

Research Article

Application of the Big Data Analysis Model in Higher Education Talent Training Quality Evaluation

Lijun Li,¹ Wentao Wang ,² and Fei Bian³

¹Evergreen Institute of Elderly Education, Shenzhen Polytechnic, Shenzhen, Guangdong 518000, China

²School of Digital Creation and Animation, Shenzhen Polytechnic, Shenzhen, Guangdong 518000, China

³Development and Planning Office, Shenzhen Polytechnic, Shenzhen, Guangdong 518000, China

Correspondence should be addressed to Wentao Wang; wangwentao@szpt.edu.cn

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With the increasing demand for applied and professional talents, the talent market has been in short supply. Although there are many talents in the talent market, the quality of talents cannot keep up with the development of quantity. Therefore, it is of great practical significance to establish a visual evaluation system of personnel training quality in the field of higher education. In view of the unreasonable evaluation and unclear weight relationship in the evaluation of educational indicators, this paper puts forward a big data analysis model to comprehensively evaluate teaching evaluation indicators, which has more scientific significance. In this paper, different systems in the index system are used as the analysis objects and the first-level weight relationship is normalized, which can distribute the weights more reasonably. Through the big data analysis method, the teaching quality evaluation system is more reasonable and scientific. In this paper, the quality index system for higher education background is designed and constructed and the weight relationship of different educational indicators is analyzed through big data, and four main indicators are obtained; then, the weight relationship of secondary indicators is analyzed, and finally, the weight relationship of all indicators is formed. The results show that the weight relationship of four indexes is 0.3285, 0.1973, 0.2967, and 0.1755, and the evaluation model of education quality is given.

1. Introduction

Higher education is in the tide of mass entrepreneurship and innovation education reform. How to establish an effective mass entrepreneurship and innovation education quality evaluation system is a hot topic of great concern to the state, society, and enterprises. Colleges and universities across the country have introduced big data technology in personnel training, aiming at recognizing their own strength through visual data, so as to improve their teaching efficiency and promote the sustainable development of colleges and universities. In addition, the evaluation of personnel training quality in higher education is a long-term systematic project. A comprehensive and correct evaluation of personnel training quality is not only conducive to adjusting training programs and optimizing training modes in colleges and universities, but also conducive to students' self-evaluation, finding deficiencies, and correcting them in time, so as to improve their own quality.

Under the background of “Made in China 2025” strategy, from the perspective of quality transformation, it is an effective way to deepen the reform of innovation and entrepreneurship education, integrate schools and enterprises to educate people, and improve the evaluation feedback mechanism to explore and improve the quality of higher education personnel training [1]. Therefore, we need to uphold the concept of “deepening education reform, promoting quality education, and innovating educational methods” and actively promote school-enterprise cooperative education and professional construction to connect with industrial development [2]. At the same time, under the macro environment of the development of higher education, it is also a bright road to cultivate high-quality innovative talents based on the theory of subject education and the combination of production, education, and research [3].

On the national level, the fourth-generation evaluation theory emphasizes the principle of full participation and

pays attention to value diversification, and the constructivist method emphasizes psychological construction and puts forward the consensus theory of response consultation, which is conducive to stakeholder empowerment, co-construction mode, and key quality evaluation reform [4]. However, the predicament presented in its training operation is consistent with the predicament in which China's higher education personnel training is now in. As an important link in China's talent training system, the development of higher education directly affects the development of China's national economy [5]. The important direction that restricts the higher education system is quantity, and the core of work is to improve the quality, scientific potential, and organizational skills of cultivating professional talents.

