Training Mode and Quality View of High-Class Talents

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Xia Gao[1(✉)], Yufang Wang[1], Bingna Lou[2]
[1] Department of Science and Technology Development and School-Enterprise Cooperation, Shijiazhuang University of Applied Technology, Shijiazhuang, China
[2] Management Department, Shijiazhuang University of Applied Technology, Shijiazhuang, China
gaoxia@sjzpt.edu.cn

Abstract—Building a sound system for assessing the training quality of high-class talents with talent introduction as the target is helpful for effectively analyzing the training mode of high-class talents in colleges and universities and discovering the underlying problems and weak links, thereby further optimizing the current mode, and improving the training level of high-class talents in the region. However, existing papers generally focus on macroscopic research of the training quality of high-class talents, so this paper attempts to study the training mode and quality view of high-class talents under the intervention of talent introduction policy. At first, this paper elaborated on the strategies for adjusting the training mode of high-class talents under the intervention of talent introduction policy, gave a diagram of the research model, and assessed the quality view of colleges and universities for talent training using four selected evaluation indexes, including solid knowledge base, independent research ability, rich practical ability, and sound personality and career outlook. Then, to figure out the changes in the training quality of different high-class talent training modes under the intervention of talent introduction policy, this paper built a high-class talent training quality prediction model based on Gated Recurrent Units (GRU) deep neural network, and gave the statistics of the prediction results of high-class talent training quality in the experiment. At last, this paper compared the differences in the quality view of high-class talent training of different colleges and universities under the intervention of talent introduction policy.

Keywords—talent introduction, high-class talent training, training quality, training mode, quality view

1 Introduction

As human society has entered an era of knowledge economy, now the economic activities have transcended borders, and world countries and regions have formulated various talent introduction policies to compete for high-class talents [1-5]. Via researching and sorting out these high-class talent introduction policies, we can better understand the changing features of student training modes of colleges and universities under the intervention of these policies [6-11], predict and analyze the optimization direction of the student training view of these schools to cope with the development trend of regional economy, thereby enriching the regional policies for introducing high-class talents and improving the decision-making level of high-class talent introduction, therefore, it is of certain value to research the training mode and quality view of high-class talents under the intervention of talent introduction policy [12-14]. Building a sound system for assessing the training quality of high-class talents with talent introduction as the target is helpful for effectively analyzing the training mode of high-class talents in colleges and universities and discovering the underlying problems and weak links, thereby further optimizing the current mode, and improving the training level of high-class talents in the region.

Academic contests are important means to examine the teaching ability of colleges and universities and the application ability of students. In order to effectively improve the training quality of students, Li [15] took academic contests in local application-oriented undergraduate colleges and the application of industrial robots in the e-commerce logistics as subjects to study the role of academic contests in promoting the deep integration of production and education, in the hopes of driving comprehensive transformation and developing application-oriented colleges so that they could better serve the local economy and society. Lin and Geng [16] proposed and implemented a multi-party collaborative education (MPCE) model of in-depth cooperation between universities, enterprises, research institutions, industry organizations, and governments, the paper suggested that the systemic, synergistic, and complete policies are crucial to the training quality of high-class talents. Ju and Rao [17] pointed out that contemporary college students pay more attention to actively showing high level moral standards and noble personalities, while ignore the mid and low level moral standards, and the personalities they are showing are incomplete; therefore, emphasis should be laid on the education of mid and low level moral norms, and rational spirit and values. Self-learning ability, teamwork ability and practical operation ability are core competencies for graduates majoring in computer network technology in higher vocational schools, Bi and Xu [18] analyzed the current situation in the training of high-class application-oriented internet technology talents, and proposed a training mode for this type of talents based on their core competitiveness. The developing higher education in China has put forward higher requirement for the comprehensive quality of talents, to respond to this requirement, Zhang and Dong [19] studied the topic of introduction and training of high-class talents in colleges and universities, discussed the main content of human capital, expounded the necessity, existing problems, and research methods of this topic, and analyzed the attained conclusions; the research revealed that, for the introduction of high-class talents in colleges and universities, there is still a big room for improvement, and this conclusion laid a good foundation for future studies on the construction of faculty teams in colleges and universities. Special economic zones in China closely follow the pulse of the times, relying on high-end research institutions and high-tech industries, they have formed an innovative high-class application-oriented talents training mode participated by multiple parties including governments, universities, and industrial enterprises, Zhou et al. [20] discussed the situations and problems of the newly emerging characteristic colleges and gave some suggestions for the promotion of this type of colleges.

