



Quantitative Analysis of Educational Informatization Evaluation

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Abstract. With the implementation of the “education informatization 2.0 action plan”, high-quality and continuous promotion of college informatization construction has become an inevitable requirement for deepening education reform. The social attention of online teaching has further condensed the consensus of accelerating the construction of school informatization. Information technology is promoting the comprehensive reform of education management mode, which is of great significance to promote the development and connotation construction of education. Evaluating the level of educational informatization construction can provide an important basis for decision-making of informatization construction. Constructing scientific and effective quality evaluation methods plays an important role in improving the level of information construction. In this paper, the analytic hierarchy process and fuzzy comprehensive evaluation method are used to quantitatively analyze the informatization evaluation indicators. At the same time, some suggestions are given for the deep integration of information technology and education.

Keywords: Information technology · Educational informatization · Quantitative analysis

1 Introduction

Educational informatization is the basic connotation and remarkable feature of educational modernization, and it is the key content and important symbol of “educational modernization 2035”. It is of great significance to build an educational power to support and lead the modernization of education with the support of educational informatization. China’s educational informatization has basically completed the two stages of start-up and application, and is about to enter a new stage of integration and innovation.

The development of mobile internet, big data, cloud computing and other information technologies has provided opportunities for the development of educational informatization. Information technology is one of the core elements of the reform of educational modernization. How to seek the forward force point and future trend of educational informatization is an important topic today.

At present, information technology for education is still a simple application at the tool level. The reform of education and teaching mode and the reconstruction of school

management system supported by information technology have rarely occurred. The revolutionary impact of information technology on the development of education has not been fully demonstrated.

In 2018, the “education informatization 2.0 action plan” issued by the Ministry of education proposed to continue to promote the deep integration of information technology and education, promote the improvement of teaching, optimize management and improve performance [1]. We should accurately understand the remarkable characteristics of education informatization 2.0, and promote the innovative development of informatization education with the structural reform supported by information technology.

Information technology provides unprecedented opportunities for the reform and innovation of teaching environment and teaching mode, students’ autonomous learning and interactive communication, and the co construction and sharing of teaching resources. The deep integration of information technology and education can optimize the educational resource system, build a new learning environment, reform the teaching mode and reconstruct the student knowledge system, and can provide a rich and colorful educational environment and powerful learning tools for the learning and development of teachers and students. Information technology is conducive to the transformation of educational ideas and the management of educational resources, and is conducive to the cultivation of innovative talents and the improvement of educational quality.

Without the development of information technology, it is impossible to promote the realization of educational informatization, and even more impossible to realize educational modernization. The development of educational informatization is inseparable from scientific and comprehensive evaluation. Peter F. Drucker, a famous management master, once said, “if you can’t measure, you can’t manage”, emphasizing the significance of evaluation to management. Scientific evaluation of educational informatization can provide decision-making basis for informatization construction, measure the level of informatization construction, and guide the rapid and healthy development of educational informatization construction.

At present, there are still many problems in the evaluation of educational informatization, mainly including: the evaluation index system is imperfect, the evaluation method is unscientific, the evaluation standard is chaotic, the evaluation quality is not high, and so on. Especially in the evaluation method, it focuses on qualitative evaluation and ignores quantitative evaluation. Qualitative evaluation is highly subjective, while quantitative evaluation is highly logical, with a high degree of standardization and accuracy. It can accurately analyze the causal relationship of objective phenomena, and the conclusion is more objective and scientific.

This paper uses the principle of fuzzy mathematics to evaluate and quantify the construction level of educational informatization, which can accurately evaluate the application level of information technology in educational management, and provide decision-making basis for better integration of information technology and education.

2 Quantitative Analysis of Educational Informatization Evaluation

2.1 Construction of Evaluation Indicators

By analyzing and comparing the survey data of relevant higher vocational colleges, and based on the principle of seeking common ground while reserving differences, the evaluation of educational informatization is summarized into five main indicators, namely, informatization mechanism, informatization infrastructure, informatization management, informatization teaching and informatization service.

