Journal of Contemporary Educational Research, 2025, Volume 9, Issue 1
http://ojs.bbwpublisher.com/index.php/JCER
ISSN Online: 2208-8474
ISSN Print: 2208-8466

Construction of Vocational Education Quality Evaluation Index System from the Perspective of Digital Transformation Based on the Analytic Hierarchy Process of Higher Vocational Colleges in Hainan Province, China

Limei Fu*

Hainan Vocational University of Science and Technology, Haikou 571126, Hainan Province, China

***Corresponding author:** Limei Fu, orange2022155009@163.com

Abstract: In the context of the digital transformation of vocational education, a quality evaluation index system has been constructed. Based on a questionnaire survey conducted among higher vocational colleges and enterprises in Hainan Province, it has been found that the quality of vocational education generally depends on the talent training program and professional construction at the macro level. At the meso level, the teacher level and teaching environment are critical, while at the micro level, the evaluation of talent training quality cannot be underestimated. Strategies for quality improvement in vocational education are proposed from the perspectives of talent training programs, major construction, teacher development, teaching environment, and talent training quality, all under the lens of digital transformation.

Keywords: Digital transformation; Vocational education; Evaluation index system

Online publication: February 14, 2025

1. Introduction

China's vocational education is currently undergoing a critical period of reform and development, with various regions and colleges actively exploring pathways for digital transformation. The "Vocational Education Quality Improvement Action Plan (2020–2023)" issued by the Ministry of Education emphasizes accelerating the informatization process of vocational education, building intelligent teaching environments, and cultivating high-quality skilled talents to meet the needs of the new era. Establishing a quality evaluation index system for vocational education in the context of digital transformation has become an urgent and important task.

2. Practical exploration of constructing a vocational education quality evaluation index system in the context of digital transformation

2.1. Construction and design of the vocational education quality evaluation index system

In the context of digital transformation, the quality evaluation of higher vocational education is constructed and designed through a rigorous and scientific process. This includes analyzing teaching problems using literature review and theoretical research. The evaluation draws on the Annual Report on the Quality of Higher Vocational Education in Hainan Province, the China Education Monitoring and Evaluation Statistical Index System (2020 Edition), and the Social Adaptability Assessment Report on Higher Vocational Colleges. Expert consultation in Hainan Province further refines this approach. Focusing on macro-level professional construction and talent cultivation, meso-level training processes, and micro-level training quality, the evaluation incorporates digital teaching elements. It aims to reshape and refine indicators, ensuring they are scientific, quantifiable, operable, and verifiable [1].

2.2. First-level evaluation index design

Building on an in-depth analysis of existing evaluation systems, consultations with vocational education experts, and principles such as operability, comparability, and importance, a three-level index system is proposed. This system evaluates the quality of digital education in vocational colleges based on macro, meso-level, and micro-level elements.

2.3. Macro secondary index design

The Professional Talent Training Program serves as the foundational document for guiding teaching management. It outlines training objectives, specifications, processes, and modes while providing a basis for resource allocation, task scheduling, and activity organization. Strengthening professional construction is essential to meet diverse talent demands in the new era and improve the quality of vocational education. The macro-level evaluation focuses on the ability of vocational education to contribute to economic development [2]. Drawing on theoretical analysis and scholarly research, two secondary indicators are established: (1) Professional construction: This includes tertiary indicators such as professional settings and talent training programs, considering regional talent orientation [3]. (2) Talent training program: This encompasses the design and implementation of programs aligned with societal needs.

2.4. Meso secondary index design

At the meso-level, two secondary indicators are proposed: (1) Teacher-level evaluation: This includes factors such as educational background, professional titles, multidisciplinary expertise, "dual-teacher" qualifications, and digital literacy. (2) Teaching environment evaluation: This includes metrics like per capita investment in teaching instruments, equipment, computer ownership, multimedia classroom availability, and the application rate of information technology.

2.5. Micro secondary index design

The micro-level evaluation focuses on the quality of talent training, emphasizing student quality, employment outcomes, stakeholder satisfaction, industry-education integration, societal impact, lifelong learning, and sustainable development [4]. According to the indicators of higher vocational education and related connotations, the “score card” indicators, “student feedback table,” “international impact table,” and “service contribution table” are set as the micro-level indicators.

