Comparative Analysis of Comprehensive Strength of Universities Based on Multidimensional Indicators——Take Nanjing University of Science and Technology and Nanjing University of Aeronautics and Astronautics as Examples

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Keywords: comparison of scientific research strength, index system, NJUST, NUAA.

Abstract: To a certain extent, university evaluation reflects the comprehensive strength of the school, and can also provide a certain reference for parents and students to choose a school. This paper selects multi-dimensional indicators to carry out university evaluation, and conducts empirical analysis based on Nanjing University of Science and Technology and Nanjing University of Aeronautics and Astronautics; the data sources are mainly the official websites of Nanjing University of Science and Technology and Nanjing University of Aeronautics and Astronautics, and the index system of "Netbig" ranking index system is referred to in terms of index system, and on this basis, the indicators and weights are adjusted according to the actual situation. This article aims to provide certain references and suggestions for parents and candidates to choose a school.

1. Introduction

University evaluation refers to a method in which some evaluation institutions artificially select multiple or single indexes and conduct comprehensive or single evaluation on the university's school-running strength and development level after certain weight treatment, and arrange them according to the order of scores [1]. Among them, the evaluation of the quality of the selected indicators is the key to the final value of the ranking activity. In this paper, the author reviewed the indicators used to measure the scientific research strength in the existing academic research and the indicators used in the practice of university ranking, determined the indicators used in this study, made a comparative analysis of the scientific research strength of Nanjing University of Science and Technology (NJUST) and Nanjing University of Aeronautics and Astronautics (NUAA), and analyzed the advantages and disadvantages of the two schools.

With the study of university ranking, various indicators are constantly improved, gradually from a single index to a multi-index weighting development. Since 1987, when China first published the ranking of 87 key universities, many scholars have done in-depth research on it.

In terms of index system, Huang Wei [1] made a horizontal and horizontal comparative study of the index systems of well-known ranking institutions such as Netbig, Wushulian, Zhongpingwang and Xiaoyouhui, and also made a certain study of the fluctuation of the index systems of these ranking institutions. Ren Yongcan [2] from twelve influential university ranking index system both at home and abroad as the research object, at the same time reference analysis model of the university ranking index system, deeply and concretely introduces the produce time, evolution of various ranking index system, the concept of rank, and the index weight composition and change, and in its personality. Xie Yalan [3] selected 16 representative rankings and conducted a multidimensional analysis of their index system. Based on empirical research method and resource dependence theory, this paper discusses the influence of university ranking. In terms of specific indicators, the author also studies the correlation between scientific research input and output, but the research objects are American universities. HuoXiao ran [4] is a combination of the world's best-known ranking index system and expert evaluation, summarizes the first-class university should have the characteristics, including the

first-class discipline, first-class teachers, first-class achievements, first-class personnel training mode, first-class educational condition, first-class academic environment, etc., all these features are included in the evaluation system of research in this paper. Qiu Junping [5] for five kinds of international and domestic high-profile world university rankings in-depth analysis, compare their evaluation purpose, index system and weight distribution as well as the impact, explains the characteristics, from the international and national level delve into the outside world for the world university rankings, and for the world of university evaluation provides some suggestions for improvements and the use of the user list.

In terms of specific indicators, Zhou Jing [6] analyzed the development level of liberal arts in 23 world-class science and technology universities and its impact on the global ranking. The results show that the liberal arts of these universities of science and technology are generally in the world first-class, between the world famous and the world first-class, but not up to the world famous three levels of development; The development level of liberal arts has a significant influence on its global ranking, and the development level of liberal arts is basically consistent with the global ranking. Yu Huiping [7] used objective data indicators to quantitatively describe the correlation between bibliometric indicators and university ranking, and the results showed that the scale and quantity of academic output had no significant correlation with university ranking. However, citation frequency, FWCI, highly cited papers and nature index reveal that academic influence and academic innovation level are significantly correlated with university ranking. Wang Linchun [8] introduced the application of reputation survey method in foreign university ranking based on literature and data review, and summed up two major defects of this method: From the perspective of survey objects, reputation survey is difficult to avoid the bias of evaluators; From the perspective of survey design, the rigor and scientificity of reputation survey still need to be improved. Sun gang into [9] with the aid of generally refer to four world university ranking system of indicators and teachers for the world university ranking data of the top 20 schools with China's entry into the top three to five schools through the contrast analysis of the results found that both teachers among the gap is bigger, from the side reflects the teachers proportion of university's comprehensive strength has a certain impact. Zhang Heping [10] analyzed the relationship between school-running scale and school-running achievement based on the 2016 USNEWS American University Ranking data and found that per-student education input, student size, student-teacher ratio, number of disciplines and history of school establishment all significantly affected school-running achievement, and per-student education input had a far greater impact on school-running achievement than other factors.

2. Indicator system and calculation method

2.1 Mainstream University Ranking Index System

In China, there is no authoritative university ranking agency or evaluation index system recognized by the society. The public has mixed opinions about the results presented by each ranking. The reason for this is that, in addition to the differences in accuracy of data, different evaluation indexes are adopted respectively [11]. Now had a greater influence on the social evaluation institutions, high-profile including Wu shulian version of Chinese university rankings (WSH), China Social Science Evaluation Research Center, Wuhan University ranking (ZPW), The Chinese Universities Alumni Association (CUAA) and Netbig [12].

