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Review

Study on the Competitiveness of Sports Graduate Education in Guangdong Province

Wenyue Xia [1,*]

[1] Huawei HiSilicon Semiconductor Co., Ltd., Shenzhen, Guangdong, China
* Correspondence: Wenyue Xia, Huawei HiSilicon Semiconductor Co., Ltd., Shenzhen, Guangdong, China

Abstract: Mainly with literature review and comparison method, a study on graduate education of Sports education in Guangzhou province has been done through the aspect of total strength, discipline classification, first-level discipline, second-level discipline and doctorial cultivation etc. In recent four years, to understand our provincial current situation of graduate education on sports education, some theoretical basis and quantitative date can be provided for our provincial future graduate education development on sports education.

Keywords: sports graduate education; graduate education; competitiveness; rank

1. Introduction

Graduate education is the main form of cultivating highly specialized talents and an important reflection of the comprehensive competitiveness of higher education institutions. How to scientifically, reasonably, objectively, and fairly evaluate or understand the quality, level, and overall competitiveness of graduate education at a university is a key issue closely followed by government management departments, higher education institutions, society, educators, and prospective students [1].

There are two perspectives to evaluate the competitiveness of graduate education: the vertical perspective and the horizontal perspective. The former focuses on how an institution performs under different external conditions, economic changes, or unexpected events, evaluating its long-term development and adaptability to change. The latter focuses on comparing different institutions based on various dimensions and indicators, assessing their relative competitiveness.

In evaluating the competitiveness of graduate education, especially within specialized fields like sports education, it is crucial to consider both the internal and external factors that contribute to an institution's success. From a vertical perspective, understanding how an institution adapts to various challenges and opportunities is key. This leads to the consideration of reliability modelling [2], which is widely applied in educational management and evaluation processes [3], particularly when assessing factors such as educational resources, teaching output, and quality impact [4]. By developing mathematical and statistical models, anomaly detection methodologies [5], criticality analysis [6], testing design [7], and optimal control strategy design [8], researchers can predict and simulate the performance of various variables [9] in the educational system, ensuring the reliability of the evaluation results. In the context of sports education in China, reliability modelling helps evaluate long-term performance indicators such as research funding and academic output, thereby providing a scientific basis for educational development strategies.

Building on this, reliability testing design [10] focuses on conducting experiments [11] and tests [12] to validate the accuracy of these models [13-15]. Particularly in the evaluation of sports education competitiveness, specific testing methods and frameworks are designed to help educational institutions better understand the effectiveness

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of their curricula, faculty resources, and research outcomes [16]. These tests provide critical data to improve education quality and offer policymakers theoretical support for optimizing the educational system.

As the complexity of sports education increases, resilience modelling has emerged as a crucial field [17-19]. Resilience modelling not only focuses on system reliability and stability [20] but also emphasizes how educational systems can maintain their functionality in the face of challenges [21] such as resource shortages, policy changes, or academic pressures. In sports education, resilience modelling helps higher education institutions develop flexible strategies to ensure the continuous delivery of high-quality education even in changing environments.

To achieve these goals, resilient system design plays a vital role in the sports education sector. Designing a system with high adaptability allows educational institutions to maintain quality education despite challenges like insufficient faculty or limited research funding. This design is reflected in the diversification of curricula, cross-disciplinary research platforms, and flexible teaching methods to meet complex educational needs and uncertainties.

Finally, maintenance policy design is essential in ensuring the long-term competitiveness of sports education [22-24]. Educational institutions need to formulate scientific policies that ensure the continuous optimization [25] of educational resources based on different educational goals, discipline developments, and external environmental changes. This includes regular reviews of curricula and faculty teams, support for research, and improvements to evaluation mechanisms, thus forming an effective system for maintaining and enhancing education quality.

After discussing the vertical perspective, the horizontal perspective offers a different comparative dimension, focusing on how different institutions perform under similar or identical external conditions. Through this perspective, we can assess the relative competitiveness of various institutions across different dimensions and indicators, providing valuable insights for improving competitiveness among institutions. From the horizontal perspective, the competitiveness of graduate education in sports education can be analyzed through a variety of dimensions, such as academic quality, research capabilities, educational resources, and graduate outcomes, etc. The global and national trends in graduate sports education reveal significant developments and challenges, which provide a framework for understanding the situation in Guangdong Province.

