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RESEARCH ARTICLE

Setting the Benchmark: A Comparative Analysis of Research Performance Indicators between Leading World Research Universities and Top-Ranked Research Universities in Malaysia

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ABSTRACT

The National Higher Education Strategic Plan 2007-2020 and the Malaysia Education Blueprint (Higher Education) 2015-2025 aim to strengthen research and innovation in Malaysian universities, positioning them as world-class institutions. As a result of these national initiatives, six Malaysian universities have been ranked among the top 500 in the Times Higher Education (THE) World University Rankings 2024. This paper examines the institutional research performance of the top-ranked Malaysian universities in comparison to the leading world universities. Ten top-ranked world and Malaysian universities were identified based on the Times Higher Education World University Rankings 2024. Bibliometric indicators from Elsevier's SciVal were used to compare research performance among these universities from 2018 to 2023. The results indicate that the leading world universities outperform the top-ranked Malaysian universities in areas such as scholarly output, citation counts, and research impact measured by citations and publication in top journal percentiles. They are pioneers in their respective subject areas, with citations of their publications being twice the world average. Malaysian universities are active in international co-authorship but show lower impact, reflecting a growing yet developing academic influence compared to leading world universities. The publication landscape of the world's leading universities is dominated by the subject areas of Medicine, and Physics and Astronomy. Malaysian universities demonstrate a broader range of subject area preferences, with a strong emphasis on Engineering. By benchmarking against the world's leading institutions, Malaysian universities can identify areas for research improvements to enhance their world rankings.

Keywords: Bibliometric Analysis, Research Preferences, Research Universities, Scholarly Output, World University Rankings

1. Introduction

A university is an institution of higher education for creating, preserving, and disseminating knowledge. The concept of a research university is not a recent development as it originated among German universities during the early nineteenth century, as well as was established in the United States after the conclusion of the Civil War (Atkinson & Blanpied, 2008). A research university differs from a traditional university due to its primary emphasis on advanced research. Such a university allocates a significant amount of its resources to postgraduate studies, research, and innovation activities. The impact of research universities on the economy and society can be measured by metrics such as the advancement of a nation's industrial development, attainment of Nobel Prizes, increase in international student enrolment, and enhancement of global standing.

The mandate of globalization requires Malaysian universities to adapt to the new global landscape. Therefore, four public universities were designated as research universities in 2006, with a primary focus on research innovation and commercialization. The aim of this initiative was to have two Malaysian universities ranked among the top 100 world universities (Sheriff & Abdullah, 2017). Two national initiatives were formulated to transform higher education in Malaysia: the National Higher Education Strategic Plan 2007-2020, and the Malaysia Education Blueprint (Higher Education) 2015-2025. The transformation aims to achieve national success by developing a knowledge-based economy and cultivating quality human capital characterized by knowledge, skills, innovation, and competitiveness. To date, there are a total of five research universities in Malaysia, namely Universiti Malaya, Universiti Putra Malaysia, Universiti Kebangsaan Malaysia, Universiti Sains Malaysia, and Universiti Teknologi Malaysia. These universities are expected to serve as models of research excellence for other Malaysian universities, which are categorized as focused or comprehensive universities. To date, a total of 26 Malaysian universities are ranked in the Times Higher Education (THE) World University Rankings (Times Higher Education: World University Ranking 2024, 2024).

There are several reputable global methodologies that assess research-intensive universities according to their primary objectives. One such evaluation is the World University Rankings by the Times Higher Education (THE), while other prominent rankings for higher education institutions include the Academic Ranking of World Universities (ARWU) and the QS World University Rankings. All three ranking systems have explicit evaluation criteria that are specifically designed for research universities. THE evaluates the university's performance through five areas: i) teaching (the learning environment), ii) research environment (volume, income, and reputation), iii) research quality, iv) international outlook (staff, students, and research), and v) industry (knowledge transfer) (Times Higher Education: World University Ranking 2024, 2024). Based on these criteria, research universities are distinguished by the quantity of publications and the breadth of subject areas. A university is required to publish a minimum of 150 diverse publications annually, with no single subject area accounting for more than 80% of the publications.

ARWU, also known as the Shanghai ranking, was originally compiled by the Shanghai Jiao Tong University, emphasizing Nobel laureates, ground-breaking publications, and highly cited researchers. QS World University Rankings uses various metrics to measure university performance, including academic and employer reputation, faculty/student ratio, citations per faculty, international faculty and student

ratio, international research network, employment outcomes, and sustainability (QS World University Rankings 2023). To be ranked, an institution is required to fulfil three eligibility criteria that include reputation threshold, research threshold (no less than 100 Scopus-index publications in the last five years), and size.

In Malaysia, the Malaysian Research Assessment (MyRA) is a research performance metric used to measure the university's research and development performance. Seven criteria were used to measure inputs, outputs, outcomes, and the impact of the universities' research and development and commercialization activities. Universities are rated based on their annual performance and awarded rating stars accordingly. Research universities must achieve a 6-star rating to maintain their status.

