

Quality Enhancement of Graduate Education in Local Applied Colleges and Universities: An Analysis of Strategies and Effectiveness Based on Resource Constraints

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Abstract: How to improve the quality of postgraduate education in local applied colleges and universities with limited resources is a challenge in the field of postgraduate education. The research object of this paper is 486 excellent master's thesis awardees (from now on referred to as awardees) who were trained by the sample schools from 2018 to 2023. By comprehensively analyzing the critical indicators of the awardees, such as the composition of the student population, the source of the project, the academic performance, the type of thesis, and the direction of graduation. The study aims to investigate the impact of the graduate education training system of the sample schools on the awardees. The study found that the awardees showed significant improvements in academic performance, ideological awareness, academic level, the level of the highest educational institution, the size of the city of residence, and career development. These improvements are closely related to the "Admission, Training and Employment" integrated mechanism established by the sample schools, which combines the "One Core, Two Integration and Three Synergy" educational strategy to provide students with a comprehensive and in-depth educational experience. The study's results also confirm that under the condition of limited resources, through innovative talent cultivation mechanisms and effective resource allocation, applied universities can also cultivate high-level professionals to meet the needs of society.

Keywords: Resource Constraints; Local Universities; Educational Linkages; Quality Improvement; Postgraduate Education

1. Introduction

On 24 November, the Ministry of Education

(MOE) promulgated the Opinions on Further Promoting the Classification and Development of Academic Degree and Professional Degree Graduate Education, which explicitly put the cultivation of graduate students' fundamental theories, expertise, and innovation ability as the core task [1]. Subsequently, at the conference on 19 December, Ren Youqun, Director General of the Ministry of Education, further emphasized that under the background of strong demand for talent and the expansion of the scale of cultivation, cultivation units need to improve the quality of education and increase efficiency by optimizing the management of internal variables in the context of limited resources [2]. According to the China Postgraduate Admission Information Network (CPAN), a total of 655 colleges and universities have the qualification of postgraduate enrolment [3], of which 147 colleges and universities are under the construction of "double first-class" [4], accounting for nearly a quarter of the total number of colleges and universities. The Ministry of Education announced 284 "2022 Higher Education (Postgraduate) National Teaching Achievement Award Project", "double first-class" universities awarded projects up to 226, accounting for nearly 80% [3]. These data highlight the leading position of "double first-class" universities in the reform of graduate education and research. In this context, how local universities can fully use their characteristics and advantages to cultivate excellent talents with less investment has become a question worth pondering. Domestic scholar Zhang Kai proposed that the key to the potential of resources lies in tapping their enormous energy, releasing the unlimited potential of limited resources by making full use of existing resources, and realizing the innovation and aggregation effect of local conditions [5-6].

Postgraduate education is a complex and

multi-link talent training system. The enrolment link is the starting point of talent training, and the quality of the student source directly determines the training potential and future development of postgraduate students [7-9]. The employment quality of postgraduates is the visual embodiment of educational achievements. In training postgraduates, the training unit also achieves good results with them and accumulates ample data resources. Through data mining and analysis, the optimal balance between educational input and output can be found to provide strong support for future training work. In this paper, we take the linkage of "enrolment-culture-employment" as the main line of education, take the development of postgraduate classification as the core cultivation goal, and deepen the education model of science-education integration and industry-education integration. Through the implementation of collaborative cultivation projects, including the collaborative guidance of enrolment planning and career planning, the cooperative management of cultivation inputs and outputs, and the collaborative service of the whole talent cultivation chain, we are exploring the practical way of cultivating excellent talents under the environment of limited resources.

2. Research Programme

2.1 Overview of Sample Schools

The sample school selected for this study is located in the western part of Beijing, covering an area of 452 mu and a building area of 400,000 square meters. As a university specializing in cultivating high-level applied talents, the school has a 30-year history of graduate education and has accumulated rich experience in cultivating outstanding engineers and other aspects. It has trained thousands of exceptional graduate students who highly represent applied higher education. The university has 18 first-level master's degree accreditation points, ten master's degree categories, and 39 undergraduate majors. The number of full-time students exceeds 15,000, including more than 3,600 postgraduate students, and the number of postgraduate students is stable at more than 1,200 every year. Regarding the teaching staff, the University has 1,005 full-time teachers,

including 172 professors and 380 associate professors, of whom 66.8% hold a doctorate and 58.2% are young teachers under 45. In addition, the university employs 44 doctoral supervisors and 558 master's supervisors. Since 2018, the university has significantly increased its resource investment in teaching and scientific research, with teaching operating expenses reaching 170 million yuan, research equipment reaching 120 million yuan, and books and electronic resources reaching 60 million yuan.

