Key Factors Analysis of Cultivating Research-oriented Talents in China’s Universities Based on the Talent Demand for China’s Strategic Emerging Industry

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Abstract. China’s Strategic Emerging Industries promoted by innovation have continuously increased the demand of research-oriented talents and have put forward new requirements for postgraduates in Chinese universities. Based on the demand for talents in strategic emerging industries, this paper constructed an assessment index system for evaluating the quality of postgraduate cultivation in Chinese universities, and identified the key factors on the basis of expert assessment to calculate the indicator weight by AHP method and heavy quantitative analysis of the results. The results show that academic guidance, scientific research projects and funds, teaching for professional discipline and academic achievements of postgraduates are the top 5 factors. This paper proposes to improve the quality of research-oriented postgraduates on three aspects: cultivation objectives, cultivation conditions and cultivation approaches.

Introduction

Strategic Emerging Industries are based on major technological breakthroughs and major development needs, have a major leading role in the overall economic and social development in a long term. From January to July in 2017, the operating income of 27 key industries in strategic emerging industries increased by 13.8% year-on-year, an increase of 2.3 percentage points over the same period of 2016. In 2020, the added value of strategic emerging industries will account for 15% of domestic production, the scale of the industry will continue to grow, which become a new force for economic growth [1]. In 2018, the “National Strategic Emerging Industries Planning” further clarified the new industrial framework for China’s emerging industries in 7 areas: energy conservation, environmental protection, new information industry, biological industry, new energy, new energy vehicles, advanced equipment manufacturing and new materials. It is also the largest industrial plan launched by the Chinese government. Under the new demand for talents, new requirements have been put forward for the quality of postgraduate education in various universities.

China has resumed postgraduate enrollment for 40 years. In 2016, there were 1.77 million applicants for the China Postgraduate Examination, which is an increase of 121,000 from 2015. It was the first year for in-service personnel to participate in the unified national graduate entrance examination with college students in 2017, the number of applicants for the examination increased significantly and reached 2.01 million [2]. It is expected that by 2018, all universities master's enrollment and doctoral enrollment will increase, which means that from 2019 onwards, Chinese universities will usher in the largest postgraduate enrollment expansion in history [3]. At the same time, the demand for scientific research-oriented talents is more urgent with the implementation of the development planning of Chinese emerging industry, due to the technological progress, technological innovation and economic development of the industry. In particular, it is necessary for universities to nurture new-age and research-oriented innovative talents with postgraduate qualifications, improving the quality of graduate education has become an urgent problem to be solved. At present, many scholars have conducted research on the quality of education in Chinese universities from the perspectives of the quality assurance mechanism of graduate education [4],
quality of development [5], cultivation of innovative talents [6], and international cooperation [7], and they analyzed the relationship between scientific research and post-graduate education [8], the development strategy of graduate education in the Thirteenth Five-year Plan period [9] and the reform of cultivating system [10]. The quality of postgraduate education has always been the focus of universities in China and even around the world, and it is also a hot issue of teaching reform research. The effects of postgraduate education are extensive, in order to find out the key factors, the quality evaluation index system of scientific research postgraduates in Chinese universities is constructed by the method of expert consultation, and the factors in the index system are identified by quantitative method based on AHP in this paper.

Factors Influencing the Cultivation of Research-oriented Talents

The characteristics of the development of Strategic Emerging Industries are led by major technological breakthroughs to drive the development of the industry. The technological innovation work has caused the industry to form a huge demand for technological innovation researchers in universities at present. In this paper, academic researchers in emerging industry is regarded as postgraduate cultivation objective, and figure I provides the hierarchical structure developed to evaluate the quality of research-oriented postgraduate education through expert advice and comprehensive results of previous studies. The difference between this study and previous studies is that this paper not only emphasizes the traditional teaching and management, but also pays attention to the pre-cultivation and follow-up development under the background of the demand for talents in the development of emerging industries. In other words, the quality evaluation of postgraduate education is carried out in the whole process to identify the key factors influencing the cultivation of scientific research-oriented talents.

Matriculate Quality

The quality of recruited graduates is the core element of improving the quality of postgraduate education. Postgraduate cultivation is different from undergraduate education, it has a clearer direction. The research foundation and the professional theoretical knowledge from the undergraduate study have a great influence on the cultivation of the postgraduates. The higher recruitment quality of graduates is, the higher quality of research teaching will be. Besides, postgraduates are more competitive and random when they apply for a university. The university’s social reputation, geographic location, and influence of emerging industries are also key factors in the quality of enrollment. The specific description of the three-level indicators of the indicator system is shown in Table I.