3. The weight calculation of the vocational education evaluation index system using the hierarchical analysis method

3.1. Source of sample data

Based on the Quality of Higher Vocational Education in Hainan Province (2023), Hainan Province has established 14 independent higher vocational institutions, with a total of 116,705 full-time vocational students. This represents an increase of 17,106 students compared to the previous year, reflecting an annual growth rate of 17.17%. These statistics highlight the significant achievements in talent training within Hainan’s higher vocational education system. The sample data for this study is divided into three parts: (1) Evaluation index scale and questionnaire for evaluation indicators: Thirty questionnaires were distributed to management staff and experts from higher vocational colleges in Hainan, with 29 valid responses collected. (2) Questionnaires for students: A total of 193 questionnaires were distributed to students within three years of study. (3) Talent training quality satisfaction survey: A total of 270 questionnaires were distributed, with 221 valid responses obtained.

3.2. Evaluation indicators

Building on a review of relevant literature and the distribution of questionnaires regarding the vocational education evaluation index scale for higher vocational colleges, the study developed an evaluation framework consisting of three first-level indicators, 15 second-level indicators, and 17 third-level indicators (**Table 1**).

Table 1. Evaluation index system of vocational education quality in the context of digital transformation

Level 1 indicators	Level 2 indicators	Level 3 indicators	Meaning
Macro: A1	Evaluation of talent training program: B1	Talent training program: C1	The coordination degree of regional economic development and vocational education layout, the matching degree of regional talent demand and professional level construction, etc.
		Regional talent positioning: C2	The matching degree of specialty setting with regional economy and industrial demand; whether it is a national key industry, emerging industry, and regional pillar industry, etc.
	Professional construction: B2	Specialty settings: C3	Digital literacy into the curriculum system; talent training objectives and specifications of applicability; talent training programs, etc.

Table 1 (Continued)

Level 1 indicators	Level 2 indicators	Level 3 indicators	Meaning
Meso: A2	Teacher level evaluation: B3	Academic degree: C4 Title: C5 “Double-qualified type”: C6 Multidisciplinary background: C7 Digital literacy: C8	Student-teacher ratio, double-teacher quality full-time teachers ratio, senior professional and technical position full-time teachers ratio, interdisciplinary teacher team construction, digital teaching, digital collaborative education.
	Evaluation of the teaching environment: B4	Student average teaching and research instrument investment fund: C9 Investment in teaching equipment per student: C10 Computer ownership per birth: C11 Multimedia classroom is better: C12 Information technology application rate: C13	Every 100 students have teaching terminals, the proportion of schools with campus network established, the proportion of schools with export bandwidth of more than 100Mbps, etc
Micro: A3	Evaluation of talent training quality: B5	The “points card” index: C14	Employment rate, monthly income, correlation of science, industry, agriculture and medicine, satisfaction of Alma mater, employer satisfaction, and promotion ratio of three years after graduation.
		The “student feedback form” indicator: C15	Classroom education satisfaction, ideological and political course teaching satisfaction, student work satisfaction, student community participation.
		The “international impact table” indicator: C16	Number of full-time (overseas) foreign students (more than one year), part-time (overseas) personnel training, etc.
		The “service contribution table” indicator: C17	Graduate employment direction, horizontal and vertical technical services, achievement conversion, non-academic training, public welfare training services.

3.3. Model building

3.3.1. Overview of the AHP model

The Analytical Hierarchy Process (AHP) is a systematic approach to multi-criterion decision-making and evaluation. The primary goal of AHP is to assist decision-makers in making rational choices when faced with complex problems involving multiple criteria. The core concept involves breaking down a complex decision problem into smaller, more manageable sub-problems, conducting hierarchical comparisons, allocating weights to these sub-problems, and finally arriving at a comprehensive decision. This study employed the AHP to assign weights to the evaluation index system, utilizing the 1–9 scale method (**Table 2**).

Table 2. Scoring criteria for the hierarchical analysis matrix

Degree of importance	Scale assignment	Degree of importance	Scale assignment
Two factors are equally important	1	Two factors are equally important	1
Factor A is slightly more important than factor B	3	Factor A is slightly less important than factor B	1/3
Factor A is significantly more important than factor B	5	Factor A is significantly less important than factor B	1/5
Factor A is strongly more important than factor B	7	Factor A is strongly less important than factor B	1/7
Factor A is extremely more important than factor B	9	Factor A is extremely more unimportant than factor B	1/9
Between the above levels of importance	2, 4, 6, 8	Between the above levels of importance	1/2, 1/4, 1/6, 1/8

3.3.2. Establishing a hierarchical structure model

This study adopts a decision-making goal-oriented approach. Using factor analysis, the study organizes the elements listed in **Table 1** into a three-level hierarchical structure: the three primary elements constitute the criterion layer, the 12 secondary elements form the factor layer, and the 17 tertiary elements comprise the scheme layer. This framework results in the establishment of a comprehensive three-tier hierarchical structure model.