1.1. Global Trends in Graduate Sports education

In recent years, there has been a global shift toward enhancing the quality and impact of graduate sports education. Countries with leading sports education systems, such as the United States and the United Kingdom, have placed increasing emphasis on the integration of academic research with practical training in sports disciplines. According to [26], the development of sports science and management as academic disciplines has expanded the scope of sports education, leading to a more multidisciplinary approach that includes elements of business, health, and technology. This shift has impacted graduate education by fostering greater innovation and interdisciplinary research, with institutions developing specialized programs that bridge theory with practical applications in sports coaching, management, and medicine.

Furthermore, research indicates that the competitiveness of graduate programs in sports education is often associated with the amount of funding, the reputation of faculty, and the academic output of institutions [27,28]. The international competitiveness of sports graduate education is increasingly measured by research performance, which includes the publication of high-impact papers and the successful commercialization of research findings, such as patents in sports-related technologies. As a result, universities worldwide have made substantial investments in both research infrastructure and fac-

ulty development to ensure their graduate programs remain competitive on the global stage.

1.2. National Perspectives on Sports education in China

The development of graduate sports education in China has been shaped by the national educational reform initiatives that aim to raise the overall quality of higher education. The China Science Evaluation Research Center, as noted in the current study, has been instrumental in developing a framework for evaluating the competitiveness of graduate education across various disciplines, including sports education. Studies by [29] show that the competitiveness of sports education in China is closely linked to both the government's investment in educational resources and the ability of universities to foster world-class research capabilities. This is particularly true for top-tier institutions such as Peking University and Tsinghua University, which have leveraged their comprehensive academic resources to strengthen their sports education programs and research.

In the context of graduate sports education in Guangdong Province, it is evident that while the region has made notable strides in strengthening its sports education programs, challenges remain. For instance, research by [30] highlights that Guangdong's sports education is still emerging compared to provinces like Beijing and Shanghai, where long-established programs and substantial funding allow for stronger research output and greater academic recognition. Despite this, Guangdong has shown consistent growth in areas such as educational resources and teaching quality, with universities like Sun Yat-sen University (SYSU) and South China Normal University (SCNU) making significant contributions to the development of graduate programs in sports education.

1.3. Institutional Differences and Competitiveness in Guangdong

The competitiveness of graduate sports education in Guangdong Province is further complicated by the different types of institutions offering these programs. Comprehensive universities such as SYSU and SZU typically benefit from a broad array of academic resources and are able to offer interdisciplinary programs that attract students from diverse fields. In contrast, specialized institutions like Guangzhou Sports University (GZSU) face challenges in competing in the broader academic rankings due to their more limited scope. However, studies suggest that specialized institutions can still maintain a competitive edge in terms of their expertise in specific sports disciplines, such as coaching, sports education training, and sports science [31].

Moreover, the emphasis on research and faculty development has been highlighted as a critical factor in determining the competitiveness of graduate sports programs. Research suggests that universities with stronger research teams and faculty credentials are more likely to produce high-quality graduates and attract significant research funding [32]. For example, SCNU's performance in research output and faculty development reflects its competitive position within the region, as evidenced by its consistently strong rankings in various evaluation metrics.

However, a search on China National Knowledge Infrastructure (CNKI) with keywords such as 'graduate education competitiveness', 'graduate education strength', 'graduate education development level', 'graduate education rankings', and 'graduate competitiveness in sports education' reveals that research in this area is nearly absent.

In this paper, we focus on the horizontal perspective and specifically extract relevant data on graduate education in sports education in Guangdong Province based on data from the China Science Evaluation Research Center. Under the framework of national and provincial rankings in overall strength, discipline categories, first-level disciplines, and second-level disciplines, this study offers a comprehensive and systematic analysis of the competitiveness of graduate education in sports education in the province for the first time. In addition to objectively and comprehensively understanding the current state of graduate education in sports education in the province, this research provides theo-

retical support and quantitative data for future decisions on the development of higher education in sports education in Guangdong.

