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A Bibliometrics Profile of Gujarat University, Ahmedabad during 2004-2013

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ABSTRACT

This study attempts to undertake bibliometric analysis of the research publications of Gujarat University during the ten-year period between 2004 and 2013. The data for this study was extracted from SCOPUS and included a total of 760 publications that were attributed to authors affiliated to Gujarat University. The publication data was analysed with respect to the type of publications where 83% are journal articles. The paper also analysed the publication trend of Gujarat University and found that from 2008 onwards there was a steady increase in the number of publications. The other aspects that were identified in the paper were the most prolific authors, collaborative authorship patterns and trends, most preferred publications, and so on. The collaboration was found to be the highest in the year 2012 at 0.70 based on the modified collaboration coefficient. The most preferred journal for publication by Gujarat University faculty was *ActaPoloniaePharmaceutica-Drug Research* and the most cited author of Gujarat University was P.S. Srivastav, while V.K. Jain had the best average citations per paper.

Keywords: Gujarat University, research productivity, bibliometric study

1. INTRODUCTION

Evaluation and ranking of higher education systems is gaining importance in India, and this has contributed immensely in improving the quality of discussions and deliberations among the higher education community in India. An outcome of the poor performance of Indian universities in the leading global universities rankings has led to the unanimous public agreement across the nation that there is a need to improve the ratings of our universities.

It is quite evident from the leading rankings of universities that both, research output and impact, play an important role in overall performance evaluation of a university or higher education institution. The role of research and citations in the ranking of universities has been identified to very important and in fact in of one such popular ranking, the Times Higher Education 2013, the weightage assigned to the research (volume, income and reputation) and citations (research influence) is 60 %[1]. Research is considered as one of the main indicators to rate universities in the QS World University rankings 2012-13[2] and it may be worthwhile to note that Universities 21 Ranking of National Higher Education Systems, 2014[3] also emphasises largely on the quality and quantity of research output of respective countries.

In this backdrop, it is quite evident that research plays an important role in the recognition and credibility of any university in today's context. As the importance and impact of university rankings increase, it is obvious that identifying, reviewing, monitoring, and measuring the research output of universities becomes pertinent. Bibliometrics is one of the widely used tools to identify, collate, measure, and analyse, and review the research productivity of individuals, groups, organisations or institutions, and countries. Bibliometrics also facilitates comparison of the research productivity among individuals, groups, institutions or countries.

Gujarat University, one of the oldest universities in India, established in 1949, offers post graduate, MPhil and doctoral level degree programmes in various subjects under different disciplines or streams of study that include science, commerce, arts and social science, computer science, medicine, etc. The university had more than 1200 research papers to its credit since its establishment. The present study is an attempt to explore and analyse the research output of Gujarat University published during 2004-2013 (10 years)

2. LITERATURE REVIEW

Studies like the one by Gupta[4] ranked universities in India by adopting the bibliometrics technique based on publications output and citation count. Similarly, Prathap & Gupta[5] proposed a new method for ranking research performance of universities in India by using a composite indicator that combined

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the indicator of quantity and quality of publications to develop a performance indicator to rank the institutions.

Vasishta[6] undertook a study, based on data extracted from scopus, of the 177 papers of PEC (Punjab Engineering College) University of Technology, Chandigarh published between 1996 and 2009 to examine the research productivity, publication trend, collaboration trend, etc. The study reported that though there was steady growth in research publications, there was a need to improve the publication output substantially when comparison was made to the publication output of other engineering colleges.

Koganuramath[7] *et al.*, analysed 663 papers published during 1990-2000 and authored by the scientists of TISS (Tata Institute of Social Sciences) to identify author productivity, areas of specialisation and publication pattern. The study also revealed the collaboration patterns, most prolific authors and list of preferred journals for publishing by the scientists of TISS.

Exploring the research output in terms of the papers published by researchers of the University of Mysore, Kumbar, Gupta & Dhawan[8], extracted 15-18 papers from Scopus in different disciplines of science and technology and published between 1996 and 2006. The study identified the strong and weak areas of research in terms of number of papers published at the university, annual growth rate of publications, impact generated in terms of average citations received, the collaboration pattern in different subjects and collaboration pattern with authors from other countries. The study found that the number research publications at the university were increasing at an average rate of 23 % per annum in terms of the papers being published.

