

Quality Improvement Strategy for Professional Master's Degree Postgraduates based on Key Link Detection

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Abstract. In order to improve the training quality of professional masters, a Q-GERT network model based on the training process of professional masters was constructed, the key node measurement coefficient was used to quantitatively identify the key influencing factors, and the training process of economic and management professional masters in a provincial university of Jiangsu Province was taken as an example for empirical analysis. The results show that the key factors affecting the quality of economic and management master training are the practice teaching, the guidance of tutors and the establishment of a sound quality evaluation system. To improve the training quality of professional master talents, we should start from the construction of practical ability training system, the implementation of "double tutor system" and the establishment and improvement of practical ability oriented quality evaluation standards, and monitor the training dynamic in real time, and continuously improve the quality of training.

Keywords: Professional Master Training Quality; Graphic Review Technique; Key Node Measurement Coefficient.

1. Introduction

Professional master's degree education is an important component of China's postgraduate education system, which is a degree program guided by employment market demand and committed to cultivating high-level applied talents with strong practical and entrepreneurial abilities. In recent years, due to the country's urgent demand for high-level applied talents, the structure of higher education has been constantly adjusted, and the enrollment scale of professional master's degree has continued to expand. The enrollment number has increased from 71,400 in 2009 to 700,000 in 2022, accounting for more than 60% of all graduate students from 15.9%. It is expected that by 2025, the enrollment of professional master's students will expand to two-thirds of the total enrollment of master's students. Although expanding the scale of professional master enrollment can fill the "gap" of high-level applied talents quantitatively, only by improving the quality of training can it truly meet the needs of economic and social development. Since professional postgraduate education is derived from academic postgraduate education, it started late, and its development has a phenomenon of convergence and degradation with postgraduate education [1]. At present, there are still colleges and universities that use "template and homogenous training" for professional master's degrees, and the two share a set of "teaching personnel" and "sharing similar curriculum plans", which results in poor training effect for professional master's degrees and seriously reduces the quality of professional master's degrees training [2]. As early as 2013, the Ministry of Education, the Ministry of Human Resources and Social Security issued the "Opinions on Further Promoting the Reform of Professional degree postgraduate Training Mode", which clearly pointed out that "to develop professional degree postgraduate education, we should further promote the reform of training mode, accelerate the improvement of the system and mechanism, and constantly improve the quality of education." The "Professional degree graduate Education Development Program" released in 2020 also mentioned that while further expanding enrollment, "training quality needs to be improved." It can be seen that the development of professional postgraduate education from scale to quality and connotation has become an important task in the new era of postgraduate education. Therefore, in the high-quality development and important transformation stage of China's graduate education, it has become the top priority to clarify the training objectives of professional master, focus on the whole process of professional master training, and detect the key links that are different from the master's degree in

order to accurately and effectively improve the quality of professional master training. In this paper, GERT (graphical evaluation review technique) network model is introduced into the research on the training quality of professional masters. Taking the training process of economic management professional masters in a university in Jiangsu Province as an example, this paper attempts to explore the key links that affect the training quality. It provides strategic basis for improving the quality of professional master training.

Many scholars have carried out relevant research on professional master training from different angles. From multiple perspectives, Yu Miaomiao et al. found that the employment advantages of professional masters still have room for improvement in the actual employment environment, and the employment environment needs to be strengthened [3]. Zhou Tao et al. investigated the quality of talent training from the perspective of employment of postgraduate students, and the practical results showed that dynamic adjustment of enrollment plans could effectively improve the quality of master training [4]. Shi Yue et al., after studying the survey data of full-time professional masters in two universities, concluded that the lack of professional practice opportunities and the lack of classified training with master students are the focus of professional master students' demands for the training programs of universities [5]. Sun Yuwei found that MLIS graduate students' satisfaction with course teaching and professional practice was low after studying the satisfaction with the training process of MLIS graduate students and its key factors, and there were some problems in the training process, such as imperfect curriculum system and not obvious practice and application orientation [6]. Some scholars have studied the reasons for the poor quality of professional master training. Li Wei et al. found the path-dependent phenomenon in professional master's training mode under the guidance of grade view through research, and proposed that the major way to solve the homogenization of professional degree and academic degree is to lead the transformation of professional master's training mode by classification view [7]. Chen Xiaochen et al., taking master of environmental engineering as an example, believe that "application" should be the core training concept in the training process of master of engineering, and emphasize the importance of practical teaching in the training process of master of engineering [8]. Based on the experience and actual investigation of Zhengzhou University, Zhang Shuhua et al. found that the new path of "goal forcing - process guidance" can effectively improve the training quality of journalism and communication master students [9].

