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August 2021

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Chaturbuj, Santosh and Batcha, Sadik M. Dr., "Scientometric Analysis of Scholarly Publications of University of Mumbai from 2001 to 2019" (2021). *Library Philosophy and Practice (e-journal)*. 5922. <https://digitalcommons.unl.edu/libphilprac/5922>

Scientometric Analysis of Scholarly Publications of University of Mumbai from 2001 to 2019

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Abstract

The study deals with the analysis of research output by the University of Mumbai from 2001 to 2019. The University has published 3362 articles, out of which 3205 research articles, proceeding articles, and reviews are taken for study. The year-wise distribution shows the highest publications found in 2008 with 260 articles. The study used Domestic Collaboration Index (DCI) and International Collaboration Index (ICI). It shows the highest domestic collaboration in 2011 (112.36) and the highest international collaboration in 2006 (179.15). The study used the specialisation index (SI), and as per SI, the University of Mumbai has specialised in Engineering with a 1.194 score. The study used a Priority Index (PI) to denote the correspondence of research efforts taken by the University of Mumbai with the efforts given by India. It shows that the University of Mumbai corresponds in 'Medical Chemistry' in Chemistry, 'Acoustics' in Physics, 'Microbiology' in Biology, and 'Food Science and Technology' in Engineering with the highest Priority Index value in these sub-subjects. It also provides the information on which sub-subjects the University of Mumbai focuses on and emphasises its research efforts. Priority Index also reflects India's research priority in Science and Technology with World's research efforts in major sub-subjects. 'Yadav G.D.' is the most productive author with 132 research articles. The study also evaluates and ranked by authors productivity, authors impact on research and most relevant journals.

Keywords: Specialization Index, Priority Index, h-index, g-index, m-index, University of Mumbai, Chemistry, Physics, Biology, Engineering.

1. Introduction:

Bibliometrics or Scientometric indicators are used for the quantitative and qualitative analysis of research activities. These indicators evaluate the growth of literature in a particular subject or within its sub-subjects. It is used as a "monitoring device" for universities or government agencies to understand the development and scattering of subjects. These indicators are used to understand the growth pattern, progress and nature of spreading literature of any disciplines or area of research and helps to make necessary decisions and build up the nation's science policy. These indicators help to know the different ranking of authors, institutions, universities and countries. It helps to understand the strong and weak areas of research fields; accordingly, any institute can change its policies. In the present study, research activities carried out by the University of Mumbai during 2001-2019 is analysed.

The University of Mumbai was established in 1857, and it is one of the first three Universities in India. The University of Mumbai has 56 Departments, 12 Specialized Centres, 781 Affiliated Colleges with good academic history in India, and offers bachelor, master and doctoral courses in Arts, Commerce, Science, Medical and Engineering. The great Indian industrialist Ratan Tata is appointed head of Mumbai University advisory Council. The present study reflects the research activities conducted by the University of Mumbai in Chemistry, Biology, Physics and Engineering disciplines.

2. Review of literature:

¹Moed, H.F. (1985) used bibliometrics indicator to assess the research group in the faculty of Medicine, Mathematics and Natural Science to make the university research policy of University of Leiden. The study analysis the nature of impact by using citation indicators. It tried to assess short-term and long term research on the related field. It analysed a trend as the past performance evaluation and analysed a level of research to determine the relative score on a faculty and an international scale.

²Thirumagal, A (2012) published paper entitled Scientific Publication of Manonmaniam Sundaranar University, Tirunelveli, Tamilnadu: Scientometric Analysis. This paper studied the scientific publication of this University. It focused on publishing trends, impact factors, author's patterns etc. The study found a single author did only 3.86% of the research, and collaborative authors did 96.14% of the study. It studied individual author's research productivity and found Dr Nair's research output was 47 research articles with 12.9% of total authors. Indian Journal of Chemistry Section A-Inorganic physical Theoretical & Analytical was a leading journal with 6.1% total publications.

³Baskaran, C (2013) published a research paper entitled Research Growth Trend and author collaboration of Aalgappa University in India during 1999-2011. The study disclosed a degree of collaboration with 9.63 in the Aalgappa University. South Korea ranked first producing country with 7.61% of collaborative papers. The institute-wise analysis study reveals that the Central Electro Chemical Research Institute had the highest publications with 129 articles.

⁴Aswathy, S., and Gopikuttan, A (2013) studied the productivity pattern of Universities in Kerala: A Scientometric Analysis. The study is about the publication pattern of faculty members of three universities in kerala. It deals with the productivity found in the University of Karela, Mahatma Gandhi University, and the University of Calicut. The study reveals the increasing tendency of research production. The study rejected Lotka's law of author's productivity in all studied universities.

⁵Murugan, K., and Ravanan, C. examined a Scientometric study of the research productivity of Anna University based on Scopus database in the year 1979-2019". Thirty-six of years publications were extracted from the Scopus database, and a total of 13631 published articles were studied. Most prolific authors from Anna university found 'Ramusamu P.' having 396 papers in his record, which are 5.64% of the total publications of Anna university. Anna University had the highest collaboration with the University of Madras, having 325 publications in common. Engineering is the highest discipline in Anna University with 5168 publications which is 21.30% of the total publications.

⁶Balasubramani, R., and Purameswaran, R. (2014) studied in "Mapping the research productivity of Banaras Hindu University: A Scientometric Study. The study is based on 6943 published articles. Physics have the highest publication records (1110). 'The Institute of Technology' had published 1482 articles with rank first, and 'Current Science' is the most preferred journal by authors of BHU for publishing their contribution. The study shows international collaboration with 39.2% published articles. The USA is the highest collaborated country with 390 records.