A similar study was done by Thirumagal[9] taking publication data from the Web of Science database to study the scientific publications of Manonmaniam Sundaranar University. Analysing 363 publications that were published between 1999 and 2011, the study reported that there was an increasing trend in collaborative publication, with 93 % of publications being journals papers. The paper also provided for the LCS (local citation score) and GLS (global citation score) of each author included in the study.

To assess the research contribution of Karnataka University in science and technology, Kumbar & Gupta[10] analysed the research papers extracted from Scopus database and published between the years 2001 and 2010. By analysing these 1467 papers, authors found that the publication growth was nearly 14 % per annum. Other aspects included collaboration trend, growth trend, prolific authors, were highly cited papers, subject-wise publication, etc. The study suggested that there was an urgent need to increase research publications at the university and that it would be desirable to incentivise publishing activities of the researchers.

Wani, *et al.*,[11] analysed the research output of All India Institute of Medical Sciences (AIIMS) from 1959-2011, identified 17,181 papers extracted from Scopus database. The study found that there was a need for proper planning to balance the publication and research productivity of various branches of medical sciences at AIIMS as some of the branches outpaced others by large margins.

Angadi, *et al.,*[12] studied the research productivity of University of Madras by collecting publication data for the years 1999 to 2011 from Web of Science database. A total of 3,831 publications were analysed to find out the collaboration pattern, prolific authors, most preferred journals, high-frequency keywords, etc. The authors found that journal is the most preferred form of the publication by the authors of University of Madras, and it amounts more than 93 % of the total publications. The authors suggested that further research on this topic by including other qualitative indicators based on citations and impact factor of the publications.

To analyse the research productivity, most prolific authors, most preferred journals, most cited journals, etc., of the Indian Institute of Management, Ahmedabad (IIMA), Kumar & Dora[13] undertook a study with publication data from the year 1999 to 2010, extracted from the Scopus and Web of Science databases. By analysing these research papers, the authors found that at IIMA there was a constant increase in the number of papers being published, collaborative authorship and of multidisciplinary research over the years.

3. OBJECTIVES

The main objectives of the paper are to:

(a) Evaluate and quantitatively analyse the research publication trend of Gujarat University
(b) Identify the most prolific authors
(c) Find out the collaboration pattern among the authors
(d) Identify most preferred journals/conference publications
(e) Identify the most cited papers

4. METHODOLOGY

Data of the publications of all major government universities of Gujarat was extracted through SCOPUS, which is one of the most popular sources of information that provides abstract and index of publications at a global level. To assess the research output of Gujarat University, it's publications over a ten-year period of 2004- 2013 were considered for the study. The data of the last ten years was considered to be reasonable, based on many previous studies, in size to assess the research publication trend

of Gujarat University. The data was selected by searching for the institutional affiliation 'Gujarat University' in the Scopus database. The resultant data was further refined by country India, as there was another 'Gujarat University' in Pakistan too. The refined result was exported as CSV file and then used for further analysis. The final data consisted of 760 publications by authors from Gujarat University during the ten years between 2004 and 2013.

5. DATA ANALYSIS

To set the context for this study, initially the publication data of major government universities in Gujarat was considered and the following Table 1 reveals that Gujarat University, though one of the earlier established universities, does not fare sufficiently well in comparison to other universities.

5.1 Types of Research Publications of Gujarat University during 2004-2013

The first level of analysis, as shown in Fig. 1, of the 760 publications of the Gujarat University, reveals that 83 % (631) were journal articles, followed by conference papers which were 14 % (103) and other document types like editorial, review papers, and letters constituted merely 3 % (26).

University during the ten year period of 2004-2013. The results show that though there has been overall growth over the ten year period, there have been incidences of decline in number of publications in 2005 and 2010 when compared to their previous years. In rest of the other years, there has been a marked growth in number of publications over the previous years.

5.2 Year-wise Growth in Publications

Research publications do constitute an important basis in ranking of institutions, apart from infrastructure, faculty, student, and other variables. Most of the institutions in India are now emphasising on research and encouraging researchers to publish more. Figure 2 shows that there has been a steady growth in research publications at the Gujarat University during the ten year period of 2004-2013. The results show that though there has been overall growth over the ten year period, there have been incidences of decline in number of publications in 2005 and 2010 when compared to their previous years. In rest of the other years, there has been a marked growth in number of publications over the previous years.