Through the review and analysis of the above literature, it is found that there have been a lot of studies in the academic circle on the status quo of the training quality of professional masters, the satisfaction of professional masters students on the training process and the training mode, etc. However, there are insufficient researches on the quality improvement of the whole training process of professional masters, and most of the existing researches are confined to the qualitative analysis stage. Lack of quantitative analysis of the value flow relationship and value increment among various subjects in the process of professional master training. As a new generalized stochastic network analysis method, GERT can model and analyze many real economic and social systems, and is widely used in production planning [10], quality assessment [11], key bottleneck detection [12] and other fields. Therefore, this paper takes Quality value as the carrier, uses Q-GERT (quality-graphical Evaluation Review Technique) network model to probe the key links that affect the quality of professional master training, and reforms the training mechanism and mode of training units. It has certain reference value to improve the quality of professional master training.

2. Professional Degree Graduate Training Q-GERT Network Model

(1) Model construction

The quality of professional master training is the comprehensive effect from the formulation of training objectives and plans to the course teaching and practice teaching to the awarding of degrees. The training process of professional master is a complex network system involving multiple agents, including schools, enterprises, teachers, etc. In the Q-GERT network model of professional master training, each link forms the Q-GERT network node, and the flow relationship of value and quality

among the subjects forms the edge of the network. The flow of quality value with capital, policy, human capital and other resources input as the carrier constitutes the flow of the network. Based on the consideration of the whole process of professional master training, the random network composed of nodes in series, parallel or mixed connection is called Q-GERT network for professional master training. Specific Settings are as follows:

- 1) The quality value parameters are capital I, manpower S and policy R.
- 2) The value utility index (value 0-1) is used as the quantitative index to measure quality value. The closer the value is to 1, the higher the relative value utility will be; conversely, the closer the value is to 0, the lower the relative value utility will be.
- 3) Value parameters in Q-GERT network model of mass value flow follow constant distribution.

As shown in Figure 1, the general Q-GERT network model of quality value flow is composed of three elements: node, arrow line and flow [13].

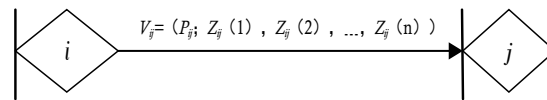


Fig 1. Schematic diagram of the basic building block of Q-GERT network in the training process of professional master

In the figure, i and j represent the upstream and downstream key entities, hereinafter referred to as node i and node j; Activities (i, j) represent value transfer activities from design node i to node j; Quality value stream realized by representative activities (i, j); Probability of implementation for nodes i to j; ..., Represents n kinds of value parameters that realize value transfer from node i to node j.

(2) Model solving

Step 1 Solve the equivalent transfer function [12]

Let it be the transfer function of the direct path r from node i to node j in the quality value flow Q-GERT network, $r=1,2,\dots, k, k \geq 1$, is the coefficient of the A-th ring transfer function in the M-order ring, then the equivalent transfer function from node i to node j is:

$$W_{ij}(S_1, S_2, \dots, S_n) = \frac{\sum_{r=1}^k W_r(S_1, S_2, \dots, S_n) [1 - \sum_m \sum_{a \neq r} (-1)^m W_a(L_m)]}{1 - \sum_m \sum_a (-1)^m W_a(L_m)}$$

Step 2 Solve the equivalent moment generating function

In the mass-value flow Q-GERT network, the equivalent transfer probability from node i to node j is equal to the value that is set at 0. According to Mason's formula, the equivalent transfer function divided by the equivalent transfer probability is the equivalent moment generating function from node to node.that is:

$$M_{ij}(s) = \frac{W_{ij}(S_1, S_2, \dots, S_k, \dots, S_n)}{W_{ij}(0, 0, \dots, 0, \dots, 0)}$$

Step 3 Solve the quality value increment

Quality value flow in Q-GERT network, the increment of quality value from node i to node j is equal to the value after the deviation corresponding to x, that is:

$$E[x(k)] = \frac{\partial}{\partial S_k} \left[\frac{W_{ij}(S_1, S_2, \dots, S_k, \dots, S_n)}{W_{ij}(0, 0, \dots, 0, \dots, 0)} \right]_{S_1=S_2=\dots=S_k=\dots=S_n=0}$$