As research is a fundamental criterion in university ranking, it is imperative to understand the impact of research on the overall academic reputation and global competitiveness of a university. Thus, the aim of this paper is to compare the research performance and research preferences of leading world universities with those of highly ranked Malaysian universities. The research questions of this study are as follows:

Q1) What are the key research performance differences between leading world universities and top-ranked Malaysian universities?

Q2) Do research preferences differ between leading world and top-ranked Malaysian universities?

2. Methodology

The Times Higher Education (THE) World University Rankings 2024 was used to determine the ten top-ranked world and Malaysian universities. Bibliometric data from Elsevier's SciVal from the period of 2018 to 2023, was used to analyze and compare the research performance of these universities across various criteria.

2.1 World University Rankings

The Times Higher Education (THE) World University Rankings 2024 was used to determine the 10 top-ranked universities in the world. The THE World University Rankings is a globally recognized ranking system that evaluates research-intensive universities. A new methodology (WUR3.0) has been expanded from 13 to include 18 calibrated performance indicators. These indicators evaluate a university's performance across five areas: teaching (29.5%), research environment (29%), research quality (30%), international outlook (7.5%), and industry (4%). The two areas relevant to this study are research environment and research quality.

The research environment considers a university's reputation for research excellence (18%), research income (5.5%), and research productivity (5.5%). A university's research excellence reputation is determined by an annual academic reputation survey completed by peers. Research income is adjusted based on the number of academic staff members and purchasing power parity (PPP). This indicator is normalized to accommodate each university's subject profile and to acknowledge that bigger research grants were awarded to science research than social science, arts, and humanities research. Research productivity was measured using the number of academic publications in Elsevier's Scopus-index

journals, scaled for institutional size, and normalized by the subject.

The indicators for research quality examine the contribution of a university in sharing and transferring knowledge through published work. This evaluation consists of four indicators: citation impact (15%), research strength (5%), research excellence (5%), and research influence (5%). The citation impact captures a university's research influence by capturing the average number of citations received by published work. The data includes all indexed publications indexed between 2018 and 2022, along with citations to these publications made from 2018 to 2023. The data are normalized to account for differences in citation volume across various subject areas. This prevents institutions from gaining an unfair advantage in research subjects with traditionally high citation counts. The research strength is measured by the 75th percentile of the field-weighted citation impact (FWCI). FWCI measures the number of citations received by a publication compared to the average or expected citation received by similar publications over three years. A FWCI value greater than 1 indicates higher-than-average citations for similar publications worldwide, while a value of 1 indicates average impact. Research excellence measures the number of publications in the top 10 percentiles normalized by year, subject, and staff numbers. Research influences measure the citation count and the importance of citing papers, considering that different disciplines have different citation patterns.

2.2 SciVal

Elsevier's Scopus is recognized as a reliable bibliographic database for scholarly work. SciVal, launched in 2014, is a research performance assessment tool from Elsevier that enables the analysis of Scopus datasets (Elsevier, 2024). It was used to extract the research performance of each university. Data were downloaded with an updated date of 1 May 2024. Publication data were extracted from 2018 to 2023, following the WUR methodology, which uses citations within a six-year window.

Bibliometric indicators extracted from SciVal are as follows:

a. Scholarly output: Total scholarly production by a university from 2018 to 2023. All types of indexed documents are accepted, including articles, conference proceedings, reviews, books, book chapters, etc.
b. Citation count: Number of times the set of publications from 2018 to 2023 have been cited
c. Citations per publication: Total number of citations divided by the total number of publications
d. Field-weighted citation impact: Number of citations received by a publication compared to the expected citation received by similar publications
e. Outputs in the top 10% citation percentiles
f. Publications in the top 10% of journal percentiles
g. International collaboration: Percentage of publications that involve at least two authors from institutions located in more than one country
h. Academic-corporate collaboration: Percentage of publications that involve authors with academic and corporate affiliations.

2.3 Research Preferences

All scholarly output published on Scopus was categorised using the All Science Journal Classification (ASJC) codes based on its subject area as shown in Table 1.

Table 1: Broad subject area classification by Scopus.

No	Subject Area	Subject Area Classifications
1	Physical Sciences	Chemical Engineering Chemistry Computer Science Earth and Planetary Sciences Energy Engineering Environmental Science Material Science Mathematics Physics and Astronomy Multidisciplinary
2	Health Sciences	Medicine Nursing Veterinary Dentistry Health Professions Multidisciplinary
3	Social Sciences	Arts and Humanities Business, Management and Accounting Decision Sciences Economics, Econometrics and Finance Psychology Social Sciences Multidisciplinary
4	Life Sciences	Agricultural and Biological Sciences Biochemistry, Genetics and Molecular Biology Immunology and Microbiology Neuroscience Pharmacology, Toxicology and Pharmaceutics Multidisciplinary

3. Results and Discussion

The THE World University Rankings 2024 included a total of 1904 universities in the latest assessment (THE, 2024). The top 10 in global and Malaysian research universities were determined based on THE World University Rankings 2024.