⁷Dutt, Bharvi, and Nikam, Khaiser (2014) published an article entitled Scientometrics of collaboration pattern in solar cell research in India during 1991-2010. Study shows that India collaborated with 31 countries from almost all region of the world. The value DCI and ICI indicate the predominance of international collaborative research activity from 2001 to 2005 and 2006-2010. DCI and ICI have no substantial variation. It was almost the same.

The present study Specialization index and Priority index used to analyze research productive of the University of Mumbai and compare it with the research productivity of India in particular subjects and its sub-subjects

3. Objectives of the study: -

1. To examine the year-wise distribution of published research articles from the University of Mumbai.
2. To identify Domestic and International collaboration trends of the University of Mumbai.
3. To compare the University's publications output with the complete publication output of the Nation.
4. To compare the University's subject-wise and sub-subject wise publications output with the Nation's production.
5. To identify the most productive authors from the University of Mumbai

3. Methodology:

The data for the study is collected from the Web of Science database. The University of Mumbai, Univ. of Mumbai, Univ. of Bombay terms are used to search data. Organization Enhanced option is used, and the duration selected is from 2001 to 2019. The data is download in plain text format and extracted with the help of R-programming and Bibexcel software. Further Analysis is done in excel software. The following are the essential bibliometric indicators used to analyze data.

3.1 Specialization Index:

This indicator is used to understand the specialized discipline or subject in which a region or country is a more significant research output than in all other fields. The specialization index stated that an aggregate is specialized when it produces more in a specific discipline than in all other disciplines. SI is obtained with the following formula.

$$SI(x/y) = \frac{Xa/Xt}{Ya/Yt}$$

Where Xa =Number of articles published by group 'X' in discipline

Ya = Number of articles published by group y in discipline 'a'

Xt = Total Number of articles published by reference group 'X.'

Yt = Total Number of articles published by reference group 'Y.'

In the above formula group, 'X' is always a subset of group 'Y'. If the answer of the indicator is higher than 1.0 indicates that 'X' is specialized in relation to, 'Y', and if the answer is lower than 1.0, it means group 'X' has not specialized in discipline 'a'.

In the present study, this indicator was used in two paired groups. One is the publications of the University of Mumbai as consider 'X' with the publications of India consider as 'Y'. In the second paired, India's publications are considered 'X' and the publication of World in the same discipline is considered 'Y'. 'a' are disciplines such as 'Chemistry', 'Physics', 'Biology' and 'Engineering'.

3.2. Priority Index:

This indicator is similar to the Specialization index. It provides the research priority of a country, an institution or a university to emphasize the efforts on given sub-fields. The priority index obtained with the help of the following formula

$$PI = \frac{n_{ij}/n_{io}}{n_{oj}/n_{oo}} \times 100$$

n_{ij} = the number of publications of country i in subject field j

n_{io} = the number of publications of country i in all sub-fields.

n_{oj} = the number of publications of all countries in sub-field j.

n_{oo} = the number of publications of all countries in all sub-fields.

If the Priority index denotes $PI= 100$, it means the research priority of a country for a given sub-fields corresponds to the average of all countries. If $PI>100$, it means higher than average

and If $PI < 100$, it means lower than average. Nation has to emphasize its research efforts to lower the Priority Index. No country has a higher priority in all sub-fields of a discipline. The priority index of sub-subjects under the University of Mumbai and at the National level are obtained in the present study.

3.4. Domestic Collaborative Index and International Collaborative Index:

Collaboration generally happened at three-level, i.e., Local, Domestic and International levels. Suppose collaboration is formed between any two institutions within the same country called Domestic Collaboration (DC). Generally, affiliation addresses should have within the same country if the paper having at least one foreign address is called international collaboration (IC). The Domestic Collaborative Index (DCI) and the International Collaborative Index (ICI) are used to examine the level or the pattern of collaboration. ⁸Garg and Padhi suggest these collaborative indices. The formula to obtain these indices are as follow.

- i. Domestic Collaborative Index:

$$DCI = \frac{Di/Dio}{Do/Doo} \times 100$$

Where D_i = number of domestically co-authored papers for block i

D_{io} = Total output of block i

D_o = Total number of domestically co-authored papers

D_{oo} = Total output

- ii. International Collaborative Index (ICI)

$$ICI = \frac{I_i/I_{io}}{I_o/I_{oo}} \times 100$$

Where I_i = number of internationally co-authored papers for block i

I_{io} = number of internationally co-authored papers for all the blocks

I_o = Total number of domestically co-authored papers

I_{oo} = Total output

If the value of DCI or ICI is equal to 100, it means a given country's collaborative efforts correspond to the world average. If DCI or ICI > 100 indicates collaboration efforts higher than the world average and if DCI or ICI < 100 means less than average collaboration.

4. Analysis of Data:

4.1. Details of Publications:

The University of Mumbai published 3362 documents from 2001 to 2019. Only 3205 are taken for study in which research articles, proceedings, and reviews are included. Table No.1 shows the data about document types published by the University of Mumbai. As per the table, the highest documents are published as research articles 2942 with 87.51 % of the total published literature. The second type of documents is proceeding papers with 5.03 % of the total records.

