Research on performance evaluation of specialty construction based on Data Mining

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Abstract. Building a performance evaluation index system for professional construction of "double high" colleges is the need to promote and improve the construction and management of the national "double high plan", it is the need to High quality complete the "double high plan" of construction goals, and It also the need to Innovate and enrich performance index evaluation system of vocational colleges. This paper establishes an index system structure including 6 primary indicators, 23 secondary indicators and 50 monitoring points from six aspects: student source and scale, school enterprise cooperation, professional teaching guarantee conditions, professional teaching and construction, scientific research and social services. Use the talent training status data for data extraction and analysis, provide support for professional (Group) construction decision-making, and improve the refinement and digitization of management services.With the data mining of talent training status data in Higher Vocational Colleges in the construction of double high plan, the application of other levels may be affected by the results of this research project, which has played an important role in promoting the modernization of university governance system and governance ability.

Keywords: Higher vocational colleges; professional construction; evaluation index

1 Introduction

In April 2019, the Ministry of education The Ministry of Finance issued the opinions on implementing the construction plan of high-level higher vocational schools and majors with Chinese characteristics (TZC (2019) No. 5), which clearly pointed out that "we should concentrate on building a number of higher vocational schools and professional groups that lead reform, support development, Chinese characteristics and world-class level, drive vocational education to continuously deepen reform, strengthen connotation construction and achieve high-quality development". The "double high plan" has opened a new chapter in the high-quality development of Vocational Education in the new era. Specialty construction is an important carrier to implement the connotation construction of "double high".

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2 Material and Methods

2.1 Significance of implementing "double high" specialty (Group) performance evaluation

The data collection of talent training status began in 2008. It has complete data on professional teaching and construction, scientific research and social services[1]. Through the research on the application of talent training status data in the performance evaluation of professional groups under the background of "double high" construction, it is of great significance to regularly carry out performance self-evaluation of professional construction and apply the self-evaluation results to the next construction work: 1) It helps to find the weakness of professional teaching quality in time, solve the problems existing in professional teaching, enhance the innovation and practicality of professional teaching, and form a normalized and sustainable internal control mechanism of professional teaching quality; 2) It is conducive to intuitively show the fit of professional structure with industrial structure and social needs, and provide data support for optimizing resource allocation and dynamic adjustment of professional structure; 3) It helps to strengthen the self-management and assessment of professional construction, correct work deviations in time, promote high-quality completion of the goal of double high construction, and achieve the expected results[2].

2.2 Existing professional evaluation methods and existing problems

There are few relevant studies on the construction and evaluation of higher vocational specialty groups in China. Fang Feihu and others divided the professional group construction evaluation into two stages: project approval evaluation and level evaluation, and constructed the corresponding evaluation index system respectively[3]. Based on the analysis of the current situation of the construction of higher vocational specialty group, Li Lin discussed how to define the evaluation index of higher vocational specialty group and set the index weight. Throughout the existing research, scholars' research mainly focuses on the research of index system, implementation path, connotation and practice. Ack of information means for data mining and analysis. Professional construction and development depends on the extraction and analysis of professional teaching process data, finding problems and targeted improvement[4]. This research will make up for the gap in this field, combine the big data of higher vocational talent training status with the improvement of professional construction quality under the background of "double high construction", create an effective index system through data analysis and in-depth mining, provide data support for the improvement of professional teaching quality of the College, and improve the refinement and digitization of *management*[5].

2.3 Key indicators of professional (Group) performance evaluation

Professional *(*Group) performance evaluation indicators are closely connected with the requirements, objectives and tasks of the construction of the "double high plan". By

analyzing the documents such as the national double high school construction and the professional teaching quality evaluation scheme of the Provincial Department of education, we can deeply understand the professional teaching quality evaluation index system and design the professional teaching quality control point[6]. Form six first-class indicators: student source and scale, school enterprise cooperation, professional teaching guarantee conditions, professional teaching and construction, scientific research and social services, training quality and social reputation.