The United Kingdom and the United States dominate the top 10 research universities in the world, with seven American and three British universities (see Table 2). These universities are well-known for their excellence in education, research, and innovation. Based on the research environment score, the top five universities are the University of Cambridge (100), the University of Oxford (100), Harvard University (99.9), the University of California, Berkeley (98.8), and Tsinghua University (98.1) from China (ranked 12th overall) (data not shown). In THE 2024 rankings, Tsinghua University was ranked first among the top Asian universities. The top five universities with the highest research quality scores are Massachusetts

Institute of Technology (99.7), Stanford University (99.6), Harvard University (99.4), University of California, Berkeley (99.0), and University of Oxford (99.0) (see Table 3).

Table 2: THE World University Rankings 2024: Top 10 universities in the world.

Times Higher Education (THE) World University Rankings 2024: Top 10		
1	University of Oxford	United Kingdom
2	Stanford University	United States
3	Massachusetts Institute of Technology	United States
4	Harvard University	United States
5	University of Cambridge	United Kingdom
6	Princeton University	United States
7	California Institute of Technology	United States
8	Imperial College London	United Kingdom
9	University of California, Berkeley	United States
10	Yale University	United States

Table 3: Top 10 universities in the world ranked according to their overall score, research environment, and research quality.

No.	Name of University	Scores Overall	Research Environment	Research Quality
1	University of Oxford	98.5	100.0	99.0
2	Stanford University	98.0	97.8	99.6
3	Massachusetts Institute of Technology	97.9	96.2	99.7
4	Harvard University	97.8	99.9	99.4
5	University of Cambridge	97.5	100.0	98.0
6	Princeton University	96.9	97.9	98.8
7	California Institute of Technology	96.5	98.0	95.9
8	Imperial College London	95.1	95.5	98.6
9	University of California, Berkeley	94.6	98.8	99.0
10	Yale University	94.2	94.9	97.7

The recent THE World University Rankings reveal that all five Malaysian research universities, Universiti Malaya, Universiti Kebangsaan Malaysia, Universiti Sains Malaysia, Universiti Teknologi Malaysia, and Universiti Putra Malaysia are ranked in the top 10 universities in the country. It is worth noting that Sunway University is the only private university that made it into the top 10 universities in the ranking, with the other 9 being public universities (see Table 4). The top 5 Malaysian universities ranked by research quality are Universiti Teknologi Petronas (77.7), Universiti Malaya (72.6), Sunway University (71.7), Universiti Utara Malaysia (69.7), and Universiti Malaysia Pahang Al-Sultan Abdullah (67.5) (see Table 5). Malaysian universities generally have a lower research environment score (>40). The top 5 Malaysian universities with the best research environment are Universiti Teknologi Petronas (37.8), Universiti Malaya (35.4), Universiti Putra Malaysia (30.5), Universiti Teknologi Malaysia (29.3), and

Universiti Kebangsaan Malaysia (27.8).

In comparison to the near-perfect overall, research environment, and research quality scores of the leading world universities, the top Malaysian universities received significantly lower scores. This highlights a significant gap in research excellence and capability. The disparity underscores that leading world universities have greater resources, including advanced infrastructure, funding, and intellectual assets, compared to Malaysian universities.

Table 4: THE World University Rankings 2024: Top 10 Malaysian universities.

No.	Name of Institution	THE World University Rankings 2024
1	Universiti Malaya	251-300
2	Universiti Teknologi Petronas	301-350
3	Universiti Kebangsaan Malaysia	401-500
4	Universiti Sains Malaysia	401-500
5	Universiti Teknologi Malaysia	401-500
6	Universiti Utara Malaysia	401-500
7	Universiti Putra Malaysia	501-600
8	Universiti Malaysia Pahang Al-Sultan Abdullah	601-800
9	Universiti Pendidikan Sultan Idris	601-800
10	Sunway University	601-800

Table 5: Top 10 Malaysian universities ranked according to their overall score, research environment, and research quality.

No.	Name of University	Scores		
		Overall	Research Environment	Research Quality
1	Universiti Malaya	53.1 – 55.8	35.4	72.6
2	Universiti Teknologi Petronas	51.1 – 53.0	37.8	77.7
3	Universiti Kebangsaan Malaysia	45.4 – 49.0	27.8	58.7
4	Universiti Sains Malaysia	45.4 – 49.0	27.8	60.0
5	Universiti Teknologi Malaysia	45.4 – 49.0	29.3	65.0
6	Universiti Utara Malaysia	45.4 – 49.0	27.6	69.7
7	Universiti Putra Malaysia	41.9 – 45.3	30.5	51.2
8	Universiti Malaysia Pahang Al-Sultan Abdullah	37.0 – 41.8	19.0	67.5
9	Universiti Pendidikan Sultan Idris	37.0 – 41.8	25.2	38.8
10	Sunway University	37.0 – 41.8	14.6	71.7