Education Investment

In order to become an education power, it is necessary to guarantee the investment of education to the hardware, so that students and teachers have a comfortable and modern campus environment,
advanced teaching facilities and rich educational resources make teaching and learning interconnected. Teaching funds is the basic guarantee, teaching facilities are the tools and basic conditions for the cultivation of postgraduates. It not only includes teaching equipment for the daily courses, but also includes experimental equipment for scientific research, especially for mining colleges. Many postgraduates need new and expensive instruments to carry out simulation analysis experiments. In addition, postgraduate teaching is more dependent on the school faculty, and different from undergraduate teaching based on classroom-theory knowledge. Postgraduate education has higher requirements on teachers' academic qualifications, professional titles, teaching abilities, and research capabilities.

Cultivation Result
Postgraduate education should be distinguished from training schools and undergraduate courses. It is not just pay attention to the employment rate to evaluate the students' ability, but to the cultivation of innovative thinking and the ability of analysis on research problems, and carry out postgraduates who have international perspectives, strategic thinking and the ability to independently participate in academic and research-related work, as well as high-quality talents with advanced scientific knowledge. In the new era, there are diversified options for postgraduates. In addition to doing doctorate and getting a job, the proportion of postgraduates participating in international exchange programs and applying for overseas continues to increase in China.

Research Foundation
Research foundations and research achievements in universities are necessary conditions for postgraduates to engage in scientific research in emerging industries. The direction of research is more specific and cutting-edge. It is necessary to carry out research on the latest technological and theoretical methods based on previous results. It is difficult to cultivate academic ability because of weak research foundation. The number of scientific research projects is the most intuitive embodiment of scientific research, and research funds is the material basis. Research achievements is quantitative indicators of research management. Social resources are the related resources that universities can use to collaborate and conduct research or transformation of research results at the regional, industrial, or corporate level, such as collaborative R&D projects with companies.

Teaching for Professional Discipline
Postgraduate cultivation is characterized by differences in the research direction, each student has specific research fields, so postgraduates need to distinguish them from undergraduate class in the professional field of curriculum teaching and academic guidance. It can be divided into two stages: professional theoretical courses in relevant emerging industries and academic guidance based on research directions. The study of theoretical courses is similar to undergraduate education. It is necessary to guarantee the quality of postgraduate education by setting up cultivation programs, specialized courses according to the cultivation objectives and teaching management, so that the students have the theoretical basis for the research. Academic guidance is conducted by supervisor in the form of projects and dissertations.

<table>
<thead>
<tr>
<th>Indicators</th>
<th>Detailed Description</th>
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<tbody>
<tr>
<td>B₁</td>
<td>The university’s social recognition, geographical location, and the recognition of professional employment in emerging industries</td>
</tr>
<tr>
<td>B₂</td>
<td>The proportion of students apply for admission to the school of statistics to evaluate school popularity</td>
</tr>
<tr>
<td>B₃</td>
<td>Published papers and participation in academic competitions during undergraduate study</td>
</tr>
<tr>
<td>B₄</td>
<td>Funds for education</td>
</tr>
<tr>
<td>B₅</td>
<td>Teaching environment, such as classroom environment and teaching equipment, laboratory equipment</td>
</tr>
<tr>
<td>B₆</td>
<td>Teaching faculty, including number of teachers and academic structure, title, overseas experience</td>
</tr>
</tbody>
</table>
The proportion of postgraduates who are engaged in new industry-related research work or go on to Ph.D.

Foreign exchange, study abroad, and academic activities during university hours

The number of dissertations/patents/ standards/software during postgraduate study

Funds for scientific research

Teacher's publication of papers, works, patented inventions, software registration rights, research awards

Research cooperation between universities and strategic emerging enterprises, focusing on the analysis of school-enterprise research cooperation projects

The cultivation program involves the professional theory curriculum arrangement in emerging industries and the quality of teaching

Supervisors' guidance in research projects, academic paper writing and graduation thesis

The rationality of the postgraduate teaching system and the management of teachers, students and administrative personnel

Analysis of Key Factors Based on AHP

AHP Method

Analytic Hierarchy Process (AHP) can be used not only to evaluate decision analysis, but also to determine the weights of factors [11]. In this paper, it can be used as an approach to evaluate the quality of research-oriented postgraduate education by building a hierarchy. Usually, AHP is being employed with the following steps [12]:

- Constructing a comparison matrix A. The comparison between the two is generally done using a 1–9 scale method.
- Calculation of eigenvalue and eigenvector.
- Consistency check. Consistency ratio \( CR = \frac{CI}{RI} \) comparison to judge matrix consistency, if CR <0.1 the result is reliable.