The five indicators were evaluated by consulting experts and questionnaires. According to the scoring rules, a grade score is given, which is divided into five grades {A, B, C, D and E} from high to low, representing the corresponding comment sets as {very good, good, average, poor and very poor}. Six colleges were selected to evaluate the importance of their indicators. The specific results are shown in Table 1.

2.2 Quantitative Treatment of Evaluation Indicators

Fuzzy comprehensive evaluation method can quantify some factors with unclear boundaries and difficult to quantify, which is suitable for solving all kinds of uncertain problems [5]. This paper uses this method to quantify the grade score of each college. The corresponding values of A, B, C, D and E are {5, 4, 3, 2 and 1}. According to the actual situation, the membership function of partial large Cauchy distribution is as follows [2]:

$$f(x) = \begin{cases} [1 + \alpha(x - \beta)^{-2}]^{-1}, & 1 \leq x \leq 3 \\ a \ln x + b, & 3 < x \leq 5 \end{cases}$$

Among them, α , β , a, b is the undetermined constant. In fact, when the evaluation is “very good”, the membership degree is 1, that is, $f(5) = 1$; When the evaluation is “average”, the membership degree is 0.8, that is, $f(3) = 0.8$; When the evaluation is “very poor”, the membership degree is 0.01, that is, $f(1) = 0.01$; Thus, it can be determined

Table 1. Evaluation grade of educational informatization

Colleges	Informatization mechanism I1	Informatization infrastructure I2	Informatization management I3	Informatization teaching I4	Informatization service I5
1	A	B	C	B	C
2	C	A	C	A	B
3	B	C	D	A	B
4	B	C	A	B	D
5	C	B	B	A	D
6	D	A	B	C	C

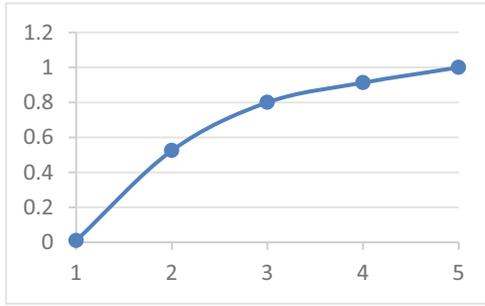


Fig. 1. Membership function graph

that $\alpha = 1.1086$, $\beta = 0.8942$, $a = 0.3915$, $b = 0.3699$. Bring it into the above equation, and the membership function is:

$$f(x) = \begin{cases} [1 + 1.1086(x - 0.8942)^{-2}]^{-1}, & 1 \leq x \leq 3 \\ 0.3915 \ln x + 0.3699, & 3 < x \leq 5 \end{cases}$$

The membership function graph is shown in Fig. 1.

After calculation, $f(2) = 0.5245$, $f(4) = 0.9126$. Then the quantitative values of evaluation grades {A, B, C, D} are {1.0, 0.9126, 0.8, 0.5245}. According to Table 1, we can get the quantitative values of the five evaluation indicators of each college. Synthesize the quantitative evaluation values of six colleges to obtain an evaluation matrix, which is recorded as $R = (r_{ij})_{6 \times 5}$, as shown below.

$$\begin{bmatrix} 1.0 & 0.9126 & 0.8 & 0.9126 & 0.8 \\ 0.8 & 1.0 & 0.8 & 1.0 & 0.9126 \\ 0.9126 & 0.8 & 0.5245 & 1.0 & 0.9126 \\ 0.9126 & 0.8 & 1.0 & 0.9126 & 0.5245 \\ 0.8 & 0.9126 & 0.9126 & 1.0 & 0.5245 \\ 0.5245 & 1.0 & 0.9126 & 0.8 & 0.8 \end{bmatrix}$$

2.3 Determination of Weight Value of Evaluation Indicators

The five evaluation indicators in Table 1 have different degrees of influence on the construction of educational informatization. Therefore, their weights must be determined. Analytic hierarchy process (AHP) is a multi-objective decision-making analysis technology combining qualitative and quantitative analysis. It has the characteristics of simple method, strong logic and high reliability. It can be used to determine the weight of each index [4].