2.2 Source of Research Data

The research data was mainly obtained from the list of award-winning master's theses from 2018 to 2023, published on the Graduate School website of the sample schools, consisting of 486 theses. Among them, the number of winning theses in 2023 is the highest, with 102 theses, while the number of winning theses in 2019 is the lowest, with 60. The research team analyzed the distribution characteristics of the award-winners and their regional competitiveness performance by mining the background data of the award-winners, such as the composition of their student sources, academic achievements, subject sources, career development, and personal information, and combining the information of the institution database of China Graduate Student Admission Information Network.

2.3 Basis for the Selection of Research Subjects

The research group selects "excellent master's thesis authors" as research subjects based on the following three primary considerations:

First, these dissertations represent the highest level of master's dissertations in the same period, and their authors not only have solid academic accumulation and research ability but also show unique insights and innovative thinking in their respective fields, reflecting the potential to become high-level applied talents.

Second, in selecting outstanding master's theses, the sample schools always adhere to the principle of "quality first, preferring lack to abundance." After 16 years of rigorous selection, the number of award-winning theses is limited. Still, it has comprehensively covered all the disciplines and majors admitted

to the Master's program at the university, ensuring the professional representation of research.

In the end, since the adjustment of the national policy on the professional degree of master's degree for working personnel in 2016, the winners selected by the university during the period 2018-2023 are all candidates who have taken the national unified entrance examination for master's degree. This will ensure the consistency and homogeneity of academic and professional degree postgraduates regarding admission channels, admission standards, and subsequent training.

3. Research Findings and Analyses

3.1 Distribution Characteristics of Prize-winning Theses

The distribution characteristics of award-winning theses reflect the effectiveness of the sample schools in cultivating different disciplines and the differences in award-winning performance between academic and vocational graduates. At the same time, the composition of student sources

and the destinations of award winners also reflect the social impact and regional attractiveness of the schools' graduate education.

3.1.1 Statistics on the distribution of award holders by academic discipline

During the period covered by this study, the sampled schools produced 4687 postgraduates, of whom 2080 were awarded academic degrees, and 2607 were awarded professional degrees. Of the dissertations submitted, only 486 were rated as excellent, or 10.4%. The award-winning dissertations covered seven academic disciplines, as shown in Figure 1. Engineering led by far with 388 excellent dissertations, followed by Science and Law with 31 and 30 dissertations, respectively, while Literature had a relatively low number of excellent dissertations with three. These data show the distribution of award-winning dissertations across the different disciplines and reflect the importance of the engineering programs at the University, which aligns with the University's philosophy of "engineering-oriented and coordinated development of several disciplines."

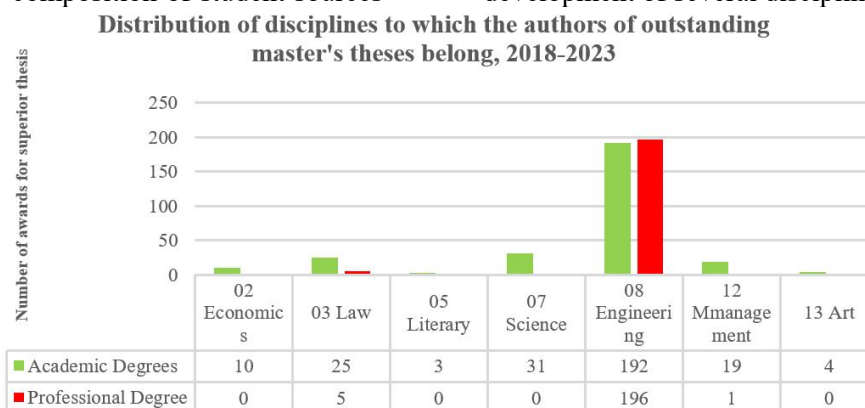


Figure 1. Distribution of the Authors of Outstanding Master's Degree Theses by Academic Disciplines

