both parts were described by multiple non-linear functions. Assuming the encoder has N layers, for a given set of input evaluation index data I, the corresponding output I' of the i-th layer of the encoder can be calculated using Formula 1 below:

$$I' = g_i = Sigmoid\left(\omega_i g_{i\text{-}1} + \varepsilon_g\right), g = 2, \cdots, N \tag{1}$$

where, ω_i is the connection weight, and ε_i is the bias term. The Sigmoid function was selected as the activation function, which can be described by Formula 2:

$$Sigmoid\left(x\right) = \frac{1}{1+e^{-x}} \tag{2}$$

Suppose the reconstruction of I is I^*, then the decoder performed inverse calculation of I^* from I'; I^*_t and $I^*_{t+\Delta t}$ respectively represent the reconstruction of evaluation index data at time t and $t+\Delta t$, then the reconstruction error $e(x)$ of evaluation index data at time t and $t+\Delta t$ is defined as:

$$e\left(I\right) = e\left(I_t\right) + e\left(I_{t+\Delta t}\right) = \frac{1}{2}\left\|I_t^* - I_t\right\|_2 + \frac{1}{2}\left\|I_{t+\Delta t}^* - I_{t+\Delta t}\right\|_2 \tag{3}$$

In addition, to explore the integration effect of quality education and skill education, it is necessary to fully measure the compatibility between individual evaluation indexes in different time periods. The evaluation index data at time t and $t+\Delta t$ were respectively input into the four autoencoder deep neural networks B_t, B^*_t, $B_{t+\Delta t}$ and $B^*_{t+\Delta t}$ to obtain the implicit representations of the k-th and l-th indexes $I^{(k)}$ and $I^{(l)}$ in I as $I'^{(k)}_t$, $I'^{(k)}_{t+\Delta t}$, $I'^{(l)}_t$ and $I'^{(l)}_{t+\Delta t}$; after reconstruction, they became $I^{*(k)}_t$, $I^{*(k)}_{t+\Delta t}$, $I^{*(l)}_t$ and $I^{*(l)}_{t+\Delta t}$. Therefore, the compatibility CO_{kl} between $I^{(k)}$ and $I^{(l)}$ can be defined as:

$$CO_{kl} = \left(1\text{-}\rho\right)\left(I_t'^{(k)}\right)^T I_{t+\Delta t}'^{(l)} + \rho\left(I_t'^{(l)}\right)^T I_{t+\Delta t}'^{(k)} \tag{4}$$

where, ρ is a non-negative trade-off parameter used to measure the importance of a single evaluation index in different time periods. When the evaluation indexes fluctuate in different time periods, it means that the integration of quality education and skill education has a certain positive or negative effect. Then, define that CR_k is the consistency relationship between $I'^{(k)}_t$ and $I'^{(k)}_{t+\Delta t}$ of the k-th index:

$$CR_k\left(I_k\right) = -\ln\left[\tau\left(\left(I_t'^{(k)}\right)^T I_{t+\Delta t}'^{(k)}\right)\right] \tag{5}$$

Assume N is number of relevance combinations formed by paired evaluation indexes at time t and $t+\Delta t$. For each piece of evaluation index data $I^{(k)}_t$ at time t, there is a positive evaluation index data set $I^{(l)+}_{t+\Delta t}$ at time $t+\Delta t$. As for the evaluation indexes that are paired, it may be because these evaluation indexes have no numerical fluctuations in different time periods, and when it is reflected on the integration effects, it is not that obvious. Therefore, to explore the compatibility between the evaluation indexes at time

t and other time moments, it is assumed that the compatibility of indexes in $I_{t+\Delta t}^{(l)+}$ is higher than the compatibility between other unobserved evaluation indexes and $I_t^{(k)}$; the Bayesian Personalized Ranking (BPR) model can be used to construct the training set shown as Formula 6:

$$T_{t+\Delta t} := \left\{ \left(k, l_+, l_-\right) \middle| I_{t+\Delta t}^{(k)+}, I_{t+\Delta t}^{(l)+} \wedge I_{t+\Delta t}^{(l)-} \right\} \tag{6}$$

where, the (k,l_+,l_-) triplet in the formula means that the evaluation index $I_{t+\Delta t}^{(l)+}$ is more compatible with $I_t^{(k)}$ than the evaluation index $I_{t+\Delta t}^{(l)-}$. The model can be defined by Formula 7:

$$M_{BPR} = \sum_{(k,l_+,l_-)\in T_{t+\Delta t}} -\ln\left(\upsilon\left(CO_{kl_+} - CO_{kl_-}\right)\right) \tag{7}$$