On the social level, compound talents are being needed by the society under the background of big data [6]. At the same time, the relevant results show that the quality evaluation indicators of undergraduate and graduate students pay more attention to personnel training than the social service dimension. The index evaluation index pays more attention to the quality of graduates than the knowledge development and transformation of social service dimension (53.13%) and pays more attention to knowledge innovation. The adoption of efficiency indicators (25.00%) pays more attention to social services [7]. This requires leaders at all levels to uphold the diversified values of higher education quality standards and evaluate the quality of personnel training in multiple dimensions and levels [8]. The evaluation principles of higher education personnel training quality include scientific evaluation principle, adaptive evaluation principle, diversified evaluation principle, and developmental evaluation principle [9].

At the level of colleges and universities, leaders of all schools should start from the starting point of carefully considering the school-running characteristics, training objectives, and personnel training mode [10]. Through repeated comparative studies with other colleges and universities on the same level or higher level, an appropriate evaluation system for the quality of dual-innovation education is established so that the quality of dual-innovation education in colleges and universities can be fully guaranteed [11]. The goal of higher education is to train adaptive compound talents, and the improvement of teaching quality has far-reaching social impact. Scientific and reasonable evaluation system of talent training quality is an important measure to ensure the quality of talent training in higher education [12]. Therefore, it is of considerable practical significance to evaluate and test the teaching quality and continuously improve the teaching quality [13].

Combining Kirkpatrick's four evaluation models, this paper innovates the evaluation mechanism of talent training quality, constructs an extensive evaluation system of talent training quality, and provides a strong theoretical basis for the evaluation of talent training quality in higher education [14]. So far, the biggest feature of this paper is based on the theory and method of system management, This paper puts forward a teaching quality evaluation system, which not only uses analytic hierarchy process to quantitatively evaluate and analyze the talent quality, but also makes full use of the B/S

mode structure and the basic principles of quality evaluation, thus establishing a talent quality evaluation standard with theoretical basis [15].

2. Construction of the Analytical Model for Personnel Training Quality Evaluation

2.1. Evaluation Model of Personnel Training Quality. The evaluation model of personnel training quality is constructed as follows:

$$\begin{aligned} Q &= AK^n = (A + {}^e_1K)K^n, \\ A &= A_0 + {}^e_1K, \\ n &= {}^e_2f(K, A) = {}^e_2f(K, A_0 + {}^e_1K). \end{aligned} \quad (1)$$

In the model, Q stands for quality, A stands for ability, A_0 stands for ability constant, 1^e stands for knowledge-ability efficiency coefficient, K stands for knowledge, n stands for quality, and 2^e stands for knowledge-ability quality efficiency coefficient:

- (1) The knowledge-ability relationship model $A = A_0 + {}^e_1K$ shows that a person's ability mainly depends on the knowledge K value. The value of A_0 must be greater than or equal to 0, which represents people's basic living abilities, such as eating, sleeping, walking, communicating, and so on. Knowledge-ability efficiency coefficient e_1cc represents the ability improvement of a normal person after acquiring unit knowledge, and it is the key factor to improve ability through knowledge.
- (2) The relation model of knowledge, ability, and quality $n = {}^e_2f(K, A) = {}^e_2f(K, A_0 + {}^e_1K)$ shows that knowledge and ability affect people's quality together. The efficiency coefficient of knowledge ability and quality 2^e indicates the degree to which the change of knowledge ability affects the quality of human body.
- (3) For the evaluation model of talent training quality, the two ends of $Q = AK^n = (A + {}^e_1K)K^n$ are, respectively, derived by the first order and the second order of K value, and the following results are obtained:

$$\begin{aligned} \frac{dQ}{dK} &= nAK^{n-1}, \\ \frac{d^2K}{d^2Q} &= n(n-1)AK^{n-2}. \end{aligned} \quad (2)$$

- (a) When the first derivative is $(dQ/dK) = nAK^{n-1} > 0$, it theoretically proves people's general understanding of the relationship between talent quality and knowledge: high-quality talents must have relatively profound knowledge, and knowledge imparting is a necessary condition for cultivating high-quality talents.
- (b) When the second derivative is $(d^2K/d^2Q) = n(n-1)AK^{n-2} > 0$, this

theoretically explains why the increase in the unit of knowledge causes some people to improve their quality rapidly.