Publication performance is vital for international university rankings such as the THE World University Rankings. Scholarly publications, including journal articles, conference proceedings, books, book chapters, editorials, letters, notes, errata, and short surveys, play a vital role in evaluating the quality and impact of research. In this study, the research performance of universities was analysed using SciVal. Harvard University produced the highest number of scholarly outputs (186,885) from 2018 until 2023, followed by the University of Oxford (107,406) and Stanford University (100,898) (see Table 6). Harvard University also received the highest total number of citations (4,551,927), which is attributed to its

scholarly outputs, surpassing all other universities. In relation to scholarly publications, the number of citations per publication reflects the impact of the research. The Massachusetts Institute of Technology had the highest average citations per publication, with an average of 29.5, and the highest FWCI of 2.40. The top 10 universities in the world generally have an FWCI higher than 2.0. An FWCI higher than 2.0 indicates that the publication will be cited twice more than the world average for similar publications. The Massachusetts Institute of Technology has the highest percentage of publications (54.2%) in the top 10% journal percentiles and the highest percentage of outputs (25.4%) in the top 10% citation percentiles among the top 10 universities in the world. Imperial College London had the highest level of international collaboration, with 64.9% of its publications involving international partners. On the other hand, the Massachusetts Institute of Technology recorded the highest percentage (10.3%) of academic-corporate collaboration. In general, the top 10 universities in the world all demonstrated high levels of scholarly productivity, citations per publication, publication in the top 10% of journal percentiles, and strong international collaboration.

Among the top-ranked universities in Malaysia, Universiti Sains Malaysia has the highest number of scholarly outputs (28,107), followed by Universiti Malaya (27,844) and Universiti Kebangsaan Malaysia (26,215) (see Table 7). It is worth noting that there is a significant disparity in the total number of scholarly outputs among the top 10 Malaysian universities, with Universiti Pendidikan Sultan Idris having the lowest number of scholarly outputs at 3,250. The five research universities have more publications than other universities. According to the number of scholarly publications, the top three Malaysian universities, in terms of the highest total number of citations, are Universiti Malaya (441,835), Universiti Kebangsaan Malaysia (333,754), and Universiti Sains Malaysia (325,032). Universiti Malaya (15.9) achieved the highest number of citations per publication, followed by Sunway University (14.3). It is essential to highlight that Sunway University has the highest FWCI (1.74) among the top 10 Malaysian universities. Generally, the top ten Malaysian universities have a minimum FWCI of 1.05, equivalent to the average world citation for a similar publication. Sunway University stands out regarding outputs in the top 10% citation percentiles and publications in the top 10% journal percentiles. Sunway University has the highest number of top-cited (19.8%) and top-ranked (23.0%) publications among the top 10 Malaysian universities.

A recent study identified three factors that influence the citation and impact of research. These factors include paper-related factors (e.g., paper quality, work novelty, and field characteristics), journal-related factors (e.g., the impact factor, journal scope, and the form of publication), and author-related factors (e.g., number of authors, international and national collaborations, gender, age, and race) (Tahamtan et al., 2016). It is important to note that citation indicators are useful in measuring the impact of a study in academia. However, studies that reach practitioners may not be cited in scholarly work but are still valuable and can have an impact in industry. It has been observed that university rankings are strongly correlated with research impact. A higher level of research impact is associated with a higher university ranking (Lancho-Barrantes & Cantu-Ortiz, 2021). Sunway University (69.3%), Universiti Teknologi Petronas (60.7%), and Universiti Malaya (58.7%) are the top three universities in Malaysia that have been actively collaborating with international institutions. These universities have been performing exceptionally well in terms of international collaboration and are on par with the world's leading universities. The proportion of international research collaborations has increased from 4.7% in 1980 to

25.7% in 2021 (Aksnes & Sivertsen, 2023). This has stemmed from the increasing complexity of interdisciplinary scientific research, more funding opportunities, and greater mobility among researchers (Larivière et al., 2015). International collaborations tend to lead to a greater research impact, resulting in higher citation rates than domestic collaborations. It is worth noting that publications with international collaboration are likely to be cited twice as often as single-country publications. On the other hand, the global trend of academic-corporate collaboration has also shown an increasing trend. The different forms of collaboration include research partnerships, equipment and facility sharing, and commercialization acceleration. By leveraging shared experience and resources, collaboration between academia and corporations can lead to industry-specific problem-solving, validation of work, financial benefits, and promotion of innovation (Esangbedo et al., 2024; Evan et al., 2023). Among the Malaysian universities, Universiti Teknologi Petronas (5.0%) achieved the highest percentage of academic-corporate collaboration, followed by Universiti Malaya (2.5%) (see Table 6).

The analysis of research publication preferences indicates that both leading world and top-ranked Malaysian universities show a strong preference for science and engineering. Analysis of publications by subject area of the top 10 universities in the world shows that either Medicine or Physics and Astronomy is the top subject area of excellence across all top 10 universities (see Table 8). Oxford University, Stanford University, Harvard University, Yale University, and Imperial College London are known for their advancements in the field of Medicine, while Massachusetts Institute of Technology, Princeton University, California Institute of Technology, and University of California, Berkeley stand out for their strong research focus in Physics and Astronomy. Other prominent research areas for publications among the top 10 universities in the include Biochemistry, Genetics, and Molecular Biology, Engineering, Computer Science, Earth and Planetary Sciences, and Social Sciences (see Table 9). These leading universities are world leaders in their respective research areas, setting the standard for other institutions to follow.

