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Construction and Practice of Higher Education Quality Assurance System Based on Artificial Intelligence Models

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ABSTRACT

More and more problems are revealed in the process of popularization of higher education, especially the imperfection of the quality assurance system of higher education, which restricts and hinders the development of colleges and universities to a certain extent. This paper uses structural equation modeling to analyze the influencing factors of higher education quality. And consequently, it combines digital technology to build a higher education quality assurance system. Take a university as an example to practice, through the higher education quality assurance system evaluation index selection and empowerment, combined with the fuzzy comprehensive evaluation method to establish an evaluation model, to assess the effectiveness of the practice of the educational quality assurance system of the sample university. The management level (0.4380) and faculty (0.1472) of the university have the most significant influence on the quality of higher education. Under the constructed higher education quality assurance system, the comprehensive scoring result of the sample colleges and universities is at a good level (8.227), with the highest quality level in the dimensions of teaching effectiveness (8.7341) and student development (8.7000), which indicates that the digitization-based higher education assurance system is able to effectively ensure and promote the quality of education in colleges and universities.

Keywords: structural equation, evaluation index system, fuzzy comprehensive evaluation, digitalization, higher education quality

1. Introduction

Studying the quality assurance system of talent cultivation in higher education in the new era and clarifying the development goals are of great value in promoting the excellent development of Chinese universities. However, due to the lagging concept of talent cultivation quality in some universities, the imbalance between talent cultivation orientation and market demand structure results in the lack of overall planning and coordination of talent cultivation quality assurance mechanism. Therefore, establishing the concept of

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talent cultivation, forming a scientific cultivation plan, and providing a perfect organizational guarantee is the key point of the construction of university talent cultivation quality assurance system in the digital era.

The quality assurance system of higher education mainly consists of two parts: internal assurance and external assurance. The internal guarantee system is responsible for the internal quality assurance of higher education institutions, and the main organizations are generally colleges and universities [1-2]. The external assurance system leads, organizes, implements, and coordinates the higher education quality appraisal activities and supervises the internal quality assurance activities of higher education institutions, and the main organizations are generally the government and society [3-4]. Under the impetus of the marketization of higher education and the stimulation of the demand for human capital upgrading in the era of knowledge economy, the scale of higher education has been expanding, and the degree of popularization of higher education has been steadily increasing, which has triggered a series of new changes in the field of higher education. At the macro level, higher education continues to penetrate and participate in other areas of society, and the links and interactions between curriculum teaching, scientific research and social services are becoming increasingly close [5-7]. At the meso level, the traditional services provided by higher education institutions are unable to adapt to the increasing scale of educated people, and more flexible and diversified forms of higher education are needed to meet the increasing demand for education [8-10]. At the micro level, people's values of higher education are increasing and they pay more attention to the quality of higher education [11-12]. Therefore, there is an urgent need to construct an educational quality assurance system that covers rigorous quality assurance standards and enriched quality assurance content to provide more adaptable quality assurance services. And digital transformation is an important initiative for higher education quality assurance system to seize the opportunity of change in the digital era [13-15].

Literature [16] proposes an education quality management system including education service quality control and education result quality evaluation sub-systems, and argues the theoretical way of education quality assurance model by establishing an indicator system within the system. Literature [17] shows that a good education quality assurance system is conducive to enhancing the competitiveness of higher education and thus realizing sustainable socio-economic development, taking the European education field as an example, discussing the methods of developing a quality assurance system and exploring the impact of quality assurance on the education field. Literature [18] clarifies the importance of Key Performance Indicators (KPIs) in sustainable accreditation of higher education through case studies, in addition to that, data management systems that can process data extensively and generate relevant insights are also necessary in sustainable quality assurance systems in higher education. Literature [19] designed a digital higher education quality assurance application based on a needs assessment of quality assurance stakeholders, which provides quality assurance stakeholders with a visualization of the structure and content of the assessment program through the analysis of data from various aspects of the assessment program's indicators. Literature [20] developed an internal quality management process focusing on student program learning outcomes, which assesses the higher education quality assurance system through a three-step process of defining competencies, screening competencies, and enhancing competencies. Literature [21] used empirical analysis to examine the level of student interest in internal quality assurance in higher education and found that an increasing number of students were involved in evaluating faculty members and that the number of faculty members with excellent pedagogical methodology ratings increased. Literature [22] analyzed the big data challenges and legal framework constraints faced by China's higher education quality assurance model, and proposed a series of solutions to improve the quality assurance system, such as engaging faculty and students in quality management and allowing higher education institutions to engage in learning-oriented self-regulation.