After carefully reviewing the research results of world field scholars, we found that existing studies generally focus on the macroscopic research of the training quality of high-class talents, most of them are qualitative research on the current situation, training necessity, and training strategies of high-class talents. Few of them have concerned about the analysis of the quality view of high-class talents or the specific influencing factors under the intervention of talent introduction policy. Thus, to fill in this research blank and provide data support and useful evidences, this paper researched the training quality of high-class talents of colleges and universities under the intervention of talent introduction policy, and the content of this paper includes these aspects: 1) The paper elaborated on the strategies for adjusting the training mode of high-class talents under the intervention of talent introduction policy, gave a diagram of the research model, and assessed the quality view of colleges and universities for talent training using four selected evaluation indexes, including solid knowledge base, independent research ability, rich practical ability, and sound personality and career outlook. 2) To figure out the changes in the training quality of different high-class talent training modes under the intervention of talent introduction policy, this paper built a high-class talent training quality prediction model based on GRU deep neural network. 3) This paper gave the statistics of the prediction results of high-class talent training quality, compared the differences in the quality view of high-class talent training of different colleges and universities under the intervention of talent introduction policy, and verified the effectiveness of the constructed model.

2 Strategies for adjusting the training mode of high-class talents under the intervention of talent introduction policy

In terms of the factors in the organizational structure, people are the most active factor in enterprises and institutions, and talents are the biggest resource for these units. The introduction of high-class talents plays a decisive role in the smooth and sustainable development of enterprises and institutions. For units who have not handled the talent management work well, there will be many unfavorable factors in their development process. Only after experiencing the process of talent introduction, cultivation, growth, and maturity, can they develop better, accelerate the merging of talents and the units, and promote them to grow together. For talents and units (enterprises/institutions), if there're great differences in their employment standards, the reasonable flow of talents becomes a necessity for the development of both parties, otherwise it will cause waste of human resources and affect the sustainable, stable, and healthy development of enterprises and institutions. Whether an enterprise or institution can introduce good talents depends on three aspects: first, whether the leadership of the units is aware of the role of talent introduction and whether they are willing to introduce high-class talents; second, whether the human resource department has the vision to identify talents suitable for the units; third, whether the units have a good environment to retain high-class talents. If enterprises and institutions pay more attention to talent introduction and recruit high-class talents from colleges and universities, then they can realize sustainable and stable development.

Figure 1 gives a diagram of the research model. As can be seen in the figure, for different types of talents, there are certain differences in the training mode of high-class talents in colleges and universities. For example, for academic type, engineering type, technical type, and skill type talents, the training content involves the lecturing of professional knowledge, the training of analytical ability in specialized fields, the proficient use of tools, and the familiarity with relevant regulations and policies; as for literary type and management type talents, the training mode is to ensure that the talents could master the knowledge and skills in a specific field.

The "high class" of talents is a complete system. The quality view of talent training in colleges and universities generally contains these aspects: solid knowledge base *EQ1*, independent research ability *EQ2*, rich practical ability *EQ3*, and sound personality and career outlook *EQ4*. These require the talents to have certain professional quality, sense of belonging in profession, ideological and political quality, psychological quality, cultural and technological quality, and physical quality, etc.