Step 4 Find the resource change amplitude

The change amplitude of input resources from node i to node j in the Q-GERT network is equal to the value after variance of x , that is:

$$V[x(k)] = \frac{\partial^2}{\partial S_k^2} \left[\frac{W_{ij}(S_1, S_2, \dots, S_k, \dots, S_n)}{W_{ij}(0, 0, \dots, 0, \dots, 0)} \right] \Big|_{S_k=0} - \left\{ \frac{\partial}{\partial S_k} \left[\frac{W_{ij}(S_1, S_2, \dots, S_k, \dots, S_n)}{W_{ij}(0, 0, \dots, 0, \dots, 0)} \right] \Big|_{S_k=0} \right\}^2$$

(3) Key node measurement coefficient

Each node in the Q-GERT network realizes the value increment of quality through the input of capital, human capital and policy resources. The quality of professional master training is affected by the average social resource input E and the change range V . Starting from the two dimensions of E and V , this section introduces the key node measurement coefficient as a comprehensive evaluation index of these two influencing factors, and further verifies the applicability and rationality of this index. The key node measurement coefficient of Q-GERT network is defined as. In the Q-GERT network of professional master training, the corresponding values are obtained according to the input of different resources in each link.

The key node measurement coefficient refers to the degree to which the difficulty of successful realization of a node i in the Q-GERT network model in the training process of professional masters affects the training quality of professional masters [12]. In other words, the larger the key node measurement coefficient of node i is, the greater the impact of this node on the training quality of professional masters in the whole process, that is, the key node affecting the training quality of professional masters. The parameters reflect the correlation between culture quality and average resource input and the range of change. At that time, it shows that the training quality is greatly affected by the average resource input. At that time, it was indicated that the culture quality was greatly affected by the average variation range [13].

3. Case Studies

(1) Introduction to the case

A provincial university in Jiangsu Province, as an industry characteristic university with a complete training system of master's and master's degrees, obtained the right to grant master's degrees in 1993, and the master's training system is relatively mature. Therefore, this paper takes the training of economic and management masters of this university as an example to study the improvement of its training quality. By combining the actual training process of the school's professional masters in economics and management with Q-GERT network, the key links affecting the training quality are identified by calculating the key node measurement coefficient, in order to provide certain references for training units to improve the training mode of professional masters and improve the training quality of professional masters.

(2) Q-GERT network model parameter calculation and result analysis

Based on the in-depth investigation of the training process of economic and management masters in the university, and the analysis of the relationship among training units, joint enterprises and professional master students (as shown in Figure 2), the Q-GERT network for the training of economic and management masters is established, as shown in Figure 3. Nodes 1 to 12 in the network are 1) setting training objectives 2) building teaching staff 3) establishing a sound quality evaluation system 4) curriculum setting 5) building practical teaching platform 6) Tutor guidance 7) supervision and evaluation 8) Course teaching 9) practical teaching 10) research activities 11) dissertation 12) Completing the professional master's degree training

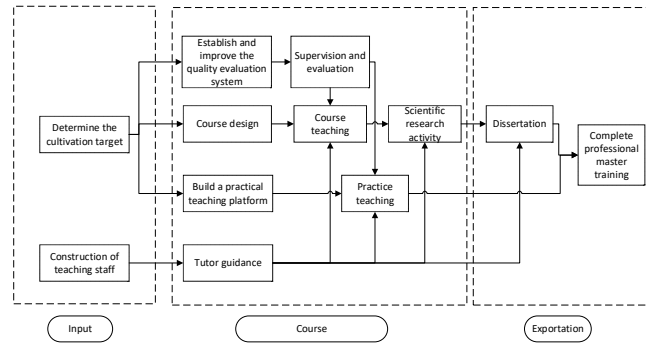


Fig 2. Schematic diagram of professional master training process

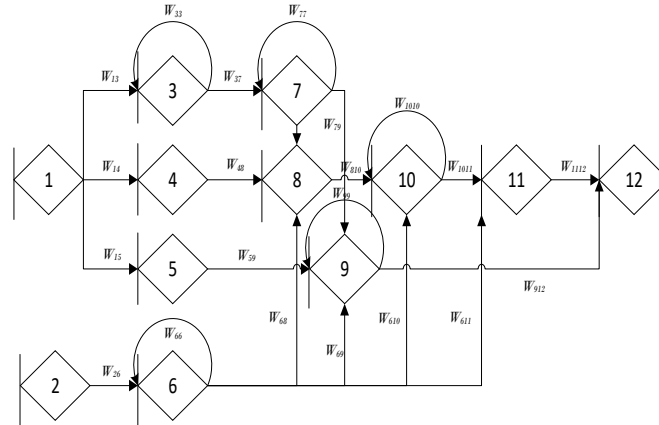


Fig 3. Q-GERT network model of professional master training process

Table 1. Professional Master training Quality value flow Q-GERT network parameters