- (c) When the second derivative is $(d^2K/d^2Q) = n(n-1)AK^{n-2} < 0$, this theoretically explains why the increase in the unit of knowledge causes some people to improve their quality slowly.
- (d) When the first derivative $(dQ/dK) = nAK^{n-1} < 0$ and the second derivative $(d^2K/d^2Q) = n(n-1)AK^{n-2} > 0$, according to the knowledge of derivative function in mathematics, the talent quality Q in the talent training quality evaluation model is a minus function of knowledge K , and when $n < -1$, the increase of knowledge unit leads to the rapid decline of talent quality.

2.2. Principles of Quality Evaluation

2.2.1. Principle of Scientific Evaluation. Human development is all-round, and the expressive force of “knowledge, ability and quality” should be different. Therefore, to a certain extent, we need the traditional evaluation mode of distinguishing students’ excellence only by their test scores because this evaluation model can only represent part of students’ quality data, not all of them. At the same time, because the traditional evaluation mode of class teacher/counselor is easily influenced by subjective impression, personal hobbies, and emotional factors, it is unfair and fair. Therefore, it is necessary to establish a quantitative assessment method combining qualitative and quantitative assessment to discuss the quality of talents in depth. This proves that the evaluation system needs not only to formulate quantitative indicators scientifically, but also to avoid being quantified absolutized, so as to reduce the problem of incomplete evaluation due to the interference of some uncertain factors as much as possible. It is advocated that in the evaluation process, while seeking students’ commonness, students’ individuality should not be stifled.

2.2.2. Principles of Adaptability Evaluation. Under the condition of popularization, adapting to social needs has become the first pursuit of talent training quality in higher education. Only by cultivating the required talents for the country and society as much as possible can the value of talent training quality in higher education be reflected. This principle will inevitably lead higher education to make necessary adjustments in the original organizational structure, teaching methods, and management modes, so as to adapt to the changes in the talent market caused by the development of society and the country. The core of higher education personnel training has also undergone the following changes: from paying attention to liberal arts knowledge to professional and technical knowledge, from paying attention to practical ability to paying attention to the quality evaluation of higher education personnel training with overall quality.

2.2.3. Principle of Diversity Evaluation. Nowadays, social needs are becoming more and more diversified, showing two major development trends of high subdivision and high integration in various fields. In this situation, higher education has naturally created a diversified and multilevel structural foundation.

The principle of diversity evaluation actually includes two aspects: first, “multilevel,” that is, vertical multilevel (doctor, master, bachelor, and junior college); the second is “diversity,” that is, horizontal multi-types (scientific research, teaching and scientific research, teaching, and professional skills). It is obvious that the quality of talents is different with different educational levels. But by the same token, a qualified vocational skill graduate, a qualified teaching and scientific research graduate, and a qualified scientific research graduate have the same quality value for the needs of different fields and positions of society, and the comment results in different fields and positions will be different.

2.2.4. Principle of Developmental Evaluation. There are great differences in the criteria for judging the quality of talents because of different living times. For example, the spring and autumn period is etiquette culture, the Han Dynasty is filial piety, the feudal period after Sui and Tang Dynasties is poetry and articles, and now it is subject knowledge. Life is like water, which is constantly changing and advancing. Only by adapting to the development track of the times and society and adjusting the corresponding evaluation criteria in a timely manner can the evaluation of the quality of higher education personnel training have original existence significance.

3. Comprehensive Evaluation

3.1. Construction of the Evaluation Index System. The constructed evaluation indexes follow independence and have no correlation with each other. In other words, the relevant evaluation indexes should be combined as much as possible to reduce the number of evaluation indexes and simplify the operation process.