In contrast, Malaysian universities show a broader range of subject preferences, including Medicine, Engineering, Computer Science, Agricultural and Biological Sciences, Physics and Astronomy, and Social Sciences (see Table 10). The findings reveal that Malaysian universities place a strong emphasis on Engineering, with five universities excelling in this subject area: Universiti Teknologi Petronas, Universiti Kebangsaan Malaysia, Universiti Sains Malaysia, Universiti Teknologi Malaysia, and Universiti Malaysia Pahang Al-Sultan Abdullah (see Table 11). This finding is consistent with a study conducted by Mohd Sarjidan and Md Kasim (2023), which indicated that Malaysian universities have the highest number of publications in the field of Engineering. Each university has a different top subject area preference. For example, Universiti Putra Malaysia leads in Agricultural and Biological Sciences, while Universiti Malaya excels in Medicine, and Universiti Pendidikan Sultan Idris stands out for Social Sciences. In comparison to the leading world universities, Malaysian universities demonstrated a pronounced research focus in Engineering and Technology that reflects national development priorities.

Table 6: Research performance and collaboration metrics of the top 10 universities in the world.

No.	Name of University	Scholarly Output	Citation Count	Authors	Citations per Publication	Field-Weighted Citation Impact	Outputs in Top 10% Citation Percentiles (%)	Publications in Top 10% Journal Percentiles (%)	International Collaboration (%)	Academic-Corporate Collaboration (%)
1	University of Oxford	107,406	2,429,266	43,144	22.6	2.21	21.6	47.2	62.2	6.6
2	Stanford University	100,898	2,594,846	44,257	25.7	2.32	23.6	49.3	42.7	8.3
3	Massachusetts Institute of Technology	70,323	2,076,835	34,449	29.5	2.40	25.4	54.2	53.3	10.3
4	Harvard University	186,885	4,551,927	81,167	24.4	2.20	22.4	48.8	49.7	7.3
5	University of Cambridge	81,923	1,921,043	33,874	23.4	2.08	21.3	48.1	62.0	7.1
6	Princeton University	29,843	713,141	10,587	23.9	2.17	23.4	49.0	48.3	6.6
7	California Institute of Technology	29,411	726,547	12,097	24.7	2.09	22.8	44.0	54.1	7.7
8	Imperial College London	92,513	2,238,625	38,744	24.2	2.17	21.0	48.0	64.9	8.9
9	University of California, Berkeley	61,343	1,515,589	27,536	24.7	2.16	22.9	48.9	47.1	7.4
10	Yale University	69,497	1,460,937	28,943	21.0	2.04	20.2	46.9	41.5	6.4

Table 7: Research performance and collaboration metrics of the top 10 Malaysian universities.

No.	Name of University	Scholarly Output	Citation Count	Authors	Citations per Publication	Field-Weighted Citation Impact	Outputs in Top 10% Citation Percentiles (%)	Publications in Top 10% Journal Percentiles (%)	International Collaboration (%)	Academic-Corporate Collaboration (%)
1	Universiti Malaya	27,844	441,835	13,348	15.9	1.41	13.8	21.9	58.7	2.6
2	Universiti Teknologi Petronas	10,118	128,815	4,545	12.7	1.41	16.5	20.8	60.7	5.0
3	Universiti Kebangsaan Malaysia	26,215	333,754	14,937	12.7	1.26	11.6	15.9	41.2	1.5
4	Universiti Sains Malaysia	28,107	325,032	15,245	11.6	1.27	12.0	13.3	48.5	1.4
5	Universiti Teknologi Malaysia	25,334	298,731	13,402	11.8	1.17	13.8	15.8	52.3	1.4
6	Universiti Utara Malaysia	5,993	53,635	3,020	8.9	1.11	11.2	9.3	44.8	0.3
7	Universiti Putra Malaysia	25,023	283,228	15,211	11.3	1.05	10.7	13.7	45.2	1.0
8	Universiti Malaysia Pahang Al-Sultan Abdullah (UMPSA)	9,225	98,819	4,860	10.7	1.23	14.8	11.8	43.2	1.5
9	Universiti Pendidikan Sultan Idris	3,250	24,188	1,841	7.4	1.07	10.9	9.5	44.3	0.9
10	Sunway University	4,808	68,598	1,161	14.3	1.74	19.8	23.0	69.3	1.4

Table 8: Research publication preferences of the top 10 universities in the world.