AHP-based Method of Indictor Weight Analysis

In combination with the above-mentioned AHP method, an expert group consisting of first-line teaching faculty and educational administration management experts was invited to compare scores of the indicators. After finishing the calculations, the weighted results of the second-level indicators were obtained in Figure II. CR=0.030<0.1, it meets consistency requirements. The top two indicators of weight are teaching for professional discipline and research foundation, and the sum of their weights is more than 63%. Teaching for professional discipline is the core work of postgraduate teaching. The proportion of weight is 38.8%, and the condition of scientific research is a basis for academic guidance in professional field, and the proportion has reached 1/4.

![Figure 2. Weight of the second-level INDICATORs.](image)

Table II shows the results of single-sort, and whole-sort of indicators by the test has satisfactory consistency. The results of single-sort, and whole-sort of indicators by the test has satisfactory
consistency. The academic foundation of the students (B₃), the teacher's situation (B₆), the graduate academic achievement (B₉), the scientific research project and the funding (B₁₀) and the academic guidance (B₁₄) are the most important indicators in each layer, and the sum of their weights is more than half, indicating the core influence of each indicator in the single layer indicator.

Table 2. The weight and consistency of the three-level indicators.

<table>
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<tr>
<th>Indicators</th>
<th>Weights in single-sort</th>
<th>CR</th>
</tr>
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<tbody>
<tr>
<td>B₁-B₃</td>
<td>0.311</td>
<td>0.493</td>
</tr>
<tr>
<td>B₄-B₆</td>
<td>0.225</td>
<td>0.101</td>
</tr>
<tr>
<td>B₇-B₉</td>
<td>0.105</td>
<td>0.258</td>
</tr>
<tr>
<td>B₁₀-B₁₂</td>
<td>0.550</td>
<td>0.240</td>
</tr>
<tr>
<td>B₁₃-B₁₅</td>
<td>0.333</td>
<td>0.528</td>
</tr>
</tbody>
</table>

Through the word cloud (Figure III), the comprehensive weights of the three-level indicators and the three-level indicators are given. The top 5 weights are the academic guidance (B₁₄), the research projects and funds (B₁₀), the teaching for professional course (B₁₃), the school faculty (B₆) and the academic achievements (B₉), the sum of their weights reached 62%, which have basically embodied the key factors. The top 5 indicators basically point to the cultivation of scientific research capabilities and the teaching conditions and teaching methods. Among them, the academic achievement is one of the cultivation objectives. The research projects and funds, and the school faculty are the core teaching resources and teaching basis for postgraduate teaching, academic guidance and the teaching for professional course are the main ways to improve the academic ability of postgraduates, they also reflect the organizational form of higher education in China. At the same time, the study found that compared with the single-sort weight, the academic foundation (B₃) has not entered the top 5, and its comprehensive weight is 0.063, its ranking is seventh after the scientific research achievements which comprehensive weight is 0.065, indicates that the students' academic foundation has a limited influence on the quality of cultivating postgraduates.

Conclusion

The study illustrates college teaching practice and conducts an expert investigation of the factors influencing the quality of postgraduate education and gives a comparison of AHP indicator importance. The results suggest that academic guidance, research projects and funds, teaching for professional courses, school faculty and academic achievements of postgraduates are the key factors that affect the quality of cultivating postgraduates. Owing to the development of China’s strategic emerging industries and the demand for talented people, the key to improve the quality of research-oriented postgraduates in Chinese universities should focus on three aspects: cultivation objectives, cultivation conditions, and cultivation approaches.

With the expansion of postgraduate enrollment in China, the number of postgraduates has rapidly increased. In order to improve the quality of postgraduate education, the cultivation objectives should be changed, and the ability to engage in scientific research in emerging industries should be
taken as a target for talents cultivation, so the scientific research achievements can be used as quantitative assessment indicators.

The construction of universities and the input of resources should focus on the investment of scientific research projects and the construction of the school faculty. The cultivation of postgraduates cannot depend on the funding of teaching reform projects as traditional education does. The school faculty should focus on the construction of company’s mentor team, and they are no longer the traditional theory-centered teachers, but rather the teachers who focus on academic research.

To cultivate research-oriented talents in the direction of specific industries or fields, it is necessary to combine the strengthening of frontier theoretical basic learning with the cultivation of research and academic abilities, strengthen the teaching quality of postgraduate education and the design of teaching programs, and refine the norms and management of academic guidance for supervisors.

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References