(1) WSH Comprehensive List.

The Wushulian Comprehensive List, which focuses on comprehensive strength, was launched in 1997 when the University Evaluation Research Group of Chinese Academy of Management first released the evaluation results of 11 universities and ranked them by category. Wu Shuian list with non-mainstream color focuses on the scale of higher education, "winning by scale" and focusing on output [13]. Through the supplement and adjustment of a series of indicators, the proportion of subjective indicators is improved, and the indicator system is becoming more scientific and stable.

(2) Netbig List

Netbig website (www.netbig.com) Nine college evaluation results have been released since 1999. The ranking of netbig universities is based on the quality of high school students and the social reputation of university students. In the setting of its indicators, the mainstream evaluation systems in Europe and the United States are largely referred to. Therefore, many British universities take online rankings as screening criteria when recruiting students, such as the University of Bath and Durham University. This paper is based on the comprehensive comparative analysis of "netbig rankings", and makes corresponding adjustments in its index system combining the characteristics and reality of the two schools.

(3) CUAA Index System

Based on the three functions of talent training, scientific research and social service of Chinese universities, the alumni association list focuses on prioritizing colleges and universities from "alumni achievements" and "academic achievements", reflecting the contribution rate and influence, emphasizing quality, and emphasizing contribution to society. This is also the biggest feature that distinguishes the China University Rankings from other university rankings at home and abroad.

(4) ZPW index system

The China Science Evaluation and Research Center of Wuhan University released the "Comprehensive Competitiveness Evaluation Report of Chinese Universities" in 2004; so far, its index system is the most comprehensive and the index system is relatively stable; in 2011, the "University Network Impact Index" was introduced for the first time in the index system to replace the "social reputation" three-level indicator.It accounts for 50% of the school's reputation index, which includes five four-level indicators such as the size of the school's website, the number of links, the degree of network display, and the influence of online academics.

2.2 Indicator weight adjustment

On the basis of the "Netbig", we have adjusted the indicator system according to the actual situation, the main adjustment content is: the first-level indicator of the school's reputation has been removed, and the second-level index of undergraduate degree points has been added, and we believe that the number of undergraduate degree points can reflect the scientific research strength of the university to a certain extent. In terms of weight allocation, the 15-point weight of the first-level indicator school reputation is evenly distributed to the remaining second-level weights using a weighted average algorithm, and one decimal place is retained. The adjusted evaluation indicators and weights are shown in Table 1.

Table 1. Evaluation indicators and weight distribution

Level 1 indicators	weight	Secondary indicators	weight
Academic Resources	24	Undergraduate degree points	2
		Discipline authorized to offer master degree program	4
		Discipline authorized to offer doctoral degree program	6
		Number of national key disciplines	6.2
		State Key Laboratory	5.8
Publications of academic achievements (per capita and total)	26	SCI (Total and Per Capita).	10.1
		EI (Total and Per Capita).	9.3
		SSCI (Total and Per Capita).	6.6
Student quality	14	Quality of New Students Admitted (College Entrance Examination Results)	6.9
		Proportion of graduate students in the whole university	7.1
Faculty	22	The proportion of full-time teachers with deputy senior or above	9.5
		The number of academicians of the two academies	5.5
		Yangtze River Scholars Distinguished Professors	4.5
		Teacher-student ratio (number of full-time teachers/number of students).	2.5
Material resources	14	Scientific research funds and the per capita scientific research funds of full-time teachers and personnel of scientific research institutions	7
		School building area and average student area	3.5
		The total number of books and the average number of books per student	3.5

2.3 Data Acquisition

In order to systematically and comprehensively analyze the scientific research strength of Nanjing University of Science and Technology and Nanjing University of Aeronautics and Astronautics, it is compared from six aspects: school reputation, academic resources, academic achievements, student quality, faculty strength and material resources. Its specific evaluation indicators and weights are shown in Table 1. The data sources for this article are mainly the official websites of Nanjing University of Science and Technology [14] and Nanjing University of Aeronautics and Astronautics [15]. When counting academic publications in two schools, the data sources are the WoS [16] website and the engineering village [17] website.

2.4 Principles of Calculation

In order to enable the evaluations in the indicator system to be combined to calculate the total score of each institution, we adopt the principle of calculating the relative score for each sub-indicator ranking and finally adding the relative points weighted. The process of calculating relative scores is the process of standardizing the results of sub-data or sub-calculations to the [0-100] range: the institution with the highest value of data or calculation results in each indicator has a final score of 100 points in this item, and the score of another school in this item is the relative percentage of its data or calculated result value divided by the highest value. Each indicator is calculated on a case-by-case basis in accordance with this principle, and the standardization process is not specifically emphasized in each of the following formulations. With the exception of "Quality of New Students Admitted", this article uses data for 2019.

2.5 Calculation Methods

Regarding the calculation of the "distribution of academic resources"(A&R) score, the score of the institution with the high value of each sub-indicator is set to 100 points, the relative score of other

institutions is calculated, and the total score of academic resources of each institution is calculated according to the weight ratio. It is calculated as follows:

$$\text{A\&R sub-index score} = \frac{\text{A\&R sub-index value}}{\text{MAX(Two school's A\&R sub-index value)}} \times 100 \quad (1)$$

$$\text{A\&R score} = \Sigma \text{A\&R sub-index score} \times \frac{\text{Weight}}{\text{A\&R weight}} \quad (2)$$

Regarding the calculation of the score of "academic achievements", the academic achievements are divided into two categories according to science and technology and social science, and then the two types of activity personnel are weighted and merged. The calculation takes into account aggregate and per capita indicators.

