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Comparative Analysis of Eight Undergraduate Universities Based on InCites Database

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Abstract

This paper selects the papers collected by Web of Science from 8 local universities in Shandong Province from 2008 to 2018 in the InCites database as a research sample for chemistry, mathematics, engineering, biology and biochemistry, environment and ecology, physics, computer science, and analyzes the amount of documents and the frequency of citations. At the same time, the secondary disciplines with more than 15 papers published in 7 university departments also carried out statistical analysis on the number of publications, citation frequency, and frequency. Using these 7 disciplines, the eight universities will be compared horizontally, and the scientific research gaps between different universities will be located to reveal the research status of the undergraduate universities in Shandong Province of China.

Keywords

Data Analysis, InCites Database, General University, Subject Analysis, Cites, WOS Subject

1. Introduction

On September 21, 2017, the Ministry of Education, the Ministry of Finance, and the National Development and Reform Commission jointly announced the list of universities and construction disciplines for world-class universities and first-class disciplines. The construction of first-class universities relies on the construction of first-class disciplines. Therefore, improving the scientific research level of universities is the foundation and premise of building a world-class university [1]. Academic papers are an important embodiment of evaluating the scientific research achievements and scientific research innovations of a university [2]. The number of papers and the number of citations are one of the important indicators to measure the level of research in schools, research institutions and

even the country. Web of Science is an internationally recognized representative tool that reflects the research level of basic subjects.

InCites is an authoritative scientific evaluation and analysis tool based on Web of Science data, not limited to document types [3]. The number of papers in the InCites database comes from the seven database indexes of SCI-E, SSCI, A & HCI, CPCI-S, CPCI-SS & H, BKCI-S, and BKCI-SSH [4]. InCites can locate key disciplines, dominant disciplines, and development potential disciplines, optimize discipline layout, track and evaluate the research performance of institutions, and conduct benchmarking analysis with peer organizations.

2. Data Source

In order to analyze the research gaps and scientific research capabilities among ordinary undergraduate universities, this paper selects 8 universities in Binzhou University, Linyi University, Dezhou University, Taishan University, Jining University, Weifang University, Heze University and Zaozhuang University as research samples. These 8 universities are all ordinary undergraduate universities in Shandong Province, and none of them have entered the ESI database. These 8 universities are the most authoritative comprehensive universities in the city, and they are all located in the second-tier cities of Shandong Province. The GDP and population of the cities are basically the same. Since these 8 universities are all local universities, the majors and advantageous disciplines offered by universities are basically the same.

Using the Incics database, the author compares the papers included in the Web of Science from 2008 to 2018 from seven disciplines: chemistry, mathematics, engineering, biology and biochemistry, environment and ecology, physics, and computer science. To locate the gaps in scientific research between different disciplines between universities, and to clarify the gap between ordinary undergraduate colleges and world-class universities and first-class disciplines, with a view to helping scientific researchers in ordinary universities understand and master the development of disciplines, research frontiers and hot issues. Improve the level of scientific research. The data in this article is directly ranked from the InCites database. The rankings of the eight universities are ranked according to the total citation frequency of each subject.

The data retrieval date is December 20, 2018, December 23, 2018. Since the update of the InCites database is delayed by 2 months, the actual time span of all data is the time span of 2008-2018.10.31. This article selects these seven disciplines because these eight disciplines represent the main research directions of engineering in eight general universities, and the strength of each university's research team is not much different.

3. Comparative Analysis of WOS Papers in 8 Universities in Shandong Province

3.1. Chemistry Subject Analysis

The core of Web of science divides chemistry into seven secondary disciplines:

analytical chemistry, applied chemistry, inorganic and atomic chemistry, pharmaceutical chemistry, organic chemistry, physical chemistry, and chemistry related to other disciplines. According to the total number of papers, among the 8 universities, 431 papers from Linyi University ranked first in the number of papers; Dezhou University published 336 papers, ranking second. The least amount of papers was Zaozhuang University, and the number of papers was 107. From the aspect of total citation frequency, the highest is Linyi University, 3798 times. Secondly, Taishan University was cited as 2949 times. The highest frequency of the articles was Taishan University, which was 9.02 times/paper. From the perspective of disciplines, Linyi University's analytical chemistry, physical chemistry, and chemistry related to other disciplines are more than the other seven universities. In terms of inorganic and atomic chemistry, Taishan University has published the most papers.