Table No.1 Document-wise distribution of published materials of the University of Mumbai

Sr. No.	Document Type	Records	% of 3362
1	Article	2942	87.51
2	Proceedings Paper	169	5.03
3	Review	94	2.80
4	Meeting Abstract	55	1.64
5	Book Review	31	0.92
6	Editorial Material	29	0.86
7	Letter	15	0.45
8	Early Access	12	0.36
9	Correction	7	0.21
10	Biographical Item	4	0.12

11	News Item	2	0.06
12	Poetry	1	0.03
13	Retracted Publication	1	0.03
Total		3362	100.00

4.2 Year wise distribution of scholarly communication: -

The University of Mumbai published a total of 3205 articles. The highest number of publications was found in 2008 with 260 (8.11%) articles, and the lowest publications count recorded in 2013 with 78 (2.43%) research articles. Table No. 2 denotes those 3205 articles received 57357 citations in 19 years. The highest citations were received by the articles published in the year 2008, with 7018 citations. It means articles received 26.99 citations per article and 501.29 citations per year. The highest mean citations are received in 2013 with 3.58 as it depends on the duration of citation years. As total published articles are 3205 and citations received by these articles are 57357, it means 17.90 average citations received by each article. The table shows that the continuous growth of publications from 2001 to 2008 suddenly decreased from 2009 to 2013, and again it slowly increased.

Table No. 2 Year wise Distribution of Articles with Citation Details

Year	Articles	% of Articles	TC	ACPA	ACPY	MCPY	CY
2001	180	5.62	4580	25.44	229.00	1.34	19
2002	188	5.87	5340	28.40	281.05	1.58	18
2003	175	5.46	4195	23.97	233.06	1.41	17
2004	185	5.77	4860	26.27	285.88	1.64	16
2005	184	5.74	4317	23.46	269.81	1.56	15
2006	188	5.87	4194	22.31	279.60	1.59	14
2007	221	6.90	4775	21.61	318.33	1.66	13
2008	260	8.11	7018	26.99	501.29	2.25	12
2009	201	6.27	4513	22.45	376.08	2.04	11
2010	125	3.90	2313	18.50	210.27	1.85	10
2011	97	3.03	1517	15.64	151.70	1.74	9
2012	84	2.62	1163	13.85	129.22	1.73	8
2013	78	2.43	1954	25.05	177.64	3.58	7
2014	99	3.09	1383	13.97	197.57	2.33	6
2015	143	4.46	1949	13.63	324.83	2.73	5
2016	155	4.84	1349	8.70	269.80	2.18	4
2017	181	5.65	1025	5.66	205.00	1.89	3
2018	202	6.30	620	3.07	206.67	1.53	2
2019	259	8.08	292	1.13	146.00	1.13	1
Total	3205	100.00	57357	17.90	2867.85		

TC=Total Citation, ACPA= Average Citations Per Article, ACPY= Average Citations Per Year, MCPY=Mean Citation Per Year, CY=Citable Year

4.3 Domestic and International Collaboration: -

Table No.3 and graph No. 1 represents the year wise domestic and international collaboration efforts taken by the authors of the University of Mumbai. For understanding these efforts Domestic Collaborative Index (DCI) and International Collaboration Index (ICI) are used. It is found from the chronological data of collaboration that the University of Mumbai have decreasing trends in domestic collaboration and increasing trends in international collaboration. The data shows the highest Domestic collaboration found in 2005, which is 112.36. DCI value. The information also represents that from 2001 to 2011 domestic collaboration is higher than 100 means research efforts were taken by the University of Mumbai during these years at the domestic level are satisfactory. But from 2012 to 2019

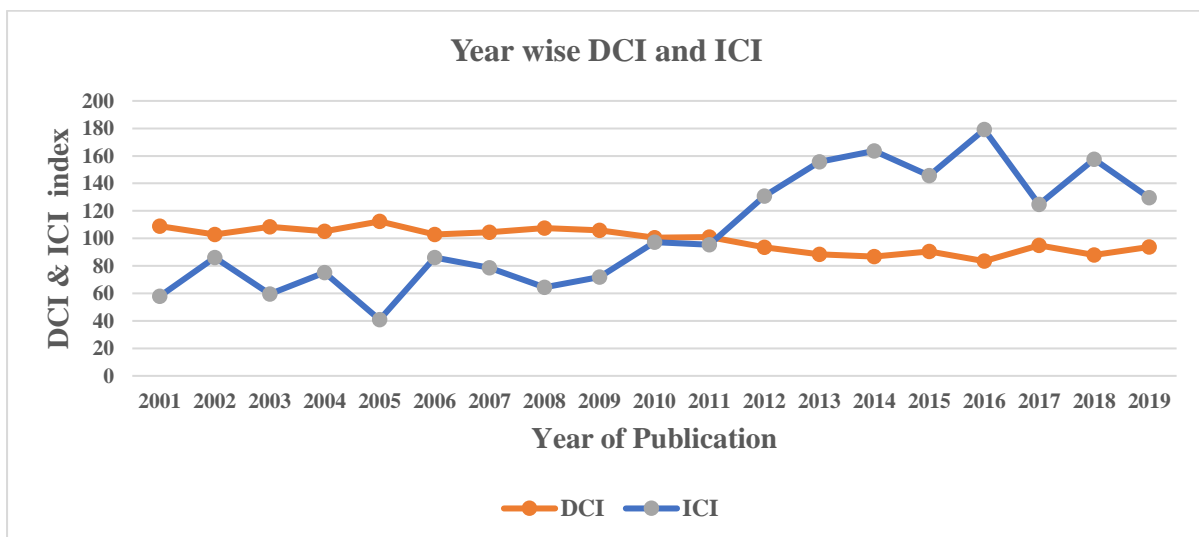
domestic collaborative efforts decreases, and international collaboration increases. According to table No. 3, the highest international collaborative efforts found in 2016 have a 179.15 ICI value. The data shows that the lowest international collaborative efforts found in 2005 that is 40.87. It is a good sign that the University of Mumbai increasing international collaboration efforts in research activities.