5.3 Most Prolific Authors

The data on Gujarat University publications during the 10 years between 2004 and 2013 reveals that in total, 935 authors contributed to publishing of the 760 publications. The data was sorted by the number of publications by each author and a

Table 1. Research output of major government universities in Gujarat (2004-2013)

Name of the university	Establishment year	Total publications (as of May 2014)	During 2004-2013 (%)
Maharaja Sayajirao University of Baroda (MSUB), Vadodara	1949	4632	2533 (54.7)
Gujarat University, Ahmedabad	1949	1484	760 (51.2)
Sardar Patel University, VV Nagar	1955	1998	1371 (68.6)
Veer Narmad South Gujarat University (VNSGU), Surat	1966	868	558 (64.3)
Saurashtra University, Rajkot	1967	1542	844 (54.7)
Maharaja Krishnakumarsinhji Bhavnagar University, Bhavnagar	1978	510	311 (61.0)
Hemchandracharya North Gujarat University, Patan	1986	122*	117 (95.9)

* Data was available from 2005 onwards

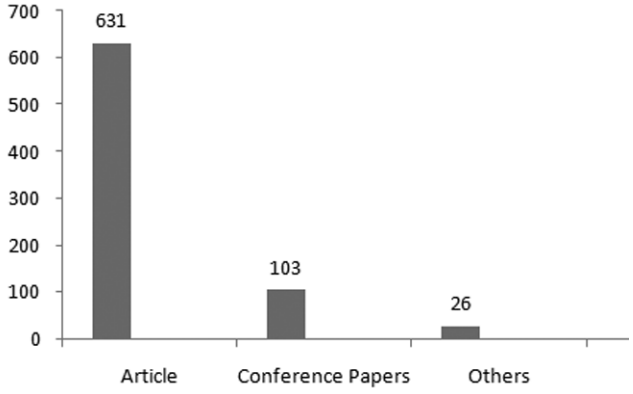

Figure 1. Types of research publications of Gujarat University (2004-2013).

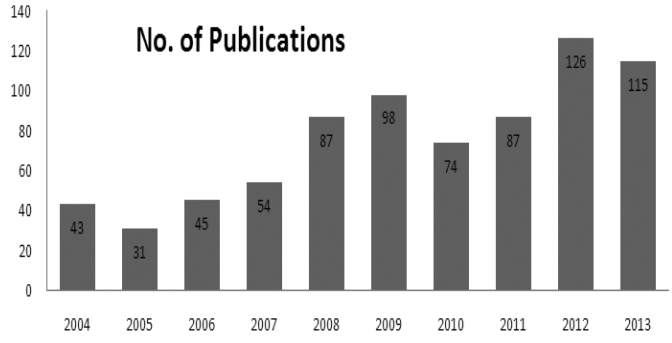

Figure 2. Year wise growth of publications of Gujarat University (2004-2013).

ranking list of top twenty authors in descending order was compiled. Table 2 indicates the list of top 20 authors of Gujarat University who had published at least 18 papers. The list was topped by P.S. Shrivastav with 67 papers to his credit, followed by S.K. Menon (60), R.J.Verma (55), A.R. Jani (49), and so on. It is noted that these 20 authors contributed more than 85 % of the papers published during the 10 years considered in this study.

Table 2. Most prolific authors (by number of papers) of Gujarat University (2004-2013)

Rank	Author's name	No. of papers	Citations	ACPP*	Rank as per ACPP
1.	Shrivastav, P.S.	67	566	8.4	4
2.	Menon, S.K.	60	286	4.8	13
3.	Verma, R.J.	55	292	5.3	12
4.	Jani, A.R.	49	106	2.2	17
5.	Chikhalia, K.H.	43	245	5.7	9
6.	Gajjar, P.N.	41	72	1.8	19
7.	Sanyal, M.	40	335	8.4	5
8.	Shah, N.H.	40	163	4.1	15
9.	Patel, R.V.	27	146	5.4	11
10.	Rana, V.A.	25	77	3.1	16
11.	Chinoy, N.J.	24	225	9.4	3
12.	Jain, V.K.	23	306	13.3	1
13.	Dave, S.R.	22	125	5.7	10
14.	Thakore, B.Y.	21	28	1.3	20
15.	Rao, M.V.	20	146	7.3	6
16.	Singhal, P.	20	133	6.7	7
17.	Yadav, M.	20	94	4.7	14
18.	Joshi, U.S.	18	36	2.0	18
19.	Kumari, P.	18	107	5.9	8
20.	Shah, N.K.	18	214	11.9	2

*ACPP means average citation per paper

However, it was interesting to note that the listing of these 20 most productive authors when ranked on the basis of average citations per paper (ACPP) would differ substantially V.K. Jain leads the top with first rank in ACPP.