2. Scientific Analysis of Evaluation Indicators

Evaluation indicator system indicator system shown in Table 1 was developed by the China Science Evaluation Research Center at Wuhan University. Based on the development and publication of the *Report on the Evaluation of Chinese Universities*, the center conducted a relatively comprehensive and systematic study of the state and level of graduate education in China for the first time in 2005 using this indicator system. After years of work accumulation, a stable, reliable, and scientific data sourcing channel has been established. The original data for the evaluation primarily comes from the following four sources: (1) Statistical data from relevant government departments (including compilations, yearbooks, reports, etc.); (2) Domestic and international relevant databases; (3) Websites of relevant government departments and universities; (4) National publications, books, newspapers, and internal documents, etc.

Table 1. Evaluation indicator system of graduate education competitiveness.

First-level indicator	Second-level indicator	Third-level indicator
Educational resources	Degree programs	Number of master's degree programs
		Number of doctoral degree programs
	Research base	National Key Natural Sciences Research Base
		National Key Social Sciences Research Base
	Research projects	Number of National Natural Science Fund projects
		Number of National Social Science Fund projects
	Research funding	National Natural Science Fund financial amount
		National Social Science Fund financial amount
	Research teams	Number of National Innovation Research Groups (Teams)
		Outstanding talents
		Number of academicians of the two academies
		Number of doctoral supervisors
Teaching and research output	Research talent training	Number of master's/doctoral graduates
	Patents	Number of patent authorizations
	Published papers	SCI, SSCI, A&HCI indexed papers; EI, ISTHP, ISSHP indexed papers; CSTPC, CSSCI indexed papers
Quality and academic impact	Research achievements	National Scientific and Technological Achievements
	Research awards	National Research Awards
	Published papers quality	Number of highly cited papers in *Science*, *Nature*, and ESI Number of cited papers in SCI, SSCI, and A&HCI
		Number of cited papers in CSTPC and CSSCI

Note: SCI refers to the Science citation index, SSCI refers to the Social sciences citation index, A&HCI refers to the Arts and humanities citation index, EI refers to the Engineering index, ISTP refers to the Index to scientific & technical proceedings, ISSHP refers to the Index to social science and humanities proceedings; CSTPC refers to the China

science and technology papers and citation database, CSSCI refers to the Chinese social sciences citation index; ESI refers to the (U.S.) Essential science indicators database.

From the perspective of the indicator system, it includes 3 first-level indicators, 11 second-level indicators, and 22 third-level indicators. This indicator system effectively addresses the following relationships: policy orientation and market orientation, teaching and research, input and output, natural sciences and social sciences, scale and effect, quantity and quality, as well as qualitative and quantitative evaluation.

From the above analysis, it can be seen that this indicator system has high validity and reliability for comprehensive universities. However, for most non-doctoral institutions and teaching-oriented 'single-discipline sports education institutions' (referred to as specialized sports education colleges in this paper to distinguish them from sports education departments in comprehensive universities), certain indicators such as natural science funding, academicians, outstanding doctors, and SCI papers are more difficult to apply and have low discriminative power, which affects the overall validity of the indicator system. For example, in the 2021 evaluation, taking Tsinghua University as the benchmark with 100 points, some weaker institutions only scored around 20 points. Fortunately, the evaluation system provided separate evaluations for first-level disciplines and second-level discipline specialties. Therefore, before an authoritative indicator system for evaluating graduate education in sports education is established, the current indicator system still holds some reference value, with high reliability and validity.

3. Analysis of the Competitiveness of Graduate Education in Sports Education in Guangdong Province over the Past Four Years

3.1. Analysis of the Domestic Competitiveness of Graduate Education in Guangdong Province

From Table 2, it can be seen that the overall competitiveness of graduate education in Guangdong Province has ranked within the top 10 nationwide for the past four years, generally around 5th place, consistently following Beijing, Jiangsu, Shanghai, and Hubei. In terms of total score, Guangdong's gap with the top four has fluctuated significantly over the past four years, but the gap narrowed noticeably in 2021. This is related to the following three indicators: In terms of educational resources, although there have been fluctuations, Guangdong has maintained 5th place from 2021 to 2024; in terms of teaching and research output, there has been a notable decline, from 5th to 4th and then fall to 6th; in terms of quality and impact, there was slight fluctuation, but it returned to 5th place in 2024. This indicates that in the future, the competitiveness of graduate education in Guangdong, particularly in the indicators of 'teaching and research output' (research awards, graduate awards, paper quality) and 'quality and impact' (research talent cultivation, patents, and papers), needs to be strengthened.