Table No. 3 Year wise Domestic and International Collaboration

Sr. No.	Year	Paper in Domestic Collaboration	DCI	Papers in International Collaboration	ICI	Total Paper
1	2001	162	108.81	18	57.85	180
2	2002	160	102.89	28	86.16	188
3	2003	157	108.46	18	59.50	175
4	2004	161	105.21	24	75.05	185
5	2005	171	112.36	13	40.87	184
6	2006	160	102.89	28	86.16	188
7	2007	191	104.49	30	78.53	221
8	2008	231	107.41	29	64.53	260
9	2009	176	105.86	25	71.96	201
10	2010	104	100.59	21	97.19	125
11	2011	81	100.96	16	95.43	97
12	2012	65	93.55	19	130.86	84
13	2013	57	88.35	21	155.76	78
14	2014	71	86.70	28	163.62	99
15	2015	107	90.46	36	145.64	143
16	2016	107	83.46	48	179.15	155
17	2017	142	94.85	39	124.65	181
18	2018	147	87.98	55	157.52	202
19	2019	201	93.82	58	129.55	259
Total		2651		554		3205

DCI= Domestic Collaborative Index, ICI= International Collaborative Index

Graph No.1 Year wise Domestic and International Collaboration



4.4 Specialization Index of Subject at University of Mumbai: -

In the present study, the output of research activities through the University of Mumbai in leading productive subjects are compared to India's output of research activities in the same subjects. It also tells the comparison of India's productivity with the world's productivity of the

same subjects. For this purpose, the Specialization Index is used. As per data shown in table No. 4, the highest value of the Specialization index found in Engineering is 1.710 SI value. The Specialization Index tells that if the value is more than 1, research efforts and productivity correspond to the Nation's productivity. In Physics, the lowest specialization index value found that is 0.673 SI value. It means University has to emphasize research efforts in this discipline. Other subjects like Chemistry (0.978) and Biology (0.944) are near to 1 Specialization index score, which means that these are the subjects that also correspond to the productivity of the Nation. The data shows that India is one of the leading countries in Physics research as the specialization index in this subject is 1.295. India takes minimal effort in Biology subject as its Specialization index is only 0.452.

Table No. 4 Specialization Index of The University of Mumbai and India in four major Subjects

Sr. No	Name of Main Subject	No. Paper Published (2001-2019)				
		University of Mumbai	India	Specialization Index Univ. Mumbai	World	Specialization Index India
1	Chemistry	1508	259083	0.978	3711911	1.235
2	Physics	980	244782	0.673	3344693	1.295
3	Biology	390	69433	0.944	2718689	0.452
4	Engineering	1288	126492	1.710	2602771	0.860
Total		4166	699790	NIL	12378064	NIL

4.5 Priority Index of Sub-subjects at the University of Mumbai: -

Priority Index denotes whether the research efforts or productivity in sub-subjects of main disciplines correspond with the Nation and the World. The sub-subjects of Chemistry, Physics, Biology, and Engineering has taken for the study the most productive subjects of the University of Mumbai.

4.5.1 Priority Index in the Sub-subjects of Chemistry –

Table No.5 expresses that the University of Mumbai has the highest research efforts in ‘Medical Chemistry’ as its priority index value is 198.204. It means this sub-subject in Chemistry correspondence the research efforts taken by the Nation. Similarly, ‘Chemistry Multidisciplinary’ (127.015), ‘Chemistry Applied’ (159.368) has a priority index of more than 100. It means the University of Mumbai has made reasonable efforts in these sub-subjects to correspond to India’s research productivity. But it is found that the University of Mumbai have to improve in other sub-subjects of Chemistry as these subjects have priority index value less than 100. In these sub-subjects, lowest priority index value was found in ‘Chemistry Physical’ with 75.429.

Table No.5 Priority Index of Sub-Subjects of Chemistry

Sr. No	Name of Sub-Subjects in Chemistry	No. Paper Published (2001-2019)				
		University of Mumbai	India	Priority Index University Mumbai	World	Priority Index India
1	Chemistry Multidisciplinary	481	65062	127.015	1363170	68.381
2	Chemistry Physical	296	67420	75.429	977777	98.789
3	Chemistry Organic	282	50379	96.169	370811	194.651
4	Chemistry Applied	184	19836	159.368	249969	113.691

5	Chemistry Analytical	131	24480	91.939	418245	83.857
6	Chemistry Medical	69	5981	198.204	90644	94.535
7	Chemistry Inorganic Nuclear	65	25925	43.076	241295	153.932
	Total	1508	259083	NIL	3711911	NIL

Table No. 5 also represents that India has good research productivity in ‘Chemistry Organic’ as its priority index value is 194.651, which is more than 100. It means the research efforts taken in this sub-subject by India correspond with World’s efforts. Similarly, India has a priority index value of more than 100 in sub-subjects of Chemistry like ‘Chemistry Applied’ (113.691), ‘Chemistry Inorganic Nuclear’ (153.932). India has found the lowest priority Index in ‘Chemistry Multidisciplinary (68.381). Table no. 5 represents contradictory facts that compared to the University of Mumbai’s priority index value with India, the University of Mumbai corresponds to its research productivity in the sub-subject ‘Chemistry Multidisciplinary’ with Nation’s productivity. On the contrary, India does not correspond its research efforts with World’s research efforts in the same sub-subject. Similarly, ‘Organic Chemistry’ has a lower priority index value at the university level; simultaneously, India has the highest priority index value in the same sub-subject.