5.4 Authorship Pattern

Collaboration among authors plays an important role in research production and Lancaster[14] had in his research found that 'a major factor in research productivity is research collaboration and collaborative authorship.' Bibliometric studies have indicated that over time collaborative authorship is gaining popularity and more papers are being published in collaboration rather than through individual efforts. To further explore this aspect of authorship in the present study, the data was divided into two time blocks of 5 years each, i.e., 2004-2008 and 2009-2013. The co authorship index (CAI), as developed by Garg & Padhi[15], was calculated for the 4 groups of authorship, i.e., single, two, multi (3 and 4) and mega (5 and above) collaborations.

Table 3. indicates that in both the 2 blocks (2004-08 and 2009-13) the trend in authorship was

Table 3. Authorship collaboration pattern

Authorship patterns	No. of contributions 2004-2008 (CAI)	No. of contributions 2009-2013 (CAI)
Single Author	20 (201.59)	9 (47.17)
Two Authors	72 (106.29)	126 (96.73)
Multi Authors	121 (96.90)	244 (101.61)
Mega Authors	47 (81.78)	121 (109.48)

Table 4. Authorship pattern

Year	Authorship pattern														DC*	MCC**
	One	Two	Three	Four	Five	Six	Seven	Eight	Nine	Ten	Eleven	Twelve	Thirteen	Total		
2013	2	26	27	30	15	9	2	1	1	2	0	0	0	**115**	0.98	0.68665
2012	1	24	32	30	21	12	3	1	0	0	0	1	1	**126**	0.99	0.70382
2011	3	21	18	27	9	6	2	1	0	0	0	0	0	**87**	0.97	0.66906
2010	0	22	22	14	6	8	1	1	0	0	0	0	0	**74**	1.00	0.67624
2009	3	33	29	15	7	7	2	2	0	0	0	0	0	**98**	0.97	0.63898
2008	9	24	20	21	8	2	1	2	0	0	0	0	0	**87**	0.90	0.60183
2007	1	17	17	8	6	2	1	0	0	1	1	0	0	**54**	0.98	0.65974
2006	5	11	14	7	5	0	0	0	2	0	1	0	0	**45**	0.89	0.60841
2005	1	6	9	7	5	1	2	0	0	0	0	0	0	**31**	0.97	0.69325
2004	4	14	17	1	6	1	0	0	0	0	0	0	0	**43**	0.91	0.58849

*Degree of Collaboration, ** Modified Collaboration Coefficient

in favour of moving away from single author papers. It is worthwhile noting that the CAI is above 100 for multi and mega authors in the block of 2009-13, which indicates a good trend[15].

5.5 Collaboration Trend

Collaboration happens in the context of research publications is when two or more than two authors research on the same problem and publish a paper with joint authorship. The extent of collaboration in a specific field or a year can be identifiedthrough measures like the CI (Collaborations Index) that measures the mean authors per paper. Later on, Subramanyam[16] developed the DC (Degree of Collaboration) measure that was derived by the simple calculation of the proportion of multiple authors to the total papers. DC was further extended to derive a measure, called as CC (Collaborative Coefficient) that combined the mean value of authors per paper and the proportion of multiple authors.

A recent measure that modified the CC, called as MCC (Modified Collaboration Coefficient), by Savnur & Srikanth[17] represents a better and efficient indication of the collaboration among authors. Adopting the MCC calculation of Savnur & Srikant, Table 4 reveals that while 2012 was the best year for collaboration, based on MCC; 2010 was the best year for Gujarat University in terms of DC.

Table 5 reveals the authorship collaboration trend in the 731 papers (authored by two or more) in terms of international, domestic and local affiliations. Collaboration was classified as local when all the authors were from the Gujarat University itself and when the authors were from other Indian institutions, the collaboration was categorised as domestic and for all other papers where at least one of the authors was from outside India, the papers were categorised as international. The data shows that there was quite a lot of fluctuation in the international collaboration over the years, while collaboration with authors from other institutions (domestic) was improving continuously, except in the year 2012.