	University of Oxford	Stanford University	Massachusetts Institute of Technology	Harvard University	University of Cambridge	Princeton University	California Institute of Technology	Imperial College London	University of California, Berkeley	Yale University
Computer Science	8.3	11.3	20.7	4.5	8.9	16.8	12.9	10.5	16.4	4.5
Mathematics	6.3	5.7	10.9	2.6	6.2	12.5	9.6	6.4	9.4	3.2
Physics and Astronomy	11.4	12.3	23.1	8.4	16.5	29.3	44.2	12.4	20.5	7.7
Chemistry	5.5	5.7	9.0	3.5	7.6	7.7	8.1	7.8	8.5	4.0
Chemical Engineering	2.5	3.2	5.1	1.8	3.8	3.9	3.6	4.7	4.2	1.8
Materials Science	4.8	6.5	11.8	2.9	8.2	7.6	11.6	8.8	10.2	2.5
Engineering	7.5	11.0	22.1	4.8	12.0	14.7	22.4	15.9	18.3	4.0
Energy	1.8	2.3	4.4	0.5	2.8	3.0	2.3	4.0	4.2	0.8
Environmental Science	5.2	3.6	4.0	2.6	5.3	5.9	4.7	4.8	8.3	3.9
Earth and Planetary Sciences	5.3	4.6	8.3	4.3	7.7	15.2	41.2	4.0	10.5	3.4
Agricultural and Biological Sciences	5.4	2.9	2.5	3.0	5.6	4.6	3.2	3.3	7.1	3.9
Biochemistry, Genetics and Molecular Biology	13.8	14.7	16.5	18.1	15.7	9.0	7.7	15.4	11.1	15.9
Immunology and Microbiology	5.0	3.5	3.8	4.8	3.6	2.2	1.7	5.5	2.9	4.2

Table 8: (cont.) Research publication preferences of the top 10 universities in the world.

	University of Oxford	Stanford University	Massachusetts Institute of Technology	Harvard University	University of Cambridge	Princeton University	California Institute of Technology	Imperial College London	University of California, Berkeley	Yale University
Veterinary	0.3	0.1	0.1	0.2	0.7	0.1	0.0	0.2	0.1	0.2
Medicine	35.0	44.4	15.4	59.2	24.4	5.3	3.3	44.4	12.9	53.5
Pharmacology, Toxicology and Pharmaceutics	1.8	1.6	1.4	2.4	1.4	0.4	0.4	2.2	0.8	2.6
Health Professions	1.2	1.6	0.7	1.9	0.8	0.3	0.1	1.3	0.6	1.4
Nursing	1.8	1.9	0.4	3.1	1.3	0.2	0.0	1.9	0.6	2.9
Dentistry	0.1	0.2	0.1	0.7	0.0	0.0	-	0.1	0.0	0.2
Neuroscience	5.5	5.5	5.6	7.3	5.5	3.7	1.9	3.9	3.5	7.0
Arts and Humanities	9.7	2.9	2.3	2.9	9.5	8.2	0.7	0.7	5.4	4.8
Psychology	3.4	3.5	1.8	4.1	3.8	2.7	0.5	1.2	3.3	6.3
Social Sciences	14.7	7.9	5.8	6.7	14.4	11.7	1.4	3.1	13.0	9.3
Business, Management and Accounting	2.1	1.3	2.1	1.2	2.3	1.4	0.3	1.1	2.1	0.9
Economics, Econometrics and Finance	2.8	1.6	2.0	1.4	2.4	3.0	0.6	0.9	2.6	1.7
Decision Sciences	1.0	1.2	2.1	0.7	1.3	1.6	0.6	1.1	1.8	0.7
Multidisciplinary	4.2	4.3	5.9	4.4	4.4	4.7	4.3	3.6	4.7	4.0

Table 9: Top five most-published subject areas by the top 10 universities in the world.

No.	University of Oxford	Stanford University	Massachusetts Institute of Technology	Harvard University	University of Cambridge	Princeton University	California Institute of Technology	Imperial College London	University of California, Berkeley	Yale University
1	Medicine	Medicine	Physics and Astronomy	Medicine	Medicine	Physics and Astronomy	Physics and Astronomy	Medicine	Physics and Astronomy	Medicine
2	Social Sciences	Biochemistry, Genetics, and Molecular Biology	Engineering	Biochemistry, Genetics, and Molecular Biology	Physics and Astronomy	Computer Science	Earth and Planetary Sciences	Engineering	Engineering	Biochemistry, Genetics, and Molecular Biology
3	Biochemistry, Genetics, and Molecular Biology	Physics and Astronomy	Computer Science	Physics and Astronomy	Biochemistry, Genetics, and Molecular Biology	Earth and Planetary Sciences	Engineering	Biochemistry, Genetics, and Molecular Biology	Computer Science	Social Sciences
4	Physics and Astronomy	Computer Science	Biochemistry, Genetics, and Molecular Biology	Neuroscience	Social Sciences	Engineering	Computer Science	Physics and Astronomy	Social Sciences	Physics and Astronomy
5	Arts and Humanities	Engineering	Medicine	Social Sciences	Engineering	Mathematics	Materials Science	Computer Science	Medicine	Neuroscience

Table 10: Research publication preferences of the top 10 Malaysian universities.