Figure 1 also shows a comparison of the awards won by postgraduate professional and academic degree students, where the sample schools have professional degree master's programs in several disciplines such as engineering, law, management, etc. The performance of professional degree students in the excellent thesis selection is weak, with only 7.7 awards per 100 students, compared with the number of awards for academic degree students. However, the performance of professional degree students in the excellent dissertation selection is relatively weak, with 7.7 awards per 100 students, while the number

of awards for academic degree students is 13.7. This may be because the existing selection procedure does not fully reflect professional and academic degree students' different educational objectives and characteristics. Therefore, it is proposed to optimize the selection conditions according to the guiding principle of "breaking the five only" in national scientific research and to adjust the recognition and evaluation of postgraduate students' academic achievements to more fairly reflect the educational achievements of postgraduate students of different categories.

3.1.2 Statistics on the composition of the

student body of the winners

From the data in Table 1, it is clear that among the awardees, 86.2% of the student's enrolment age was concentrated in the 22-24 age group, and 96.1% had no work experience before enrolment. Geographically, about 40 percent of the students came from the city clusters of China's three major economic areas. In terms of academic background, more than 90% of the students had graduated from "non-double first-class" universities. In terms of academic

performance, all of the winners have a bachelor's degree, and more than 80% of them scored more than 20 points above the national cut-off in the preliminary examination for graduate school. In comparison, only 8.6% of them took the examination across disciplines. These characteristics suggest that the winners are generally young; most have no work experience, come from less economically developed regions of China, and most have graduated from non-top universities.

Table 1. Statistics on Student Information of the Authors of the Award-winning Papers

Project classification		Academic Degree	Professional Degree
Age at Entry into School	Less than or equal to 21 years	16	1
	22-24 years	236	183
	25-29 years	32	16
	30-34 years	0	2
	Greater than or equal to 35 years of age	0	0
Work Experience Before Enrolment	Graduate with at least one year of experience	12	7
	Former graduates, no work experience	72	45
	Fresh graduates with no work experience	200	150
Place of Origin Before Enrolment	Beijing-Tianjin-Hebei Region	94	68
	Yangtze River Delta Region	17	9
	Pearl River Delta Region	0	1
	Provincial Capital	22	16
	Other Areas	151	108
Pre-entry Qualifications	Undergraduate Completion	284	202
	College graduation	0	0
Type of Pre-qualification Institution	Double first-class construction universities and construction disciplines	26	14
	Non-double first-class colleges and universities with a doctoral training qualification	199	138
	Other ordinary universities	59	50
Interdisciplinary Examination Situation	The same disciplines for bachelor's and master's degrees	259	185
	The disciplines of bachelor's degree and master's degree are not the same	25	17
Distribution of Results in the Preliminary Examination	Achievement above the national line of 100 points and above	9	19
	Number of students with scores 50-99 points above the national line	83	98
	Number of students with scores 20-49 points above the national line	125	60
	The number of people who are exempted from examination	4	1

3.1.3 Statistics on the destinations of prizewinners after graduation

After graduation, the awardees mainly chose further studies for doctoral programs, direct employment, or self-employment, as shown in Figure 2(a). In the doctoral group, most chose

to continue their studies in China's three major economic circle city clusters, while a few decided to go abroad, as shown in Figure 2(b). In the direct employment group, more than 80 percent of them found jobs in the three major economic circle city clusters in China, while

the rest chose other cities or regions in China, as shown in Figure 2(c). In terms of type of employer, postgraduates mainly went to institutions, state-owned enterprises, and private enterprises, accounting for more than 93 percent, as shown in Figure 2(d). Regardless of whether the postgraduates had academic or professional degrees, most awardees tended to develop in economically developed regions such as Beijing, Tianjin, and Hebei, with a few choosing to join government agencies, three-tier enterprises, or start their businesses.