In addition, it is necessary to distinguish functionality. For example, honesty and trustworthiness, kindness and sincerity, keeping one’s word, etc., are difficult to distinguish when evaluating these indicators. More importantly, we cannot make a rash diagnostic evaluation of human morality because of one thing or one-time behavior. Therefore, some evaluation indicators related to moral quality should be set up and evaluated with extra caution.

Comment indicators should also be oriented. The evaluation index system cannot be all-encompassing. On the one hand, the limited index should be reflected in the most important ability quality of students’ development; on the other hand, it should fully reflect the development direction of students advocated by the school. The index system should conform to the school’s development goals and student training goals and should become an important embodiment of the school-running characteristics.

So far, this paper puts forward an evaluation index system composed of 4 first-class indexes and 11 second-class indexes. The four first-class indexes are ideological and moral quality, knowledge level quality, ability quality, and physical and psychological quality. Under each first-level index, there are several attributive second-level indexes, respectively. Please refer to Table 1 for details.

In Table 1, the first-level indicators are obtained from expert investigation and data summary in relevant literature. It is necessary to scientifically analyze the correlation and role of different indicators and get the first-level indicators. The evaluation system of the first-class index is scientific and is obtained according to the method proposed in the article.

3.2. Calculation Method of Index Weight. After we determine the index system, we need to make clear the weights of indicators at all levels of the index system. This paper adopts proportional method and equidistance weight calculation method to calculate the weights of indicators at all levels:

- (1) Equal-distance weight calculation: according to the grade of each index, the equidistance weight is used for calculation. The grade weight that can be obtained is

$$f_i = 1 - 1 * \left(\frac{1}{(k-1)} \right) * (k_i - 1), \quad (3)$$

where f_i is the weight of the i grade in formula (3), and k is the total number of grades, k_i is the i grade. It has been explained in formula (3) that the relationship between K and k_i and the definition of grade are set according to the overall structure existing in the actual evaluation of teaching, which is generally divided into first-class index, second-class index, and third-class index. The weight sum of the first-level index is 1, and the second-level index is redistributed under a system of the first-level index. If we recalculate the weights of a three-level index in the whole index system, we need to comprehensively deal with the weights of the first-level index, the second-level index, and the third-level index.

- (2) Proportional calculation: the weight of each survey result is obtained by proportional calculation. The calculation formula is

$$f_{ij} = \frac{n_{ij}}{N}, \quad (4)$$

where f_{ij} is the weight of the i grade of the j index in the index, n_{ij} is the number of questionnaires of the i grade of the j index in the index, and N is the total number of questionnaires. Then, the indicator weight is defined as follows:

$$F_j = \sum_{i=1}^k f_i \cdot f_{ij}, \quad (5)$$

where F_j is the weight of the j index in the index. Normalization processing is performed on F_j , and the normalized weight $F_j(\text{NOR})$ is obtained as follows:

$$F_j(\text{NOR}) = \frac{F_j}{\sum_{j=1}^k F_j}. \quad (6)$$

The attributes of index system and weight have been defined above, and the weight values of indexes at all levels can be calculated by cooperating with the above equations.

3.3. Data Collection and Statistics. Firstly, each index in the evaluation system is qualitatively analyzed by the person in charge, and the importance ranking of the indexes in the same layer is given. Then, using the scoring results of any two adjacent indexes that have been ranked by experts, the weight value of each index is calculated by the improved single ranking method, and then the comprehensive weight value is calculated. The realization method adopts B/S mode structure. Using the weights of each index calculated above, according to the requirements of analytic hierarchy process, 100 students from the school are randomly selected to fill in the questionnaire, and the evaluation value of each upper index is calculated from the lowest evaluation index from bottom to top, and the evaluation results are displayed in various forms such as graphs and tables. In the process of data collection, there are questionnaires, data adjusted by network, and data of teaching evaluation in some literatures. The analytic hierarchy process is often used to express the weight relationship of each index in matrix. Through the big data analysis method, when the related problems between different indicators are evaluated and quoted in different literatures and other expressions, the correlation analysis of related indicators is carried out, so as to take a scientific value.