The study takes faculty, management level, student quality and external monitoring as the influencing factors, proposes a theoretical model of higher education quality and related research hypotheses, and uses structural equation modeling to dig out the relationship between the variables and test whether the research hypotheses are valid. Subsequently, digital elements are integrated into the planning and

adjustment, teaching and learning implementation and health feedback processes of higher education to construct a digital-based higher education quality assurance system. From the seven dimensions of school direction, cultivation process, teaching resources utilization, faculty, student development, quality assurance and teaching effectiveness, the assessment index system of higher education quality assurance system is refined and the weights of each index are determined by AHP. Finally, a fuzzy comprehensive evaluation method is used to assess the practical effects of the quality assurance system of a university implementing the quality assurance system and to explore the applicability of the constructed quality assurance system.

2. Analysis of factors affecting the quality of higher education

2.1. Data sources

The study used self-designed college questionnaire data as the basic database. The survey was distributed to 800 questionnaires for teachers in a local university, and 642 questionnaires were recovered. In view of the structural equation analysis of the consistency and completeness of the database has higher requirements, before the questionnaire analysis, the database and do further data selection and organization, after rigorous hoof selection, remove missing data questionnaire and other invalid questionnaires a total of 185, and finally obtain the effective data of 457. This study will use these 457 valid data as the basic data source.

2.2. Theoretical Model and Research Hypotheses

2.2.1. Presentation of the theoretical model. This study takes the sample's evaluation of the quality of higher education as the dependent variable, and the school factors and extramural factors affecting the quality of higher education as the independent variables, thus proposing a theoretical model of the interrelationships between the factors, in which the evaluation of the quality of higher education in the dependent variable can be divided into two aspects, the evaluation of the quality of talent cultivation and the evaluation of the quality of higher education as a whole. Combined with the knowledge of higher education theory and the knowledge related to structural equations to construct the theoretical model, mainly including two dependent variables and four independent variables. The theoretical model of factors affecting the quality of higher education is shown in Figure 1, which includes six structural variables, namely, the quality of higher education Y1, the quality of talent cultivation Y2, the teaching team X1, the level of management X2, the quality of students X3, and the external monitoring X4. The unidirectional arrows between the variables denote the role of the independent variables in influencing the dependent variables.

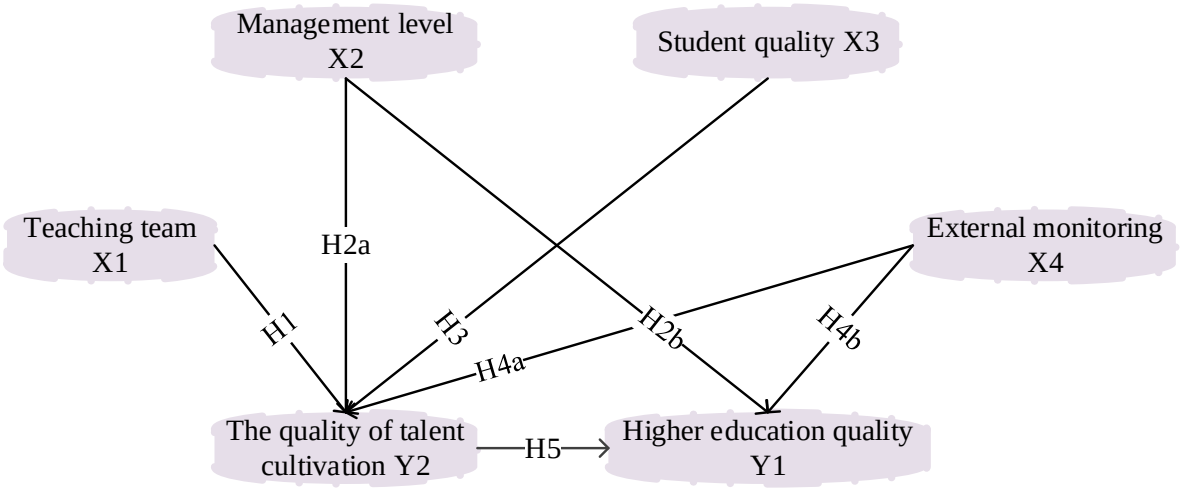

Fig. 1. Theoretical model of influence factor of higher education quality

2.2.2. Research assumptions of the model. Based on the theoretical modeling, the following hypotheses can be made:

H1: There is a positive correlation between the teaching team and the quality of talent cultivation.

H2a: There is a positive correlation between management level and the quality of talent cultivation.

H2b: There is a positive correlation between management level and quality of higher education.

H3: There is a positive relationship between student quality and the quality of talent cultivation.

H4a: There is a positive relationship between external monitoring and the quality of talent cultivation.

H4b: There is a positive relationship between external monitoring and quality of higher education.

H5: There is a positive correlation between the quality of talent cultivation and the quality of higher education.

2.3. *Structural equation modeling*

There are two main types of structural equation modeling variables, which are observed variables and latent variables. Observed variables are variables that can be directly observed and measured, and can also be referred to as explicit variables. Potential variables are variables that cannot be directly observed, which may be based on some theoretical assumptions or objective existence that cannot be precisely measured by current methods, but can be measured by other observed variables. This paper uses structural equation modeling to analyze the factors influencing the quality of higher education.