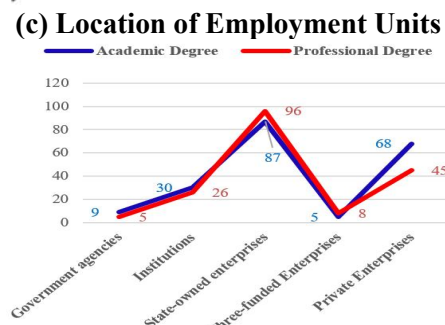
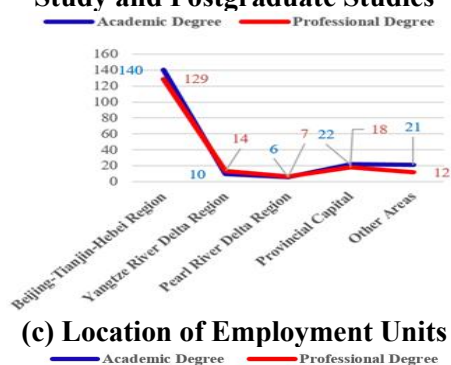
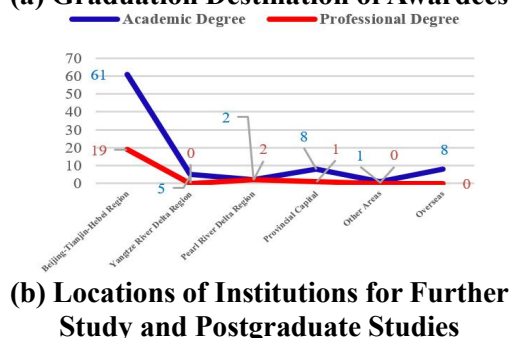
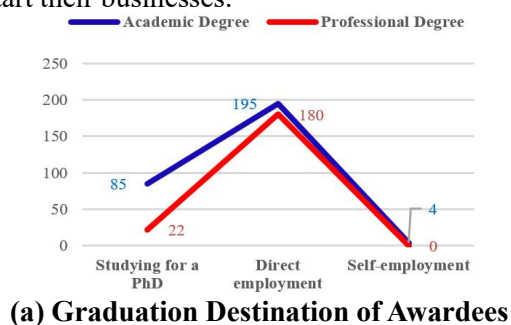


Figure 2. Statistics on the Graduation of Authors of Award-winning Papers

3.2 Analysis of the Process Development of Winning Thesis Authors

3.2.1 Statistical analysis of supervisors

This study counts the supervision of prize-winning theses and finds that the total number of prize-winning theses supervised independently by supervisors is 336, while the number of co-supervised theses is 150. Authors wrote a higher proportion of co-supervised theses of professional degree master's programs, which shows that the supervision of professional degree postgraduates tends to be collectively supervised by teams. Three hundred thirty supervisors supervised 486 awarded theses, of which 185 supervisors supervised only one thesis. In comparison, 74 and 71 supervisors supervised two and three or more theses, respectively, as shown in Figure 3. This indicates that the University is gradually moving from a single-supervisor mode of supervision to a collective supervision mode by a team of supervisors. It is worth noting that senior professors in information and communication, electrical, and industrial design engineering have demonstrated their excellent teaching and mentoring skills by supervising ten award-winning postgraduate students each year.

3.2.2 Influence of doctoral supervisors

Thirty-five doctoral supervisors supervised 110 award-winning theses, or 17%. The frequency of these supervisors supervising prize-winning theses per capita is 3.14 times, significantly higher than the average, as shown in Figure 4. This reflects the importance of high-level supervision for the training of doctoral students. PhD supervisors have a wealth of experience and deep academic insight and can also provide students with opportunities and resources to access cutting-edge research at home and abroad.

3.2.3 Statistics on the subject sources of prize-winning theses

The data on the subject sources of award-winning theses show that national scientific research projects are the most critical subject source, accounting for 41.6%, indicating that key scientific research projects dominate the university's scientific research organization mode, as shown in Figure 5(a). In addition, projects commissioned by enterprises and institutions and self-selected projects of

the university also account for a considerable proportion, indicating that the university pays attention to the combination of scientific research and social demand. The award-winning works mainly concentrate on

applied and basic research, as shown in Figure 5(b). In contrast, the proportion of comprehensive research is relatively low, possibly related to the school's orientation of cultivating high-level applied talents.