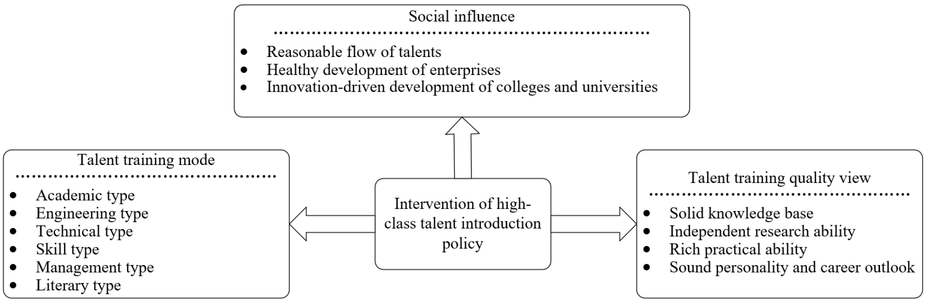

Fig. 1. The research model

3 Prediction of training quality of high-class talents

To figure out the changes in the training quality of high-class talents under different training modes with the intervention of talent introduction policy taken into consideration, this paper built a high-class talent training quality prediction model (hereinafter referred to as "prediction model" for short) based on GRU deep neural network. When running the constructed prediction model, the reset gate and update gate of the network determine the sample data information of the hidden layer at the current moment, and the update gate of the network determines whether the sample data information of the network at the next moment will be transmitted to the memory of the current moment; the greater the value output by the update gate, the larger the sample data information volume that the network is allowed to pass down at the next moment. The forgetting of the sample data information at the next moment is determined by the reset gate of the network, the smaller the value output by the reset gate, the larger the sample data information volume been forgotten by the network at the next moment. Figure 2 gives a diagram of constructed neuron network model.

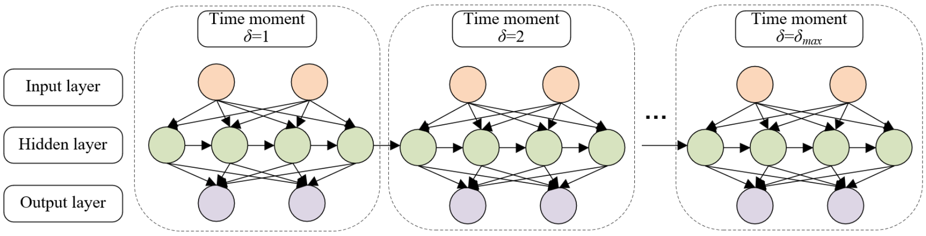

Fig. 2. The constructed neuron network model

Formula 1 gives the calculation formula of the activation f^j_δ of the j-th neuron node in the hidden layer at current moment δ; the value is calculated based on the linear interpolation of the activation $f^j_{\delta-1}$ at the next moment and the candidate activation $\tilde{f}^j_\delta$:

$$f_\delta^j = \left(1 - c_\delta^j\right) f_{\delta-1}^j + c_\delta^j \tilde{f}_\delta^j \tag{1}$$

During the update and iteration process of the network hidden layer, the update gate memorizes and forgets the sample data at the same time. The more feature information of the sample data retained in memory, the closer the value output by the update gate is to 1; the more feature information of the sample data that is selected to be forgotten, the closer the value output by the update gate is to 0. The update gate memorizes and forgets the sample data at the same time, assuming: Q_s, V_s, Q, V, Q_c, V_c, Q_b represent weight coefficients; n represents the number of input layer nodes of the unit; r represents the number of hidden layer nodes of the unit; m represents the number of output layer nodes of the unit; $Q \in R^{n\times r}$ and $V \in R^{r\times r}$ represent the connection matrices from the input layer and the hidden layer at time moment δ-1 to the state to be activated f; $Q_s \in R^{n\times m}$ and $V_s \in R^{r\times r}$ represent the connection matrices from the output layer and the hidden layer at time moment δ-1 to the reset gate c; $Q_b \in R^{r\times m}$ represents the weight matrix of the structural transformation calculation from the *GRU* unit hidden layer to the output layer; ε represents the *sigmoid* activation function, then Formula 2 gives the calculation formula of the update gate c^j_δ:

$$c_\delta^j = \varepsilon\left(Q_c a_\delta + V_c f_{c-1}\right)^j \tag{2}$$

Assuming: Ψ represents the *tanh* activation function; $\oplus$ represents the *Haadamard* product; s_δ represents the reset gate group; then Formula 3 gives the calculation formula of unit candidate activation $\tilde{f}^j_\delta$:

$$\tilde{f}_\delta^j = \Psi\left[Q a_\delta + V\left(s_\delta \oplus f_{\delta-1}\right)\right]^j \tag{3}$$

Formula 4 gives the calculation formula of reset gate s^j_δ:

$$s_\delta^j = \varepsilon\left(Q_s a_\delta + V_s f_{\delta-1}\right)^j \tag{4}$$