2.3.1. Forms of model representation:

1) Measurement model.

$$\begin{cases} X = \Lambda_x \xi + \delta \\ Y = \Lambda_y \eta + \varepsilon \end{cases} \tag{1}$$

In the measurement model, X, Y is the $(q \times 1), (p \times 1)$ vector in the manifest variable, ξ, η is the $(n \times 1), (m \times 1)$ vector in the latent variable, Λ_X, Λ_Y is the factor loading matrix of $(q \times n), (p \times m)$, δ, ε is the $(q \times l), (p \times l)$ error vector in the manifest variable, and η is assumed to be uncorrelated with the error terms ε, δ and the latent variable ε, as per standard SEM assumptions.

2) Structural modeling.

$$\eta = B\eta + \Gamma\xi + \zeta \tag{2}$$

From the measurement model and the structural equation model, it is known that in solving the structural equation model, the four coefficient matrices of $\Lambda_X, \Lambda_Y, B, \Gamma$ are actually solved. The model includes the following covariance matrices: $\Theta\delta$ for measurement errors of endogenous variables, $\Theta\varepsilon$ for measurement errors of exogenous variables, Φ for the exogenous latent variables, and Ψ for structural error terms (ζ).

2.3.2. Parameter estimation of the model. For the given data, the great likelihood estimation is the maximization of the likelihood function of the parameters. If variables χ and y both obey a normal distribution and S is an unbiased covariance matrix, then S obeys a Wishart distribution, the objective function is:

$$F = \ln|C| - \ln|S| + tr[SC^{-1}] - n \tag{3}$$

where n denotes the number of observed variables. Great likelihood estimation requires that the observed variables are normally distributed and continuous.

2.3.3. Overall model evaluation. The χ^2 statistic is one of the commonly used metrics when performing the evaluation of the overall model of structural equation modeling, $\chi^2=(N-1)F$. Where F is the minimum value of the objective function and N is the sample size. Model degrees of freedom $df=1/2\times(n+1)-t$. Where n denotes the number of observed variables and t the number of parameters to be estimated. For degrees of freedom, χ^2 a larger statistic indicates a worse fit of the model. However, when the sample size is large, the χ^2 statistic tends to easily reject the model that fits well with the data, whereby the model and the data can be considered to have a better fit if $\chi^2/df<5$ In order to be able to make use of the disadvantage of too large a sample size when carrying out the evaluation of the model's fitting effect, other fitting indexes have been developed: the absolute fitting index, the relative fitting index, the informatization criterion index, and the thrifty fitting index.

1) Absolute Fit Index. Commonly used indexes are Goodness of Fit Index (GFI), Adjusted Goodness of Fit Index (AGFI).

Goodness of Fit Index (GFI) and Adjusted Goodness of Fit Index (AGFI):

$$GFI=1-\frac{tr[(W^{-1}(S-C))^2]}{tr[(W^{-1}S)^2]} \tag{4}$$

$$AGFI=1-\frac{n(n+1)/2}{df}(1-GFI) \tag{5}$$

The two of the calibration values are used to represent the weighted proportion of the estimated variance in the sample variance. When the range is greater than 0.85, the fitting is better.

Root Mean Square Residual (RMR):

$$RMR=\left[2\sum_{i=1}^{n}\sum_{j=1}^{i}\left(s_{ij}-c_{ij}\right)^2/n(n+1)\right]^{\frac{1}{2}} \tag{6}$$

The Root Mean Square Residual (RMR) is a measure of the average fit residual and takes a value in the range of 0-1. The smaller the value the better, less than 0.08 indicates a better model fit.

Root Mean Square Error of Approximation (RMSEA):

$$RMSEA=\sqrt{\max\left(\frac{F}{df}-\frac{1}{N-1},0\right)} \tag{7}$$

The Root Mean Square Residual Error (RMSEA) is able to more accurately map the fit of the model, and the RMSEA is considered to be the most informative criterion. When the RMSEA is less than 0.08 it means the model fits better.

2) Relative Fit Index. Relative fit indices are obtained from the fitting of independent or saturated models. Commonly, there are canonical fit index (NFI), comparative fit index (CFI) and so on.

Normative Fit Index (NFI):

$$NFI=\frac{X_0^2-X^2}{X_0^2} \tag{8}$$

The canonical fit index (NFI) takes values between 0 and 1, where X_0^2 indicates the chi-square value of the model when all the parameters to be estimated are 0, and its in the degree of freedom df_0. It is generally accepted that a value greater than 0.80 indicates a better model fit, but the NFI does not control for the degree of freedom, and it is easy to underestimate the model when N is small.