3.3.3. Hierarchical single ranking and consistency testing

The index elements of this level are the ranking weight of the relative importance of adjacent index elements, which is the hierarchical single ranking result. After calculating the feature vector W is normalized, the maximum feature root value is calculated, and the calculation formula is

$$\gamma_{max} = \frac{1}{n}\sum_{k=0}^{n}\frac{(AW_i)}{W_i} \quad (1)$$

Consistency checks are conducted. The CI calculation formula is:

$$\text{CI} = \frac{\gamma\text{max} - n}{n - 1} \quad (2)$$

where CI is the consistency ratio and RI is the random consistency index. Generally, if the CR value is less than 0.1, the judgment matrix satisfies the consistency test.

3.3.4. Hierarchical sorting and consistency testing

By using hierarchical single sorting to calculate the results, the total ranking weight of the factor layer can be obtained, and further comprehensive calculation of the order of superiority and inferiority relative to the higher layer can be carried out. The consistency test formula for hierarchical total sorting is:

$$\text{CR} = \frac{\sum_{i=1}^{n} a_i CI_i}{\sum_{i=1}^{n} a_i RI_i} \quad (3)$$

Among them, a_i is the total ranking weight of the criterion layer, CI_i is the consistency index of the judgment matrix in the factor layer corresponding to a_i, and RI_i is the random consistency index of the judgment matrix in the factor layer corresponding to a_i. CR < 0.1 is obtained. At this point, it is considered that the hierarchical sorting results meet the consistency testing requirements. From this, the same level weights and global weights of each indicator are obtained (**Table 3**).

Table 3. Evaluation index system of vocational education quality in the context of digital transformation

Level 1 indicators	Weight value	Level 2 indicators	Weight value	Level 3 indicators	Weight value	Combined weight
Macro: A1	0.392	Evaluation of talent training program: B1	0.578	Talent training program: C1	0.164	0.027
				Regional talent positioning: C2	0.297	0.0674
		Professional construction: B2	0.422	Specialty settings: C3	0.539	0.1221
Meso: A2	0.402	Teacher level evaluation: B3	0.652	Academic degree: C4	0.103	0.027
				Title: C5	0.056	0.015
				"Double-qualified type": C6	0.251	0.066
				Multidisciplinary background: C7	0.169	0.044
				Digital literacy: C8	0.421	0.110
		Evaluation of the teaching environment: B4	0.348	Student average teaching and research instrument investment fund: C9	0.389	0.054
				Investment in teaching equipment per student: C10	0.268	0.037
				Computer ownership per birth: C11	0.157	0.022
				Multimedia classroom is better: C12	0.134	0.019
				Information technology application rate: C13	0.051	0.007
Micro: A3	0.206	Evaluation of talent training quality: B5	0.206	The "points card" index: C14	0.261	0.011
				The "student feedback form" indicator: C15	0.514	0.022
				The "international impact table" indicator: C16	0.063	0.003
				The "service contribution table" indicator: C17	0.162	0.007

3.3.5. Result interpretation

The analysis results in **Table 3** reveal differences in the weight of each dimension within the criterion layer: the meso dimension holds the highest weight at 0.402, followed by the macro dimension at 0.392, and the micro dimension at 0.206. Differences are also observed within the actor and decision layers. Studies indicate that vocational colleges in Hainan place greater emphasis on teaching staff development and the teaching environment in their evaluation of the quality of digital transformation in vocational education. These factors have a significant impact on educational quality. Professional development and talent training plans are also valued but to a slightly lesser extent. However, the element of talent training quality evaluation appears to receive insufficient attention.

4. Quality improvement strategies for vocational education under the evaluation index system

4.1. Optimizing talent training programs, strengthening professional development, and ensuring scientific and cutting-edge practices

Talent training programs should be continuously optimized and updated to meet the new demands of digital transformation. This includes integrating professional courses with digital technologies, utilizing virtual simulations, online training, and other innovative methods to cultivate students' digital vocational skills. Talent training goals should be established with practical and reasonable positioning to align with the needs of regional economic and social development.