Classification method: SCI and EI are classified as science and technology, and due to the lack of CSSCI data, only SSCI is classified as social science.

The calculation formula is as follows:

(1) Scientific and technological(S&T) achievements and social(S&S) science achievements

$$\text{S\&T achievements} = \text{SCI} \times \text{SCI weight} + \text{EI} \times \text{EI weight} \quad (3)$$

$$\text{S\&S achievements} = \text{SSCI} \times \text{SSCI Weights} \quad (4)$$

(2) Total academic achievement score

$$\text{Total S\&T achievements score} = \frac{\text{S\&T achievements}}{\text{MAX(two schools S\&T achievements)}} \times 100 \quad (5)$$

$$\text{Total Academic Achievement Score} = \frac{\text{S\&T achievements} \times \text{S\&T workers} + \text{S\&S achievements} \times \text{S\&S workers}}{\text{headcount}} \quad (6)$$

(3) Academic achievement scores per capita

$$\text{S\&T achievements per capita} = \frac{\text{S\&T achievements}}{\text{S\&T workers}} \quad (7)$$

$$\text{S\&T achievements per capita} = \frac{\text{S\&S achievements}}{\text{S\&S workers}} \quad (8)$$

$$\text{Score of S\&T achievements per capita} = \frac{\text{S\&T achievements per capita}}{\text{MAX(two schools S\&T achievements per capita)}} \times 100 \quad (9)$$

$$\text{Score of S\&S achievements per capita} = \frac{\text{S\&S achievements per capita}}{\text{MAX(two school's S\&T achievements per capita)}} \times 100 \quad (10)$$

$$\text{Score of academic achievements per capita}$$
$$= \frac{\text{S\&T achievements per capita} \times \text{S\&T workers} + \text{S\&T achievements per capita} \times \text{S\&S workers}}{\text{headcount}} \quad (11)$$

(4) Academic achievement score

$$\text{Academic achievement score} = \text{Total academic achievement score} \times 50\% + \text{Academic achievement score per capita} \times 50\% \quad (12)$$

Regarding the calculation of the "Quality of Admitted Freshmen" score, the quality of new students is calculated using the average score data of the college entrance examination of new students

admitted to the two colleges and universities in each province from 2015 to 2019 (not the admission score line). Since the full scores of the college entrance examination vary from province to province, most provinces use a 750-point system, so it is necessary to unify the score standard and then rank it. In the rankings, we first collect the average admission scores of the two colleges in each province, and since both colleges belong to the science and engineering colleges, when collecting the average score data, only the average score of science and engineering is taken. The calculation of the quality of admitted new students is to first take the average score of each province, and for provinces where the full score value is not 750, the calculation formula is as follows:

$$\text{Standard average score} = \frac{\text{A certain year in a province admitted average points}}{\text{The province's full marks}} \times 750 \tag{13}$$

Due to the difficulties in counting the number of admissions in various provinces, such as incomplete data in some provinces, the arithmetic average is used when calculating the national ranking, and the formula is as follows:

$$\text{National average score} = \frac{\Sigma \text{Standard mean score}}{\Sigma \text{Province}} \tag{14}$$

The score and weight calculation formula for student quality(S&Q) is as follows:

$$\text{S\&Q sub-index score} = \frac{\text{S\&Q sub-index values}}{\text{MAX(S\&Q sub-index values)}} \times 100 \tag{15}$$

$$\text{Total score of S\&Q} = \Sigma_{\text{S\&Q sub-index score}} \times \frac{\text{Weights}}{\text{Total weight of S\&Q}} \tag{16}$$

Regarding the calculation of the score of "scientific research funds", the general principle is to calculate the score according to the total amount of funds, and the calculation should take into account the total amount and per capita indicators. The analysis is as follows:

(1) Taking into account the nature of scientific research in the two institutions, when calculating the score of scientific research funds of each institution, all researchers are counted as scientific and technological activity personnel

(2) Among the two institutions, the institution with the highest score in scientific research funding scored 100 points;

(3) Similarly, the maximum score of the total amount and per capita scientific research funding is 100 points, which can further balance the scientific research funding, because the total funding can reflect the scientific research strength of the institution, and can also reflect the possible advantages of the institution in multidisciplinary research and group cooperation;

(4) When calculating the score of scientific research funds, the weight of the relative score obtained per capita and the relative score obtained by the total amount is 50%.