Events	Chance	Correlation parameter		
		I	S	R
(1, 3)	0.68	0.31	0.26	0.18
(1, 4)	0.71	0.27	0.22	0.21
(1, 5)	0.82	0.69	0.14	0.13
(2, 6)	0.67	0.27	0.23	0.27
(3, 3)	0.09	0.19	0.27	0.42
(3, 7)	0.13	0.13	0.17	0.33
(4, 8)	0.87	0.20	0.19	0.15
(5, 9)	0.97	0.32	0.47	0.31
(6, 6)	0.31	0.41	0.38	0.27
(6, 8)	0.35	0.82	0.35	0.37
(6, 9)	0.37	0.31	0.51	0.23
(6, 10)	0.25	0.17	0.32	0.12
(6, 11)	0.32	0.28	0.27	0.18
(7, 7)	0.82	0.36	0.23	0.11
(7, 8)	0.41	0.21	0.17	0.12
(7, 9)	0.39	0.41	0.18	0.21
(8, 10)	0.38	0.25	0.34	0.14
(9, 9)	0.17	0.11	0.11	0.32
(9, 12)	0.19	0.14	0.27	0.25
(10, 10)	0.24	0.15	0.15	0.29
(10, 11)	0.46	0.34	0.33	0.13
(11, 12)	0.89	0.12	0.31	0.34

According to the parameter setting 1) and 2) in 2 (1), capital I, manpower S and policy R are selected as the value carriers in the quality-value flow Q-GERT network during the training process of professional masters, and the value utility index (value 0-1) is taken as the quantitative index of the value carriers. Based on the actual situation of the training of economic and management masters in this university and the survey and interview of relevant experts, Combined with the maximum entropy model [14], the transfer probability of each node and the function parameters of each node in the professional master training path are determined.

In each link of professional master's training process, quality increment is generated by the input of required resources. Due to the differences in resources required in each link of professional master's training, the result of quality increment will vary according to the proportion and utilization rate of resources input such as capital I, human resources S and policy R. Therefore, it is necessary to measure the amount of unit resources invested in each node and the quantity of quality value generated in the whole process of professional master training. In order to facilitate calculation, the value utility index is selected as a quantitative index, and its value range is 0 ~ 1. The transfer probability of each node and the function parameters of each node in the training path of professional master's degree are determined according to the actual situation of the training of professional master's degree in the universities investigated in this paper, as well as the investigation and interview of relevant experts, combined with the maximum entropy model. As shown in Table 1.

According to Mason's formula $W_E(s) = \frac{1}{H} \sum_{k=1}^n W_k(s) H_k$, the equivalent transfer function from node 1 to node 12 is:

$$W_E(s) = \frac{W_{(1,3)}W_{(3,7)}W_{(7,9)}W_{(9,12)}H_1 + \dots + W_{(1,5)}W_{(5,9)}W_{(9,12)}H_4}{1 - \sum_1 W + \sum_2 W - \sum_3 W + \sum_4 W - \sum_5 W}$$

Among, 1) represents a first-order ring, 2) represents a first-order ring, and 3), 4), 5) are the same.

By substituting the data from Table 1 into the formula, the equivalent transfer probability, quality value increment and input resource change amplitude from node 1 to node 12 are respectively:

$$P_{(1,12)} = W_{E(1,12)}(s_1, s_2, s_3) \Big|_{s_k=0} = 0.896$$

$$E_{(1,12)}[x(k)] = \frac{\partial}{\partial s_k} \left[\frac{W_{E(1,12)}(s_1, s_2, s_3)}{W_{E(1,12)}(0)} \right] \Big|_{s_k=0} = 0.432 + 0.509 + 0.556 = 1.497$$

$$V_{(1,12)}[x(k)] = \frac{\partial^2}{\partial s_k^2} \left[\frac{W_{E(1,12)}(s_1, s_2, s_3)}{W_{E(1,12)}(0)} \right] \Big|_{s_k=0} - \left\{ \frac{\partial}{\partial s_k} \left[\frac{W_{E(1,12)}(s_1, s_2, s_3)}{W_{E(1,12)}(0)} \right] \Big|_{s_k=0} \right\}^2$$

$$= 1.265 + 0.782 + 1.216 = 3.263$$

The training quality of professional masters is affected by the average resource input and the variation range of each link, and the influence of both on the training quality of economic and management professional masters is equally important, so the value is =0.5. Then the key node measurement coefficient of node 1 is