AHP method compares five evaluation indexes in pairs and assigns values according to their relative importance, uses the nine degree measurement method to establish the corresponding comparison matrix (as shown in Table 2), and then uses the geometric average method to analyze the data and calculate the weight. After calculating the

Table 2. Comparison matrix and weight

	I1	I2	I3	I4	I5	Weight
I1	1	1/5	1/3	1/4	1/2	0.061
I2	5	1	3	1	4	0.352
I3	3	1/3	1	1/5	1/2	0.104
I4	4	1	5	1	3	0.356
I5	2	1/4	2	1/3	1	0.127

Note: Maximum eigen value $\lambda_{max} = 5.21$; Consistency ratio C.R. = 0.047

maximum characteristic root of the comparison matrix, it needs to do the consistency proportion test. After the test is qualified, the normalized characteristic vector of the comparison matrix can be used as the weight vector [3]. The relevant calculation process is complex, so it is recommended to use simple Matlab programming. The reference program is as follows:

```
A=[1 1/5 1/3 1/4 1/2;5 1 3 1 4;3 1/3 1 1/5 1/2;4 1 5 1 3;2 1/4 2 1/3 1]
a=eig(A)
[X,D]=eig(A)
a1=a(1,:)
a2=X(:,1)
a3=ones(1,5)
a4=a3*a2
w=1/a4*a2
ci=(a1-5)/4
cr=ci/1.12
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In the above procedure, a1 represents the maximum eigenvalue, cr represents the consistency ratio, and w represents the eigenvector, that is, the calculated weight vector.

Through calculation, the weight of each evaluation index is shown in Table 2. The consistency ratio C.R. < 0.1 in the table indicates that the comparison matrix is consistent. Otherwise, it is considered that the deviation of the matrix is too large and needs to be corrected and assigned again until the consistency is met.

As can be seen from Fig. 2, I4 and I2 rank first in the weight. This shows that informatization teaching and informatization infrastructure have a great impact on the construction of educational informatization, and we need to strengthen the construction of these two aspects. The low weight of I5 and I1 does not mean that the impact of informatization service and informatization mechanism on the construction of educational informatization can be underestimated, but only that these two aspects have not received due attention. Although they are in line with general expectations, from the perspective of the development trend of education, this is not conducive to the development of educational informatization, and the development of educational informatization should be a comprehensive, balanced and sustainable development.

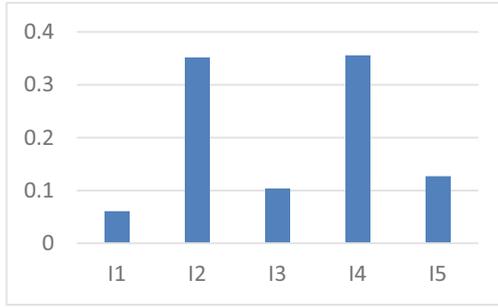


Fig. 2. Histogram of evaluation index weight

Table 3. Final quantitative score and ranking of evaluation indicators

Colleges	1	2	3
Quantitative score	0.892	0.956	0.864
Ranking	2	1	5
Colleges	4	5	6
Quantitative score	0.833	0.888	0.865
Ranking	6	3	4

2.4 Determination of Final Score of Evaluation Index

According to the calculated weights of each index, the final scores of the five evaluation indexes are further calculated. The scores of the six colleges can be expressed as:

$$A_i = \sum_{j=1}^5 \omega_j r_{ij} (i = 1, 2, \dots, 6)$$

Among them, ω is the corresponding weight.

After Excel list calculation, the final quantitative scores and ranking of the evaluation indicators of the six colleges are shown in Table 3.

The level of informatization construction reflects the pattern of talent training and the level of running a school. As can be seen from Table 3, college 2 ranks first, indicating that the level of educational informatization construction of this college is high. However, the college has a general performance in informatization mechanism and informatization management, so it is necessary to strengthen the construction of these two aspects to make the informatization construction comprehensively balanced and sustainable development.

The fundamental purpose of quantitative analysis of educational informatization is to measure the application level of information technology, find short boards, and provide data support and decision-making basis for the further integration of information technology and education.

3 Countermeasures to Promote the Application of Information Technology in Education

Although China has made outstanding achievements in the construction of educational informatization in recent years, there are still shortcomings and many problems in the level of educational informatization. It is necessary to reengineer the whole process of education, fully stimulate the revolutionary impact of information technology on education, and promote the renewal of educational concepts, model reform and system reconstruction.

We should promote the construction and application of digital campus and improve the level of campus intelligence. We should build a complete network infrastructure and a long-term mechanism for network operation and maintenance. We should comprehensively use big data, internet of things, cloud computing and other technologies to build an intelligent platform integrating teaching, management and service, and realize the transformation from environmental data to data environment through data collection and automatic analysis of information.