The calculation formula is as follows:

(i) The score of total scientific research funding(R&F)

$$\text{Total research funding score} = \frac{\text{R\&F}}{\text{MAX(Two school's R\&F)}} \times 100 \tag{17}$$

(ii) Research funding score per capita

$$\text{R\&F per capita} = \frac{\text{R\&F}}{\text{S\&T workers}} \tag{18}$$

$$\text{R\&F per capita score} = \frac{\text{R\&F per capita}}{\text{MAX(Two school's R\&F per capita)}} \times 100 \tag{19}$$

(iii) Research Funding Score:

R&F score =Total R&F score×50%+ R&F per capita score ×50%

Regarding the calculation of the score and weight of "faculty strength"(F&S), the calculation formula is as follows:

$$\text{Sub-indicator score of F\&S} = \frac{\text{F\&S sub-indicator value}}{\text{MAX(F\&S sub-indicator value)}} \times 100 \tag{20}$$

$$\text{score of F\&S} = \Sigma \text{Sub-indicator score of F \& S} \times \frac{\text{Weight}}{\text{Total weight of}_{F\&S}} \tag{21}$$

When calculating the "material resources" (M&R) score, the total number of books and the average number of books per student are used at the same time, and then each account for 50% of the total number of books. Increasing the total number of books outside of the average person is important for students to consider that the total number of books means that more and more opportunities for students to use books are more and more widely available. The same approach is taken to the school building floor area, taking into account the performance of the total amount and the average student area. The calculation formula is as follows:

$$\text{Total score} = \frac{\text{Total sub-index of M\&R}}{\text{MAX(Two school's M\&R)}} \times 100 \tag{22}$$

$$\text{M\&R per capita score} = \frac{\text{Per capita sub-index of M\&R}}{\text{MAX(Two school's M\&R per capita)}} \times 100 \tag{23}$$

$$\text{Sub-index of M\&R score} = \text{Total score} \times 50\% + \text{per capita score} \times 50\% \tag{24}$$

$$\text{M\&R total score} = \Sigma \text{sub-index of M\&R score} \times \frac{\text{Weight}}{\text{M\&R weight}} \tag{25}$$

Regarding the conversion of the "number of students", when calculating the proportion of graduate students in the whole university, the teacher-student ratio, the average number of books per student, and the building area of the average student building, the number of students is calculated according to the number of full-time students in this specialty.When calculating the proportion of graduate students in the whole university, the number of graduate students is also converted into the equivalent number of full-time undergraduate students according to the level (doctoral /master's students), and then calculated together with the number of equivalent students in the whole university.

3. Data analysis results

3.1 Academic Resource Score

The academic resources mentioned in this article mainly involve the number of undergraduate degree points, the number of doctoral points in first-level disciplines and the proportion of undergraduate degree points, the proportion of master's degree points and relative to undergraduate degree points, the number of national key disciplines and the proportion of undergraduate degree points, the number of state key laboratories and national engineering (technology) research centers, and the proportion of undergraduate degree points. It is generally believed that the richer the academic resources, that is, the more degree points, the greater the number of national key disciplines and state key laboratories and research centers, the stronger the scientific research strength of the university. The specific values are shown in Table 2"Academic Resources".

Table 2. Evaluation indicators and weight distribution

Level 1 indicators	weight	Secondary indicators	NJUST	NUAA	weight
Academic Resources	24	Undergraduate degree points	69	58	2
		Discipline authorized to offer master degree program	18	17	4
		Discipline authorized to offer doctoral degree program	36	33	6
		Number of national key disciplines	9	11	6.2
		State Key Laboratory	6	5	5.8
Academic achievements (per capita and total)	26	SCI (Total and Per Capita).	21312(33.3)	21473(31.9)	10.1
		EI (Total and Per Capita).	98832(211.5)	41172(141.3)	9.3
		SSCI (Total and Per Capita).	395(1.9)	702(2.3)	6.6
Student quality	14	Quality of New Students Admitted (College Entrance Examination Results)	595	605	6.9
		Proportion of graduate students in the whole university	40%	34%	7.1
Faculty	22	The proportion of full-time teachers with deputy senior or above	60%	68.4%	9.5
		The number of academicians of the two academies	20	11	5.5
		Yangtze River Scholars Distinguished Professors	19	12	4.5
		Teacher-student ratio	6.67%	6.36%	2.5
Material resources	14	Scientific research funds and the per capita scientific research funds of full-time teachers and personnel of scientific research institutions	3.48 billion (1.742 million)	3.761 billion (2.938 million)	7
		Books and the average number of books per student	2.43 million copies (81 volumes)	2.84 million copies (97.9 volumes).	3.5
		School building area and average student area	1.08 million ^{m2} (36 ^{m2}).	1.678 million ^{m2} (57.9 ^{m2}).	3.5

Note: In parentheses, per capita

After calculation, the scores of Nanjing University of Science and Technology under "Academic Resources" can be obtained as 100 points, 100 points, 100 points, 82 points and 100 points respectively, and the scores of Nanjing University of Aeronautics and Astronautics are 84 points, 94 points, 92 points, respectively. 100 points, 83 points. According to the weight ratio, the total score of academic resources of Nanjing University of Science and Technology is 95.4 points, and the total score of academic resources of Nanjing University of Aeronautics and Astronautics is 91.6 points. From the perspective of academic resource distribution, Nanjing University of Science and Technology is slightly better than Nanjing University of Aeronautics and Astronautics.

3.2 Academic publication score

The publications of academic achievements mentioned in this article mainly involve the Science Citation Index SCI, the Engineering Citation Index EI, and the Social Science Citation Index SSCI. When evaluating academic achievements, this paper mainly judges from two dimensions: total

number of publications and per capita publications. Taking the SCI search of Nanjing University of Science and Technology as an example, the source of academic achievement data is woS official website, and the institution name Nanjing University of Science & Technology is retrieved in the journals index expanded by science citation index, and the search time is 1990-present.- The results show that the total number of papers included in SCI by Nanjing University of Science and Technology is 21312; all authors and the number of papers included are downloaded.