1. Source and size of students. It includes two secondary indicators: enrollment scale and the scale of students in school. It is monitored from three observation points: freshman admission rate, reporting rate, and the proportion of the number of students in the major to the average number of students in the province[7].
2. School enterprise cooperation. It includes two secondary indicators: the number of cooperative enterprises, the form and content of cooperation, and is monitored from seven observation points, such as jointly developing courses, teaching materials, accepting internship students and enterprise donations.
3. Professional teaching guarantee conditions. It includes three secondary indicators: teacher team, practical teaching conditions and teaching fund investment. It is monitored from 16 observation points, such as the structure and proportion of full-time and part-time teachers, the total number of practical training projects, the number of practical teaching stations, special practice fees and consumables[8].
4. Professional teaching and construction. It includes five secondary indicators: professional curriculum system, teachers' teaching, students' off campus practice, professional qualification certificate and professional construction effect, from the class hour allocation of professional talent training scheme, the teaching of double teachers, the teaching of full-time and part-time teachers with different professional titles, the counterpart ratio of students' off campus practice, the employment rate of students' off campus practice enterprises, the construction of high-quality courses 11 observation points such as key points and characteristics or the construction of modern apprenticeship specialty.
5. Scientific research and social services. It includes three secondary indicators: award-winning projects, scientific research ability and training services. It is monitored from six observation points, such as teachers' teaching materials, monographs, patent papers and vertical and horizontal topics.
6. Cultivate quality and social reputation. It includes two secondary indicators: Students' awards and graduates' employment quality. Monitoring was conducted from five observation points, including students' access to national or provincial and municipal awards, employment rate, professional counterpart rate and local students' employment contribution.

2.4 Data mining of talent training status

Since 2008, talent training status data collection has become one of the tasks that must be completed by higher vocational colleges every year[9]. A large number of talent training process data have been accumulated, but the data is still fragmented and lack of

data application. For example, classify and summarize all aspects of school data, conduct vertical comparison and analysis between the data of the current year and the data of previous years, or compare the data of our school with the median of the same kind, the median of the whole province Horizontal comparative analysis of the national median, lack of in-depth analysis of the quality of various elements, and unable to provide monitoring, early warning and scientific decision-making for schools.

The professional data part of the talent training status data platform consists of 18 form data, including professional opening, professional leaders, curriculum, enrollment, employment of fresh graduates, scientific research topics, etc. Taking the quality control point of the index system as the reference, the data of the whole province, colleges and disciplines are extracted according to the data platform, and the index data are mined and evaluated quantitatively by using the formula to obtain the evaluation value. The following table 1 shows the corresponding relationship between talent training status data and indicator monitoring points so far:

Table 1. Correspondence between monitoring indicators and status data

Talent training data platform	Primary indicators	Secondary indicators
7.1.1 Setting up majors	Source and scale of students	Enrollment situation
7.6.1 Enrollment		Size of students on campus
7.1.1 Setting up majors	School enterprise cooperation	Number of cooperative enterprises
7.5 Industry University Cooperation		
7.6.2 Employment situation of fresh graduates		Cooperation form and content
4.1 On campus practice base	Professional teaching guarantee conditions	Teaching staff
4.2 Off campus internship and training base		
6.1.1 Basic information of full-time teachers on campus		Practical teaching conditions
6.1.3 Other situations of full-time teachers on campus		
6.3.1 Basic information of part-time teachers outside of school		
7.1.1 Setting up majors		Investment in teaching funds
7.1.2 Professional leaders		
7.3.1 Vocational Qualification Certificate		
4.1 On campus practice base	Professional Teaching and Construction	Professional course system
6.1.1 Basic information of full-time teachers on campus		
6.1.2.1 Teaching situation of full-time teachers on campus		Teaching situation of teachers
7.1.1 Setting up majors		
7.2 Curriculum Setting		practice
7.3.2 Certification and social training status of fresh graduates		Professional Qualification Certificate

7.4 Post Internship		Professional construction achievements
6.1.1 Basic information of full-time teachers on campus	Scientific research and social services	Award winning projects
6.1.3 Other situations of full-time teachers on campus		Scientific research ability
7.5 Industry University Cooperation		training
7.6.2 Employment situation of fresh graduates	Cultivate quality and social reputation	Student Awards
9.6.1 Student Awards		Employment quality of graduates