Table 5. Collaboration trend

Year	International	Domestic	Local collaboration	Total papers
2013	7.08	61.95	30.97	113
2012	12.00	32.80	55.20	125
2011	3.57	69.05	27.38	84
2010	13.51	50.00	36.49	74
2009	1.05	55.79	43.16	95
2008	7.69	57.69	34.62	78
2007	9.43	60.38	30.19	53
2006	5.00	57.50	37.50	40
2005	0.00	53.33	46.67	30
2004	10.26	41.03	48.72	39

Further analysis on the collaboration pattern by the affiliation of the collaborating authors is shown in Table 6 that includes institutions with at least 10 authors who collaborated with Gujarat University authors. Sardar Patel University topped the list of collaborating institutions with 75 of its authors collaborating with the Gujarat University authors.

5.6 Most Preferred Journals

The data collected for the study indicated that from the 760 publications of the authors from Gujarat University over the 10-year period, 83 % of them (631) were articles published in 293 journals. Among these 293 journals, '*ActaPoloniaePharmaceutica-Drug Research*' was the most preferred journal with 30 papers, followed by *Fluoride* (27), *Journal of Chromatography B*(19), and so on.The resulting list of journals, ranked by the number of papers published by authors from Gujarat University during the ten years between 2004 and 2013 is shown in Table 7.

It may be noted that the journals in the areas of science and technology dominate the list and journals related to the subject of Chemistry seem

Table 6. Top collaborative institutions

S. No.	Top collaborative institutions	No. of collaborating authors
1.	Sardar Patel University	75
2.	Veer Narmad South Gujarat University	48
3.	St. Xavier's College	42
4.	Gujarat Cancer and Research Institute	29
5.	North Gujarat University	29
6.	M.S. University of Baroda	28
7.	S. V. National Institute of Technology	28
8.	Veeda Clinical Research	22
9.	C U Shah Science College	17
10.	Physical Research Laboratory	17
11.	Nirma University	16
12.	Bhavnagar University	11
13.	Accutest Research Laboratories (I) Pvt. Ltd	10
14.	BA Research India Ltd (Cliantha Research Limited)	10
15.	KadiSarva Vishwavidyalaya	10

Table 7. Most preferred journals for publishing by authors of Gujarat University during 2004 to 2013

Name of the publication	Country of origin	Impact factor in 2013	No. of papers	% of total publications
ActaPoloniaePharmaceutica-Drug Research	Poland	0.665	30	4.75
Fluoride	New Zealand	0.758	27	4.28
Journal of Chromatography B: Analytical Technologies in the Biomedical and Life Sciences	Netherlands	2.862	19	3.01
Journal of Inclusion Phenomena and Macrocyclic Chemistry	Netherlands	1.426	13	2.06
Asian Journal of Chemistry	India	0.355	12	1.90
Indian Journal of Pure and Applied Physics	India	0.711	11	1.74
Journal of Chromatographic Science	United States	1.026	10	1.58
Journal of Pharmaceutical and Biomedical Analysis	Netherlands	2.829	10	1.58
Biomedical Chromatography	United Kingdom	1.662	9	1.43
Bioresource Technology	United Kingdom	5.039	7	1.11
Research Journal of Biotechnology	India	0.262	7	1.11
Talanta	Netherlands	3.511	7	1.11
Five Publication have 6 paper each			30	4.75
Three Publication have 5 paper each			15	2.38
Thirteen Publication have 4 paper each			52	8.24
Twenty-six publication have 3 paper each			78	12.36
Sixty publication have 2 paper each			120	19.02
172 Publication have 1 paper each			176	27.58
Total			**631**	**100.00**

to be very popular among the Gujarat University authors, indicating it as the most productive areas of research at the University. The other indication that could be derived from this list is the popularity of inter disciplinary journals among the authors. It may also be noted that among these journals, that included at least 7 papers, 3 were Indian and 4 were from Netherlands.

5.7 List of Highly Cited Papers

Impact of research is an important yardstick in evaluation of any research and counting the citations is one of the important and common criteria used in calculating the impact of research. Citations are indications of positive recognition to the published work of author(s) and the journal itself and it can be said that the number of citations received is directly proportional to the recognition or impact of the published work. Exploring the citation data, for all the 760 publications during the year 2004 and 2013, 524 (67 %) papers are cited and 236 (33 %) papers have not been cited in any publication. Table 8 shows the most cited papers, i.e., top ten ranks by citation count.