The data distribution of authors with a volume greater than 10 is shown in Figure 1, involving a total of 640 authors, and the SCI per capita of Nanjing University of Science and Technology is 33.3. Similarly, since 1990, the total number of papers included in SCI by Nanjing University of

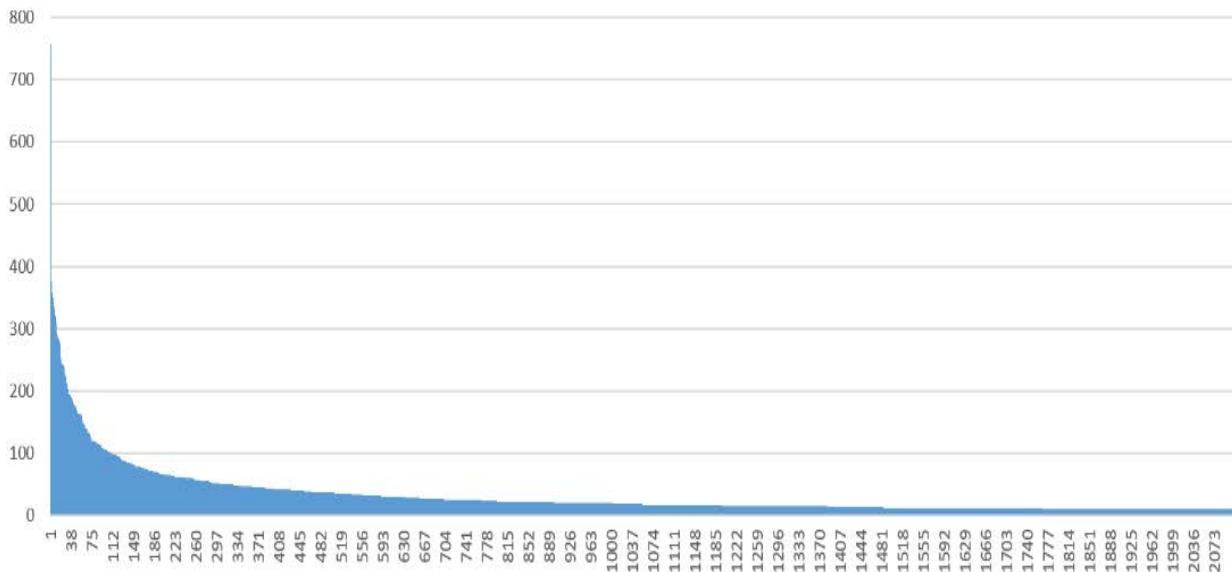Aeronautics and Astronautics has been 21473, involving 673 authors, or 31.9 per capita.

Figure 1. Distribution of SCI data of NJUST

Similarly, the total number of SSCI and EI of the two universities since 1990 and the average can be obtained, and the statistical results are shown in Table 2. After calculation, it can be obtained that Nanjing University of Science and Technology scored 99.6 points, 100 points and 69.4 points in the science citation index SCI, engineering citation index EI and social science citation index SSCI, respectively, and the score values of Nanjing University of Aeronautics and Astronautics were 97.9 in order /b110>Points, 54.2 and 100 points. Based on weighted calculations, the total student quality scores of Nanjing University of Science and Technology and Nanjing University of Aeronautics and Astronautics were 91.8 points and 82.4 points, respectively. From the perspective of academic achievements, Nanjing University of Science and Technology is obviously better than Nanjing University of Aeronautics and Astronautics.

3.3 Student Quality Score

The student quality indicators mentioned in this article mainly involve the quality of admitted new students and the proportion of graduate students in the whole university, of which the evaluation index of the quality of admitted new students is mainly the college entrance examination results of full-time undergraduates. It is generally believed that the higher the score of the college entrance examination for the admitted new students, the higher the proportion of graduate students in the whole school, and the stronger the scientific research strength of the students in the school.

3.3.1 Quality of admission of new students

This paper counts the average scores of NJUST and NUAA in each province, municipality and autonomous region from 2015 to 2019 (among them, Shanghai and Zhejiang province comprehensively reformed in 2017, without distinguishing between arts and sciences). Since NJUST and NUAA are both science and engineering universities, when collecting average score data, science

