Exploring the path of cultivating students' professional ability based on DEMATEL method

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Abstract. In order to strengthen students' understanding of the curriculum system, improve the effect of teachers' teaching and students' learning, the training route of students' ability is designed. Taking the information management and information system specialty of a university as an example, this paper introduces DEMATEL method into the analysis of training scheme structure, and identifies the basic courses and core courses in the curriculum system by calculating the correlation degree of each course, which provides a theoretical basis for the allocation and arrangement of course hours, provides a reference for teachers to impart knowledge, students to select courses, and both sides to clarify the knowledge context. This paper divides the curriculum ability group into curriculum ability groups, clarifies the connection between courses, and provides strong support for the formulation of curriculum plan. It also designs the training path of students' ability from the perspectives of course study time and teaching content.

1. Introduction
"The plan of higher education is based on undergraduate education, which is not solid and shaking". Specialty construction is the foundation of undergraduate education. The training program is one of the important factors affecting the quality of specialty construction. The curriculum system is the soul element of the training program. The consensus of "back to common sense", let us meet the students of the norm of course. Students have a prediction of the importance of the course before learning. This kind of preconceived judgment determines their learning attitude. If they think that the important courses are highly involved, the unimportant courses will naturally choose to give up. In fact, the fundamental reason for their choice and judgment of courses is that they lack the understanding, do not know what specific abilities they need to have, the relationship between the abilities and the courses, the connection between various courses. Therefore, all of these lead to the judgment of the blindness and arbitrariness, lead to a series of bad performance. To effect a radical cure the behavior of students, the correct its irrational selective needs to begin. From the professional point of view, through the analysis of the curriculum system structure, it shows the relevance, importance and cohesion of the courses in a visual form, so as to guide students correctly.

In information management and information systems professional is a typical cross disciplines, curriculum system is relatively complicated. The students are more likely to have in the process of practical training for their own professional skills, and the selected subject knowledge is not enough. Therefore, represented by the professional for the analysis of the major curriculum system, to better
promote the implementation of undergraduate education in school. Since the establishment of the major, there have been a lot of research in curriculum system, in terms of social background and analysis the market demand, Ning Zhang and Qinjian Yuan[1] set up a course system of information management specialty for data science based on the rapid increase of market demand for data science talents in the era of big data; Qiuping Guo[2] and others analyzed the core courses of the major of information management by investigating the students and employers of the major of information management. In the aspect of ability cultivation, Jing Wang, Zhonghua Yang [3] constructed the "ability stage" matrix to guide students to choose courses, and provided reference for the establishment and adjustment of the curriculum system. In the aspect of curriculum module division, Guojiang Xin, Changshong Ding [4] put forward a new curriculum system setting model - "fly" curriculum model, and divided the curriculum system into four platforms.

According to these research findings, the research on the curriculum system of the major of information management mainly focuses on the social background, market demand and ability cultivation. The analysis of curriculum system is insufficient from the perspective of the internal relationship of curriculum itself, the relationship between knowledge points. Therefore, DEMATEL method is used to accurately describe the internal relationship between courses, and the results of quantitative analysis are used to visually display the hierarchical relationship of courses, forming the path of students' ability training.

2. DEMATEL analysis method

DEMATEL method is a systematic factor analysis method using graph theory and matrix tools, which is most effective for systems with uncertain factor relations. Yue Sun [5] Based on DEMATEL method, studied the continuous information adoption behavior of middle-aged and elderly people in online health community, providing reference; Deshan Lin[6] set up the index system of influencing factors of scientific and technological innovation ability in Colleges and universities, and identified the key factors by using DEMATEL method.

2.1. Analysis process

In this article, through draw lessons from the research achievements of many scholars, the DEMATEL analysis process is divided into seven steps:

1) Determine system influencing factors, set to \( a_1, a_2, a_3, \ldots, a_n \); 

2) Determine the degree of direct influence among influencing factors. \( A \) is the direct influence matrix, in which the element \( a_{ij} \) represents the direct influence degree of the factor \( a_i \) on the factor \( a_j \).

\[
A = \begin{bmatrix}
0 & a_{12} & \cdots & a_{1n} \\
a_{21} & 0 & \cdots & a_{2n} \\
\vdots & \vdots & \ddots & \vdots \\
a_{n1} & a_{n2} & \cdots & 0
\end{bmatrix}
\]

3) Normalized direct impact matrix \( D \):

\[ D = sA, (s > 0) \]  \hspace{1cm} (1)

Which \( s \) is called standardized coefficient, usually take

\[ s = \frac{1}{\max_{a_{ij}} \sum_{j=1}^{n} |a_{ij}|} \]  \hspace{1cm} (2)