Table 2. Regional competitiveness rankings of graduate education in China from 2021 to 2024.

Region	Regional ranking				Total score				Educational resources ranking			
	21-	22-	23-	24-	21-	22-	23-	24-	21-	22-	23-	24-
Beijing	1	/	1	1	100	/	100	100	1	/	1	1
Jiangsu	2	/	2	2	97.17	/	91.93	89.36	3	/	2	2
Shanghai	3	/	3	3	96.67	/	86.09	87.05	2	/	3	3
Hubei	4	/	5	5	94.55	/	81.66	79.27	5	/	6	6
Guangdong	5	/	4	4	94.25	/	82.24	79.59	4	/	4	4
Shanxi	6	/	6	6	93.37	/	81.20	76.63	6	/	5	5
Zhejiang	7	/	7	8	92.56	/	80.78	74.07	8	/	8	11
Sichuan	8	/	9	9	92.42	/	78.01	72.51	10	/	11	10
Shandong	9	/	8	7	92.39	/	80.43	74.09	9	/	9	7
Hunan	10	/	11	10	92.05	/	74.44	71.13	7	/	11	8

Liaoning	11	/	10	11	91.08	/	76.79	70.03	12	/	7	9

Table 2. Continued.

Region	Teaching and research output ranking				Quality and impact ranking			
	21-	22-	23-	24-	21-	22-	23-	24-
Beijing	1	/	1	1	1	/	1	1
Jiangsu	2	/	2	2	2	/	2	3
Shanghai	3	/	3	3	3	/	3	2
Hubei	4	/	6	4	4	/	5	4
Guangdong	5	/	4	6	5	/	4	5
Shanxi	6	/	5	5	6	/	8	8
Zhejiang	9	/	8	9	9	/	6	6
Sichuan	7	/	7	7	7	/	10	9
Shandong	8	/	10	10	8	/	7	7
Hunan	11	/	11	11	11	/	9	10
Liaoning	10	/	9	8	10	/	12	16

Note: In 2022, the data of competitiveness is missing, therefore '/' is used to represent these missing data.

3.2. Analysis of the Competitiveness of Graduate Education in Sports education within Guangdong Province

3.2.1. Comparison of Overall Competitiveness

Table 3 presents the graduate education competitiveness rankings of graduate training institutions in sports education within Guangdong province from 2021 to 2024.

Table 3. Graduate education competitiveness rankings of graduate training institutions in sports education in Guangdong province from 2021 to 2024.

Provincial ranking in 2023	Provincial ranking in 2024	University Names	Domestic ranking				Total score			
			21-	22-	23-	24-	21-	22-	23-	24-
1	1	SYSU	11	9	9	8	90.77	82.24	84.70	88.33
4	4	SCNU	65	56	53	54	76.47	54.88	56.10	69.74
6	6	SZU	87	79	75	73	72.54	50.54	51.41	67.67
8	8	GZHU	115	107	99	96	68.14	45.75	46.62	63.93
21	17	GAFA	427	473	422	341	52.06	24.16	19.07	45.24
24	24	XHCM	458	508	460	456	51.44	23.34	17.27	39.65
33	26	GZSU	525	578	615	514	49.62	22.20	11.85	36.73

Table 3. Continued.

University Names.	Educational resources ranking				Teaching and research output ranking			
	21-	22-	23-	24-	21-	22-	23-	24-
SYSU	17	7	7	8	14	10	9	11
SCNU	70	65	67	57	93	89	50	41
SZU	103	75	70	69	82	76	74	68
GZHU	140	122	100	89	95	93	107	96
GAFA	414	474	436	352	443	493	427	338
XHCM	457	499	481	440	440	539	461	473
GZSU	500	574	625	520	536	576	644	473

Table 3. Continued.