	Universiti Malaya	Universiti Teknologi Petronas	Universiti Kebangsaan Malaysia	Universiti Sains Malaysia	Universiti Teknologi Malaysia	Universiti Utara Malaysia	Universiti Putra Malaysia	Universiti Malaysia Pahang Al-Sultan Abdullah	Universiti Pendidikan Sultan Idris	Sunway University
Computer Science	12.5	24.5	16.6	12.7	25.0	28.9	12.5	20.3	20.0	15.2
Mathematics	5.2	8.9	6.2	5.3	8.6	8.0	5.4	7.0	4.3	6.4
Physics and Astronomy	15.2	15.6	12.0	12.1	17.2	8.6	9.6	14.7	12.6	19.6
Chemistry	8.9	14.2	7.9	9.1	10.2	1.8	10.0	10.0	6.4	15.6
Chemical Engineering	6.8	17.3	7.0	8.6	13.5	2.6	9.0	16.0	4.3	8.9
Materials Science	14.2	21.9	13.1	14.8	20.1	3.3	14.3	27.6	8.2	17.0
Engineering	22.3	42.3	23.6	22.1	41.3	23.1	20.0	50.5	21.2	18.0
Energy	6.4	19.3	6.1	4.8	9.5	5.5	5.2	9.9	2.9	8.7
Environmental Science	8.7	16.7	12.3	11.0	16.0	8.5	13.8	9.6	7.7	10.2
Earth and Planetary Sciences	2.9	10.0	3.4	3.5	6.6	1.4	3.4	4.5	2.9	1.7
Agricultural and Biological Sciences	6.5	2.6	8.2	7.0	4.5	2.0	20.4	3.3	6.9	3.6
Biochemistry, Genetics and Molecular Biology	9.3	4.4	9.2	9.5	6.5	2.6	10.8	4.9	7.5	8.8
Immunology and Microbiology	4.0	0.4	2.1	3.1	0.9	0.1	3.6	0.8	1.2	3.8
Veterinary	0.6	0.0	0.2	0.3	0.1	0.0	2.2	0.0	0.2	0.4
Medicine	22.8	3.5	19.3	21.2	3.7	3.6	15.3	2.6	9.4	14.3

Table 10: (cont.) Research publication preferences of the top 10 Malaysian universities.

	Universiti Malaya	Universiti Teknologi Petronas	Universiti Kebangsaan Malaysia	Universiti Sains Malaysia	Universiti Teknologi Malaysia	Universiti Utara Malaysia	Universiti Putra Malaysia	Universiti Malaysia Pahang Al-Sultan Abdullah	Universiti Pendidikan Sultan Idris	Sunway University
Pharmacology, Toxicology and Pharmaceutics	3.3	1.0	3.3	4.5	1.2	0.9	4.0	1.3	3.5	3.3
Health Professions	1.2	0.3	1.3	1.7	0.3	0.3	1.0	0.2	3.7	1.1
Nursing	1.8	0.1	1.9	1.6	0.2	0.6	2.0	0.2	0.6	1.5
Dentistry	1.4	0.0	0.6	1.4	0.1	0.0	0.1	0.1	0.0	0.3
Neuroscience	1.7	0.4	1.2	1.3	0.2	0.2	0.8	0.1	0.1	1.4
Arts and Humanities	4.2	0.4	3.9	2.9	1.0	7.7	2.5	0.5	9.9	2.3
Psychology	1.4	0.4	1.3	1.3	0.5	2.4	1.1	0.1	2.7	2.7
Social Sciences	13.2	7.0	12.4	11.6	9.2	28.6	10.0	3.9	33.3	10.8
Business, Management and Accounting	4.9	3.2	4.8	6.2	5.3	28.4	5.7	3.8	9.3	11.6
Economics, Econometrics and Finance	3.6	1.5	3.1	3.8	2.0	16.3	4.1	1.1	4.4	6.7
Decision Sciences	1.4	3.9	2.1	2.4	2.9	10.7	1.5	3.9	3.3	4.0
Multidisciplinary	3.4	1.9	6.2	3.2	2.5	2.6	4.0	2.3	2.7	3.3

Table 11: Top five most-published subject areas by the top 10 Malaysian universities.

No.	Universiti Malaya	Universiti Teknologi Petronas	Universiti Kebangsaan Malaysia	Universiti Sains Malaysia	Universiti Teknologi Malaysia	Universiti Utara Malaysia	Universiti Putra Malaysia	Universiti Malaysia Pahang Al-Sultan Abdullah	Universiti Pendidikan Sultan Idris	Sunway University
1	Medicine	Engineering	Engineering	Engineering	Engineering	Computer Science	Agricultural and Biological Sciences	Engineering	Social Sciences	Physics and Astronomy
2	Engineering	Computer Science	Medicine	Medicine	Computer Science	Social Sciences	Engineering	Materials Science	Engineering	Engineering
3	Physics and Astronomy	Materials Science	Computer Science	Materials Science	Materials Science	Business, Management and Accounting	Medicine	Computer Science	Computer Science	Materials Science
4	Materials Science	Energy	Materials Science	Computer Science	Physics and Astronomy	Engineering	Materials Science	Chemical Engineering	Physics and Astronomy	Chemistry
5	Social Sciences	Chemical Engineering	Social Sciences	Physics and Astronomy	Environmental Science	Economics, Econometrics and Finance	Environmental Science	Physics and Astronomy	Arts and Humanities	Computer Science