Among the seven secondary disciplines, Binzhou University, Heze University, and Weifang University have only three research directions, and there are more than 15 research directions. Zaozhuang University has more than 15 subjects in 2 disciplines. It can be seen that in the chemistry discipline, Linyi University has more than the other seven universities regardless of the number and quality of documents issued. See Table 1 for details.

3.2. Mathematics Subject Analysis

The core set of Web of science divides mathematics into four sub-disciplines: interdisciplinary applications in mathematics and computational biology, mathematics, applied mathematics, and mathematics. In terms of the number of papers, Linyi University issued a total of 574 articles, of which mathematics and applied mathematics were the largest in eight universities. It can be seen that Linyi University has certain advantages in these two research directions compared to the other seven universities. Binzhou University published a total of 172 mathematics papers, of which the most published research direction is applied mathematics, a total of 93, accounting for 54% of the total number of texts issued by mathematics. The total number of citations was 885, ranking 2nd among 8 universities. The average number of citations is 5.15 times/paper, which is the highest number of citations in the eight universities. The least amount of papers is Heze University, and there are only 48 papers in WOS. In the second-level discipline of WOS, there are no more than 15 universities in mathematics and computational biology research. It can be seen that the research of mathematics and computational biology in these eight universities is relatively weak. See Table 2 for details.

3.3. Engineering Discipline Analysis

The core set of Web of science divides mathematics into 11 secondary disciplines such as electrical and electronic engineering, chemical engineering industrial engineering, and manufacturing engineering. In terms of the number of papers,

among the 8 universities, Weifang University has 641 articles, and the number of articles is the first. Linyi University issued 611 articles, ranking second. The least amount of papers is Heze University, and the number of papers is 81. From the perspective of secondary disciplines, Linyi University has the largest number of publications in electrical and electronic engineering; Weifang University's papers in chemical engineering, environmental engineering, and mechanical engineering are higher than other seven universities. The total number of citations of

Table 1. Comparative analysis of chemistry disciplines in 8 universities.

Rank	Institutions	WOS Documents	Total Cites	Cites/Paper	WOS SUBJECT	papers ≥ 15	Cites
1	Linyi University	431	3798	8.81	Chemistry, Analytical	102	1344
					Chemistry, Inorganic & Nuclear	28	67
					Chemistry, Multidisciplinary	145	1287
					Chemistry, Physical	115	759
2	Taishan University	327	2949	9.02	Chemistry, Analytical	21	249
					Chemistry, Applied	22	265
					Chemistry, Inorganic & Nuclear	96	782
					Chemistry, Multidisciplinary	86	681
					Chemistry, Organic	23	208
					Chemistry, Physical	77	731
3	Dezhou University	336	2682	7.98	Chemistry, Analytical	26	263
					Chemistry, Inorganic & Nuclear	85	580
					Chemistry, Multidisciplinary	122	804
					Chemistry, Physical	75	582
4	Jining University	315	2677	8.5	Chemistry, Inorganic & Nuclear	83	487
					Chemistry, Multidisciplinary	90	994
					Chemistry, Organic	35	152
					Chemistry, Physical	87	871
5	Binzhou University	161	1080	6.71	Chemistry, Inorganic & Nuclear	25	107
					Chemistry, Multidisciplinary	38	224
					Chemistry, Physical	68	477
6	Heze University	108	691	6.4	Chemistry, Multidisciplinary	25	69
					Chemistry, Physical	29	122
					Chemistry, Inorganic & Nuclear	33	131
7	Weifang University	159	689	4.33	Chemistry, Multidisciplinary	85	177
					Chemistry, Physical	21	176
					Chemistry, Multidisciplinary	47	217
8	Zaozhuang University	107	587	5.49	Chemistry, Multidisciplinary	47	217
					Chemistry, Physical	37	254

Table 2. Comparative analysis of mathematics subjects in 8 universities.