Comparative Fit Index (CFI):

$$CFI = 1 - \frac{\max(\chi^2 - df, 0)}{\max(\chi_0^2 - df_0, 0)} \tag{9}$$

Comparative Fit Index (CFI) is also fitted by comparison of the model, CFI takes values in the range of 0-1, and greater than 0.80 indicates a better fit.

3) Thrift Fit Index. Based on in when the model has a better fit index, whether it is because the model constraints are less or the model fit is better the frugal fit index (PGFI) is proposed, PGFI greater than 0.5 indicates that the model is acceptable.

2.4. Structural equation modeling analysis

In this paper, a total of 457 valid questionnaires were retained by standardizing the questionnaires, and the model of factors influencing the quality of higher education was validated and analyzed using structural equations.

2.4.1. Model Fitting. The degree of model fit was analyzed in conjunction with the evaluation methods of structural equation modeling. The values of the test indexes for the overall goodness of fit of the model are shown in Table 1. The CFI of the model is 0.985 and the GFI is 0.936, which basically meets the evaluation criteria, indicating that the model fits well.

Table 1. The test index of the overall fitting of the model

Test content		Result	Evaluation standard
Absolute index	x^2	1535	
	df	541	
	x^2 / df	1.381	Less than 2 and is acceptable in 5
	p	0.029	Less than 0.05
	RESEA	0.036	Less than 0.08
	GFI	0.936	Greater than 0.85
	RMR	0.025	Less than 0.08
	AGFI	0.921	Greater than 0.85
Relative index	CFI	0.985	Greater than 0.80
	NFI	0.997	Greater than 0.80
Simple index	PGFI	0.841	Greater than 0.50

2.4.2. Model evaluation. The model evaluation is mainly a judgment of the reasonableness and significance of the parameters, the size of the path coefficients between the latent variables and the fitting index. In this paper, we have to use the software to run the structural equation model, and the path coefficients between the latent variables are shown in Table 2. The path coefficients between the latent variables according to are in the range of 0.08 to 0.46, which are all greater than 0, and the paths between the variables are all significant at the 1% level, indicating that the hypotheses made in this paper are all verified. Teaching team X1, management level X2, student quality X3, and external monitoring X4 have a significant positive effect on the quality of talent cultivation Y2, and there is a positive correlation between management level X2, external monitoring X4and the quality of talent cultivation Y2 and the quality of higher education Y1.

Table 2. The path coefficient between the latent variables

Hypothesis path	Path coefficient	T value	P value	Significance
X1→Y2	0.32	7.306	0.009	Significant
X2→Y2	0.30	5.353	0.006	Significant
X3→Y2	0.12	3.289	0.003	Significant
X4→Y2	0.08	5.448	0.004	Significant
X2→Y1	0.31	2.404	0.005	Significant
X4→Y1	0.09	3.213	0.008	Significant
Y2→Y1	0.46	6.053	0.001	Significant

According to the model, analyze the influence of each influential factor on the quality of colleges and universities, the quality of higher education and the relationship between these two influence size, the influence of the relationship between each variable is shown in Table 3. Teacher team, student quality, management level and external monitoring have a direct impact on the quality of talent cultivation in colleges and universities, and the teacher team has the greatest direct impact on the quality of talent cultivation, amounting to 0.32. The management level and external monitoring have a direct impact on the quality of higher education, with an impact capacity of 0.31 and 0.09.

Teaching staff and student quality indirectly affect the quality of higher education by influencing the quality of talent cultivation, with an influence capacity of 0.1472 and 0.0552, respectively. Management level and external monitoring not only have a direct impact on the quality of higher education, but also have an indirect impact on the quality of higher education through the impact on the quality of talent cultivation, with an indirect impact capacity of 0.1380 and 0.0414 respectively.

Overall, the degree of influence of each factor on the quality of higher education is as follows: management level is the highest, with an influence capacity of 0.4380, faculty is the second, with an

influence capacity of 0.1472, external monitoring is the second, with an influence capacity of 0.1214, and the influence of students' quality is relatively weaker, with an influence capacity of 0.0552. In a word, the teachers, , the management activities and are the important parts of the educational activities, and the influence on the quality of higher education is also the most important. Activities and have some direct or indirect influence on the quality of higher education.

Table 3. The influence between variables

Influence factors	Effect	Endogenous variable	
		The quality of talent cultivation	The quality of higher education
Teacher team X1	Direct effect	0.32	0
	Indirect effect	0.00	0.32*0.46
	Total effect	0.32	0.1472
Engagement level X2	Direct effect	0.30	0.31
	Indirect effect	0.00	0.30*0.46=0.1380
	Total effect	0.30	0.4380
Student quality X3	Direct effect	0.12	0
	Indirect effect	0.00	0.12*0.46
	Total effect	0.12	0.0552
External monitoring X4	Direct effect	0.08	0.09
	Indirect effect	0.00	0.09*0.46=0.0414
	Total effect	0.08	0.1214

3. Construction of a digitization-based quality assurance system for higher education

Based on the background of the era of digitization, combined with the above analysis of the factors affecting the quality of higher education, the quality assurance system of higher education is constructed. The quality assurance system of higher education based on digitalization is shown in Figure 2, which contains three processes and eight dimensions throughout planning and adjustment, teaching implementation, monitoring and feedback.