2.5 Application of talent training status data in the performance evaluation index system of "double high" majors (groups)

2.5.1 Data analysis of professional teachers' scientific research ability.

2.5.1.1 Monitoring index and calculation basis.

Taking the data analysis of professional teachers' scientific research ability as an example, this observation point mainly observes the scientific research projects of full-time teachers of this specialty, including horizontal scientific research projects, vertical scientific research projects and the level of scientific research projects. Among them, one scientific research project (including teaching and Research) at or above the provincial level is scored 1 point, one horizontal scientific research project is scored 0.6 point, and one school level scientific research project is scored 0.3 point. Weighted scoring shall be carried out for the subject of professional full-time teachers, and the cumulative maximum score of this item is 3 points. If the weighted score of the professional teacher's scientific research topic is higher than 3 points, the maximum score is 3 points, and if the score is lower than 3 points, it shall be calculated according to the actual score to form professional scientific research achievements.

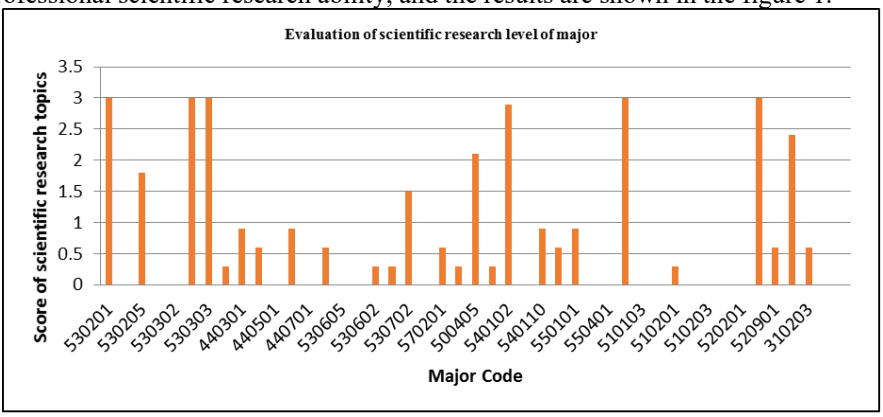
$$Q_{5221} = min\{\frac{1}{3}N_{\mathrm{SKY}} + \frac{1}{5}*\mathrm{N}_{\mathrm{HKY}} + \frac{1}{10}*\mathrm{N}_{\mathrm{XKY}},1\} \quad (1)$$

Among them, NSKY represents the number of scientific research (including teaching and Research) projects hosted by full-time teachers of the specialty at provincial level and above, NHKY represents the number of horizontal scientific research projects hosted by full-time teachers of the specialty, and NXKY represents the number of school level scientific research projects hosted by full-time teachers of the specialty. Q5221 indicates the score of professional teachers' scientific research ability.

2.5.1.2 State data extraction and analysis.

The talent training status data platform 6.1.1 teachers' basic information table collects basic information such as teachers' job number and administrative specialty, and 6.1.3 collects teachers' research projects and project levels[10]. Lack of summary and visual presentation of scientific research ability of a certain specialty, Lack of summary and visual presentation of the scientific research ability of a specialty, so it is impossible

to evaluate the scientific research and social service ability among specialties. Data analysis: firstly, bind the scientific research data of teachers in 6.1.1 and 6.3.1 according to the formula, and extract the data. Then, the data of teachers' scientific research results are weighted, summarized and scored according to the formula to obtain the data of professional scientific research ability, and the results are shown in the figure 1.



Note: the major code comes from the professional directory of Vocational Education (2021).

Fig. 1. Evaluation of scientific research level of major

2.5.1.3 Analysis result feedback.

After analysis, the highest score of scientific research ability of 42 majors is 3 points, 9 majors with more than 1.5 points, and some majors do not score this item. The reason is that some majors are newly opened, and some professional teachers' scientific research ability and scientific research consciousness need to be further improved. In the next year's work, strengthen the training of scientific research ability and better use scientific research to serve teaching.