4.5.2. Priority Index of Sub-subjects of Physics:

Table No. 6 expressed the priority index value in the sub-subjects of the Physics discipline. As per data, the University of Mumbai has found the highest priority index in Acoustics (18461.819). It means the University of Mumbai is one of the highest productive universities in India. Similarly, ‘Polymer Science’ is one of the prominent subjects in which the University of Mumbai has a good priority index value of 3639.616. The University of Mumbai received a less priority index value in ‘Nanoscience Nanotechnology’ with a 15.307 score. It means that the University has taken significantly fewer research efforts in this sub-field of Physics. ‘Physics Applied’(64.550), ‘Physics-Condensed Matter’ (79.761), ‘Physics Multidisciplinary’ (87.008), ‘Physics Particles Fields’ (98.497), these are the sub-subjects of Physics in which priority index value is less than 100 and the University of Mumbai has to take enough research efforts to correspond it with nation’s efforts.

Table No 6 Priority Index of Sub-Subject in Physics

Sr. No	Name of Sub-Subjects in Physics	No. Paper Published (2001-2019)				
		University of Mumbai	India	Priority Index University Mumbai	World	Priority Index India
1	Polymer Science	153	1050	3639.616	25107	57.144
2	Physics Applied	118	45660	64.550	1026891	60.756
3	Physics Condensed Matter	102	31942	79.761	553539	78.848
4	Astronomy and Astrophysics	100	7063	353.642	104055	92.748
5	Physics Nuclear	91	8382	271.173	138902	82.455
6	Physics Atomic Molecular Chemical	81	15169	133.377	298901	69.344
7	Physics Multidisciplinary	68	19521	87.008	427846	62.344

8	Optics	55	5568	246.727	150066	50.698
9	Nanoscience Nanotechnology	54	88117	15.307	212503	566.593
10	Physics Particles Fields	51	12933	98.497	221484	79.787
11	Acoustics	34	46	18461.819	1393	45.121
12	Physics Fluids Plasmas	25	7501	83.248	155983	65.708
13	Thermodynamics	25	550	1135.353	9314	80.687
14	Crystallography	23	1280	448.819	18709	93.484
	Total	980	244782	NIL	3344693	NIL

Table No.6 also expressed that India has the highest priority index value in 'Nanoscience and Nanotechnology, with a 566.593 PI value. It means India is one of the leading research productive countries in the World in this Nanoscience. At the same time, all other sub-subjects given in the table for Physics have a lower priority index value than 100. It means India has to make enough effort in Physics to corresponds to the efforts given by the World. The data shows that the research activities of all universities are not sufficient in Physics. The University of Mumbai has higher research efforts than the national level in 'Polymer Science', 'Astronomy and Astrophysics', 'Physics Nuclear,' 'Physics Atomic Molecular Chemical', 'Acoustics', 'Thermodynamics', and 'Crystallography'.

4.5.3. Priority Index of Sub-subjects of Biology:

As data expressed in table No. 7 University of Mumbai have the highest priority index in 'Microbiology' (685.720) and lowest in 'Cell Biology' (18.416). Research efforts by the University of Mumbai in 'Biotechnology Applied Microbiology' (671.689), 'Microbiology (685.720)', 'Plant Science (163.680)', and 'Biology in general (110.642)' have higher priority index value than 100. It means the University efforts in these sub-subjects correspond with India's productive efforts in the same sub-subjects. However, the University of Mumbai has to concentrate its efforts on other sub-subjects like Cell Biology (18.416), Biochemistry, Molecular Biology (41.369) and Biophysics (76.073) having a Priority Index value less than 100.

Table No.7 also expressed that India has the highest priority Index value in 'Biophysics' (181.080) and lowest in 'Biology' in general (32.374) as data shows that the University of Mumbai has a much higher priority index value than the Nation in 'Microbiology', 'Biotechnology Applied Microbiology', and 'Biology in general'.

Table No. 7 Priority Index of Sub-Subjects of Biology

Sr. No	Name of Sub-Subjects in Biology	No. Paper Published (2001-2019)				
		University of Mumbai	India	Priority Index University Mumbai	World	Priority Index India
1	Biotechnology Applied Microbiology	188	4983	671.689	128823	151.458
2	Biochemistry Molecular Biology	92	39593	41.369	1329904	116.571
3	Biophysics	34	7957	76.073	172057	181.080
4	Microbiology	27	701	685.720	31395	87.428

5	Plant Science	26	2828	163.680	66499	166.517
6	Cell Biology	12	11601	18.416	775931	58.542
7	Biology	11	1770	110.642	214080	32.374
	Total	390	69433	NIL	2718689	NIL

4.5.4. Priority Index of Sub-subjects of Engineering: -

Table No.8 analysed the research efforts taken by the University of Mumbai and India in sub-branches of Engineering. The University of Mumbai received the highest priority index value in 'Food Science Technology' (1864.901) and the lowest in 'Engineering Electrical Electronics' (8.592). The priority Index shows that the University of Mumbai has less emphasis on 'Material Science Multidisciplinary' (77.987), 'Engineering Electrical Electronics' (8.592) and in 'Engineering Multidisciplinary' (14.002) to correspond to National productive efforts in the same sub-subjects of Engineering. The University of Mumbai has a higher priority index value than 100 in 'Engineering Chemical' (187.981) 'Biotechnology Applied Microbiology' (820.928), Food Science Technology (1864.901), 'Engineering Environment (101.797), 'Environmental Science' (105.795) and 'Instruments Instrumentation' (143.865) which shows that research efforts correspond to the efforts taken by the Nation.