Rank	Institutions	WOS Documents	Total Cites	Cites/Paper	WOS SUBJECT	papers ≥ 15	Cites
1	Linyi University	574	1686	2.94	Mathematics	237	553
					Mathematics, Applied	274	872
					Mathematics, Interdisciplinary Applications	55	261
2	Binzhou University	172	885	5.15	Mathematics	53	167
					Mathematics, Applied	93	595
					Mathematics, Interdisciplinary Applications	25	104
3	Weifang University	196	516	2.63	Mathematics	73	183
					Mathematics, Applied	108	234
4	Dezhou University	99	509	5.14	Mathematics	23	51
					Mathematics, Applied	46	225
					Mathematics, Interdisciplinary Applications	19	130
5	Taishan University	93	428	4.6	Mathematics	16	69
					Mathematics, Applied	54	289
					Mathematics, Interdisciplinary Applications	20	70
6	Zaozhuang University	116	280	2.41	Mathematics	32	98
					Mathematics, Applied	49	132
					Mathematics, Interdisciplinary Applications	28	39
7	Jining University	54	122	2.26	Mathematics	17	33
					Mathematics, Applied	22	62
8	Heze University	48	83	1.73	Mathematics	16	11
					Mathematics, Applied	26	66

Binzhou University Engineering was 1229 times, and the frequency of citations was 5.06 times/paper, which was higher than that of other 7 universities. However, the number of papers sent in all directions in the engineering discipline is relatively average, and there is no dominant research direction. The number of publications in the biomedical engineering, geological engineering and petroleum engineering of the eight universities is less than 15 articles. It can be seen that the undergraduate colleges have less research on these two secondary disciplines of engineering. Especially for aerospace engineering, only Binzhou University published three related papers, and none of the other seven universities published relevant academic papers.

Based on the various data, the engineering discipline of Heze University has the least amount of publications and the least influence. Although Binzhou University has the highest number of citations, it has a small number of publications and needs to increase the number of publications. See **Table 3**.

3.4. Biological and Biochemical Discipline Analysis

The core of Web of science is a two-level discipline of biochemistry research methods

Table 3. Comparative analysis of engineering in 8 universities.

Rank	Institutions	WOS Documents	Total Cites	Cites/Paper	WOS SUBJECT	papers ≥ 15	Cites
1	Binzhou University	243	1229	5.06	Engineering, Electrical & Electronic	58	145
					Engineering, Chemical	43	252
					Engineering, Environmental	34	393
					Engineering, Mechanical	31	159
					Engineering, Multidisciplinary	26	51
					Engineering, Manufacturing	18	34
2	Taishan University	191	803	4.2	Engineering, Electrical & Electronic	80	259
					Engineering, Chemical	20	242
					Engineering, Mechanical	29	81
					Engineering, Multidisciplinary	24	53
					Engineering, Manufacturing	16	2
3	Linyi University	611	810	1.32	Engineering, Electrical & Electronic	216	175
					Engineering, Chemical	33	93
					Engineering, Environmental	38	176
					Engineering, Mechanical	102	69
					Engineering, Multidisciplinary	90	112
					Engineering, Industrial	25	6
					Engineering, Manufacturing	48	19
					Engineering, Civil	39	23
4	Weifang University	641	655	1.02	Engineering, Electrical & Electronic	169	122
					Engineering, Chemical	58	229
					Engineering, Environmental	39	39
					Engineering, Mechanical	129	108
					Engineering, Multidisciplinary	77	98
					Engineering, Industrial	19	5
					Engineering, Manufacturing	82	13
					Engineering, Civil	43	12
5	Zaozhuang University	195	307	1.57	Engineering, Electrical & Electronic	58	84
					Engineering, Chemical	26	146
					Engineering, Environmental	17	33
					Engineering, Mechanical	28	10
					Engineering, Multidisciplinary	37	25
					Engineering, Manufacturing	15	6
6	Dezhou University	208	346	1.66	Engineering, Electrical & Electronic	103	80
					Engineering, Chemical	18	106
					Engineering, Mechanical	27	38
					Engineering, Multidisciplinary	23	24
7	Jining University	103	357	3.46	Engineering, Electrical & Electronic	31	27
					Engineering, Chemical	24	229
					Engineering, Mechanical	20	63
8	Heze University	81	177	2.18	Engineering, Electrical & Electronic	18	7
					Engineering, Chemical	22	117