The statistical results are shown in Figure 1.

The correlation between specific index coefficients is shown in Tables 2–5.

4. Calculation of Weight Value

4.1. Calculation of First-Class Index Weight. The statistical analysis of the indexes in the primary indicators is shown in Table 6.

When the total grade number k of the first grade index is 3, f_i can be calculated from equation (3); the weight distribution is shown in Table 7 and Figure 2.

Such as ideological and moral expression, f_{ij} is obtained from formula (4), the weights of the secondary indicators ideological and moral are shown in Table 8.

4.2. Weight Calculation of Secondary Indicators

- (1) The secondary indicators of ideology and morality are shown in Table 9.

TABLE 1: Comprehensive evaluation index system of talent training quality in higher education.

Indicators	First-class indicators	Second-class indicators
Comprehensive evaluation index system of talent training quality in higher education	Ideological and moral quality	Ideological quality Moral character Knowledge level
	Knowledge level quality professional	Extracurricular knowledge level Professional skill level Learning ability
	Ability quality	Communication skills Practical ability Innovation ability
	Physical psychological quality	Psychological quality Physical quality

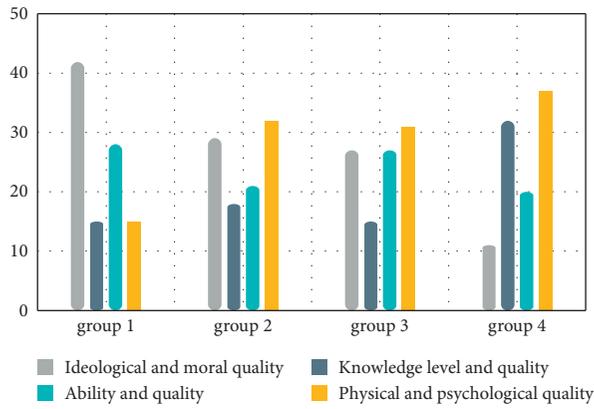


FIGURE 1: Statistical chart of level 1 indicator survey data.

TABLE 2: Ideological and moral quality.

Serial number	Ideological quality	Moral character
1	53	47
2	45	55

TABLE 3: Knowledge level quality professional.

Serial number	Knowledge	Extracurricular knowledge	Professional skill
1	36	18	46
2	48	9	43
3	20	73	7

TABLE 4: Ability quality.

Serial number	Learning	Communication skill	Practical	Innovation
1	10	32	44	14
2	12	53	27	8
3	34	12	23	31
4	43	15	16	26

TABLE 5: Physical psychological quality.

Serial number	Psychological quality	Physical quality
1	66	34
2	67	33

TABLE 6: Statistical table of first-class index survey data.

Serial number	Ideological and moral	Knowledge professional	Physical psychological	Quality
1	42	15	28	15
2	29	18	21	32
3	27	15	27	31
4	11	32	20	37

TABLE 7: The weight distribution.

Rank	1	2	3	4
Weight	1	0.6667	0.3333	0

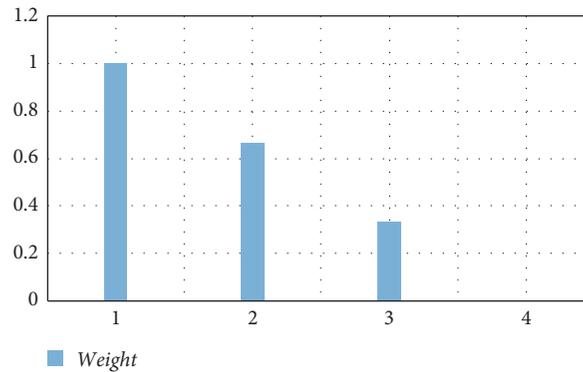


FIGURE 2: Grade weight of grade I indicators.