and engineering and literature and history are no longer subdivided, but equally scored in science and engineering. In addition, Shanghai Municipality, Jiangsu Province, and Zhejiang Province have implemented the reform of the college entrance examination since 2017, not distinguishing between arts and sciences, but divided into professional groups, and the statistical data in this article take the arithmetic average of the average score of the three professional groups.
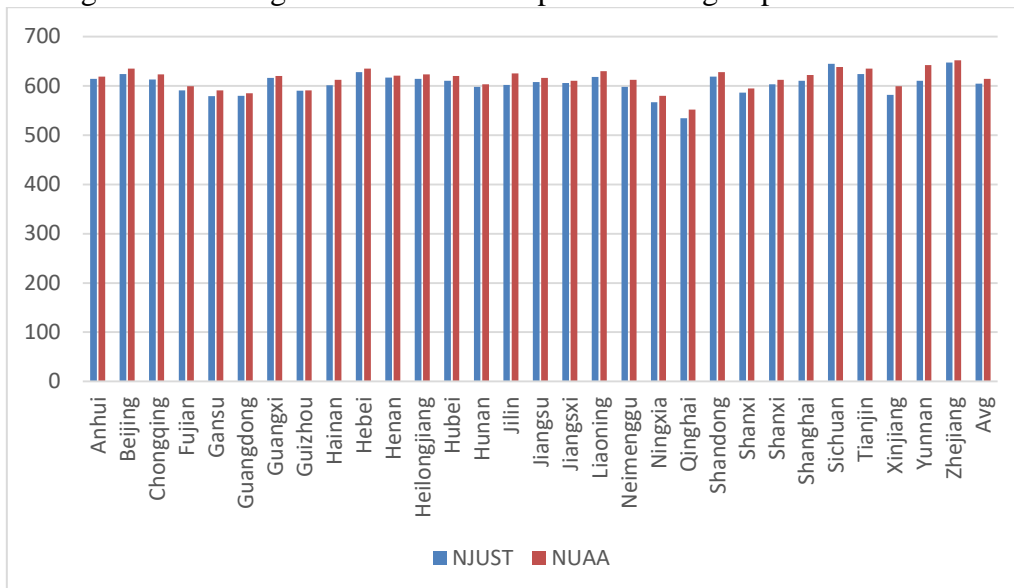

Figure 2. Comparison of provincial scores of two schools in 2019

As can be seen from Figure 2, except for Sichuan Province, the score line of NUAA in the remaining provinces is higher than that of NJUST, and for a clearer comparison, we have made the difference between the admission scores of the two schools in each province as shown in Figure 3. As can be seen from Figure 3, in addition to Sichuan Province (-7), the province with the largest difference in admission scores is Yunnan Province (32), followed by Jilin Province (23). As many as 21 provinces with score differences in the range of [5,15] had an average score of 9.7 for both schools. It can be seen that the quality of new students admitted by NUAA is much better than that of NJUST.
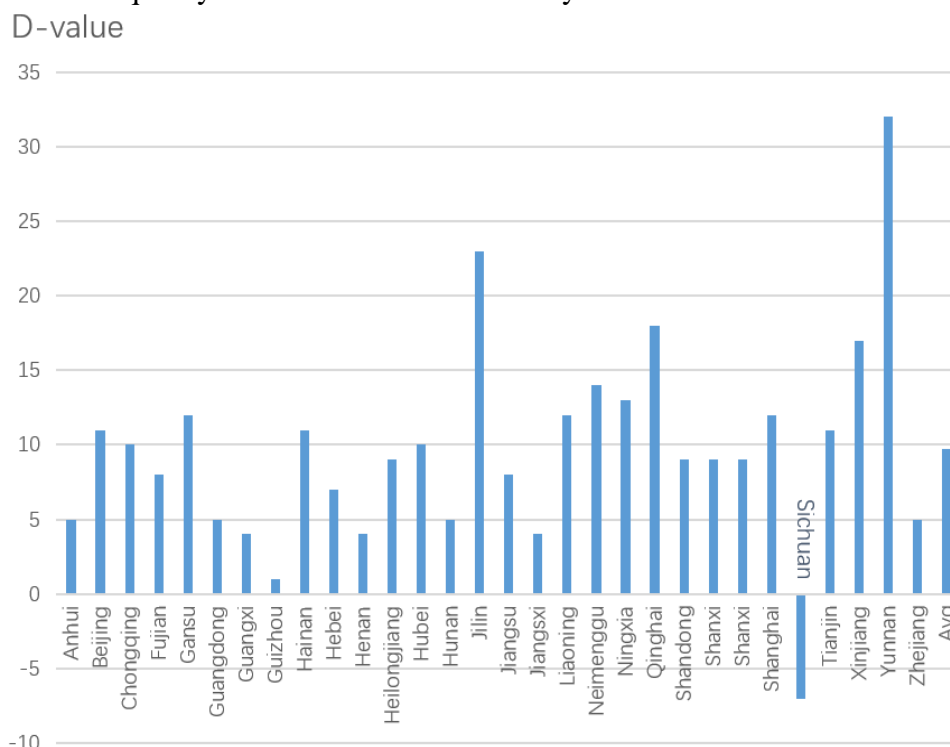

Figure 3. NJUST and NUAA D-value

Finally, it was calculated that the average score of the first batch of college entrance examination science in the past five years of Nanjing University of Science and Technology was 595 points, and the average score of the first batch of college entrance examination science in the past five years of Nanjing University of Aeronautics and Astronautics was about 605 points. At the level of the quality index of new students admitted, Nanjing University of Aeronautics and Astronautics performed even better. Since the statistical data spans a five-year period and covers 30 provinces, municipalities and autonomous regions across the country, its depth and breadth can be guaranteed, and it can be considered that the indicator is relatively comprehensive in evaluating the quality of new students.

3.3.2 Proportion of postgraduate students in school

This paper counts the proportion of graduate students in the whole university. It is generally believed that the proportion of graduate students can well reflect the scientific research strength of a university, and the higher the proportion, the stronger the scientific research strength of the institution. After preliminary statistics and calculations, it was found that as of the fall of 2019, Nanjing University of Science and Technology had more than 30,000 students, including more than 12,000 graduate students, and the proportion of graduate students in the whole university was about 40%; Nanjing University of Aeronautics and Astronautics had more than 29,000 students, including 10,000 There are more than one graduate students, and the proportion of graduate students in the whole university is about 34%.