in biochemistry and biochemistry, biochemistry and molecular biology, biodiversity conservation, biology, biophysics, biotechnology and applied microbiology. It can be seen from Table 4 that compared with other disciplines, the biology and biochemistry of 8 universities have less publications in 10 years. The largest number of papers is Dezhou University, with only 147 articles; The number of papers published by Linyi University was 124, and the number of papers published was the second; Jining University and Heze University have only 19 publications each in 10 years, with an average of less than 2 publications per year. Binzhou University has published 73 papers on biology and biochemistry, among which biotechnology and applied microbiology research has the highest volume, accounting for 36% of biology and biochemistry. The total number of citations was 1751, ranking first in eight universities, and the number of citations was 24.03/piece, therefore, the articles published by Binzhou University were cited more frequently than the ESI threshold. The largest number of publications in biochemistry and molecular biology is Dezhou University, with 70 articles. Binzhou University, which has the largest number of documents in biology, has only 17 papers. Linyi University has the largest number of documents in the direction of biotechnology and applied microbiology. The largest number of biophysical publications is Dezhou University.

As can be seen from Table 4, the research on biology and biochemistry in 8 universities is relatively weak. It can be inferred that the research in biology and biochemistry is relatively weak due to the limitations of experimental conditions and talent policies in the two universities. See Table 5.

Table 4. Comparative analysis of environment and ecology in 8 universities.

Rank	Institutions	WOS Documents	Total Cites	Cites/Paper	WOS SUBJECT	papers ≥ 15	Cites
1	Binzhou University	69	671	9.72	Environmental Sciences	68	671
					Environmental Studies	1	0
2	Linyi University	150	503	3.35	Environmental Sciences	114	501
					Environmental Studies	36	2
3	Zaozhuang University	33	272	8.24	Environmental Sciences	32	272
					Environmental Studies	1	0
4	Taishan University	18	125	6.94	Environmental Sciences	12	117
					Environmental Studies	6	8
5	Weifang University	40	107	2.68	Environmental Sciences	40	107
6	Dezhou University	31	57	1.84	Environmental Sciences	29	57
					Environmental Studies	2	0
7	Heze University	10	32	3.2	Environmental Sciences	9	32
					Environmental Studies	1	0
8	Jining University	5	12	2.4	Environmental Sciences	5	12

Table 5. Comparative analysis of biology and biochemistry in 8 universities.

Rank	Institutions	WOS Documents	Total Cites	Cites/Paper	WOS SUBJECT	papers ≥ 15	Cites
1	Binzhou University	73	1754	24.03	Biochemistry & Molecular Biology	18	521
					Biology	17	750
					Biotechnology & Applied Microbiology	26	365
2	Linyi University	124	1378	11.11	Biochemistry & Molecular Biology	35	265
					Biophysics	26	406
					Biotechnology & Applied Microbiology	45	585
3	Dezhou University	147	1169	7.95	Biochemical Research Methods	15	148
					Biochemistry & Molecular Biology	70	562
					Biophysics	30	178
4	Taishan University	56	433	7.73	Biochemistry & Molecular Biology	17	86
					Biophysics	15	49
5	Zaozhuang University	60	226	3.77	Biochemistry & Molecular Biology	16	90
					Biology	16	18
6	Weifang University	32	178	5.56	Biochemistry & Molecular Biology	17	126