$$\lambda = 0.5 E_{(1,12)}[x(k)] + 0.5 \sqrt{V_{(1,12)}[x(k)]} = 1.643$$

Similarly, the parameters from other nodes i to the final node are obtained successively, and the results are shown in Table 2. In order to more intuitively compare the measurement coefficients of key nodes in each link in the training process of economic and management professional masters, an analogy diagram is obtained, as shown in Figure 4. The larger the key node measurement coefficient,

the greater the influence of this link on the final cultivation quality. As can be seen from Figure 4, the top three links are node 9 (practice teaching), node 6 (tutor guidance) and node 3 (establishment and improvement of quality evaluation system). In the process of professional master training, training institutions should focus on the key links of resource investment and policy formulation, and adopt appropriate training programs to improve the efficiency of resource allocation and utilization in key links.

Table 2. Q-GERT network parameters in the training process of master in economics and management

node	Chance		Correlation parameter		
i	P	E	V	λ	
1	0.220	1.523	6.116		1.998
2	0.559	1.483	6.335		2.000
3	0.137	2.612	12.170		3.050
4	0.178	1.769	11.781		2.601
5	0.222	3.116	7.530		2.930
6	0.835	2.984	10.150		3.085
7	0.962	0.760	2.331		1.143
8	0.205	0.967	3.180		1.375
9	0.229	4.626	7.404		3.674
10	0.539	0.958	2.281		1.234
11	0.890	0.865	0.865		0.898

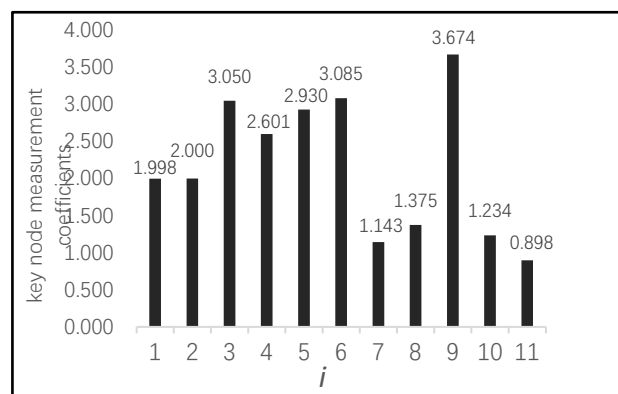


Fig 4. Analog diagram of key node measurement coefficients of each node

4. Conclusion and Recommendations

This paper takes the professional master's degree in economics and management of a university in Jiangsu province as an example, builds a Q-GERT network model for professional master's training, analyzes the quality transfer process among various links, and uses the key node measurement coefficient to identify the key links that affect the quality of training. The results show that the practice teaching, the guidance of tutors and the establishment of a sound quality evaluation system are the most critical links in the process of professional master training. Based on this, the following suggestions are put forward:

(1) Improve practical conditions and build a system for training practical ability. Based on the training objectives of professional master's students, a coordinated and unified practical ability training system should be established, and practical ability training should run through the aspects of course learning, scientific research activities and practical practice, etc., so as to meet the diversified development needs of enterprises [15]. Improve the school-enterprise collaboration talent training mechanism and

talent input scheme, encourage more high-quality enterprises to participate in professional master training through measures such as reciprocal sharing of resources and research and development results, and further enrich the selectivity of professional master practice activities.

(2) Implement and improve the "double tutor system" [16], and implement the "2+n" tutor system. Each graduate student is strictly equipped with two tutors, that is, one on-campus theoretical tutor and one off-campus practice tutor who is a senior executive of an enterprise or the person in charge of a research and development institution; On this basis, n enterprises and institutions with senior technical titles are flexibly equipped as off-campus mobile mentors to ensure that there is no shortage of practical training. At the same time, further clarify the division of responsibilities for the training of tutors inside and outside the school, better exert the advantages of tutors in different fields such as theory and practice, improve the regular exchange mechanism of training results, and form joint training forces.

(3) Establish and improve a practice-oriented quality evaluation system, pay attention to the combination of process evaluation and final evaluation, and make dynamic adjustments to teaching and practice arrangements in a timely manner according to the evaluation results. Through the construction of scientific quality assessment system, the quality of professional master's practical skills training under the school-enterprise cooperation model is judged, and the dual development of theoretical and practical ability is emphasized.

This paper, taking a master of administration of colleges and universities in Jiangsu province as a case study of professional master's training process, the data collected from the professional master's cultivation of administration related survey data and expert interviews, the conclusion to some extent, although can provide reference for other colleges and universities and professional, but because of the difference of region and professional with only a single case study master's training quality problem, It has certain limitations.

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