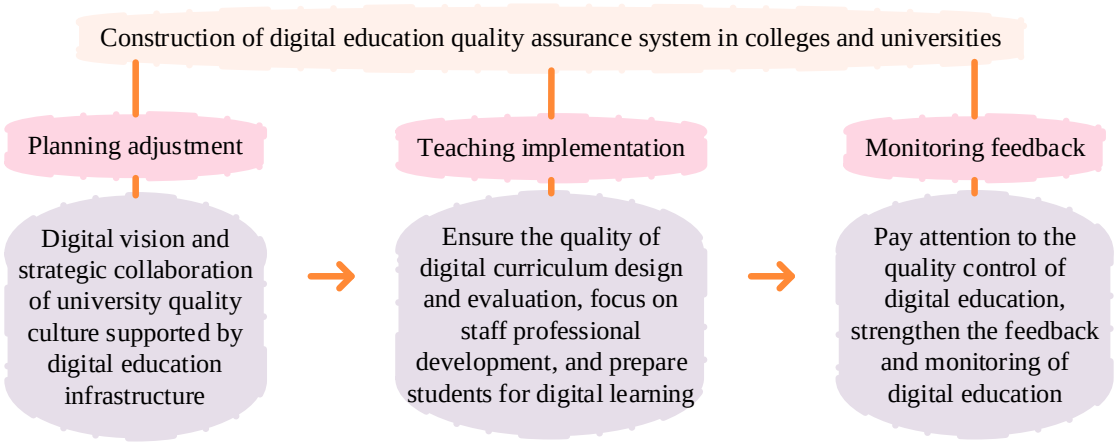

Fig. 2. Digital education quality assurance system

3.1. Planning and adjustment

In order to achieve high quality education, universities need to use digital technology to develop an organizational strategic plan for the quality assurance system in higher education.

1) Vision, mission and strategy. Colleges and universities must communicate with key stakeholders, such as students, faculty, administrators, and support providers, about digital teaching and learning and related quality assurance policies, procedures, and guidelines to ensure that the educational vision is fully implemented and integrated into the existing quality assurance system.

2) Collaborative quality culture in higher education. The ultimate goal of quality assurance is to "move from an existing control framework to a culture-creating framework and to integrate quality assurance activities into the organizational culture and daily practices". First, select the right people to lead and support quality assurance. Second, introduce policies to encourage multiple groups to engage in quality assurance. Third, identify processes and resources for quality assurance of digital curriculum and instruction.

3) Educational Infrastructure Support. Making high-quality digital education infrastructure support services available to all students, teachers and administrators is the foundation of quality assurance. Educational infrastructure specifically includes tools and resources used in the teaching and learning process, and there should be stable maintenance and support staff who can resolve technical and privacy issues when students and teachers use the tools and resources.

3.2. Teaching and learning implementation

The implementation of quality assurance in education involves the development of policies and processes in three areas: first, to ensure the quality of digital curriculum content, design, implementation and assessment; second, to support and motivate professional development of staff; and third, to support students' use of digital technologies for learning.

1) Curriculum design and assessment. First, to ensure the quality of course content, in order to improve the quality, diversity and interactivity of course content, develop and integrate catechism or open educational resources into the school curriculum system. Second, to conduct high-quality and strongly inclusive digital curriculum design. Third, use digital technology to enhance the interactivity of the course and student participation. Fourth, ensure credible and authentic online assessment of courses. Fifth, engaging students and faculty in the development and regular review of online course design, instruction, and assessment is an effective way to improve course quality and overall student experience and learning outcomes.

2) Support and incentivize staff professional development. First, colleges and universities need to strengthen their teams of educational digitization workers and technical support staff. Second, support professional development and digital skills assessment for faculty and staff. Teacher professional development centers can be established and used to support the improvement and professionalization of teachers' teaching practice skills.

3) Digital Learning. Colleges and universities can try a blended and flexible education model to tailor learning programs to students' individual circumstances and preferences. Students are supported to use digital technology for learning and to improve their independent learning and digital learning skills.

3.3. Monitoring and feedback

Educational quality assurance is a cyclical process, and it is very important for colleges and universities to monitor the collection of quality assurance data and the corresponding implementation feedback in the process of teaching and learning implementation.

1) Emphasis on education quality monitoring. Colleges and universities can initiate an internal review of the quality of digital courses. In addition to self-assessment and internal review, external review is also an important way for colleges and universities to safeguard their educational quality, and they can actively seek external professional bodies or organizations to help them monitor the quality of teaching on campus.

