Analysis on the Development of Potential Disciplines in Universities Based on Incites and ESI---Taking University of Jinan as an example

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Abstract. We provide objective data support for the discipline planning and discipline construction of University of Jinan, and speed up the entry of potential disciplines into advantageous disciplines, increase the influence of disciplines, and improve the quality of higher education. The threshold value relative gap method is used to calculate the potential value of potential disciplines, and the most potential disciplines of biology and biochemistry are selected. We analyze the trends of biology and biochemistry from the output of papers and the total citation frequency of papers, the distribution of cooperative institutions, and the situation of publishing journals. The total number of scientific research papers in biology and biochemistry is insufficient, and the total citation frequency of these papers has dropped significantly. There are fewer international and domestic cooperation agencies and the coverage of journals is narrow.

1. Introduction

Subject construction and development is the core of university construction and development, is a long-term arduous and complex system engineering. It is closely related to national politics, economy, culture, science and technology and social development, and can reflect the development orientation, talent training, academic team, scientific research, international competitiveness of universities and so on [1]. The college entrance examination in Shandong Province will adopt the "major + school" filling mode in 2020. The innovation of this mode highlights the importance of college majors. This mode will also promote the scientific orientation of colleges and universities, pay more attention to the construction of disciplines and majors, set up more characteristic majors and advantageous majors, form the school brand and characteristics, enhance the core competitiveness, and improve the quality of running schools.

At present, domestic education authorities regard ESI as an important indicator to evaluate the discipline development in colleges and universities. In the third and fourth disciplinary evaluation activities of colleges and universities carried out by the Ministry of Education, "highly cited ESI papers" are all taken as the assessment content of academic paper quality indicators [2]. ESI (Essential Science Indicators) is the database of basic scientific Indicators. The research papers collected are from SCIE and SSCI citation databases, and the top 1% of research institutions, scientists and research papers in the world are ranked according to the citation frequency [3]. Incites database is a supplement to ESI database, including relevant data of research institutions, scientists and research papers that are not in...
the top 1% of the world [4]. Disciplines listed in ESI citation rankings are called preponderant disciplines [5]. Potential disciplines refer to disciplines that have not yet been ranked in ESI rankings, but have certain development advantages and are likely to be ranked in the top 1% of ESI global rankings in the future. It is a new growth point or growth point of an institution's scientific research [2-5].

When making the discipline construction and development plan, colleges and universities should not only pay attention to the development of superior disciplines, but also should understand the development of potential disciplines, give consideration to potential disciplines, enhance the academic influence of potential disciplines, and accelerate the entry of potential disciplines into superior disciplines.

In this paper, the threshold relative gap method [6] is used to calculate the potential value of potential disciplines and select the disciplines with the most potential. Analyses are carried out from three aspects: the variation trend of paper output and total citation frequency of papers, the distribution of cooperative institutions and the situation of publishing journals. It is found that the output of scientific research papers in this discipline needs to be further improved. At the same time, on the basis of ensuring the output of papers, the decline trend of total citation frequency of papers cannot be ignored. Scientific research cooperation is helpful to increase the output of papers, and the overall quality of published papers with cooperative institutions reaches the global average level. However, there are fewer cooperative institutions outside China and domestic and provincial institutions, and the coverage of published journals is narrow.

2. Identification of data sources and potential disciplines

2.1. Data Sources

Data in this paper were obtained from ESI and Incites databases, and the data retrieval date was October 29, 2020. The institution name of data retrieval is set as "University of Jinan", the subject classification adopts the 22 subject categories of ESI, the publication year of data retrieval is set as 2010 to 2020, and the literature types are Article and Review. The ESI database was updated on September 10, 2020, and the data range included on Web of Science was January 1, 2020 to June 30, 2020, with a total of ten years and six months. The Incites database was updated on August 27, 2020, and the Web of Science data range was January 1, 2010 to July 31, 2020, for a total of 10 years and 7 months.