Professional development is a critical component in enhancing the quality of vocational education. In the context of digital transformation, vocational colleges must stay aligned with the digital advancements of industries and enterprises by dynamically adjusting their program offerings and reinforcing the relevance and foresight of professional development. Vocational colleges should deepen their integration with industrial enterprises, establish long-term school-enterprise cooperation mechanisms, jointly design talent training programs, optimize curriculum systems, and achieve precise alignment between professional programs and industry needs.

4.2. Promoting teacher digitalization to facilitate the high-quality development of vocational education

In the era of digital transformation, the competency level of teachers is a key factor influencing the quality of vocational education. Teachers equipped with robust theoretical knowledge and practical skills are essential for cultivating high-quality technical and skilled professionals. Digital teaching introduces new demands, requiring educators to effectively utilize modern information technology and innovate teaching methods and models. Firstly, the training of professional teachers should be prioritized. Efforts must be made to improve their academic qualifications, expand pathways for professional title promotions, strengthen foundational teaching skills, and update professional knowledge and practical expertise. Secondly, employment and career promotion mechanisms should be enhanced to attract high-caliber talent with interdisciplinary backgrounds to join teaching teams. By doing so, vocational education can achieve sustainable and high-quality development.

4.3. Promoting the development of new educational infrastructure and building a high-quality education support system

In the context of digital transformation, establishing a high-quality teaching environment is critical for enhancing the quality of vocational education. Schools should develop advanced, technology-driven teaching platforms to offer teachers and students a variety of digital learning methods, such as cloud classrooms, online courses, and virtual simulations [4]. Leveraging modern information technology can create immersive, situational teaching environments that enrich students' learning experiences and enhance the effectiveness of professional skill training. Efforts should be made to comprehensively improve campus network infrastructure, ensuring full wireless network coverage and enabling students to access high-quality connectivity anytime, anywhere. Additionally, investments in modern information facilities, including intelligent classrooms and virtual training rooms, should be increased. These initiatives provide robust hardware support for digital teaching and foster independent learning.

4.4. Improving the talent training quality evaluation system in the context of digital transformation

Amid digital transformation, improving the quality of talent training remains a core goal of vocational education. Digital education necessitates the establishment of clear evaluation standards for talent training quality in vocational colleges [5]. A multi-dimensional evaluation system should focus on key indicators such as students' campus performance, societal growth within three years of graduation, and satisfaction levels among students, schools, and employers. These include the "student feedback table" and the "point card" index. The integration of advanced information technology offers unprecedented opportunities and enduring momentum for the high-quality development of education. Sophisticated technological tools can significantly enhance talent training quality and act as a catalyst for sustainable development.

5. Conclusion

Digital transformation presents both new opportunities and challenges for vocational education. Information technology enables innovative teaching methods, enriches educational resources, broadens teaching spaces, and provides students with personalized, flexible, and diversified learning experiences. Simultaneously, digital transformation demands that vocational colleges accelerate their informatization processes, improve teachers' technological proficiency, and update teaching content and training models. These efforts aim to cultivate high-quality, skilled talent equipped to master emerging technologies and adapt to evolving industrial landscapes.

Disclosure statement

The author declares no conflict of interest.

References

[1] Qian M, Jiang Y, 2023, Data-Driven Undergraduate Teaching Quality Monitoring: Basic Logic and Dilemma Breakthrough. Education Theory and Practice, 43(15): 51–55.

[2] Zhang H, 2015, Industry Enterprises Participate in the Quality Evaluation of Vocational Education: Index System, Implementation Path and Guarantee Mechanism. Vocational and Technical Education in China, (33): 5–9.

[3] Wu Y, Lei Y, Yang F, et al., 2013, Building a New Ecological Environment of Digital Education——Review on the Research and Development of Electronic Textbooks and Electronic Packages. China Audio-Visual Education, (12): 3–13.

[4] Hu D, Xing Z, 2023, Study on the Evaluation Index Construction and Level Measurement of Talent Training Quality in Higher Vocational Colleges under the Background of "Double High School" Plan. Modern Education Management, (11): 85–97.

[5] Zhang D, 2022, The Connotation and Path of Enabling High-Quality Talent Training with Modern Information Technology. Higher Education Research in China, (09): 14–17.