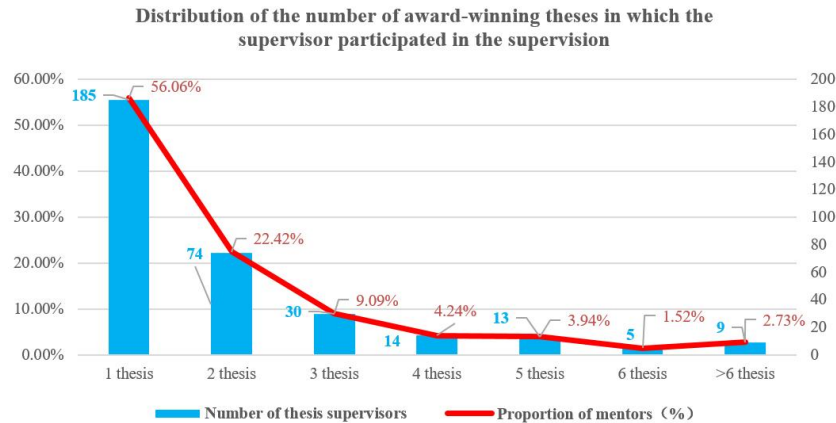


Figure 3. Number of Award-winning Theses in Which the Mentor was Involved in Supervision

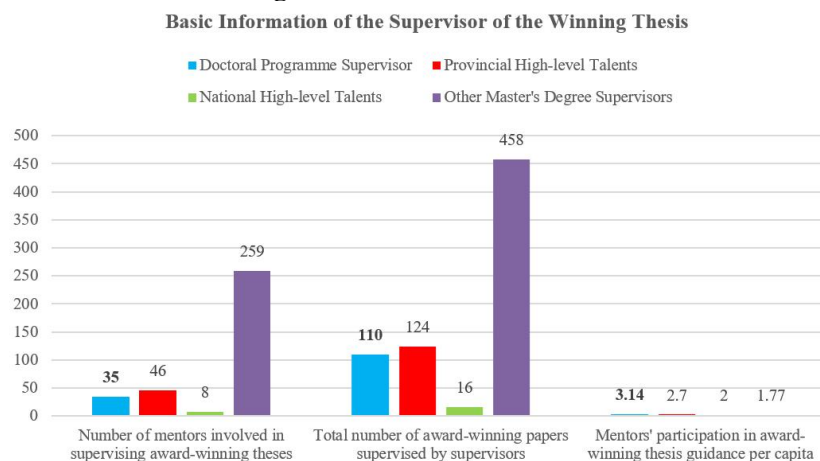
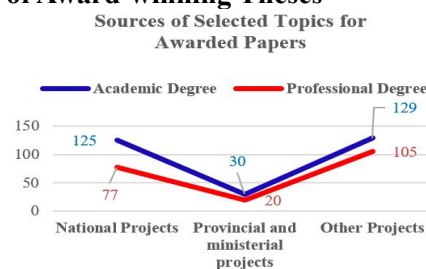


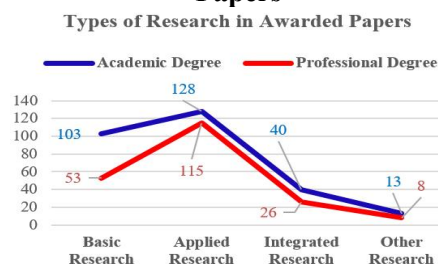
Figure 4. Basic Analysis of the Instructors of Award-winning Theses

3.2.4 Statistics on the academic performance of award winners

The statistical analysis of the awardees' academic achievements, representative achievements, and thesis quality shows that academic and professional degree postgraduates have comparable performance in course study and thesis defense. The performance of professional degree graduates in practice is better, while academic degree graduates have more outstanding achievements in attending academic conferences, publishing papers, and applying for patents. In addition, the acquisition of professional qualification certificates also reflects the career development tendency of postgraduates, among which teaching certificates, legal professional qualification certificates, and accountant certificates are in the top three, and the specific data are shown in Table 2.