2.2. Identify the disciplines with the most potential

The identification of potential disciplines refers to the identification of a discipline with the greatest potential among disciplines that have not been included in the ESI. The potential value of potential disciplines is mainly measured based on the relevant data of the shortlisted disciplines in ESI database and the relevant data of the shortlisted disciplines in Incites database. Through the investigation, it is found that there are seven methods for calculating the potential value of potential disciplines. The first method is the discipline proportion method proposed by Dong Zhenge et al. [7] in Donghua University. The second is the subject deficiency degree method proposed by Chen Shiji et al. from China Agricultural University. The third is the discipline access rate method of Xia Yuanjun et al., Southwest Jiaotong University, or Ren Ruilong et al., Donghua University, and the one with letters is the discipline access rate method of Zhao Yong et al., Anhui Agricultural University. The fourth is the relative difference method proposed by Qin Ping et al., Nanjing University of Aeronautics and Astronautics [11]. The fifth is the threshold relative gap method proposed by Zhang Jie of Shanxi University. The sixth and seventh are EV index method and MNCS index method proposed by Chen Shiji of China Agricultural University.

The seven methods can be divided into two categories. In the first method, the potential value of potential discipline calculated by the first method is close to the ESI threshold value, and the difference between potential discipline and ESI threshold value is compared. These methods include discipline deficiency degree, discipline admission rate, relative difference method and threshold relative gap method. The potential value of the potential discipline calculated by one kind of method is close to the
average level of the discipline, and the difference between the potential discipline and the average level of the discipline is compared. Such methods include EV index method and MNCS index method.

The purpose of this study is to promote potential discipline into superior discipline and compare the gap between potential discipline and ESI threshold value. Therefore, the first method is adopted. Compared with the discipline deficiency degree, discipline admission rate and relative gap value method in the first category, the threshold value has been modified in the calculation process and is more accurate, so the threshold value relative gap method is adopted.

The calculation formula of threshold relative gap method is as follows:

$$Q_i = \frac{X_i - Y_i}{X_i} \times 100\%$$  \hspace{1cm} (1)

Among them, \(i\) refers to the discipline of the 22 discipline categories of ESI, and \(X_i\) is the citation frequency of discipline \(i\) of threshold institution in 10 years, with data from Incites database. \(Y_i\) is the citation frequency of discipline \(i\) in the analysis institution in the recent 10 years. The data is from Incites database, and \(Q_i\) is the difference between discipline \(i\) and threshold institution of this discipline in the analysis institution. The smaller the \(Q_i\) is, the greater the potential of the subject to become a dominant discipline in the future; otherwise, the smaller the potential of the subject to become a dominant discipline in the future.

The subject classification system adopted in this paper is the 22 subject classification of ESI. Identifying the disciplines with the greatest potential requires four steps. Step 1: Identify the institution's strengths. Use relevant data of ESI database to find the top 1% disciplines of our institution in the world. Step 2: Identify the organization's potential discipline. The 22 disciplines in the ESI classification minus the dominant disciplines are the remaining disciplines of the institution's total potential disciplines. Step 3: Use threshold relative gap method to calculate the potential value of potential discipline. Step 4: Sort potential disciplines according to potential value, and select the disciplines with the largest potential value (that is, the minimum threshold value gap).

(1) Preponderant discipline of the University of Jinan

According to the updated statistics of the current data, the basic information of the superior disciplines of University of Jinan is shown in Table 1, including four superior disciplines: chemistry, material science, clinical medicine and engineering.

| Research fields | Web Of Science Documents | Cites | Cites/Paper | Top Papers | Cites to Top Papers | Cites/Top Paper |
|-----------------|--------------------------|-------|-------------|------------|---------------------|-----------------|
| chemistry       | 3084                     | 48149 | 15.61       | 35         | 4065                | 116.14          |
| materials       | 1804                     | 23088 | 12.8        | 26         | 3032                | 116.62          |
| clinical medicine | 1255                  | 13135 | 10.47       | 10         | 2684                | 268.4           |
| engineering     | 793                      | 8692  | 10.96       | 25         | 2950                | 118             |