TABLE 8: Weights of ideological and moral.

Rank	1	2	3	4
Weight	0.39	0.22	0.33	0.06

TABLE 9: The secondary indicators of ideology and morality.

Serial number	Ideological quality	Moral character
1	52	48
2	56	44

TABLE 10: Weights of ideological and moral ranks.

Rank	1	2
Weight	1	0

TABLE 11: F_j of ideological and moral quality.

Second-level index	Ideological quality	Moral character
F_j	0.54	0.46

TABLE 12: $F_j(\text{NOR})$ of ideological and moral quality.

Second-level index	Ideological quality	Moral character
$F_j(\text{NOR})$	0.54	0.46

TABLE 13: $F_j(\text{NOR})$ of knowledge level quality.

Second-level index	Professional knowledge	Extracurricular knowledge	Professional skill
$F_j(\text{NOR})$	0.4045	0.1483	0.4472

TABLE 14: $F_j(\text{NOR})$ of ability and quality.

Second-level index	Learning ability	Communication skills	Practical ability	Innovation ability
$F_j(\text{NOR})$	0.1485	0.3543	0.3493	0.1479

TABLE 15: $F_j(\text{NOR})$ of physical and psychological.

Second-level index	Ideological quality	Moral character
$F_j(\text{NOR})$	0.73	0.27

The total number of secondary indicators of ideology and morality, k , is 2, and the f_i value is obtained from formula (3) in Tables 10 and 11.

The sum of F_j values is 1, and $F_j(\text{NOR})$ values of ideological and moral qualities are obtained by normalization of formula (6) as shown in Table 12. Referring to the above calculation method in this paper, the $F_j(\text{NOR})$ values of other secondary indexes can be calculated reasonably.

- (2) The $F_j(\text{NOR})$ of knowledge level quality is shown in Table 13.
- (3) The $F_j(\text{NOR})$ of ability and quality is shown in Table 14.
- (4) The $F_j(\text{NOR})$ of physical and psychological qualities are as follows in Table 15.

4.3. Determination of Weight of the Evaluation Index

4.3.1. *Calculation Results of the Weights.* The final adjusted weights in this article are shown in Table 16 and Figure 3.

In Table 16, the weight is corrected. There are some problems in dealing with related weights; for example, the

sum of some weights is not 1, which will lead to errors. If the errors between different levels will increase continuously, it will have an impact on the evaluation results. Therefore, revising the weight value can improve the accuracy and objective fairness of evaluation.

4.3.2. *Application of the Evaluation System.* After the final rounding according to the weight score, one or two decimal places are reserved for calculation, and this result is used as the revised weight score. The revised scores and their corresponding evaluation grades are excellent (1 point), good (0.8 points), passing (0.6 points), and failing (0.4 points). To know the final total score, firstly, the score value of each second-level index is multiplied with its corresponding second-level weight, and then the second-level scores under the same first-level index are accumulated and multiplied with its corresponding first-level weight, so as to obtain the score of each first-level index. Finally, the final score of the investigated object can be obtained by synthesizing the actual scores of each first-level index. The calculation formula is as follows:

$$V_C = \text{excellent} - \text{rate} * 1 + \text{good} - \text{rate} * 0.8 + \text{qualification} - \text{rate} * 0.6 + \text{unqualified} - \text{rate} * 0.4. \quad (7)$$

In formula (7), 0.8, 0.6, and 0.4 are the total evaluation scores in an index system, which are used to correctly evaluate the comprehensive scores in the whole evaluation index. It has a certain scientific basis and can analyze the comprehensive scores of different index systems as a whole, thus having certain guiding significance for balancing the weight relationship of different indexes.

$$\begin{aligned} \text{Quality evaluation} = & 0.3 * \{(0.5 * V_{C1}) + (0.5 * V_{C2})\} \\ & + 0.2 * \{(0.4 * V_{C3}) + (0.15 * V_{C3}) + (0.45 * V_{C5})\} \\ & + 0.3 * \{(0.15 * V_{C6} + 0.35 * V_{C7} \\ & + 0.35 * V_{C8} + 0.15 * V_{C9})\} \\ & + 0.2 * \{(0.7 * V_{C10}) + (0.3 * V_{C11})\}. \end{aligned} \quad (8)$$

TABLE 16: Weight scores of indicators at all levels.