(a) Sources of Selected Topics for Awarded Papers



(b) Types of Research in Awarded Papers
Figure 5. Statistics on Research on the Topics of the Awarded Papers

Table 2. Statistics on the Academic Achievements of the Authors of the Winning Papers

Project Classification		Academic Degree	Professional Degree
Academic Achievements	Degree Programme Average (Percentage)	87.15	86.08
	Practical Session Credits (average)	5.44	8.89
	Degree English Grades (percent)	74.20	73.82
Representative Achievements	Number of Awards in High-level Academic Competitions	112	118
	Number of Academic Lectures, Academic Conferences Participation	1383	363
	Number of certificates obtained for professional qualifications	49	8
	Number of assisting tutors in writing monographs	5	1
	No. of assisting tutors to formulate industry standards	0	2
	Number of participants in innovation and entrepreneurship projects	31	3
	Number of high-level academic papers published	431	303
Dissertation Quality Control	Number of patents granted and applied for	116	94
	Dissertation text repetition ratio (average value)	3.05%	3.27%
	Evaluation results of external experts (average value)	83.28	82.99
	Evaluation of on-site defense as excellent (number of students)	284	202

3.3 Analysis of the Regional Competitiveness of the Beneficiaries

3.3.1 Academic qualifications and career progression

By comparing the data before and after the awardees' enrolment, we found that the awardees achieved significant improvements in several aspects. All awardees completed their studies and obtained a Master's degree. In particular, those with no previous work experience could successfully develop their careers after graduation. In addition, the

awardees generally preferred to create in economically developed regions such as Beijing, Tianjin, and Hebei. At the same time, a few joined government agencies and three-tier enterprises or started their businesses, as shown in Table 3.

3.3.2 Birth background and career choice

The winners' birthplace has some influence on their choice of employment, but regardless of the region's economic level, the winners generally preferred SOEs, private enterprises, and institutions as employment units.

Table 3. Relationship between the Graduation Destination of Authors of Award-winning Papers and the Characteristics of the Student Population

Statistical Features			Employment Situation				
			Government Agencies	Institutions	State-owned Enterprises	Three-funded Enterprises	Private Units
Pre-academic Institution Category	Top Universities		0	1	3	0	2
	Top Disciplines		1	1	10	1	8
	Ordinary College	Public General Colleges	13	51	160	10	97
		Private General Colleges	0	3	10	2	6
Pre-academic Institution Affiliation	Ministry of Education		0	0	7	0	5
	Other Ministries		0	1	4	0	2
	Provincial		14	55	172	13	106
Place of Origin	Urban Agglomerations of the Three Major Economic Circles in China		5	25	84	6	37
	Provincial Capital		1	5	12	2	9
	Other Areas		8	26	87	5	67

3.3.3 Upgrading at school level

The sample schools have been qualified for

doctoral training since 2012 when they were approved for the National Special Needs

Doctoral Talent Training Programme. Even though the undergraduate institutions of 109 awardees were not authorized to award doctoral degrees, their academic backgrounds were upgraded to universities with doctoral training qualifications after they completed their master's degrees in the sample schools.

Of the 107 awardees who continued their studies, eight chose foreign universities. In contrast, 87 chose domestic "double first-class" universities, indicating that their academic backgrounds will be further upgraded in the future. The specific data are shown in Table 4.

Table 4. Distribution of Authors of Prize-winning Papers in Universities for Further Study and Doctoral Degrees

Statistical Features	Category of Higher Education			Higher Education Affiliation			Foreign Universities and Colleges
	Top Universities	Top Disciplines	Ordinary College	Ministry of Education	Other Ministries	Provincial	
Number of Colleges and Universities	15	15	5	23	5	8	8
Number of Students	51	36	12	54	24	21	8
Distribution Ratio	47.7%	33.6%	11.2%	50.5%	22.4%	19.6%	7.4%

3.3.4 Geographical development opportunities
The awardees, whether from economically developed or underdeveloped regions, actively responded to the state's call and devoted themselves to the economic construction of their hometowns. Among them, 200 awardees returned to their hometowns, while 27 continued their studies. In particular, one student from a provincial capital chose to support the construction of the West, reflecting the improvement of his ideological consciousness. Most of the winners from the city clusters of China's three major economic circles chose to stay in their localities for development. In contrast, most of the winners from less economically developed regions chose to seek development opportunities in more economically developed city clusters; see Figure 6 for specific data.