Table No. 8 Priority Index of Sub-Subject of Engineering

Sr. No	Name of Sub-Subjects in Engineering	No. Paper Published (2001-2019)				
		University of Mumbai	India	Priority Index University Mumbai	World	Priority Index India
1	Engineering Chemical	513	26801	187.981	559386	98.585
2	Biotechnology Applied Microbiology	188	2249	820.948	27269	169.704
3	Material Science Multidisciplinary	181	22793	77.987	361535	129.725
4	Food Science Technology	124	653	1864.901	11493	116.910
5	Engineering Environmental	99	9551	101.797	213150	92.201
6	Environmental Science	76	7055	105.795	161286	90.006
7	Instruments Instrumentation	53	3618	143.865	114063	65.267
8	Engineering Electrical Electronics	36	41147	8.592	935712	90.483
9	Engineering Multidisciplinary	18	12625	14.002	218877	118.687
	Total	1288	126492	NIL	2602771	NIL

The data also expressed in table No. 8, India has received the highest priority Index Value in 'Biotechnology Applied Microbiology' (169.704) and the lowest in 'Environmental Science' (90.006). India's research efforts correspond to the world in 'Biotechnology Applied Microbiology', 'Material Science Multidisciplinary' (129.725), 'Food Science Technology' (116.910), and 'Engineering Multidisciplinary' (118.687) as these values are more than 100.

4.6 Ranking of Authors as per productivity: -

Total 4513 authors contributed research articles to the University of Mumbai from 2001 to 2019. The table represents the fact that ‘Yadav G. D.’ is the most productive author having 132 (4%) records. The second rank was received by ‘Josh, J. B.’ with 119 documents in his credit. The first 50 authors with their contributions are given in table No. 9 with their citations. The first 26 ranks are shown in the table. The highest citations were received by ‘Pandit A.B.’ with 4652 citations and get rank first in citation ranking. During the study, it is found that the first five highest citations received by authors are ‘Pandit, A. B.’ (4652), ‘Singhal, R.S.’ (4389), ‘Joshi, J. B.’ (4124), ‘Yadav, G.D.’ (3829) and ‘Srivastava, A.K.’ (2999).

Table No. 9 Ranking of Author as per contribution with Citation details

Sr. No.	Name of Authors	No of Papers	Rank	% Of 3205	Total Citations	% Of 57357
1	Yadav GD	132	1	4.12	3829	6.68
2	Joshi JB	119	2	3.71	4124	7.19
3	Singhal RS	114	3	3.56	4389	7.65
4	Pandit AB	103	4	3.21	4652	8.11
5	Srivastava AK	101	5	3.15	2999	5.23
6	Kothari DC	79	6	2.46	1837	3.20
7	Gaikar VG	58	7	1.81	953	1.66
8	Lokhande RS	56	8	1.75	386	0.67
9	Mashraqui SH	55	9	1.72	773	1.35
10	Pangarkar VG	53	10	1.65	2293	4.00
11	Patel N	45	11	1.40	1384	2.41
12	Miotello A	41	12	1.28	1381	2.41
13	Patwardhan AW	40	13	1.25	886	1.54
14	Karnik AV	39	14	1.22	353	0.62
15	Garje SS	37	15	1.15	350	0.61
16	Dubey SK	36	16	1.12	105	0.18
17	Mehta BH	36	16	1.12	141	0.25
18	Sawant SB	36	16	1.12	864	1.51
19	Bhanage BM	35	17	1.09	1170	2.04
20	Kanjilal D	35	17	1.09	161	0.28
21	Vavia PR	34	18	1.06	925	1.61
22	Gogate PR	32	19	1.00	2651	4.62
23	Chaskar AC	30	20	0.94	276	0.48
24	Fulekar MH	30	20	0.94	851	1.48
25	Samant SD	30	20	0.94	871	1.52
26	Yadav AD	30	20	0.94	97	0.17
27	Dhadke PM	29	21	0.90	314	0.55
28	Fernandes R	29	21	0.90	642	1.12
29	Jayaram RV	28	22	0.87	1044	1.82
30	Mahajani VV	28	22	0.87	616	1.07
31	Sawant MR	28	22	0.87	209	0.36
32	Kumar S	27	23	0.84	236	0.41
33	Misra A	27	23	0.84	145	0.25
34	Natarajan L	27	23	0.84	166	0.29
35	Kumar A	26	24	0.81	419	0.73
36	Singare PU	26	24	0.81	312	0.54
37	Athawale VD	25	25	0.78	362	0.63
38	Vadagaonkar KS	25	25	0.78	266	0.46
39	Kamble RM	24	26	0.75	179	0.31

40	Ramana MMV	24	26	0.75	181	0.32
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4.7 Author's Impact on Research: -