2.5.2 Data analysis of professional curriculum system.

The professional curriculum system is the concrete embodiment of the training of technical and skilled talents and the implementation of the training plan of professional talents. Talent training status data platform 7.2 curriculum collects the data of all professional courses. Cluster analysis and data mining technology are used to classify and count the public courses, professional courses and practical teaching courses in the professional course data. Data mining is carried out from three monitoring points: the total class hours of talent training program, public course students and practical teaching class hours.

2.5.2.1 Alent training program

The total class hours of talent training program are in the range of 2500-2800, full score; If the total class hours of the talent training program are less than 2500 or more

than 2800, points will be deducted according to the proportion of insufficient or excess. The calculation formula is as follows:

$$Q_{4111} = \begin{cases} 1, & 2500 \le H_Z \le 2800 \\ 1 - \frac{2500 - H_Z}{2500}, & H_Z < 2500 \\ 1 - \frac{H_Z - 2800}{2800}, & 2800 < H_Z < 5600 \\ 0, & H_Z > 5600 \end{cases} \tag{2}$$

Hz refers to the total class hours of the professional talent training program (excluding the class hours of professional courses in the statistical direction).

a)Public class hours

1 point will be given if the class hour ratio of public courses reaches 25%; Otherwise, score according to the actual proportion of public course hours and 25%;

$$Q_{4112} = \begin{cases} 1, & B_{GG} \ge 25\% \\ \frac{B_{GG}}{25\%}, & B_{GG} < 25\% \end{cases} \quad B_{GG} = \frac{H_{GG}}{H_Z} \tag{3}$$

HGG represents the total class hours of public courses of the specialty, and Hz represents the total class hours of talent training program of the specialty

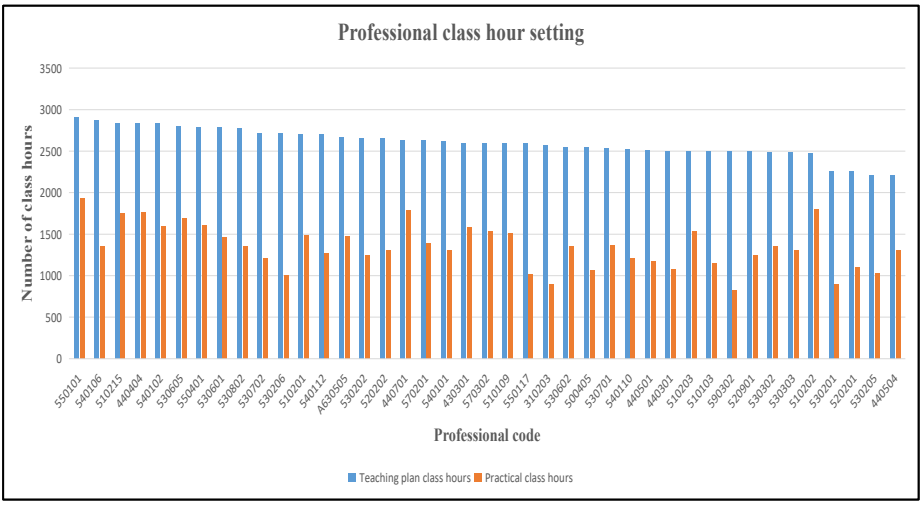
2.5.2.2 Practical teaching hours.

If the proportion of professional practice teaching hours reaches 50%, 1 point will be obtained; Otherwise, the item will be scored according to the proportion of practical teaching hours and 50%;

$$Q_{4113} = \begin{cases} 1, & B_{SJ} \ge 50\% \\ \frac{B_{SJ}}{50\%}, & B_{SJ} < 50\% \end{cases} \quad B_{SJ} = \frac{H_{SJ}}{H_Z} \tag{4}$$

Hsj represents the total hours of practical teaching of the specialty, Hz represents the total hours of talent training program of the specialty, and BSJ represents the proportion of the total hours of practical teaching of the specialty in the total hours of talent training program.

The talent cultivation status data platform 7.2 collects basic information such as professional code, professional course teaching plan hours, and professional course practice hours, but lacks a visual representation of a certain professional teaching plan and practice teaching hours. Data analysis first summarizes the teaching plan hours and practical teaching hours of platform 7.2 according to the formula, and then calculates the weighted summary score to obtain the proportion of professional teaching plan hours and practical teaching hours. The results are shown in the following figure2.