We should explore new teaching forms and pay attention to the personalization, collaboration and diversification of education in the intelligent space environment. Use information technology to reform the talent training mode, encourage personalized analysis of students based on big data, formulate personalized training programs that meet the development needs of students, and realize the organic combination of large-scale education and personalized training in the form of intelligent collaboration and virtual teaching.

Creating an information-based teaching environment is the main content of the deep integration of information technology and education. To deepen the integrated development of information technology and education, we need to build a new learning environment supported by information technology. Teachers can use the advantages of modern information technology, such as integration, digitalization, controllability and openness, to overcome the shortcomings of traditional education and promote the application of information technology in education and teaching. We should create an information-based teaching environment, reform the teaching concept and teaching mode, optimize the teaching process, and meet the needs of high-quality talent training.

We should use information technology to digitally transform the whole teaching process, optimize and integrate teaching resources, break information barriers, and realize the sharing and co construction of resources. To speed up the training of information-based teachers, we should establish the concept of digital teaching among teachers and promote digital teaching.

We should speed up the construction of the cloud service system of digital education resources and provide convenient and fast services for learners to enjoy high-quality digital education resources. We should make full use of information technology to create a new education mode of networking, digitization, mobility, personalization and intelligence, that is, digital learning mode. We should innovate the format of education services, and advocate the accurate promotion of customized education services in the form of online learning.

We should adapt to the development of 5G network technology and speed up the construction of intelligent learning system for the next generation network. We should

use information technology and big data technology to speed up the construction of intelligent learning spaces such as online intelligent classrooms and virtual factories, and form an intelligent learning system.

We should improve the top-level design of education management informatization, deepen the application of education big data, and improve the informatization level of education management. We should use information technology to reform the traditional education service mode, develop a new education service mode based on the Internet, and strive to build a networked, digital, personalized and lifelong education system to achieve more open, equal and sustainable education.

We should use information technology to reform the way of education governance, and pursue accurate education management and scientific decision-making based on big data. A modern educational management and monitoring system will be formed on the basis of intelligent information management system. Optimize the information network security environment to ensure the safety and reliability of the network education environment.

4 Conclusions

At present, China's education informatization has entered the 2.0 era. Using information technology to promote educational reform will become the new normal of education. Promoting the deep integration of information technology and education, leading educational reform and innovation, and improving educational quality are the essential requirements for the sustainable and ecological development of vocational education.

As connotative development has become the main theme of educational development, educational informatization must also take the road of connotative development. Establishing a scientific evaluation system and carrying out quantitative analysis is of great significance for the connotative development of educational informatization. It can effectively reflect the development status of educational informatization, diagnose the bottleneck of educational informatization development, and promote the gradual improvement of educational informatization level.

In the future, the development of educational informatization must completely get rid of the development idea based on the application of technology, take the promotion of educational innovation as the starting point and foothold, truly show the technical power in educational reform, and constantly create new forms of future education through the innovative application of information technology.

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