The author's impact is calculated by 'h-index', 'g-index', and 'm-index'; with the help of these indices, one can easily understand which authors have a higher impact than others. It means which author's articles have cited more. The quality of research depends on the impact of the author on that field. The table shows that the highest h-index received by two authors, 'Yadav, G.D.' and 'Pandit A.B.', with a 39 h-index Score. The second rank was received by 'Singhal R.S.' with 35 h-index, and the third rank was received by 'Joshi J.B.' with 33 h-index.

g-index is more related to citations received by authors. It is the improved form of the h-index. So, in g-index ranking, 'Pandit, A.B.' have 64 scores with the first rank, 'Singhal, R.S.' have 62 scores with the second rank.

m-index is the higher version of the h-index. It is the average of low and high citations received during a long period of a career. It includes the entire years of research as a third variable to indicate the author's impact more precisely. As data represents in table No. 10 that 'Yadav, G.D.' and 'Pandit, A.B.' received the first rank with a 1.95 m-index score. 'Singhal, R.S.' gets a 1.75 m-index score and obtained the second rank. 'Fernandes, R.' have a 1.70 score and received the third rank. The table shows the first 50 authors with their h-index, g-index and m-index.

Table No. 10 Author Impact: h-index, g-index and m- index

Sr. No.	Author	h-index	Authors	g-index	Authors	m-index
1	Yadav GD	39	Pandit AB	64	Yadav GD	1.95
2	Pandit AB	39	Singhal RS	62	Pandit AB	1.95
3	Singhal RS	35	Joshi JB	59	Singhal RS	1.75
4	Joshi JB	33	Yadav GD	55	Fernandes R	1.70
5	Srivastava AK	29	Srivastava AK	52	Chaskar AC	1.67
6	Gogate PR	27	Pangarkar VG	47	Vadagaonkar KS	1.67
7	Pangarkar VG	24	Kothari DC	40	Shimpi NG	1.67
8	Kothari DC	23	Patel N	37	Punde NS	1.67
9	Patel N	21	Miotello A	37	Rajpurohit AS	1.67
10	Miotello A	21	Bhanage BM	34	Pinjari DV	1.67
11	Bhanage BM	21	Gogate PR	32	Joshi JB	1.65
12	Jayaram RV	21	Vavia PR	30	Kalambate PK	1.57
13	Sawant SB	20	Patwardhan AW	29	Srivastava AK	1.45
14	Gaikar VG	19	Sawant SB	29	Patel N	1.40
15	Patwardhan AW	18	Fulekar MH	29	Rawool CR	1.40
16	Mashraqui SH	17	Samant SD	29	Dashora A	1.38
17	Samant SD	17	Gaikar VG	28	Gogate PR	1.35
18	Fernandes R	17	Jayaram RV	28	Shah AP	1.33
19	Fulekar MH	15	Mashraqui SH	26	Bhanage BM	1.31
20	Shukla SR	15	Fernandes R	25	Pangarkar VG	1.20
21	Nandurkar NS	15	Mahajani VV	24	Shaikh AM	1.17
22	Vavia PR	14	Shukla SR	22	Sharma BK	1.17
23	Mahajani VV	14	Dongre VG	21	Kalmode HP	1.17

24	Lokhande RS	13	Kumar A	20	Kothari DC	1.15
25	Singare PU	13	Gupta S	20	Dar RA	1.14
26	Survase SA	13	Dongre PM	20	Miotello A	1.11
27	Kulkarni VM	13	Nandurkar NS	20	Jayaram RV	1.11
28	Kumar A	12	Sivakami S	20	Karna SP	1.09
29	Singh A	12	Kulkarni PR	19	Sanghavi BJ	1.09
30	Dongre VG	12	Survase SA	19	Fulekar MH	1.07
31	Sivakami S	12	Athawale VD	18	Nandurkar NS	1.07
32	Ijeri VS	12	Singh A	18	Sawant SB	1.00
33	Lele SS	12	Lokhande RS	17	Singh A	1.00
34	Thorat BN	12	Karnik AV	17	Choudhary S	1.00
35	Ananthanarayan L	12	Garje SS	17	Ahmad B	1.00
36	Karna SP	12	Dhadke PM	17	Patil BN	1.00
37	Bajaj IB	12	Shimpi NG	17	Lade JJ	1.00
38	Sanghavi BJ	12	Kale DD	17	Sathe PA	1.00
39	Dhadke PM	11	Ijeri VS	17	Saxena G	1.00
40	Bhagwat SS	11	Khadilkar BM	17	Orlandi M	1.00

4.8 Most Relevant Journals: -

Table No. 11 represents the ranking of journals in which authors from the University of Mumbai prefer to publish their articles. The most relevant journal is Industrial Engineering Chemistry Research, with 81 records published by the University of Mumbai that received the first rank. This journal received 2416 citations for 81 records. It means 29.83 average citations per article and 127.16 average citations per year (2001-2019)—the second rank received by ‘Asian Journal of Chemistry’ with 66 records. A total of 99 citations were received from 2001 to 2019. It means 2.89 average citations per article and 10.61 average citations per year. The table shows the first 29 journals with 17 ranks.