3.5. Environmental and Ecological Discipline Analysis

The core set of Web of science divides environment and ecology into two secondary disciplines: environmental science and environmental research. It can be seen from Table 6 that in terms of the number of papers, 150 papers from Linyi University rank first in terms of number of papers. The least amount of papers is Jining University, and the number of papers is only five. Binzhou University published 69 papers on environment and ecology, including 68 papers in environmental science, 671 times in total citations, and 1st in 8 universities, the number of citations was 9.72 times/paper. More than 8 universities on environmental and ecological research focus on the direction of environmental science. There are very few papers in the direction of environmental research. For example, Binzhou University, Zaozhuang University, and Heze University each have only one related academic paper. There is no relevant paper in Jining University, and there are only 6 colleges with the largest number of publications. Linyi University has the largest number of documents in the environmental sciences, with a volume of 114 articles, followed by Binzhou University. According to various data, there are very few academic papers published by eight universities in environment and ecology.

All universities should strengthen management and investment in environmental and ecological aspects, and try to consider scientific research policies and talent introduction. The data are shown in Table 4.

3.6. Physics Subject Analysis

The core set of Web of science divides environment and ecology into eight secondary

Table 6. Comparative analysis of physics in 8 universities.

Rank	Institutions	WOS Documents	Total Cites	Cites/Paper	WOS SUBJECT	papers ≥ 15	Cites
1	Linyi University	287	1950	6.79	Physics, Applied	91	651
					Physics, Atomic, Molecular & Chemical	34	221
					Physics, Condensed Matter	59	355
					Physics, Mathematical	36	206
					Physics, Multidisciplinary	53	372
2	Jining University	260	1553	5.97	Physics, Applied	52	436
					Physics, Atomic, Molecular & Chemical	42	330
					Physics, Condensed Matter	49	373
					Physics, Mathematical	16	21
					Physics, Multidisciplinary	74	340
3	Dezhou University	140	1400	10	Physics, Applied	50	520
					Physics, Atomic, Molecular & Chemical	15	87
					Physics, Condensed Matter	28	398
					Physics, Multidisciplinary	27	201
4	Taishan University	143	845	5.91	Physics, Applied	61	332
					Physics, Atomic, Molecular & Chemical	21	178
					Physics, Condensed Matter	27	175
					Physics, Multidisciplinary	24	113
5	Binzhou University	132	650	4.92	Physics, Applied	27	71
					Physics, Atomic, Molecular & Chemical	23	152
					Physics, Condensed Matter	20	102
					Physics, Multidisciplinary	40	206
6	Heze University	162	605	3.73	Physics, Applied	22	102
					Physics, Condensed Matter	20	43
					Physics, Mathematical	16	17
					Physics, Multidisciplinary	91	411
7	Weifang University	87	282	3.24	Physics, Applied	38	119
					Physics, Multidisciplinary	28	59
8	Zaozhuang University	82	192	2.34	Physics, Applied	26	67
					Physics, Multidisciplinary	23	38

disciplines: applied physics, atomic physics, polymer physics, mathematical physics, and nuclear physics. From the number of papers, Linyi University has the largest number of papers, totaling 287 papers; The least amount of papers was Zaozhuang University, and the number of papers was only 82. From the citation frequency, Linyi University's total citation frequency is the highest total citation frequency of 1950 times; Zaozhuang University has the lowest frequency

of citations, mainly because its number of posts is too small. The highest number of citations was from Dezhou University, 10 times/piece, and the last institution ranked 1% before ESI was the University of Kentucky. The citations were 17.87 times/paper, so the general undergraduate in Shandong Province, there is still a big gap between colleges and world-class disciplines. In the fields of applied physics, polymer physics, and mathematical physics, Linyi University has the largest number of publications, which shows that it is higher than the other seven universities in these three directions. The largest number of documents in the interdisciplinary direction of atomic physics and physics is Jining University, with only 42 articles.

It can be seen from the above data that the gap between the physics research of the eight universities and the world-class universities is very large, mainly due to the talent problem. Among the more than 8 colleges and universities, the most prominent physics research is Linyi University and Jining University. See Table 6 for details.