4. Conclusion

During the COVID-19 pandemic, social distancing was one of the crucial measures in breaking the chain of virus spread. This study provided a comparison of the research performance of the top ten universities in the world and the top ten Malaysian universities based on the THE World University Rankings 2024. The leading world universities share common characteristics such as high scholarly outputs, citation count, and citation per publication, which receive twice as many citations as the world average for similar publications. Additionally, they also have a high number of publications in top-cited and top-ranked journals, as well as strong scientific collaborations with international and corporate institutions. The analysis of the research performance of the top ten ranked universities in Malaysia offers an overview of the Malaysian universities' scholarly output and focus areas. This provides insights for refining the research focus of Malaysian universities and strengthening international and corporate partnerships as well as unique regional research areas. However, having emphasized the significance of research in determining university rankings, Malaysian universities should adopt a more holistic approach that includes quality teaching and research, industry relevance and an international outlook to become a top-ranked world university.

We acknowledge that this study has several limitations since we only relied on Scopus datasets and are confined to the performance indicators in the THE WUR 2024 methodology. We have not conducted a comprehensive analysis of the research ecosystem, such as funding opportunities and research policies, of each country. Future studies should conduct a more in-depth study of the research ecosystem in Malaysia and evaluate the impact of inter-organizational collaborative research, including international and corporate collaborations on Malaysian universities.

References:

Abdelrahman, M., Al-Adwan, D., & Hasan, Y. (2022). Impact of social distancing on the mental health of parents and children in Qatar. *International Journal of Mental Health and Addiction*, *20*(5), 2894–2905. https://doi.org/10.1007/s11469-021-00555-6

Aksnes, D. W. & Sivertsen, G. (2023). Global trends in international research collaboration, 1980-2021. *Journal of Data and Information Science*, *8*(2), 26-42. https://doi.org/10.2478/jdis-2023-0015

Atkinson, R.C. & Blanpied, W.A. (2008). Research universities: Core of the US science and technology system. *Technology in Society*, *30*(1), 30-48. https://doi.org/10.1016/j.techsoc.2007.10.004

Elsevier. (2024). (2024, January 3). Retrieved from https://www.elsevier.com/products/scival

Esangbedo, C.O., Zhang, J., Esangbedo, M.O., Kone, S.D. & Xu, L. (2024). The role of industry-academia collaboration in enhancing educational opportunities and outcomes under the digital driven Industry 4.0. *Journal of Infrastructure, Policy and Development*, *8*(1), 2569. https://doi.org/10.24294/jipd.v8i1.2569

Evans, N., Miklosik, A., & Du, J.T. (2023). University-industry collaboration as a driver of digital transformation: Types, benefits and enablers. *Heliyon*, 9(10), e21017. https://doi.org/10.1016/j.heliyon.2023.e21017

Lancho-Barrantes, B.S. & Cantu-Ortiz, F.J. (2021). Quantifying the publication preferences of leading research universities. *Scientometrics*. *126*(3*)*, 2269-2310. https://doi.org/10.1007/s11192-020-03790-1

Larivière, V., Gingras, Y., Sugimoto, C.R. & Tsou, A. (2015). Team size matters: Collaboration and scientific impact since 1900. *Journal of the Association for Information Science and Technology*, *66*(7), 1323-1332. https://doi.org/10.1002/ asi. 23266

Mohd Sarjidan, M. A. & Md Kasim, A. (2023). Trends of academic publications: A case study of Malaysian research universities. *Journal of Research Management and Governance*, *5*(1), 18-29. https://doi.org/10.22452/jrmg.vol5no1.2.

QS World University Rankings. (2023). (2024, January 2). Retrieved from https://support.qs.com/hc/en-gb/articles/4405955370898-QS-World-University-Rankings-

Sheriff, N.M. & Abdullah, N. (2017). Research universities in Malaysia: What beholds? *Asian Journal of University Education*, *13*(2), 36-50. Retrieved from https://education.uitm.edu.my/ajue/wp-content/uploads/2018/02/3.-RESEARCH-UNIVERSITIES-IN-MALAYSIA.pdf

Times Higher Education: World University Ranking 2024. (2024, January 10). Retrieved from https://www.timeshighereducation.com/world-university-rankings/2024/world-ranking

Tahamtan, I., Safipour Afshar, A. & Ahamdzadeh, K. (2016). Factors affecting number of citations: A comprehensive review of the literature. *Scientometrics*, *107*(3*)*, 1195-1225. https://doi.org/10.1007/s11192-016-1889-2