(2) Discipline potential value of potential

The 22 disciplines in the ESI classification minus the 4 dominant disciplines (chemistry, material science, clinical medicine and engineering) and the remaining 18 disciplines are potential disciplines. The data \(X_i, Y_i\) acquisition steps are as follows:

Step 1: According to the name of the discipline, the last institution in the global top 1% of discipline \(i\) is searched in the ESI database, and this institution is the threshold institution of discipline \(i\). Step 2: Query the citation frequency of discipline \(i\) threshold institutions in Incites database, i.e. \(X_i\). Step 3: Query the citation frequency of discipline \(i\) in recent 10 years according to institution name in INCITES database, i.e. \(Y_i\).
We obtained $X_i$ and $Y_i$ of 18 potential disciplines respectively according to the above steps, according to the formula (1) $Q_i$ of different disciplines is calculated to obtain the potential value distribution of potential disciplines of University of Jinan, as shown in Table 2.

It can be seen from Table 2 that the potential value of biology and biochemistry is equal to 0.237853, which is the lowest among the 18 potential disciplines, indicating that biology and biochemistry have the greatest potential to enter the dominant disciplines. Next, we select biology and biochemistry from three aspects of paper output, total citation frequency, distribution of cooperative institutions and publication journals.

### Table 2. University of Jinan potential discipline potential value distribution table

| Num | discipline                  | $Y_i$ | $X_i$ | $Q_i$  |
|-----|-----------------------------|-------|-------|--------|
| 1   | Biology & Biochemistry      | 5396  | 7080  | 0.237853 |
| 2   | Pharmacology & Toxicology   | 2435  | 3855  | 0.368353 |
| 3   | Environment/Ecology         | 2498  | 4768  | 0.476091 |
| 4   | Mathematics                 | 2524  | 5146  | 0.509522 |
| 5   | Agricultural Sciences       | 1134  | 2774  | 0.591204 |
| 6   | Computer Science            | 1998  | 5390  | 0.629314 |
| 7   | Physics                     | 7135  | 23122 | 0.691419 |
| 8   | Social Sciences, general    | 405   | 1593  | 0.745763 |
| 9   | Molecular Biology & Genetics| 3642  | 15435 | 0.764043 |
| 10  | Immunology                  | 1087  | 5655  | 0.807781 |
| 11  | Plant & Animal Science      | 243   | 3163  | 0.923174 |
| 12  | Neuroscience & Behavior     | 544   | 7126  | 0.92366 |
| 13  | Geosciences                 | 466   | 6726  | 0.930717 |
| 14  | Microbiology                | 401   | 5966  | 0.932786 |
| 15  | Economics & Business        | 200   | 5566  | 0.964068 |
| 16  | Multidisciplinary           | 92    | 2903  | 0.968309 |
| 17  | Psychiatry/Psychology       | 117   | 4619  | 0.97467 |
| 18  | Space Science               | 12    | 43728 | 0.999726 |

3. **Discipline analysis of potential**

3.1. **Basic information of biology and biochemistry**

There are 1,128 institutions in the global biology and biochemistry ranking, led by the University of California and the Polytechnic University of Catalonia. Shandong province has three universities on the list, namely Shandong University, Ocean University of China and Qingdao University.

The output of academic papers in recent ten years is an important index to be referred to in the discipline construction planning. The total number of papers published in biology and biochemistry of the University of Jinan in recent ten years is 364, and the total citation frequency of the papers in 10 years and six months is 5533, including 4 highly cited papers and 133 papers in Q1 journal. According to the current ESI data, the total citation threshold of biology and biochemistry in the top 1% of the world is 6,441 times, and they have not entered the dominant discipline by November 2020.

Discipline standardized citation influence CNCI is the standardized citation influence calculated by discipline, publication year and literature type [12]. Discipline standardized citation influence is 1.16, greater than the global average.