Based on the activation f_δ at current moment, the output value of the network can be calculated:

$$b_\delta^j = \varepsilon\left(Q_b f_\delta\right)^j \tag{5}$$

In above formula, weight coefficients Q_s, V_s, Q, V, Q_c, V_c, Q_b are all parameters attained by the trained network model, then Formula 6 gives the network loss function at time moment δ:

$$D_\delta = \frac{1}{2}\left(b_{e,\delta} - b_\delta\right)^2 \tag{6}$$

The expression of the sample loss is:

$$D = \sum_{\delta=1}^{T} D_\delta \tag{7}$$

Let $\xi^b_\delta=\partial D/\partial GRU^b_\delta$, $\xi^c_\delta=\partial D/\partial GRU^c_\delta$, $\xi_\delta=\partial D/\partial GRU^f_\delta$, $\xi^s_\delta=\partial D/\partial GRU^s_\delta$, wherein the input of the corresponding activation function satisfies $GRU^b_\delta=Q_b f_\delta$, $GRU^c_\delta=Q_c a_\delta+V_c f_{\delta-1}$, $GRU^s_\delta=Q_s a_\delta+V_s f_{\delta-1}$, $GRU^f_\delta=Q a_\delta+V(s_\delta \oplus f_{\delta-1})$, then there is:

$$\xi_\delta^f = \frac{\partial D}{\partial_\delta^f} = \xi_\delta^b Q_b + \xi_{\delta+1}^b V_c + \xi_{\delta+1} \oplus V s_{\delta+1} + \xi_{\delta+1}^s V_s + \xi_{\delta+1}^f \oplus \left(1 - c_{\delta+1}\right) \tag{8}$$

Assuming: ε' and $\Psi'=tanh'$ represent the derivatives of activation functions, then after adjusted by the stochastic gradient descent method, the expressions of the network weight coefficients are:

$$\xi_\delta^b = \left(b_e - b_\delta\right) \oplus \varepsilon' \tag{9}$$

$$\xi_\delta^c = \xi_\delta^f \oplus \left(f_\delta^\% - f_{\delta-1}\right) \oplus \varepsilon' \tag{10}$$

$$\xi_\delta = \xi_\delta^f \oplus c_\delta \oplus \Psi' \tag{11}$$

$$\xi_\delta^s = f_{\delta-1} \oplus \left[\left(\xi_{f,\delta} \oplus c_\delta \oplus \Psi'\right) V\right] \oplus \varepsilon' \tag{12}$$

The weight gradient expressions are:

$$\frac{\partial D}{\partial Q_c} = \xi_\delta^c a_\delta \tag{13}$$

$$\frac{\partial D}{\partial V_c} = \xi_\delta^c f_{\delta-1} \tag{14}$$

$$\frac{\partial D}{\partial Q} = \xi_{\delta} a_{\delta} \tag{15}$$

$$\frac{\partial D}{\partial Q} = \left(s_{\delta} \oplus f_{\delta-1}\right) \xi_{\delta} \tag{16}$$

$$\frac{\partial D}{\partial Q_b} = \xi_{\delta}^{b} f_{\delta} \tag{17}$$

$$\frac{\partial D}{\partial Q_s} = \xi_{\delta}^{s} a_{\delta} \tag{18}$$

$$\frac{\partial D}{\partial V_s} = \xi_{\delta}^{s} f_{\delta-1} \tag{19}$$

For the output data attained from the calculation of forward propagation of input sample data, its difference with the actual sample data was calculated to get the network calculation error. The network weight matrix was constrained by the learning rate of key parameters of the network, and the prediction performance of the network was improved through a certain number of iterations.

This paper adopted an improved firefly algorithm to optimize the constructed network model. Under the intervention of talent introduction policy, the changes in the high-class talent training quality view exhibited a certain regularity. The random walk model has been successfully applied in many fields such as finance, computer science, and environmental science, it can help us explore and study the change laws and development directions of the high-class talent training quality view under the intervention of talent introduction policy. Assuming: A_i represents the random walk step size constructed for different random distributions; R_M represents the continuous summation of A_i; then Formula 20 gives the expression of the random walk *Lévy* flight model selected in this paper:

$$R_M = \sum_{i=1}^{M} A_i = A_1 + ... + A_M \tag{20}$$

Formula 21 gives another expression form of this model:

$$R_M = \sum_{i=1}^{M-1} A_i + A_M = R_{M-1} + A_M \tag{21}$$

According to above formula, the R_{M-1} at the current moment and the transfer amount A_M at the next moment together determine the R_M at the next moment. Formula 22 gives the calculation formula of the random walk step size of *Lévy* flight:

$$r = \frac{v}{|u|^{1/\zeta}} \tag{22}$$

In above formula, random numbers v and u obey normal distribution and they satisfy:

$$v \sim M\left(0, \varepsilon_v^2\right), u \sim M\left(0, \varepsilon_u^2\right) \tag{23}$$

where,

$$\varepsilon_v = \left\{ \frac{\Phi\left(1+\zeta\right) sin\left(\pi\zeta / 2\right)}{\Phi\left[\left(1+\zeta\right)/2\right] \zeta 2^{(\zeta-1)/2}} \right\}^{1/\zeta}, \varepsilon_u = 1 \tag{24}$$