3.7. Computer Science Subject Analysis

Web of science divides computer science into eight secondary disciplines for computer science: Artificial Intelligence, Cybernetics, Hardware & Architecture, Information Systems, Interdisciplinary Applications, Theory & Methods, Software Engineering. When counting the two secondary disciplines, only the disciplines with a volume of ≥15 articles were counted, and the second-level disciplines with less than 15 articles were ignored here.

In terms of the number of papers, 573 Weifang University ranked first, and 561 papers from Linyi University ranked second; Heze University has the least amount of papers, only 52 articles. In terms of total times cited, the highest is Taishan University, 620 times; Secondly, Linyi University, the total number of citations was 580 times; Among the 8 colleges and universities, the highest number of papers cited was Binzhou University, 5.01 times/paper. The most published in the direction of Artificial Intelligence is Weifang University, 127 articles; Linyi University has the largest number of documents in Information Systems and Theory & Methods; Weifang University is in the direction of computer science, with more research on Interdisciplinary Applications. The number of papers in each direction of Binzhou University, Dezhou University, Zaozhuang University, Heze University, Jining University, Taishan University no more than 100 papers. In particular, Heze University and Jining University have only one research direction with more than 15 articles. Therefore, these six colleges have a certain gap in computer science compared to Weifang University and Linyi University. See Table 7.

4. Conclusions

The data is the most iconic performance of anything. From the above data, we can see that there are very wide gaps in the number of universities in the eight

Table 7. Comparative analysis of computer science in 8 universities.

Rank	Institutions	WOS Documents	Total Cites	Cites/Paper	WOS SUBJECT	papers ≥ 15	Cites
1	Taishan University	169	620	3.67	Artificial Intelligence	42	350
					Information Systems	28	15
					Interdisciplinary Applications	33	124
2	Linyi University	561	580	1.03	Artificial Intelligence	101	283
					Hardware & Architecture	18	14
					Information Systems	122	72
					Interdisciplinary Applications	144	95
					Software Engineering	17	39
					Theory & Methods	145	64
3	Weifang University	573	420	0.73	Artificial Intelligence	127	92
					Hardware & Architecture	19	11
					Information Systems	117	103
					Interdisciplinary Applications	148	87
					Software Engineering	22	47
					Theory & Methods	138	80
4	Binzhou University	74	371	5.01	Artificial Intelligence	22	146
					Interdisciplinary Applications	15	82
					Theory & Methods	16	2
5	Dezhou University	269	320	1.19	Artificial Intelligence	42	69
					Hardware & Architecture	16	17
					Information Systems	54	51
					Interdisciplinary Applications	82	134
					Theory & Methods	62	34
6	Zaozhuang University	161	132	0.82	Artificial Intelligence	41	34
					Information Systems	30	48
					Interdisciplinary Applications	41	40
					Theory & Methods	38	7
7	Heze University	52	30	0.58	Artificial Intelligence	18	9
8	Jining University	56	26	0.46	Artificial Intelligence	15	5

universities. The horizontal comparison of the eight universities, the volume of publications and the depth of research in each discipline are not the same. Comprehensively, Linyi University has obvious academic advantages in 8 universities, but the comprehensive data of Zaozhuang University and Heze University are relatively low.

It can also be seen from the data that due to the limitations of experimental conditions, talent policies, scientific research awards, etc., the research in some

experimental and technical disciplines is relatively weak, such as biology students' chemistry and environment, science and so on. In addition, in ordinary colleges and universities, the main research force is generally young doctors and graduate students, but this part of the teachers has heavy work tasks and more teaching time, so that the research time is less [5]. The management of ordinary colleges and universities can adjust internal talent management policies and research incentive policies according to the gap between disciplines. At the same time, it is hoped that China's relevant scientific research and education management departments will take corresponding measures to encourage university faculty and students to carry out scientific research and innovation, and accelerate the output of scientific research results.

This paper only studies the status quo of scientific research in universities from the perspective of thesis, and there is a certain one-sidedness. The author will further study from scientific research cooperation, patent cooperation and cooperation in science and technology projects.

Conflicts of Interest

The author declares no conflicts of interest regarding the publication of this paper.

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