3.3.5. Improvement in the Ranking of the Place of Residence

The rank of the winner's place of residence generally improved. Most students from provincial capitals chose to develop in the city clusters of China's three major economic circles. In contrast, a few decided to go abroad for further studies, reflecting improved living environment and quality of life. The individual growth and progress of the winners are influenced by many factors, such as the impetus of urbanization, the learning environment and resources provided by schools, and the booming socio-economic development. Schools and society, as the cradle of talent cultivation and the place of practice, should strive to enhance students' all-round abilities and help them cope with social challenges and changes.

Distribution of Awardees' Place of Residence after Graduation

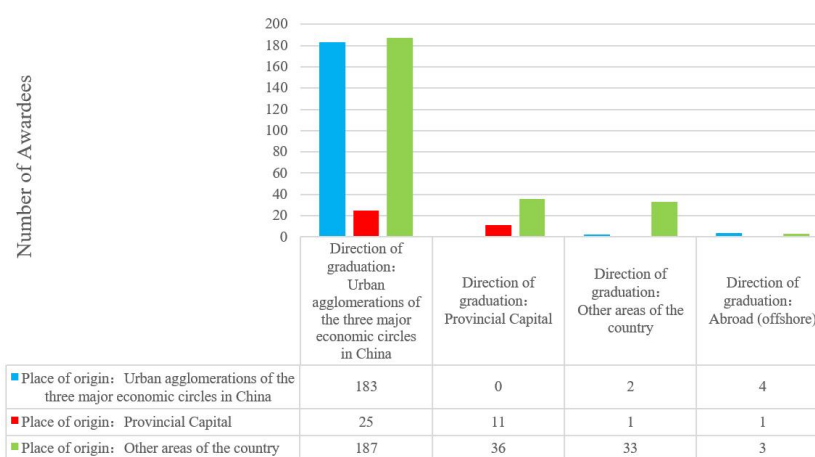


Figure 6. Distribution of Post-graduation Residence of Authors of Award-winning Papers

4. Conclusion

This study provides an in-depth analysis of the background characteristics of the outstanding master's graduates produced by the sample school between 2018 and 2023, with critical dimensions covering the student body's composition, the subject matter's source, academic outcomes, and graduation destinations. The study's results highlight the university's remarkable effectiveness in postgraduate education, particularly the positive results in the efficient use of resources. In particular, over 90 percent of students with no work experience before enrolment had made significant career changes by the time they graduated. Regarding student background, only 10 percent of students initially came from a 'two-tier' university, and 25 percent chose to continue their education at a 'two-tier' university after graduation, indicating a significant upgrading of the school at an academic level. In terms of economic background, although 60 percent of students initially came from relatively less developed regions of China, more than 80 percent chose to continue their academic or professional careers in the three major economic areas after graduation, which also reflects a significant upgrade at the level of the city of residence. It is also worth noting that 40% of the graduates chose to return to work in their hometowns, which reflects an upgrading of ideological perception and positively contributes to local development. All of the graduates in the study completed their studies and obtained Master's degrees, thus upgrading their academic level. However, the study also found significant differences in educational effectiveness between degrees and specializations. The uneven distribution of academic disciplines reflects a degree of disciplinary preference. The analyses of the composition of students' origin and graduation destination show that, regardless of whether the awardees come from economically developed or underdeveloped regions, most of them tend to build in the Beijing-Tianjin-Hebei region, and a few of them join government organs, three-tier enterprises, or engage in self-employment. Regarding supervision, most of the award-winning theses were written by students independently, which means that barriers to cooperation between graduate training units

need to be removed. Regarding subject sources and research types, the uneven distribution of disciplines, the concentration of subject types, and the phenomenon that the subject sources tend to be high-level projects deserve attention. From the perspective of regional competitiveness, the competitiveness of postgraduates in different disciplines shows significant asymmetry, forming a unique "big pin" distribution characteristic.

Given the above findings, this study suggests that training units should closely follow the actual needs of local economic development, optimize the layout of disciplines, rationally allocate educational resources, and strengthen the advantageous disciplines while supporting the disadvantaged disciplines to ensure that the input-output ratio of talent cultivation achieves the best effect. Through these measures, the overall quality of postgraduate education can be further improved, and more high-quality talents can be cultivated for society.

Acknowledgments

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