When the step size factor of the firefly algorithm takes a small value, in the early iteration stage of the algorithm, the movement speed of individual fireflies slows down, which will affect the search progress of the optimal solution; on the contrary, if the step size takes a large value, in the later iteration stage of the algorithm, the distance between individual fireflies is too small, which will result in oscillations near the optimal solution, and the accuracy of the optimal solution will be affected. Assuming: s_i^* represents the distance from the i-th firefly individual to the brightest individual s^* in the firefly population; e_{max} represents the maximum distance between firefly s^* and other individuals in the population; β represents the step size factor of standard firefly algorithm, then Formula 25 gives the expression of dynamic step size:

$$\beta_I = \beta \cdot \frac{s_i^*}{e_{max}} \tag{25}$$

The prediction accuracy and training efficiency of the prediction model are greatly affected by the initial weight of the network, and the optimal weight matrix is mainly related to the number of neuron nodes in each layer. Since the number of features of the evaluation data of high-class talent training quality had been determined already, the numbers of neuron nodes in each layer corresponding to the weight matrix were determined as well. This paper took the number of hidden neuron nodes in the prediction model and the network learning rate as the optimization objects, and applied the improved firefly algorithm to search for optimal solution iteratively. The position information corresponding to the firefly individual with the highest brightness output by the algorithm was the optimal combination result of the number of hidden neuron nodes and the network learning rate (Figure 3).

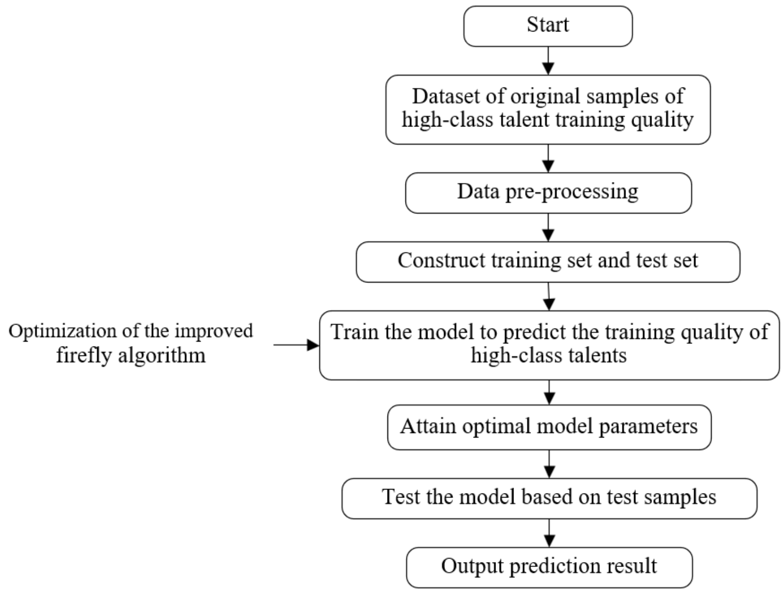

Fig. 3. Flow of the optimized neural network model

4 Experimental results and discussion

Table 1 shows the statistics of the prediction results of training quality of high-class talents. According to the data in the table, the average value of the current status of the quality view of high-class talent training was 67.63, which was close to the theoretical median value of 68, indicating that the quality view of colleges and universities for high-class talent training was close to the ideal effect. Among the four dimensions of *EQ1*, *EQ2*, *EQ3* and *EQ4*, the average value of *EQ4* was 13.68, which was greater than the theoretical median value of 12, indicating that the high-class talents had complete and healthy personality and positive career outlook, but in terms of knowledge base, research ability, and practical ability, there's still big room for improvement.