According to Formula 5, the consistency relationship between $I_t^{(k)}$, positive index $I_{t+\Delta t}^{(l)+}$ and negative index $I_{t+\Delta t}^{(l)-}$ can be obtained as:

$$CR_{BPR} = \sum_{(k,l_+,l_-)\in T_{t+\Delta t}} \left(CR_j\left(I_t^{(k)}\right) + CR_l\left(I_{t+\Delta t}^{(l)+}\right) + CR_l\left(I_{t+\Delta t}^{(l)-}\right)\right) \tag{8}$$

According to Formula 3, the reconstruction error of $I_t^{(k)}$, positive index $I_{t+\Delta t}^{(l)+}$ and negative index $I_{t+\Delta t}^{(l)-}$ after being subject to the autoencoder deep neural networks can be defined as:

$$E_{BPR} = \sum_{(k,l_+,l_-)\in T_{t+\Delta t}} \left(e\left(I_t^{(k)}\right) + e\left(I_{t+\Delta t}^{(l)+}\right) + e\left(I_{t+\Delta t}^{(l)-}\right)\right) \tag{9}$$

Finally, by minimizing the loss function shown as Formula 10, the training of BPR model was performed:

$$Loss = M_{BPR} + \alpha CR_{BPR} + \beta E_{BPR} + \frac{\phi}{2}\left\|\Gamma\right\|_2 \tag{10}$$

where, Γ represents the parameters of the connection weight ω_i and the bias term ε_i in the model. The hyperparameters α, β, and φ are used to control the compatibility preferences of CR_{BRP}, ER_{BR} and the L_2 norm regularization term which is used to prevent overfitting.

For the multi-index compatibility modeling scheme, this paper aimed to measure the influence of multiple complementary evaluation indexes in different time periods on the integration effect of quality education and skill education. First, $I'^{(k)}_t$={$I'^{(k)}_{t+1}$, $I'^{(k)}_{t+2}$, …, $I'^{(k)}_{t+T}$} and $I'^{(l)}_t$={$I'^{(l)}_{t+1}$, $I'^{(l)}_{t+2}$, …, $I'^{(l)}_{t+T}$} respectively represent all the implicit representations of the k-th and l-th index in time period [0,T], then, the compatibility *CO* between $I_{t+\Delta t}^{(l)}$, $I_{t+\Delta t'}^{(l)}$ and $I_{t+\Delta t'}^{(k)}$ is:

$$CO'_{kl} = CO_{kl\text{-}\Delta t} + CO_{kl\text{-}\Delta t'} \tag{11}$$

where, $CO_{kl+\Delta t}$ and $CO_{kl+\Delta t'}$ can be calculated by Formula 4. Assume that $I_{t+\Delta t}^{(l)}$ and $I_{t+\Delta t'}^{(l)}$ have the same contribution to the compatibility with $I_{t+\Delta t'}^{(k)}$, and the indexes in the positive sample sets $I_{t+\Delta t}^{(l)+}$ and $I_{t+\Delta t'}^{(l)+}$ are more compatible with the given $I_{t+\Delta t'}^{(k)}$ than other unobserved evaluation indexes. The compatibility preference of $I_{t+\Delta t}^{(l)}$ and $I_{t+\Delta t'}^{(l)}$ to $I_{t+\Delta t'}^{(k)}$ can be expressed by defining M'_{BRP}:

$$M'_{BPR} = \sum_{\left(k,l_+^{\Delta t},l_-^{\Delta t},l_+^{\Delta t'},l_-^{\Delta t'}\right)\in T'_{t+\Delta t}} -\ln\left(\upsilon\left(CO'_{jl_+} - CO'_{jl_-}\right)\right) \tag{12}$$

The model training set is:

$$T'_{t+\Delta t} := \left\{\left(k,l_+^{\Delta t},l_-^{\Delta t},l_+^{\Delta t'},l_-^{\Delta t'}\right)\middle| I_{t+\Delta t}^{(k)+}, I_{t+\Delta t}^{(l)+} \wedge I_{t+\Delta t}^{(l)-}, I_{t+\Delta t'}^{(l)+} \wedge I_{t+\Delta t'}^{(l)-}\right\} \tag{13}$$

where, the five-tuple $(k,l_+^{\Delta t},l_-^{\Delta t},l_+^{\Delta t'},l_-^{\Delta t'})$ represents that, compared with $I_{t+\Delta t}^{(l)-}$ and $I_{t+\Delta t'}^{(l)-}$, $I_{t+\Delta t}^{(l)+}$ and $I_{t+\Delta t'}^{(l)+}$ are more compatible with $I_{t+\Delta t'}^{(k)}$. The consistency relationship can be expressed by Formula 14:

$$CR'_{BPR} = \sum_{\left(k,l_+^{\Delta t},l_-^{\Delta t},l_+^{\Delta t'},l_-^{\Delta t'}\right)\in T'_{t+\Delta t}} \begin{pmatrix} CR_k\left(I_{t+\Delta t}^{(k)}\right) + CR_l\left(I_{t+\Delta t}^{(l)+}\right) + CR_l\left(I_{t+\Delta t}^{(l)-}\right) \\ +CR_l\left(I_{t+\Delta t'}^{(l)+}\right) + CR_l\left(I_{t+\Delta t'}^{(l)-}\right) \end{pmatrix} \tag{14}$$

The reconstruction error can be redefined as:

$$E'_{BPR} = \sum_{\left(k,l_+^{\Delta t},l_-^{\Delta t},l_+^{\Delta t'},l_-^{\Delta t'}\right)\in T'_{t+\Delta t}} \left(e_k\left(I_{t+\Delta t}^{(k)}\right) + e_l\left(I_{t+\Delta t}^{(l)+}\right) + e_l\left(I_{t+\Delta t}^{(l)-}\right) + e_l\left(I_{t+\Delta t'}^{(l)+}\right) + r_l\left(I_{t+\Delta t'}^{(l)-}\right)\right) \tag{15}$$

The loss function can be redefined as:

$$Loss' = M'_{BPR} + \alpha CR'_{BPR} + \beta E'_{BPR} + \frac{\phi}{2}\left\|\Gamma'\right\|_2 \tag{16}$$

where, Γ' represents parameters in the model, and α, β, and φ are also used to control the compatibility preference of CR'_{BRP}, ER'_{BRP} and the regularization term.

5 Experimental Results and Analysis

Figure 5 gives the weights of evaluation indexes. According to the figure, between indexes B1 and B2, school attribute is a more important integration condition resource; among B3-B6, the weights of these indexes are relatively balanced, and this is consistent with the research results of the subjects of quality education and skill education integration; as for B7-B9, the weights of the indexes are obviously structured, which is consistent with the framework of the three-stage evaluation index system.

To verify the prediction effectiveness of unsupervised deep neural network autoencoder on the integration effect of quality education and skill education, this paper modeled the compatibility of evaluation indexes. The dataset of the evaluation indexes was

divided into 5 parts, 3 for network training, 1 for experimental verification, and 1 for sample testing. The selection of network hyperparameters was carried out through experimental verification, and the verification of network performance was completed through sample testing. The AUC value was employed to evaluate the network prediction performance. Figure 6 shows the curves of neural network training loss and AUC value. As shown in the figure, the two curves rapidly rose or fell in the first few iterations, but both tended to stabilize in the end, which had verified the good convergence of the model.

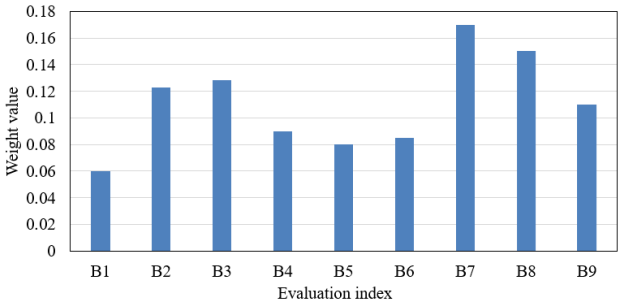

Fig. 5. Weights of evaluation indexes of quality education and skill education integration

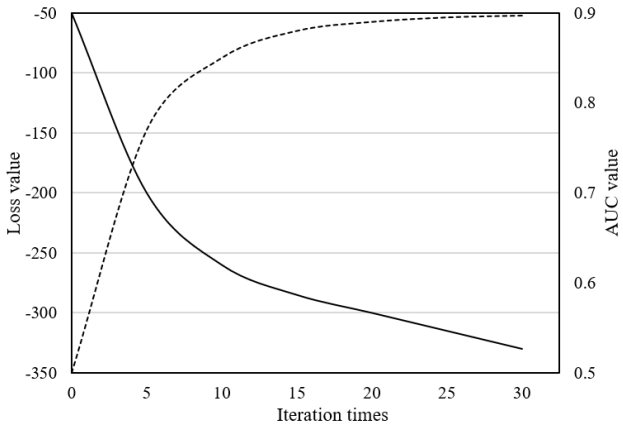

Fig. 6. Neural network training loss and AUC value

To verify the performance of the constructed BPR model in evaluating the compatibility of multiple complementary evaluation indexes of different time periods, this paper chose the Mean Reciprocal Rank (MRR) method, and Figure 7 shows a comparison of the influence of different time periods on the performance of the model in different situations. It can be seen that the model constructed in this paper performed better than other models in processing the compatibility under the condition of a longer sample collection time span, it can accurately rank the integration effect evaluation indexes of positive samples.