Note: the major code comes from the professional directory of Vocational Education (2021).

Fig. 2. Professional teaching plan and practical lesson presentation

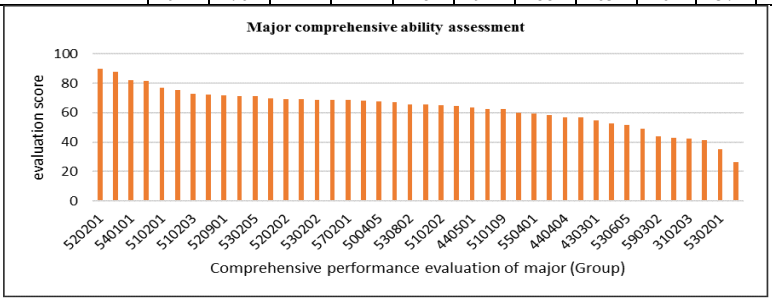
2.5.3 Analysis and feedback of comprehensive performance data of professional construction.

According to the formula of 50 observation points of professional performance evaluation, the data are extracted and analyzed in the talent training status data platform. For the scientificity and rationality of the index formula, the highest score is set for a single index, and the scores of all professional disciplines are benchmarked only with the provincial average of the discipline, so as to avoid the difference of evaluation scores due to different disciplines. The data of professional evaluation results in 2021 is shown in the Table2 and figure 3.

Table 2. Professional (group) comprehensive performance evaluation

Professional code	**520 201**	**530 302**	**530 302**	**540 101**	**540 106**	**510 201**	**570 302**	**510 203**	**540 102**	**520 901**	**530 701**
score	89. 62	87. 59	87. 59	81. 96	81. 52	77. 15	75. 46	72. 55	72. 08	71. 58	71. 5
Professional code	**530 205**	**540 112**	**520 202**	**540 110**	**530 202**	**530 303**	**570 201**	**510 103**	**500 405**	**550 101**	**530 802**
score	71. 31	69. 73	69. 21	68. 94	68. 84	68. 58	68. 55	68. 41	67. 83	67. 09	65. 53
Professional code	**530 602**	**510 202**	**510 215**	**440 501**	**A6 305 05**	**510 109**	**550 117**	**550 401**	**530 601**	**440 404**	**440 301**

score	65.43	65.31	64.48	63.62	62.58	62.23	59.82	59.39	58.57	57.02	56.65
Professional code	**430301**	**530206**	**530605**	**530605**	**440504**	**590302**	**440701**	**310203**	**530702**	**530201**	**340101**
score	54.91	52.76	51.41	51.41	49.15	43.92	42.88	42.63	41.6	35.37	26.53



Note: the major code comes from the professional directory of Vocational Education (2021).

Fig. 3. Professional (group) comprehensive performance evaluation

The highest score was 89.62, with an average of 63.12. According to the score data, each specialty finds weak blocks in specialty construction, adjusts the work plan, reasonably allocates resources, finds defects in specialty construction, effectively promotes the development of specialty construction such as teaching team and training conditions, and improves the quality of talent training.

The data results show that among the six first-class indicators, the quality of talent training, teachers and the achievements of professional group construction have a great impact on the level of professional group construction; Among the 20 secondary indicators, graduates' employment, leaders of professional groups, social services, vocational qualification certificates and curriculum system have a great impact on the construction level of professional groups.

3 Conclusion

The construction of Higher Vocational Specialty (Group) is a multi-level complex system, which is affected by many factors. It is impossible to make scientific and reasonable evaluation only by experience[11]. With the help of modern information technology such as big data, the accuracy and effectiveness of evaluation can be effectively improved. This paper applies the working state data of talent training in Higher Vocational Colleges to the performance evaluation of Higher Vocational Majors (groups), quantitatively evaluates the performance of specialty construction process, gives early warning to unqualified index items, puts forward solutions, provides dynamic reference basis for specialty construction, and opens up new ideas and methods for research in this field. With the data mining of talent training status data in Higher Vocational Colleges in the construction of double high plan, the application of other levels may be affected

by the results of this research project, which has played an important role in promoting the modernization of university governance system and governance ability.

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