2) Strengthening Educational Feedback and Monitoring. In monitoring the quality of education, more and more colleges and universities are using digital technology to monitor and feedback teaching practice data. Among them, learning analytics data generated by online learning platforms is an effective way for HEIs to use as evidence for quality determination. In addition, learning analytics data can be used to enhance support for student learning.

4. Effectiveness of the quality assurance system in practice in higher education

Based on the constructed digital higher education quality assurance system, taking a certain university implementing the quality assurance system as a sample, with the help of fuzzy comprehensive evaluation method, a higher education quality assurance evaluation model is established to assess the implementation effect of the constructed digital higher education quality assurance system.

4.1. Evaluation indicators

The content of quality assurance in higher education can be divided into seven major parts: orientation, training process, utilization of teaching resources, faculty, student development, quality assurance and teaching effectiveness. The assessment indicators of the higher education quality assurance system are shown in Table 4, covering seven primary indicators and twenty-seven secondary indicators.

Table 4. Evaluation index of the high education quality assurance system

Primary index	Symbol	Secondary index	Symbol
Running direction	A1	School idea	B1
		School target	B2
		Talent training target	B3
Talent training process	A2	Training plan	B4
		Professional construction	B5
		Practical teaching	B6
		Classroom teaching	B7
		Excellence cultivates	B8
		Innovation entrepreneurship education	B9
Teaching resource utilization	A3	Facility condition	B10
		Resource construction	B11
Teacher team	A4	Teacher virtue	B12
		Teaching ability	B13
		Teaching input	B14
		Teacher development	B15
Student development	A5	Ideal belief	B16
		Academic achievement and comprehensive quality	B17
		International vision	B18
		Support service	B19
Quality assurance	A6	Quality management	B20
		Quality improvement	B21
		Quality culture	B22
Teaching performance	A7	Achievement degree	B23
		Fitness degree	B24
		Assurance degree	B25
		Validity degree	B26
		Satisfaction	B27

4.2. Determination of indicator weights

Based on the evaluation indexes of higher education quality assurance system, combined with the requirements of AHP, the "Questionnaire on the Importance Degree of the Evaluation Indicators of Higher Education Quality Assurance System" was formulated, and 15 expert teachers were surveyed, 15 questionnaires were issued, 14 valid questionnaires were retrieved, and the recovery rate was 93.33%.

The results of the weights of each indicator are shown in Fig. 3, and in the color interval, the blue color indicates that the weight of the indicator is smaller, the green color indicates that the weight is moderate, and yellow indicates that the weight of the indicator is large. The weights of direction A1, cultivation process A2, teaching resources utilization A3, teacher team A4, student development A5, quality assurance A6 and teaching effectiveness A7 are 0.0138, 0.2336, 0.0734, 0.1335, 0.1439, 0.0785, 0.2233. Among them, the cultivation process A2 and teaching effectiveness A7 are the most heavily weighted, both of them above 0.2, followed by student development A7, and student development A7. or more, followed by student development A5 and faculty A4.Among the secondary indicators, the weights of attainment B23 and academic achievement and comprehensive quality B17 are greater than 0.06, which have the greatest influence on the effect of the quality assurance system of higher education.

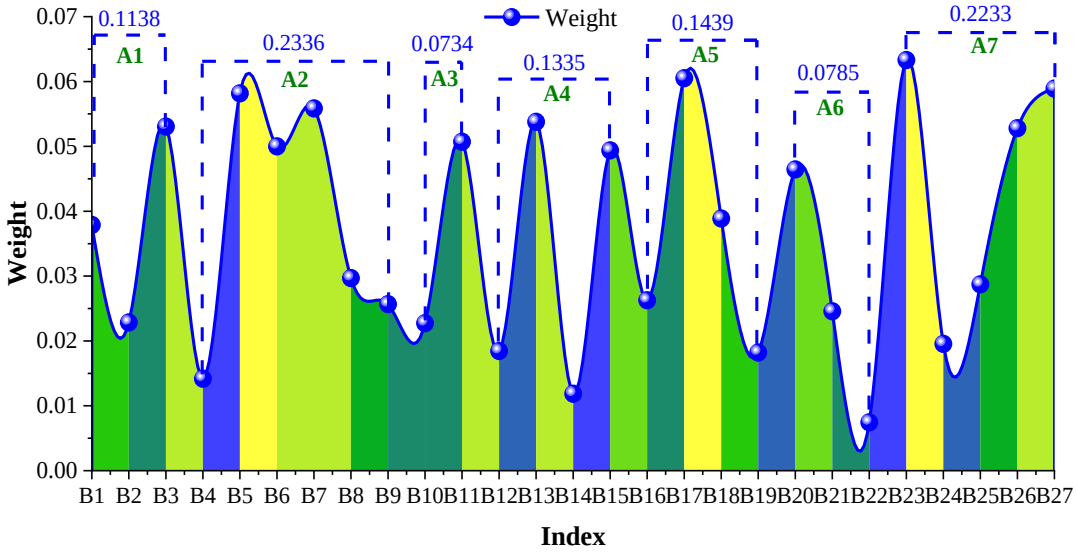

Fig. 3. The weight of each index

4.3. *Evaluation modeling*

4.3.1. Fuzzy integrated evaluation model. B is the result of fuzzy comprehensive evaluation, A is the set of fuzzy evaluation factor weights, and R is a fuzzy relationship from U to V. In this paper, the second level fuzzy comprehensive evaluation is used then its mathematical model is:

$$B = A \cdot R = A \cdot \begin{bmatrix} B_1 \\ B_2 \\ M \\ B_i \end{bmatrix} = A \cdot \begin{bmatrix} A_1 \cdot R_1 \\ A_2 \cdot R_2 \\ M \\ A_i \cdot R_i \end{bmatrix} = (b_1, b_2, L \quad, b_m) \tag{10}$$

4.3.2. Determination of fuzzy operators. $B = A \cdot R$ is a fuzzy subset on V:

$$b_j = \vee(a_k \wedge k_j), k = 1,2,\mathrm{L}\,,n,\ j = 1,2,\mathrm{L}\,m \tag{11}$$

If the result of the judgment is $\sum_{i=1}^{m} b_i \neq 1$, the result is normalized and set to $b_j = \max\{b_1, b_2, \Lambda, b_m\}$, then the combined result of the judgment is to make a decision about the thing b_j. Depending on the different definitions of the operations, various different decision models are obtained:

Model I: $A(\wedge, \vee)$

At this point:

$$b_j = max\{(a_i \wedge r_{ij}), l \le i \le n\},\ j = 1,2,\Lambda\,,m \tag{12}$$

$$a_i = \frac{na_i}{m\sum_{i=l}^{n} a_i}, i = 1,2,\Lambda\,,n \tag{13}$$

Model II: $M(\cdot, \vee)$

The model uses two operations: one is the ordinary multiplication operation, denoted by -. The other is the take large operation, denoted by V. At this point:

$$b_j = max\{(a_i \cdot r_{ij}), l \le i \le n\},\ j = 1,2,\Lambda\,,m \tag{14}$$

Model III: $M(\cdot, +)$

At this point:

$$b_j = \sum_{i=l}^{n} a_i \cdot r_{ij},\ j = l, 2, \Lambda, m, \sum_{i=l}^{n} a_i = l \tag{15}$$

Model 4: $M(\cdot, \oplus)$ The model is used to calculate b_j as:

$$b_j = \sum_{i=1}^{n} a_i \cdot r_{ij},\ j = 1, 2, \Lambda, m \text{ or } b_j = \min\left[I, \sum_{i=1}^{n} a_i \cdot r_{ij} \right],\ j = 1, 2, \Lambda, m \tag{16}$$

Model V: $M(\wedge, \oplus)$

$$b_j = \min\left[1, \sum_{i=1}^{n} a_i \wedge r_{ij} \right],\ j = 1, 2, \Lambda, m \tag{17}$$

Model VI: $M(\wedge, \otimes)$

At this point:

$$b_j = \underset{i=1}{n}(r_{ij}^{a_i}),\ j = l, 2, \mathrm{L}, m \tag{18}$$

4.3.3. Treatment of evaluation indicators. After obtaining the evaluation indicator $b_j (j = 1, 2, \ldots, m)$, the specific result of the evaluation object can be determined according to the method of maximum affiliation.

The alternative element V_L corresponding to the largest evaluation indicator $ma \times b_j$ is taken as the result of the evaluation, i.e.:

$$V = (V_L \mid V_L \to maxb_j) \tag{19}$$

Gray correlation:

$$\begin{aligned} &\eta_{ij}(k) = \frac{*\min \Delta_i(k) + \rho_{*\max} \Delta_i(k)}{\Delta_i(k) + \rho_{*\max} \Delta_i(k)} \\ &\rho \in (0,1) \\ &\Delta_{ij}(k) = \mid A_j^{'}(k) - A_i^{'}(k) \mid \\ &\eta_{ij} = \frac{1}{k} \sum_{1}^{k} \eta_{ij}(k) \\ &n = 1, 2, \Lambda, n \end{aligned} \tag{20}$$

4.4. Survey respondents

Selected a digital education quality assurance system of colleges and universities, its education quality assurance system research, distribution of 863 questionnaires, returned 784 questionnaires, the questionnaire recovery rate of 90.85%, of which 703 valid questionnaires, questionnaire effective recovery rate of 89.67%.