Table No. 11 Most contributed Journals by authors of Mumbai University

Sr. No.	Source Titles	records	% of 3205	Rank	TC	ACPA	ACPY
1	Industrial Engineering Chemistry Research	81	2.527	1	2416	29.83	127.16
2	Asian Journal of Chemistry	66	2.059	2	191	2.89	10.61
3	Chemical Engineering Science	59	1.841	3	2436	41.29	121.8
4	Separation Science and Technology	44	1.373	4	565	12.84	29.74
5	Synthetic Communications	44	1.373	4	458	10.41	24.11
6	Journal of Applied Polymer Science	43	1.342	5	1159	26.95	61
7	Tetrahedron Letters	42	1.31	6	1178	28.05	62
8	Indian Journal of Chemistry Section B Organic Chemistry Including Medicinal Chemistry	36	1.123	7	91	2.53	5.06
9	RSC Advances	35	1.092	8	511	14.60	73
10	Ultrasonics Sonochemistry	33	1.03	9	2152	65.21	107.6
11	Journal of Chemical Technology and Biotechnology	32	0.998	10	1437	44.91	75.63
12	Chemical Engineering Journal	31	0.967	11	1380	44.52	69
13	Journal of Molecular Catalysis A Chemical	30	0.936	12	694	23.13	36.53

14	Physical Review C	30	0.936	12	316	10.53	18.59
15	Journal of Dispersion Science and Technology	26	0.811	13	156	6.00	10.4
16	Surface Coatings Technology	26	0.811	13	352	13.54	18.53
17	Nuclear Instruments Methods In Physics Research Section B Beam Interactions With Materials And Atoms	25	0.78	14	170	6.80	8.95
18	Organic Process Research Development	25	0.78	14	489	19.56	24.45
19	Applied Catalysis a General	23	0.718	15	684	29.74	38
20	Chemical Engineering Research Design	23	0.718	15	510	22.17	30
21	Chemistry selects	23	0.718	15	114	4.96	22.8
22	Current Science	23	0.718	15	91	3.96	5.35
23	Monthly Notices of The Royal Astronomical Society	23	0.718	15	97	4.22	5.44
24	Abstracts of Papers of The American Chemical Society	22	0.686	16	0	0.00	0
25	Biochemical Engineering Journal	22	0.686	16	1261	57.32	63.05
26	Food Chemistry	22	0.686	16	675	30.68	42.19
27	Journal of Polymer Materials	22	0.686	16	26	1.18	1.53
28	Sensors And Actuators B Chemical	22	0.686	16	547	24.86	32.18
29	Astrophysical Journal	21	0.655	17	142	6.76	10.92

5. Finding and conclusion: -

The study evaluates the scholarly communication published by the University of Mumbai. It published 3362 documents from 2001 to 2019, out of which 3205 research articles, proceeding articles and reviews are taken for study.

1. The University published 87.51% of research articles, and the highest publications were found in 2008 with 260 (8.11%) articles. It is found that the highest citations were received in the year 2008 with 7018.
2. The highest domestic collaboration was found in 2005 with a 112.36 DCI score, and in 2016 highest international collaboration was received with a 179.15 ICI value.
3. The study reveals that domestic collaboration is prominent from 2001 to 2011, and international collaboration is increasing continuously from 2012.
4. The specialization index shows that Engineering is a specialized discipline of the University of Mumbai with 1.170 SI scores, but the lowest specialization index score found in Physics at the university level.
5. The University of Mumbai has to emphasize its research activities in 'Biology', 'Physics', and 'Chemistry' to correspond it with Nation.
6. Priority index in sub-subjects of Chemistry reveals that the highest priority is given to 'Medial Chemistry'(198.204) by the University of Mumbai.
7. The University of Mumbai should have to focus on research activities in 'Inorganic Nuclear Chemistry (43.076)', 'Analytical Chemistry' (91.939), 'Organic Chemistry (96.169) and 'Physical Chemistry (75.429). All these sub-subjects have less priority index than 100, which means these do not correspond to research efforts with India efforts.
8. Indian has corresponded its research efforts with the world in 'Inorganic Chemistry' India has to improve its research efforts in other sub-subjects of Chemistry.

9. The University of Mumbai is one of the leading Universities of India in 'Acoustics' (18461.819), 'Polymer Science' (3639.616), and Thermodynamics (1135.353).
10. India corresponds to research activities with the world in 'Nanoscience and Nanotechnology' (566.593), but all other sub-subjects of Physics have less priority index than 100.
11. The University of Mumbai has the highest priority index in 'Microbiology' (685.720) and lowest in 'Cell Biology' (18.416) in the Biology discipline.
12. India has to improve research efforts in 'Microbiology' (87.428), 'Cell Biology' (58.542), and 'Biology in general' (32.374) to correspond with the world's research productivity.
13. In the Engineering sub-subjects, the University of Mumbai has the highest priority in 'Food Science Technology' (1864.901) and the lowest priority Index is found in 'Engineering Electrical Electronics' (8.592).
14. India has the highest priority index in 'Biotechnology Applied Microbiology' (169.704) and lowest in 'Instruments Instrumentation' (65.267).
15. The study found that 'Yadav G.D' has the most productive author in the University of Mumbai with 132 records, and 'Pandit A. B' has received the highest citations with 4652 citations.
16. The study analyses the author's impact on research, and 'Yadav, G.D' and 'Pandit A.B' received the highest h-index score of 39. In the g-index ranking, 'Pandit A.B' received 64 scores with the first rank. Similarly, in the m-index ranking, 'Yadav G.D' and 'Pandit A.B' have ranked first with a 1.95 score.
17. The Highest preferred journal by the authors of the University of Mumbai is 'Industrial Engineering Chemistry Research' with 81 published records.

The study reflects the light on strengths and weaknesses in the primary discipline of the University of Mumbai. It helps the University to give priority to research accordingly. It helps the University of Mumbai and India while deciding the research policy for Science and Technology.

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