University Names	Quality and impact ranking				Category ranking			
	21-	22-	23-	24-	21-	22-	23-	24-
SYSU	11	13	8	11	7 (Comprehensive)	6 (Comprehensive)	5 (Comprehensive)	6 (Comprehensive)
SCNU	56	42	57	49	6 (Normal)	3 (Normal)	3 (Normal)	3 (Normal)
SZU	85	74	79	69	28 (Comprehensive)	27 (Comprehensive)	26 (Comprehensive)	25 (Comprehensive)
GZHU	89	102	98	97	34 (Comprehensive)	33 (Comprehensive)	32 (Comprehensive)	31 (Comprehensive)
GAFA	424	452	403	333	18 (Arts)	21 (Arts)	19 (Arts)	18 (Arts)
XHCM	477	486	438	455	21 (Arts)	23 (Arts)	24 (Arts)	27 (Arts)
GZSU	539	584	576	549	9 (Sports education)	9 (Sports education)	13 (Sports education)	12 (Sports education)

Note: In the years 2021, 2022, 2023, and 2024, there were 578, 596, 596, and 596 training institutions, respectively. SYSU, SCNU, SZU, GZHU, GZSU, GAFA, XHCM are abbreviations for Sun Yat-sen University, South China Normal University, Shenzhen University, Guangzhou University, Guangzhou Sports University, Guangdong Academy of Fine Arts, and Xinghai Conservatory of Music, respectively.

3.2.2. Comparison of Competitiveness in the Discipline of Education

Sports education is a subdiscipline of the discipline of education. To better analyze the situation of the first-level discipline of sports education, it may be helpful to start with a comparison of the education discipline.

Table 4 shows the provincial competitiveness rankings of graduate education disciplines in Guangdong Province (education discipline). The upper part of Table 4 shows that, whether from the provincial or national rankings, GZSU (the sports education university) has a significant gap compared to the other four institutions (marked with an asterisk). SYSU and SCNU cover graduate education in all 11 major disciplines (excluding military science), while GZHU and SZU cover up to 8 major disciplines. In contrast, GZSU, as a single-discipline institution, offers only 2 major disciplines (education and medicine). Despite this, when considering the competitiveness within the discipline of education, GZSU ranks significantly lower than SCNU, weaker than SYSU, but stronger than SZU and GZHU. However, in 2024, SYSU and SCNU remained relatively stable, GZSU experienced slight declines, and SZU and GZHU showed significant setbacks.

Table 4. Provincial competitiveness rankings of graduate education disciplines in Guangdong Province (education discipline).

University names	2021 ranking	2022 ranking	2023 ranking	2024 ranking	Number of academic disciplines involved
SYSU*	48	40	39	36	11
SCNU*	5	3	3	3	11
SZU*	57	60	63	65	8
GZHU*	40	51	55	59	8
GZSU*	50	46	47	50	2
SCUT	146	124	150	149	8
JNU	98	96	117	95	10
SMU	170	156	153	161	6
STU	139	132	149	156	8
GPNU	106	101	99	111	4

Note: In the years 2021, 2022, 2023, and 2024, 299 training institutions were involved in the education discipline, respectively. The provincial ranking involves 23 training institutions. SCUT, JNU, SMU, STU, and GPNU are abbreviations for South China University of Technology, Jinan University, Southern Medical University, Shantou University, and Guangdong Polytechnic Normal University, respectively.

Among the 23 graduate training institutions in Guangdong Province, 10 of which are listed in Table 4 and are involved in the field of education. GZSU has consistently ranked among the top three in the national rankings over the past four years. This indicates that, although the education discipline encompasses three first-level disciplines: education, psychology, and sports education. GZSU, with only its first-level discipline in sports education, holds the third position among the 10 institutions in Guangdong that offer programs in the field of education. This is indeed remarkable for a single-discipline sports education institution.

The data from several single-discipline institutions in Guangdong Province in Table 5 further demonstrate that GZSU's main discipline (the field of education, ranked 50th nationwide among 299 institutions in 2024) is significantly stronger than GAFA (ranked 115th among 349 institutions in the field of literature in 2024) and XHCM (ranked 241st in the same category). It is even stronger than 'quasi-doctoral' institution GDMU (ranked 105th among 215 institutions in the field of medicine in 2024). This shows that GZSU still holds a clear advantage among single-discipline institutions in the province.

Table 5. Disciplinary rankings of several single-discipline universities in Guangdong Province (with fewer than 3 disciplines).