Table 3 shows the total number of published papers and the total number of cited papers in Biology and Biochemistry of the University of Jinan from 2010 to 2020. The trend of the number of papers and citation frequency in biology and biochemistry of University of Jinan is shown in Figure 1.
Table 3. List of Biology and Biochemistry of the University of Jinan

| Organization Names | Web Of Science Documents | Cites | CNCI | Top Papers | Q1 Papers |
|--------------------|--------------------------|-------|------|------------|-----------|
| University of Jinan| 364                      | 5533  | 1.16 | 4          | 133       |

Figure 1. Papers and Cites of Biology & Biochemistry, 2010-2020

As can be seen from Figure 1, the total number of papers in biology and biochemistry presented a trend of slow growth from 2010 to 2015. The weight of papers in 2015 was 48, which was 8 times of the total number of papers in 2010. From 2015 to 2018, the total output of papers remained basically flat, at about 45 papers per year. Compared with the previous four years, the number of papers produced in 2019 increased slightly, reaching the maximum of 57 in this decade. With the increase of the output of papers, the attention of papers has been declining year by year since 2013. From the perspective of the total number of citations of papers, the total number of citations of papers presented a rapid growth trend from 2010 to 2013, and the total number of citations of papers in 2013 reached the highest value of 1050 times in the past decade. From 2014 to 2020, only the total citation frequency of papers in 2015 increased by more than 200 times compared with the previous year. Overall, the total citation frequency of papers decreased by nearly 5 times.

3.2. Cooperative Institution for Biology and Biochemistry

The analysis of discipline cooperation institutions can, on the one hand, understand the tendency of the discipline to choose scientific research cooperation institutions, and on the other hand, help the university management department to introduce relevant policies suitable for the school-enterprise cooperation of the discipline or the exchange of scientific research institutions.

According to the total number of papers jointly produced, we ranked the top 10 cooperative institutions in terms of paper output, including 11. This is shown in Table 4.

Table 5. Top 10 Cooperative Institutions in Biology and Biochemistry of University of Jinan

| Organization Names | Rank | Web Of Science Documents | Cites | CNCI | Top Papers | Q1 Papers |
|--------------------|------|--------------------------|-------|------|------------|-----------|
| Shandong First Medical University & Shandong Academy of Medical Sciences | 1    | 203                      | 2003  | 0.87 | 2          | 43        |
| Shandong University   | 2    | 122                      | 1924  | 0.91 | 1          | 37        |
| Chinese Academy of Sciences | 3    | 17                       | 248   | 1.14 | 0          | 9         |
| Shandong University of Traditional Chinese Medicine | 4    | 15                       | 74    | 0.29 | 0          | 2         |
From 2010 to 2020, the Department of Biology and Biochemistry of the University of Jinan has carried out academic cooperation with 181 institutions around the world, and the total number of papers jointly produced by the Department is 311, accounting for 85% of the total number of papers. From the perspective of cooperative institutions, Shandong First Medical University has the highest output of papers among cooperative institutions, with 203 Web of Science papers, accounting for 65% of the total output of cooperative papers. The citation frequency of papers is 2003 times, with 2 highly cited papers and 43 papers in Q1 journals. Among the top 10 cooperative institutions, there is only one foreign cooperative institution, the University of Technology Sydney, with 13 cooperative papers and 343 citation times. The citation influence of discipline standardization is 2.37, higher than the global average level of the discipline. Among the 11 cooperation institutions, the citation influence of discipline standardization of Beijing University of Chemical Technology ranks the first, reaching up to 3.0. From the perspective of citation influence index of discipline standardization, the influence of 5 cooperation institutions in jointly publishing papers with the partner institutions is above the global average level of discipline. Only one of the other six cooperative institutions (Shandong University of Traditional Chinese Medicine) had a large gap between the citation influence of standardized papers and the global average level of the discipline.