After calculation, it can be obtained that Nanjing University of Science and Technology scored 98.3 points and 100 points in the quality of admitted new students and the proportion of graduate students in the whole university, respectively, and the score values of Nanjing University of Aeronautics and Astronautics were 100 points and 85.0 points, respectively. Based on weighted calculations, the total student quality scores of Nanjing University of Science and Technology and Nanjing University of Aeronautics and Astronautics were 99.2 points and 92.4 points, respectively. From the perspective of student quality, Nanjing University of Science and Technology is slightly better than Nanjing University of Aeronautics and Astronautics.

3.4 Faculty Score

When evaluating the teaching strength of colleges and universities, this paper analyzes the proportion of full-time teachers above deputy senior (associate professor), the number of academicians of the two academies, the number of specially appointed professors of Yangtze River scholars, and the teacher-student ratio (number of full-time teachers/number of students). It is generally believed that the higher the proportion of associate professors and above, the greater the number of academicians and Yangtze River scholars of the two academies, the higher the teacher-student ratio, and the stronger the teaching force of the institution; correspondingly, its scientific research strength is also stronger. The specific distribution of the teaching staff of the two institutions is shown in Table 2 "Teaching Staff".

After calculation, it can be obtained that Nanjing University of Science and Technology scored 87.8 points, 100 points, 100 points and 100 points in the second-level index of "faculty strength", respectively, and the score values of Nanjing University of Aeronautics and Astronautics were 100 points, 55 points and 63.2 points, respectively 95.4 points. Based on weighted calculations, the total faculty scores of Nanjing University of Science and Technology and Nanjing University of Aeronautics and Astronautics were 94.7 points and 70.8 points, respectively. From the perspective of faculty, Nanjing University of Science and Technology is obviously superior to Nanjing University of Aeronautics and Astronautics.

3.5 Material Resource Score

When considering material resources, it mainly involves factors such as the school environment, infrastructure, total scientific research funds, and total books. Sufficient material resources can provide effective support for the scientific research activities of universities, so it is necessary to take them into account when evaluating the scientific research strength of universities. When evaluating

this indicator, this paper mainly involves the total amount of scientific research funds (2019) and the per capita scientific research funds of full-time teachers and researchers, the total number of books (the total number of paper collections) and the average number of books per student, and the building area of the school building and the average student building area. The per capita indicator is mainly calculated to take into account the scale of the school. The specific distribution of material resources is shown in Table 2 "Material Resources".

After calculation, it can be obtained that Nanjing University of Science and Technology scores 89 points, 84 points and 63.3 points in scientific research funds, library collections and building area, respectively, and Nanjing University of Aeronautics and Astronautics scored 100 points. Through weighted calculations, the total scores of material resources of Nanjing University of Science and Technology and Nanjing University of Aeronautics and Astronautics were 81.3 points and 100 points, respectively. From the perspective of material resources, Nanjing University of Aeronautics and Astronautics is obviously superior to Nanjing University of Science and Technology.

When calculating the total weight, that is, the score of various first-level indicators is multiplied by the corresponding weight ratio, and the calculation formula is as follows:

$$\text{Total score} = \Sigma\text{First} - \text{level index score} \times \frac{\text{weight}}{\text{total weight}} \qquad (26)$$

3.6 Comprehensive evaluation results

Through the above statistics and calculations, the total score of Nanjing University of Science and Technology is 92.9 points, and the total score of Nanjing University of Aeronautics and Astronautics is 85.9 points, according to the statistical results and weight distribution in this paper, the scientific research strength of Nanjing University of Science and Technology is slightly better than that of Nanjing University of Aeronautics and Astronautics. The scores of the first and second level indicators of the two schools are shown in Table 6. In terms of academic resources, Nanjing University of Science and Technology is slightly better than Nanjing University of Aeronautics and Astronautics in the number of undergraduate degree points, first-level discipline master's points, first-level discipline doctoral points and the number of national key laboratories and national engineering (technology) research centers; Nanjing University of Aeronautics and Astronautics has obvious advantages in the number of national key disciplines; in terms of academic achievements, the two schools are not much different, but due to the different weights of the second-level indicators, there is a large gap in the final score; in terms of student quality, The quality of new students admitted to Nanjing University of Aeronautics and Astronautics is significantly higher than that of Nanjing University of Science and Technology, with an average score of about 10 points higher, but in the proportion of graduate students in the whole university, Nanjing University of Science and Technology performs slightly better than Nanjing University of Aeronautics and Astronautics; in terms of faculty strength, Nanjing University of Science and Technology has obvious advantages; in terms of material resources, Nanjing University of Aeronautics and Astronautics has obvious advantages.