By default, the high-class talent introduction policy follows the "accelerated-stabilized" response law. Figure 4 shows the time-series distribution of the response to high-class talent introduction policy. According to the figure, after the study region had issued the high-class talent introduction policy, the policy quickly spread among enterprises and institutions, and the response speed was fast. In this paper, the responses of seven colleges and universities to the high-class talent introduction policy during the study period were compared, on the whole, the responses of different schools showed a stable state.

Table 1. Statistics of prediction results of training quality of high-class talents

Variable	*EQ*1	*EQ*2	*EQ*3	*EQ*4	Training quality
Number of items	5	3	6	9	17
Minimum	13	8	5	9	13
Maximum	22	25	21	27	23
Average	16.25	12.84	16.39	13.68	67.63
Mean of each item	4.68	3.92	3.27	3.05	3.68
Standard deviation	2.05	2.74	2.69	2.38	8.53
Theoretical median	17	13	19	12	68

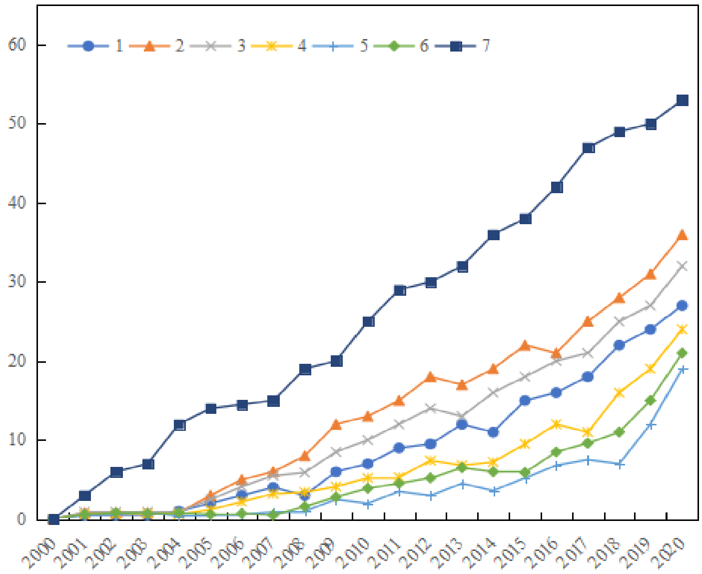

Fig. 4. Time-series distribution of response to high-class talent introduction policy

This paper selected seven colleges and universities for research. Figure 5 shows the cumulative number of adjustments on the high-class talent training mode made by the seven schools under the intervention of talent introduction policy over time. As can be seen from the figure, for schools that responded fast to the high-class talent introduction policy, the cumulative numbers of adjustments on the high-class talent training mode were much greater than other schools. Schools of this type generally located in economically developed coastal areas, the regional development platform for high-class talents is broader, and the preferential conditions guaranteed by the talent introduction policy are more attractive in the eyes of high-class talents, which has further promoted the update of high-class talent training mechanism in these schools. As for schools that responded slower to the policy, they generally located in economically underdeveloped areas and haven't paid enough attention to the introduction of high-class talents, which has resulted in insufficient training platform and resources, and the update of high-class talent training mechanism is slow.

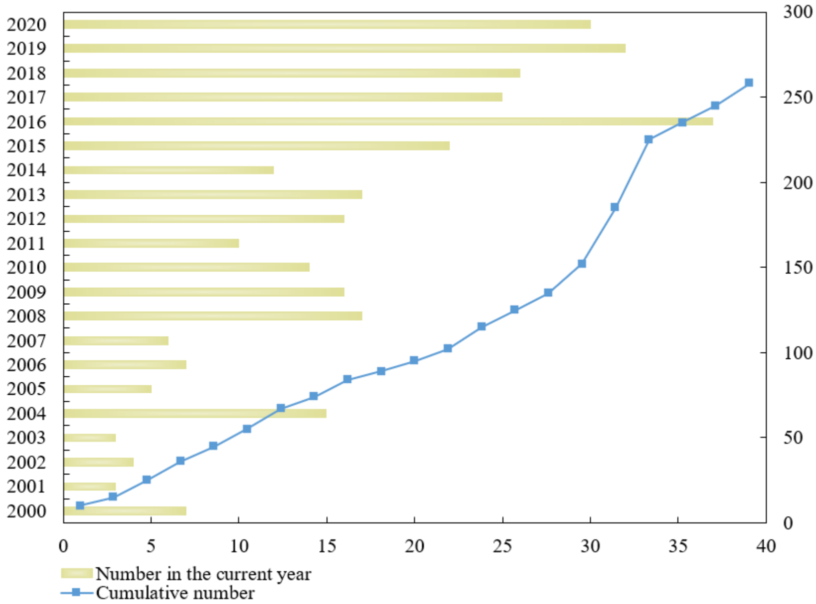

Fig. 5. Spatial distribution of response to high-class talent introduction policy