Serial number	First-level index			Second-level index			
	Item	Weight score	After revision weight score	Serial number	Item	Weight score	After revision weight score
1	Ideological and moral quality	0.3285	0.3	1.1	Ideological quality	0.54	0.5
				1.2	Moral character	0.46	0.5
2	Knowledge level quality professional	0.1973	0.2	2.1	Knowledge	0.4045	0.4
				2.2	Extracurricular knowledge	0.1463	0.15
				2.3	Professional skill	0.4472	0.45
3	Ability quality	0.2967	0.3	3.1	Learning	0.1485	0.15
				3.2	Communication	0.3543	0.35
				3.3	Practical	0.3493	0.35
				3.4	Innovation	0.1479	0.15
4	Physical psychological quality	0.1755	0.2	4.1	Psychological	0.73	0.7
				4.2	Physical	0.27	0.3

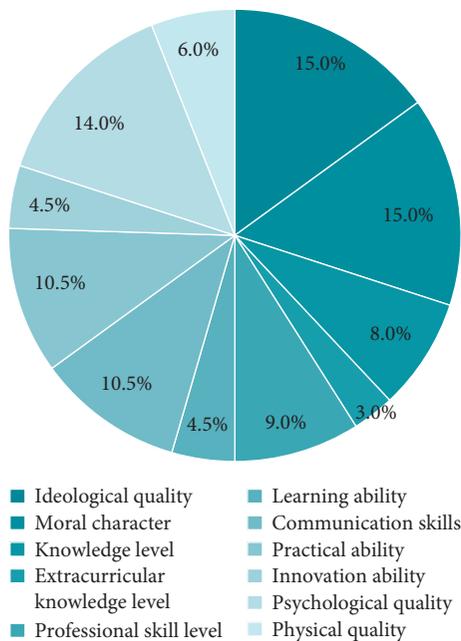


FIGURE 3: Weight proportion chart of secondary indicators.

5. Conclusions

Under the background of big data, society needs compound talents. It is necessary to uphold the diversified values of higher education quality standards and evaluate the quality of personnel training in multiple dimensions and levels. The methods and principles of evaluating the quality of personnel training in higher education are the principles of scientific evaluation, adaptability evaluation, diversity evaluation, and development evaluation.

Based on CIPP evaluation model, the experimental analysis model of this paper constructs the evaluation model of talent training in new higher education and establishes the evaluation index system of talent quality. Through the evaluation of ideological and moral quality, knowledge level quality, ability quality, physical and psychological quality,

and the construction of comprehensive evaluation index system of personnel training quality, a questionnaire survey was conducted among 100 students to obtain experimental data sources. The grade result of evaluation is not the key point, but after the statistics and analysis of the obtained sample data, the advantages and disadvantages in the process of personnel training can be discovered, and targeted measures can be reformed. To a certain extent, this evaluation analysis model has certain feasibility and popularization, which can be used for colleges and universities to clarify the current situation of their own training mode.

The disadvantage of this paper is that the experimental data is too little, the model establishment is only elementary steps, and there is no practical in-depth study, investigation and excavation of more comprehensive evaluation indicators. The limitation of the system described in this paper is that it can only present valuable results to a certain unit of colleges and universities and cannot represent the current situation of general colleges and universities.

Data Availability

The experimental data used to support the findings of this study are available from the corresponding author upon request.

Conflicts of Interest

The authors declare that they have no conflicts of interest regarding the publication of this work.

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