University names	21-	22-	23-	24-
GZSU	50/299 Education	46/299 Education	47/298 Education	50/299 Education
	141/214 Medicine	150/215 Medicine	163/215 Medicine	179/215 Medicine
GAFA	164/349 Literature	169/349 Literature	137/349 Literature	115/349 Literature
XHCM	238/349 Literature	251/349 Literature	234/349 Literature	241/349 Literature
GDMU	108/214 Medicine	103/215 Medicine	94/215 Medicine	105/215 Medicine
	304/389 Science	315/386 Science	295/388 Science	311/388 Science

Note: 50/299 Education indicates that there are 299 training institutions nationwide involved in the education discipline, with GZSU ranked 50th, and other institutions ranked similarly. GDMU refers to Guangdong Medical University.

3.2.3. Analysis of the Competitiveness of the First-Level Discipline of Sports education

The upper part of Table 6 shows the rankings of the first-level discipline of sports education at five institutions in Guangdong Province. SCNU, a doctoral-granting institution, has consistently maintained a five-star position, ranking in the top 5% nationally. GZSU, a non-doctoral institution, held a 5-star position over the past four years, with its ranking increasingly diverging from SCNU. Despite this, GZSU's competitiveness in the first-level discipline of sports education is still much stronger than that of other doctoral-granting institutions such as SYSU, GZHU, and SZU. This highlights GZSU's important position in graduate education in sports education within Guangdong Province.

Table 6. Rankings of the first-level discipline of sports education in four years.

University names	Discipline	21- 108 institutions		22- 108 institutions		23- 106 institutions		24- 107 institutions	
		Level	Ranking	Level	Ranking	Level	Ranking	Level	Ranking
SYSU	Sports education	2-star	76	2-star	80	2-star	61	2-star	69
SCNU	Sports education	5-star	7	5-star	5	5-star	5	5-star	5
SZU	Sports education	2-star	68	3-star	53	2-star	65	2-star	71
GZHU	Sports education	1-star	95	2-star	88	2-star	79	2-star	75
GZSU	Sports education	5-star	9	5-star	9	5-star	13	5-star	12
GZSU	Clinical medicine	95/113		89/113		92/110		109/113	
GAFA	Arts	4-star	36/199	4-star	37/199	4-star	35/201	4-star	33/201
XHCM	Arts	3-star	91/199	2-star	111/199	3-star	99/201	3-star	96/201
GDMU	Clinical medicine	3-star	53/113	3-star	56/113	3-star	50/110	3-star	52/113

Another first-level discipline at GZSU, clinical medicine, is in an increasingly unfavorable situation, with its performance declining and now ranking at the bottom.

The lower part of Table 6 shows data for the main first-level disciplines of three other single-discipline institutions (with fewer than three major disciplines, as shown in Table 5). It is evident that GZSU's first-level discipline rankings are stronger than the national ranking of GAFA' first-level discipline in Arts (which is in the four-star position, within the top 20%). GZSU's ranking is also higher than XHCM's national ranking, and even surpasses that of the 'quasi-doctoral' institution GDMU. Table 6 indicates that GDMU's first-level discipline in Clinical Medicine is ranked at the 3-star level nationally, while its other first-level disciplines in Biology, Basic Medicine, and Pharmacy all fall below the three-star level. This shows that GZSU's first-level discipline competitiveness is superior to that of other single-discipline institutions in the province.

4. Conclusion

The comparative analysis of the competitiveness of graduate education in sports education at five universities in Guangdong Province over the past four years reveals the following:

1) The overall strength ranking is as follows: SYSU, SCNU, SZU, GZHU, and GZSU. The ranking based on type evaluation is as follows: SYSU, SCNU, GZSU, SZU, and GZHU.
2) The ranking in the field of education is as follows: SCNU, SYSU, GZSU, GZHU, and SZU. Among the four single-discipline institutions in the province (GAFA, XHCM, GDMU), GZSU ranks first in terms of competitiveness within its field.
3) The ranking of the first-level discipline in sports education is as follows: SCNU, GZSU, with SYSU, SZU, and GZHU almost at the same level. Among the four single-discipline institutions in the province, GZSU ranks first in its main first-level discipline, although its strength has shown a clear downward trend.
4) The comparison of second-level disciplines shows that in 2024, all four second-level disciplines at SCNU were ranked first in the province. The gap between GZSU and SCNU in its four second-level disciplines has been widening, with GZSU's once strong advantage in Sports Education and Training being surpassed by SCNU in 2024. While SYSU, SZU, and GZHU currently only offer one second-level discipline each, their strength has shown noticeable improvement over the past four years.

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