Table 3. Results of scoring

Level 1 indicators	Secondary indicators	Secondary indicator score		Level 1 indicator score	
		NJUST	NUAA	NJUST	NUAA
AR	Undergraduate degree points	100	84	95.4	91.6
	Discipline authorized to offer master degree program	100	94		
	Discipline authorized to offer doctoral degree program	100	92		
	Number of national key disciplines	82	100		
	State Key Laboratory	100	83		
PA	SCI (Total and Per Capita).	99.6	97.9	91.8	82.4
	EI (Total and Per Capita).	100	54.2		
	SSCI (Total and Per Capita).	69.4	100		
SQ	The quality of admitted new students	98.3	100	99.2	92.4
	Proportion of graduate students	100	85		
Faculty	The proportion of full-time teachers with deputy senior or above	87.8	100	94.7	70.8
	The number of academicians of the two academies	100	55		
	The number of Yangtze River Scholars Distinguished Professors	100	63.2		
	Teacher-student ratio (number of full-time teachers/number of students).	100	95.4		
MR	Scientific research funds and the per capita scientific research funds of full-time teachers and personnel of scientific research institutions	89	100	81.3	100
	Books and average books per student	84	100		
	School building area and average student area	63.3	100		

4. Conclusion

This paper mainly from the academic resources, academic achievements published, student quality, faculty and material resources of the five aspects of research, through calculation and comparison, there are the following three aspects of the conclusions and suggestions, and the shortcomings of the calculation methods used in the text to make a certain explanation:

(1) In terms of the comprehensive strength of the two schools, the indicators with a large gap between the two schools are the two indicators of teacher strength and material resources, and the other indicators of Nanjing University of Science and Technology score slightly better. In terms of the number of top teachers, Nanjing University of Science and Technology has obvious advantages, but in terms of the proportion of full-time teachers above the deputy senior, Nanjing University of Aeronautics and Astronautics is 8.4% higher, but there is little difference between the two in terms of quantity; and in terms of material resources, Nanjing University of Aeronautics and Astronautics is fully leading. Overall, after weighted calculations, the total score of Nanjing University of Science and Technology is 92.9 points, slightly better than Nanjing University of Aeronautics and Astronautics (85.9 points), and the scientific research strength of Nanjing University of Science and Technology is stronger in terms of the indicators mentioned in this article.

(3) From the perspective of school development policy, although Nanjing University of Science and Technology has an overall advantage in the first four first-level indicators, there are still places to be improved, such as the introduction of high-level scientific research talents and the increase in the proportion of full-time teachers above the deputy senior level; in the score of the "material resources" indicator, Nanjing University of Science and Technology is lagging behind in an all-round way and has a lot of room for improvement. (Expand) 0

(4) In terms of school choice, the average score of Nanjing University of Aeronautics and Astronautics is about 10 points higher than that of Nanjing University of Science and Technology, so the cost performance of Nanjing University of Science and Technology is higher. If the score meets the requirements, and it is hoped to obtain better scientific research conditions and living conditions, Nanjing University of Aeronautics and Astronautics is undoubtedly a better choice.

Due to the limitations of the conditions, the indicator system is not very comprehensive, and there is a certain degree of subjectivity; and because it only involves the comparison of the two schools, it will amplify the advantages and disadvantages when calculating, resulting in a large gap in the final result, so this article aims to provide certain suggestions for parents and students when choosing a school.

References

[1] Huang Wei. Comparative analysis of the evaluation index system of domestic university rankings [D]. Guangxi Normal University, 2019.

[2] Ren Yongcan. Research on the characteristics and trends of university ranking index system at home and abroad [D]. Zhejiang Normal University, 2014.

[3] Shearan. University ranking index system and impact study [D]. Shanghai Jiao Tong University, 2010.

[4] Huo Xiaoran. Research on the characteristics of world-class universities based on university ranking evaluation system [J]. Journal of Higher Education, 2020 (04): 1 - 6+10.

[5] Qiu Junping, Dong Xilu. A comparative study of five world university rankings [J]. Evaluation and Management, 2018, 16 (03): 1 - 6.

[6] Zhou Jing, Tu Yangjun, Xu Shang. The level of liberal arts development of first-class polytechnic universities and their impact on global rankings [J]. Higher Science Education, 2019 (03): 31 - 37.

[7] Yu Huiping, Gao Yuping, Guo. Correlation analysis based on bibliometric indicators and university rankings of 17 first-class universities in China and the United States [J]. Statistics and Management, 2019 (07): 107 - 115.

[8] Wang Linchun, Jiang Yuheng. The application and reflection of reputation survey in foreign university rankings[J]. World Education Information, 2019, 32 (20): 40 - 47.

[9] Sun Gangcheng, He Lielie. Comparison of faculty from top Chinese and foreign universities based on world university ranking panel data [J]. Heilongjiang Higher Education Research, 2018 (02): 46 - 52.

[10] Zhang. Scale and Achievement of Schools: An Empirical Analysis Based on USNEWS U. S. University Rankings [J]. Foreign Education Research, 2018, 45 (01): 55 - 66.

[11] Dai Yuenong. Perspectives on university evaluation systems and there. Journal of Yangzhou University (Higher Education Edition) 2013(1.

[12] Xu Zhenlu, Li Yan, Zhang Yu'an,. et al. Comparison of evaluation index systems of domestic universities [J]. Henan Social Sciences, 2015, 017 (002): 187 - 189.

[13] Yan Yan, Geng Huaping. A Comparative Study of Domestic University Evaluation Institutions and Their Evaluation Index Systems [J]. Educational Development Research, 2014, 024 (011): 96 – 99.

[14]   www.njust.edu.cn

[15] www.nuaa.edu.cn

[16] http://apps.webofknowledge.com/

[17] http://www-engineeringvillage-com-s.vpn.njust.edu.cn: 8118/search/quick.url