6. CONCLUSIONS

In the present study, the analysis of the research productivity of Gujarat University shows that there has been an overall trend of growth in research publications over the ten-year period (2004-2013). The study clearly indicates that journals are the most preferred form of publication by the researchers of Gujarat University. The research collaboration trend indicated a positive environment of collaboration and in most of the recent years (2004-2013) the number of collaborative papers seems to be on the rise. In fact the co authorship index (CAI) of the later years of the study 2009-2013 indicates a healthy trend towards multi and mega authorship. The modified collaboration coefficient also indicates that in the recent years (2009 to 2013) there was an improvement in terms of collaborative research.

The study also indicates that though international collaborations existed in its research output, Gujarat University needs considerable improvement in this area. The university could gain much through international collaboration by not only increasing the research productivity of its researchers, but also may facilitate improvement in citations to its publications. There is a dire need to improve the quality of research in humanities and social sciences research and compete with the papers published in the science and technology domain especially in chemistry, in terms of citation count, within Gujarat University itself. In comparison to other institutions like Madras University where average publication

Table 8. Highly cited papers

Title	Authors	Source title	Year	Citations	Rank
Anion recognition through novel C-thiophenecalix[4] resorcinarene: PVC based sensor for chromate ions	Jain, A.K., Gupta, V.K., Singh, L.P., Srivastava, P., Raisoni, J.R.	*Talanta*	2005	133	1
Schiff bases of ethylenediamine as corrosion inhibitors of zinc in sulphuric acid	Agrawal, Y.K., Talati, J.D., Shah, M.D., Desai, M.N., Shah, N.K.	*Corrosion Science*	2004	83	2
Simultaneous preconcentration of uranium(VI) and thorium(IV) from aqueous solutions using a chelating calix[4]arene anchored chloromethylated polystyrene solid phase	Jain, V.K., Pandya, R.A., Pillai, S.G., Shrivastav, P.S.	*Talanta*	2006	64	3
Effect of C:N ratio on alpha amylase production by Bacillus licheniformis SPT 27	DharaniAiyer, P.V.	*African Journal of Biotechnology*	2004	50	4
Hepatoprotective effect of andrographolide against hexachlorocyclohexane- induced oxidative injury	Trivedi, N.P., Rawal, U.M., Patel, B.P.	*Integrative Cancer Therapies*	2007	49	5
Liquid chromatography tandem mass spectrometry method for simultaneous determination of antidiabetic drugs metformin and glyburide in human plasma	Mistri, H.N., Jangid, A.G., Shrivastav, P.S.	*Journal of Pharmaceutical and Biomedical Analysis*	2007	49	6
Optimal ordering policy for stock-dependent demand under progressive payment scheme	Soni, H., Shah, N.H.	*European Journal of Operational Research*	2008	43	7
Prognostic significance of molecular markers in oral squamous cell carcinoma: A multivariate analysis	Shah, N.G., Trivedi, T.I., Tankshali, R.A., Goswami, J.V., Jetly, D.H., Shukla, S.N., Shah, P.M., Verma, R.J.	*Head and Neck*	2009	40	8
Rapid and sensitive method for the determination of sertraline in human plasma using liquid chromatography-tandem mass spectrometry (LC-MS/MS)	Jain, D.S., Sanyal, M., Subbaiah, G., Pande, U.C., Shrivastav, P.	*Journal of Chromatography B: Analytical Technologies in 9the Biomedical and Life Sciences*	2005	39	9
Recognition of lysine, arginine and histidine by novel p-sulfonatocalix[4] arenethiol functionalized gold nanoparticles in aqueous solution	Patel, G., Menon, S.	*Chemical Communications*	2009	37	10
Activation of MMP-2 and MMP-9 in patients with oral squamous cell carcinoma	Patel, B.P., Shah, P.M., Rawal, U.M., Desai, A.A., Shah, S.V., Rawal, R.M., Patel, P.S.	*Journal of Surgical Oncology*	2005	37	10

is 296 papers per year[12] and Mysore University it is 206 papers in 2006[8], Gujarat University seems to be far behind in terms of the number of papers published. While comparing its publications output with other universities in Gujarat state also, Gujarat University does not fare too well.

The present study could find its use with the Gujarat University authorities to explore the reasons, issues and challenges in improving its research profile. The study leads to the following suggestions:

(a) Design and develop research-friendly environment at the university to promote research
(b) Invest in developing research support facilities for the researchers
(c) Promote the publishing efforts of authors with special awards or incentives
(d) Conduct workshops to improve research and publishing efforts of its researchers
(e) Develop strategies to address the imbalances in research output across various departments

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