Using the form of network questionnaire, with the help of higher education quality assurance system evaluation index system, requiring each teacher or student in each indicator "evaluation level" column check the college in the indicator should be rated level, each indicator rating for excellent [10, 9], good [8,9), medium [7,8), to be improved [6, 7).

4.5. Evaluation results

Based on the fuzzy comprehensive evaluation method, the evaluation results of the education quality assurance system of the sample universities are statistically calculated, and different indicators get different scores, and the scores of the indicators of the education quality assurance system are shown in Fig. 4, and

in the color interval, the blue color indicates that the weight of the indicator is small, the green color indicates that the weight is moderate, and the yellow color indicates that the indicator has a large weight. The scoring coefficients of the indicators of the education quality assurance system of the sample colleges and universities are, from highest to lowest, teaching effectiveness A7 (8.7341), student development A5 (8.7000), quality assurance A6 (8.3750), faculty A4 (8.2476), utilization of teaching resources A3 (8.1810), cultivation process A2 (7.7334), and direction of schooling A1 (7.5498). The scores of the two indicators of teaching effectiveness and student development of the sample colleges are higher than 8.7, corresponding to a good evaluation grade. The overall score of the education quality assurance system of the sample colleges and universities is 8.227, indicating that the practice of the higher education quality assurance system under the digitalization condition is relatively satisfactory, and the overall quality of the colleges and universities under this quality assurance system is at a good level.

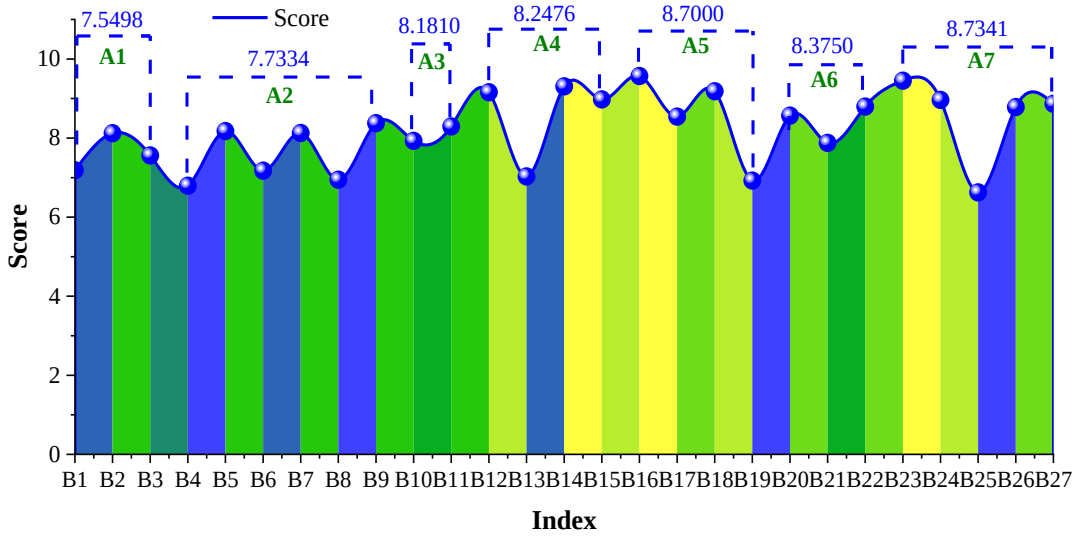

Fig. 4. Each index score of education quality assurance system

5. Conclusion

The development of higher education in colleges and universities has ushered in new opportunities in the digital era. The study combines structural equation modeling to mine the influencing factors of higher education quality, on the basis of which a digitalization-based higher education quality assurance system is constructed. The feasibility of the constructed quality assurance system is explored by evaluating the practical effect of the quality assurance system in a university.

The hypotheses proposed in this paper are all tested, and the coefficients of each path of the structural equation model are all greater than 0, and the significance is less than 0.01. That is, the teacher team, the management level, the quality of students, and the external monitoring can positively affect the quality of higher education, among which the management level and the teacher team have the greatest influence on the quality of higher education, and the overall influence effect is 0.4380 and 0.1472.

In the quality assurance system of higher education based on digitalization, colleges and universities need to integrate the elements of digital education into the existing quality assurance system of colleges and universities, focusing on the three processes of "planning and adjustment of digital education, teaching implementation, and monitoring and feedback of education quality".

The overall rating of the quality of education in the sample universities is 8.227 points, which is a good grade. Among them, teaching effectiveness (8.7341) and student development (8.7000) are the best performers, and five out of the seven dimensions of their education quality assurance system have scores of 8.0 or above, indicating that the quality assurance system of higher education based on digitization has achieved good practical results.

Digitization of higher education is a global trend and a collision and integration of technology and education. Colleges and universities should strengthen the top-level planning of digital education and the construction of collaborative culture, improve the cultivation of digital literacy of teachers and students and service support, and utilize digital technology for education quality monitoring and feedback to drive the continuous improvement of education quality.

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