3.3. Publication journals of biology and biochemistry

According to the statistics of the periodicals of biology and biochemistry published by the University of Jinan, there are 97 periodicals of biology and biochemistry published by the University of Jinan, and 1147 periodicals of biology and biochemistry published in the world. We sorted the published journals according to the number of Web of Science papers, and selected the top 10 journals with published amount for analysis. Among them, 3 journals had the same published amount, a total of 13 journals, as shown in Table 5.

Table 5. Top 10 Publication Journals of Biology and Biochemistry of the University of Jinan

| Journal names                                      | rank | Web Of Science Documents | Cites | JNCI   |
|----------------------------------------------------|------|--------------------------|-------|--------|
| BIORESOURCE TECHNOLOGY                             | 1    | 42                       | 1059  | 1.18   |
| INTERNATIONAL JOURNAL OF CLINICAL AND EXPERIMENTAL MEDICINE | 2    | 32                       | 108   | 0.69   |
| BIOCHEMICAL AND BIOPHYSICAL RESEARCH COMMUNICATIONS | 3    | 22                       | 307   | 2.50   |
| INTERNATIONAL JOURNAL OF BIOLOGICAL MACROMOLECULES | 4    | 19                       | 479   | 1.44   |
| BIOSCIENCE TRENDS                                  | 4    | 19                       | 289   | 1.31   |
| COLLOIDS AND SURFACES B-BIOINTERFACES             | 5    | 17                       | 1125  | 2.54   |
| BIOMED RESEARCH INTERNATIONAL                      | 6    | 11                       | 26    | 0.49   |
| AMERICAN JOURNAL OF TRANSLATIONAL RESEARCH         | 7    | 10                       | 130   | 1.21   |
4. Conclusions and recommendations

By analyzing the maximum potential value of potential disciplines, we can have a deeper understanding of the development status of potential disciplines and the gap between them and the top 1% of academic institutions in the world. We can formulate the discipline construction plan suitable for the development of potential disciplines and cultivate the potential to become superior disciplines. By this way, we can help increase the number of institutional superior disciplines, and improve the academic influence of colleges and universities and the construction of specialty with strength characteristics.

From the basic situation of biology and biochemistry, cooperative institutions and publishing journals, one is the total output of disciplinary papers has been maintained at about 50 in the past five years, the output of the number of papers need to be further increased, on the premise of increasing the total output of papers, the total citation frequency of papers decreased year by year can not be ignored. Second, the development of cooperative institutions helps to improve the total output of the paper, but the cooperative institutions are mainly concentrated in the universities in Shandong province, and there are few domestic and foreign institutions and international institutions. Third, the overall periodical standardization impact factor is acceptable, but the coverage of published journals is narrow.

Based on this, the author suggests that at the level of scientific research management, One, in the process of planning and construction of scientific research project funds, we should not blindly focus on the superior disciplines and ignore the potential disciplines. Second, we should formulate scientific, comprehensive and reasonable research evaluation policies, appropriately increase funding support, encourage researchers of potential disciplines to actively participate in top academic activities in the industry, stimulate the inspiration of writing papers, and increase the total output of papers. At the level of library information service, One, the library uses the scientific research evaluation database to actively carry out potential discipline analysis, which provides theoretical data support for the university to formulate related discipline construction and discipline planning. Second, it pays attention to the highly cited papers in the field of potential discipline, and the high-yield authors of papers in the top 1% of institutions. It uses information retrieval technology and scientific research tools to sort out the research hot spots and research frontier of the discipline, and selects high-quality journals by consulting the discipline journals, so as to provide suggestions for researchers to submit papers. One, researchers of potential discipline should establish correct scientific research concepts, concentrate on research, not be eager for quick success and instant benefits, and ensure the quantity and quality of papers. Second, we should go out more to see the world development level of the industry, and carry out cooperation in
scientific research projects not only in universities in the same field in the province, but also strengthen long-term cooperation at home and abroad with high interdisciplinary level.

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