4) Calculate the comprehensive influence matrix according to the normalized matrix:

\[ T = \sum_{i=1}^{\infty} D^i - D(D - I)^{-1} \]
5) Calculate the influence degree and affected degree of each factor. The degree of influence and the degree of being affected are expressed in row sum $f_i$ and column sum $e_i$ respectively.

$$f_i = \sum_{j=1}^{n} t_{ij}, i = 1, 2, ..., n$$

$$e_i = \sum_{i=1}^{n} t_{ij}, j = 1, 2, ..., n$$

(4)

6) Calculate the centrality and cause of each factor. Define the center as follows:

$$m_i = f_i + e_i, i = 1, 2, ..., n$$

Centrality indicates the magnitude and importance of this factor in the whole system.

Define the cause as follows:

$$r_i = f_i - e_i, i = 1, 2, ..., n$$

(5)

(6)

7) If the cause degree is positive, it means that the element has a great influence on other factors, which is the cause factor; if the cause degree is negative, it means that the factor is greatly affected by other factors, which is the result factor.

2.2. Directly affect the setting of matrix elements

When exploring the relationship between factors, some scholars use the interpretative structural model; some scholars use the method of 1-5 five-level scale division to determine the influence matrix between the factors. These methods can not accurately show the relationship between the factors. When the relationship between the two factors is relatively weak, we should use more accurate values to represent them. The inaccuracy of initial value will cause "bullwhip effect". In this paper, the degree of association between courses is represented by a value between 0-3. The value size represents the influence degree of a row of influencing factors on a column of influencing factors. If the influence is not enough to be expressed as an integer, it is expressed as a decimal. Calculate and analyze the core and key factors, cause factors and result factors, and the curriculum is divided into groups according to the relevant degree, which provides a reference for the scientific and reasonable curriculum.

3. Analysis on the definition and influence of the curriculum system of the major of information management

This paper uses DEMATEL method to make an empirical analysis of professional courses, so as to comprehensively improve the quality of undergraduate training, clearly show the degree of relevance and importance between the courses, and provide a reference for the selection of students' course sequence, the adjustment of course credits and the setting of students' professional ability training path.

3.1. Definition of curriculum system

Taking 23 professional courses as the research object, respectively for the a1: Introduction to information system, a2: JAVA Basics, a3: website development technology, a4: programming training, a5: data structure, a6: ERP software application, a7: JAVA advanced programming, a8: information security technology, a9: database applications, a10: principle of database system, a11: Database comprehensive training, a12: data analysis and mining, a13: data analysis tools, a14: Data analysis comprehensive training, a15: information resources management, a16: MIS course design, a17: systems engineering, a18: IT project management, a19: management information system, a20: computer networks, a21: computer network engineering network, a22: computer network training, a23: system analysis and design.
3.2. Curriculum relationship determination

The elements in the curriculum system are each course, and the relationship between the elements is the degree of correlation between the knowledge points of the two courses. Through the weighted calculation of the survey results, the direct influence matrix between courses is determined, see Table 1.

Table 1. Direct impact matrix between courses in the course system.

|   | 0.5 | 0.5 | 0.5 | 0.4 | 0.4 | 0.3 | 0.5 | 0.5 | 0.4 | 0.5 | 0.4 | 0.7 | 0.5 | 0.8 | 0.3 | 1.3 | 0.3 | 0.4 | 0.3 |
|---|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
|   | 0.29 | 3 | 0.6 | 2 | 1 | 1 | 0 | 0.5 | 2 | 1 | 1 | 0 | 0.4 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 |
| a1 | 0.1 | 0 | 0.3 | 3 | 0 | 1 | 1 | 1 | 0 | 0.8 | 0 | 2 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 |
| a2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 |
| a3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 0 |
| a4 | 0.1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 |
| a5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 |
| a6 | 0.8 | 0 | 0.8 | 1 | 1 | 0 | 0 | 0 | 0 | 2 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| a7 | 0.4 | 0 | 1 | 0 | 1 | 0 | 6 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| a8 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| a9 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| a10 | 0.6 | 0 | 0.8 | 1 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| a11 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| a12 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| a13 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| a14 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

The influence degree, affected degree, center degree and cause degree of each course are calculated, see Table 2.