The total number of evaluation data samples participated in the research was 167, wherein 55, 57, and 55 samples were respectively from Schools 1, 2, and 3. One-way variance analysis was adopted to study whether students of different grades have significant differences in the four aspects of knowledge base, research ability, practical ability and sound personality and career outlook, and the variance analysis results are given in Table 2. Judging from the results, the significance values of the four test variables of students from different schools under the intervention of talent introduction policy were all greater than 0.05, indicating that under the intervention of talent introduction policy, there's no significant difference in the quality view of these colleges and universities in training students of different grades, and post hoc comparison was not necessary. Compared with the training mode of focusing on the research ability of a single discipline or the mastery of a single skill, under the intervention of talent introduction policy, colleges and universities should emphasize more on the improvement of students' practical ability and the shaping of professional ethics and values in them, and such a training mode has a long-term beneficial effect on students, to a certain extent, it is the reason for the small difference in the quality view of high-class talent training in different grades.

Table 2. Comparison of test variables in terms of the quality view of high-class talent training

Test variable	School No.	Number of samples	Average	Standard deviation	*F*-test	Significance
*EQ*1	1	55	15.36	2.15	1.43	0.36
	2	57	13.25	3.62		
	3	55	12.95	1.84		
*EQ*2	1	55	15.42	2.98	1.39	0.31
	2	57	19.15	3.37		
	3	55	13.62	2.05		
*EQ*3	1	55	18.23	3.24	0.38	0.74
	2	57	15.04	2.61		
	3	55	19.26	2.48		
*EQ*4	1	55	14.28	2.37	0.29	0.72
	2	57	16.19	2.24		
	3	55	17.42	3.69		

5 Conclusion

This paper studied the training mode and training quality view of high-class talents under the intervention of talent introduction policy. At first, this paper elaborated on the strategies for adjusting the training mode of high-class talents under the intervention of talent introduction policy, gave a diagram of the research model, and assessed the quality view of colleges and universities for talent training using four selected evaluation indexes, including solid knowledge base, independent research ability, rich practical ability, and sound personality and career outlook. Then, to figure out the changes in the training quality of different high-class talent training modes under the intervention of talent introduction policy, this paper built a high-class talent training quality prediction model based on GRU deep neural network. After that, via experiment, this paper gave the statistics of the prediction results of high-class talent training quality, and compared the differences in the quality view of high-class talent training of different colleges and universities under the intervention of talent introduction policy. In the later part, this paper gave the time-series distribution and spatial distribution of the response to high-class talent introduction policy, and compared the differences in the quality view of high-class talent training among different colleges and universities under the intervention of talent introduction policy, and attained the conclusion that, compared with the training mode of focusing on the research ability of a single discipline or the mastery of a single skill, under the intervention of talent introduction policy, colleges and universities should emphasize more on the improvement of students' practical ability and the shaping of professional ethics and values in them.

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7 Authors

Gao Xia, with a master’s degree, is the prominent teacher of the Department of Science and Technology Development and School-enterprise Cooperation in Shijiazhuang University of Applied Technology. She has been engaged in teaching for 16years, and the main research direction is educational administration & talent cultivation (email: gaoxia@sjzpt.edu.cn).

Yufang Wang, associate professor, is a teacher of the Department of Scientific Research in Shijiazhuang University of Applied Technolog. She received her PHD degree from Tianjin University in 2014. In recent years, she has been committed to higher vocational research, and has presided over 3 provincial-level projects and published 7 SCI papers (email: wangyufang@tju.edu.cn).

Bingna Lou, who holds a master's degree is the backbone teacher majoring in hotel managements in Shijiazhuang University of Applied Technology. She is one of the members of Yanzhao Forum Experts. And she started her career in August, 2004 and has been engaged in education for 18 years. Her main research field is business administration (email: 2004110267@sjzpt.edu.cn).

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