Figure 8 shows the annual prediction results of the integration effect of quality education and skill education based on the model constructed in this paper. From the figure, we can intuitively see the difference and importance of the various influencing factors in the integration process of quality education and skill education. Based on the time series, the weights of the evaluation indexes were calculated to obtain the development situations of the integration of quality education and skill education in different time periods. Then, the evaluation values of the influencing factors over the years were superimposed and averaged to obtain the development situations of the integration of quality education and skill education from 2006 to 2019.

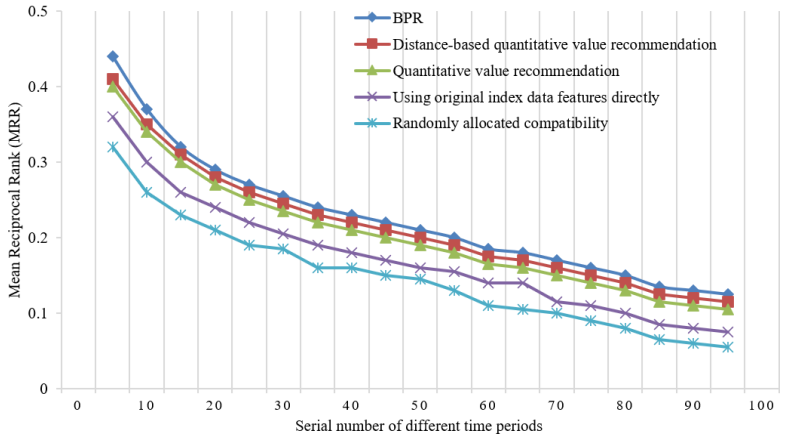

Fig. 7. Influence of different time periods on the performance of the model in different situations

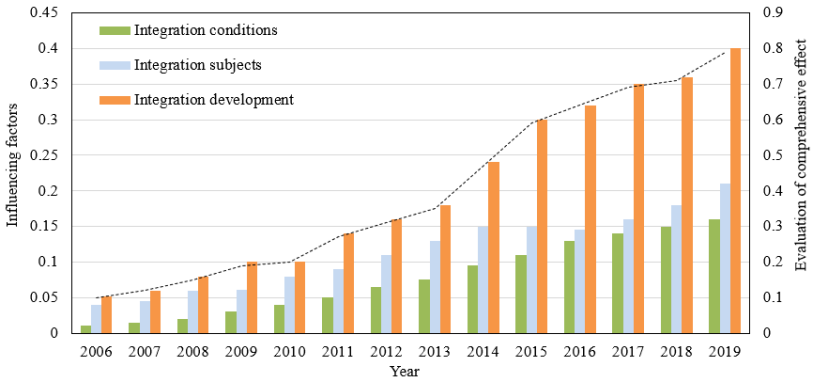

Fig. 8. Prediction results of the integration effect of quality education and skill education

In terms of integration conditions, the improvement of the integration effect in the initiation stage (2006-2008) and the factor driving stage (2009-2013) was relatively stable, these stages are the gradual growing period, indicating that the quality education and skill education was in the integration process, and the integration resources were

growing gradually. Since 2014, the integration of quality education and skill education grew rapidly, both the school attribute and basic teaching facilities had received resource supplements. In terms of integration subjects, throughout the entire observation periods, the growth was relatively stable, indicating that the school and society subjects were in stable improvement state in terms of talent cultivation scale and quality. Among the three influencing factors, the change rate of integration conditions was the fastest, which is consistent with previous analysis.

6 Conclusion

This paper applied ANN to evaluate the integration effect of quality education and skill education, owing to its advantages in processing nonlinear information adaptively. First, the paper analyzed the subjects and motivation mechanisms of quality education and skill education integration, and constructed the evaluation index system; then the experiments gave the weights of the corresponding influencing factors and evaluation indexes, and an ANN model was built for the compatibility of the evaluation indexes, realizing the prediction of the integration effect of quality education and skill education. The experimental results verified that the construction evaluation model had good convergence and can accurately rank the compatibility of integration effect evaluation indexes. At last, based on the prediction results, the current integration effect was analyzed and the development state of the integration of quality education and skill education between 2006-2019 was obtained.

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