Table 2. Calculation results of each course in the course system.

| Course title | Influence degree | Affected degree | Centrality | Cause degree |
|--------------|------------------|-----------------|------------|-------------|
| a1           | 0.8451           | 0.352           | 1.1971     | 0.4931      |
| a2           | 1.5949           | 0.526           | 2.1209     | 1.0689      |
| a3           | 1.0518           | 1.3957          | 2.4475     | -0.3439     |
| a4           | 0.2644           | 1.8249          | 2.0893     | -1.5605     |
| a5           | 0.9525           | 0.1408          | 1.0933     | 0.8117      |
| a6           | 0.4963           | 0.9676          | 1.4639     | -0.4713     |
| a7           | 1.3447           | 0.7784          | 2.1231     | 0.5663      |
| a8           | 0.5889           | 0.1522          | 0.7511     | 0.4467      |
| a9           | 1.4994           | 0.783           | 2.2924     | 0.7164      |
| a10          | 1.6902           | 0.6286          | 2.3088     | 1.0516      |
| a11          | 0.2199           | 0.928           | 1.1479     | -0.7081     |
| a12          | 0.6065           | 1.3544          | 1.9609     | -0.7479     |

4. Analysis of curriculum system structure

In order to improve the quality of curriculum system, we must analyze it objectively, find out the main influencing factors, and analyze its characteristics.

4.1. Foundation course analysis

The cause index reflects the degree of relevance of each course in the course system. If the cause index is greater than 0, it is the cause factor. According to the influence degree (> 0), the above 12 courses should be studied first, which is the basis and guarantee of the follow-up study. The
curriculum of the curriculum system is closely linked. A correct understanding of the relationship between the pre course and the follow-up curriculum will help to improve the teaching effect of teachers and the learning effect of students.

4.2. Core curriculum analysis
Center degree index reflects the importance of other courses in the curriculum system, according to the degree of the influence degree of the curriculum system, the influence degree bigger sorting 10 courses, namely: the a3>a9>a10>a19>a7>a2>a4>a12>a14>a16, have a significant impact on the establishment of curriculum system. Combining with the analysis of the basic course knowable, a9, a10, a7, a2, a23, how important is higher also partial to the influence of other factors, so the course is the key to courses, should be used with higher levels of professors, enterprise outstanding personnel for teaching, increasing courses, higher credit.

4.3. Cluster analysis ability course
To analyze various curriculum form the comprehensive influence of matrix, the numerical value indicates that the correlation degree between two courses, the close degree. The greater the value, the closer relations between the two courses. According to the maximum of all data will be various curriculum cluster is divided into four abilities. Program design ability group(a2, a3, a7, a4) can cultivate talents with professional basic knowledge such as programming, design software; System development and implementation ability group(a1, a6, a8, a15, a16, a17, a18, a19, a23) can cultivate talents with basic knowledge such as developing various systems and implementing ERP; Data analysis ability group(a5, a9, a10, a11, a12, a13) can cultivate students' professional knowledge in data analysis and big data, etc. The ability group of computer network system (a20, a21, a22) can systematically cultivate students' ability of network construction and network security. According to the correlation degree of each course in the course group, teachers should pay attention to the connection of all kinds of course contents, improve the planning and standardization.

5. Path design of students' ability training

5.1. Based on the teaching content dimension design ability training path
Each group can cultivate talents with different ability, and ability to form is based on the accumulation of knowledge, each group of course according to knowledge acquisition sequence can connect curving path, as shown in Figure 1.

It can be seen that several courses at the beginning of the training path are the basic courses to form various professional abilities. The school should increase the University sub setting to attract students' attention. This chart clearly shows the connotation of cultivating students' professional ability, which should be studied and accumulated step by step according to the path. For example, students interested in data analysis and management should focus on learning a10, a9, a13, a12, a14, a11 and other courses; students should choose courses orderly according to their learning interest and training path to study, reduce the number of blind selection, and achieve the purpose of professional ability training.

5.2. Based on time dimension design ability training path
From learning path of the order, the classes of order directly reflect the knowledge structure of the sequence. A reasonable curriculum, students are easy to learn, easy to carry out teaching work. In program design ability, for example, the ability is the main form to a2, a3, a7, a4 of this a few courses, but other courses also has effect on the formation of the ability, according to the comprehensive influence matrix, to program design training is greater than 0.07 courses selected, as shown in Figure 2.
Figure 1. Ability cultivation path based on teaching content dimension.

Figure 2. Ability cultivation path based on time dimension.

Figure 2 shows that in addition to the necessary course, the other associated course also cannot be ignored, according to the related degree of learning other courses at the same time is essential. Teacher should be timely communication in each discipline, to avoid repetition and imparting knowledge; Schools should try to arrange the same teacher course teaching of knowledge to more closely. Develop direction guidance to students at the same time.

6. Conclusions
Education is in a period of rapid development, the construction of professional curriculum system needs continued research and exploration, constantly adjust and perfect. Quantitative research is to determine the influence degree and the placement of the follow-up relationship between curriculum, define the basic courses and core curriculum, cultivate ability of curriculum group and path to provide a reference for teachers, students acquire knowledge, and provide a scientific basis for revision of the plan for the cultivation of the each semester.

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