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Analysis of Open Access Scholarly Journals in Chemistry

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Abstract
The present study has investigated the trends of open access journals appeared in the Directory of Open Access Journals (DOAJ). It provides an insight to the open access publishing in the field of chemistry based on the data collected from DOAJ. The DOAJ available at http://en.wikipedia.org/wiki/Website lists Open Access Journals and is maintained by Infrastructure Services for Open Access (IS4OA). Notably, it has listed about 9804 journals across 124 countries till 8th January 2014. Out of 9804 journals, 164 (1.67%) journals are listed under Chemistry. The data was extracted in excel format and analysis was carried out on the basis of subject coverage, decade and year, country of origin, publisher, language, format and Indian contribution to OA journals. The select subject i.e. Chemistry is being categorised into Chemistry General, Chemical Engineering, Analytical Chemistry, Organic Chemistry and Inorganic Chemistry. It was found that out of 164 journals from chemistry, majority of the open access journals belong to the category chemistry general and contribute some about 68.9% of the total chemistry journals in DOAJ. Though the maximum growth of these journals has been recorded in the decade 2000s, however in 2011, a record number of 30 journals of Chemistry appeared in DOAJ. Interestingly, India contributed 24 OA journals and is placed second after Egypt in publishing OA journals in chemistry. Further, it has been found that commercial publishers with 29 journals are the major contributors to OA in DOAJ with Hindawi Publishing Corporation as the leading contributor. Moreover, English has been found as the most popular language of OA journals. While as Indian Academy of Sciences: Chemical Sciences is reported to be the oldest journal publishing since 2005.

Keywords: Open access journals, Chemistry, DOAJ, Open Access, OA.

1. Introduction

Scholarly communication has undergone a remarkable change over the last couple of decades primarily due to the exponential growth of e-publications which in turn has given birth to the innumerable open access journals. Notably, the open access has picked up the momentum during last decade and is presently acknowledged widely by the scholars' world over. It enhances the users' accessibility to make the free use of content/literature available online regardless of financial, copyright and technological barriers and is helpful to expedite their research efforts. The freely accessible literature now-a-days attracts a large number of users to make the maximum utilization of the available online literature. However, the accessibility to relevant and current literature in quality journals has been a major setback for the scholars and students of developing nations because of their higher subscription rates.

In this backdrop, the investigators have taken up this research effort of studying open access journals. Open access provides a solution to this problem and makes the literature available freely to scholarly society without any restriction. An open-access journal is a freely available peer-reviewed literature that will allow the users to read, copy, download, distribute, print, search and link to the full text articles on internet. Presently, many well known and renowned publishers are making some of their contents freely available to Research and Development community to propagate open access movement. The Directory of Open Access Journals (DOAJ) maintained by Infrastructure Services for Open Access (IS4OA) is a significant step in this direction. However, this directory until January 2013 was maintained by Lund University. This research effort defines open access journals as scientific and academic journal communication that meets high quality standards by exercising peer review or editorial quality control and use a funding model that does not charge readers or their institutions for access.

2. Research Problem

Although a number of initiatives have been taken on open access journals in a variety of disciplines in DOAJ, however, this research effort is one of its kinds that examine the Research and Development community around the world for the latest trends and status, publishing patterns and usefulness of open access journals in chemistry field appeared in DOAJ.

3. Literature Review

A large number of studies have been conducted both at National and International level as far as open access is concerned; however, the investigators have outlined some of the noteworthy studies hereunder:

The study of (Sanchez-Tarrago and Fernandez-Molina, 2008) examined the attitudes of the Cuban health researchers towards the open access movement. The study found biomedical sciences i.e. PubMed Central, HINARI and BioMed Central as the best known initiatives for researchers. Though the rate of publication in open access journals and deposit in open access repositories was low, but, most of the researchers (85%) agreed to upload a copy of their papers onto an open access repository if their institution requests so. The study further reveals that there is a need for the promotion of the beneficial aspects of the open access movement as well as the training and encouragement for researchers so that they can take full advantage of the potential of this movement. Another study (Bjork et al., 2008) had thrown light on open access versions of a sample of scientific journal articles published in 2008 and found that 20.4% of articles in their sample were available in OA either on the publishers' websites or from another website or repository. The study found that open access to articles in the sample were varied by discipline; the authors attributed these differences to factors such as the availability of subject repositories or preprint servers in some disciplines as well as an uneven availability of funds to pay for author fees or article processing charges. A similar study by (Choudhary and Khode, 2010) identified 114 open access journals in computer science that are a part of DOAJ. The authors revealed that 21% of the journals were published from USA while as only two journals were India's contribution in this direction. The study of (Hebrang Grgic and Ana, 2011) however presented the importance of institutional open access (OA) repositories. The authors found that though the number of OA repositories in Croatia is rather small, but, all the academic librarians' are aware of the importance of institutional OA repositories and strive continuously for the development of new repositories. The lack of administrative support and unawareness of the benefits of OA were however the biggest bottlenecks in this regard. Likewise (Obuh and Bozimo, 2012) examined the awareness and use of open access scholarly publications by Library and Information Science (LIS) lecturers in Southern Nigeria. The study revealed that the awareness of open access concepts accounts for the tendency of LIS lecturers in southern Nigeria and has thus shown a high level usage of open access publications by both senior and junior LIS lecturers. However,

the authors recommended that efforts should be geared up towards inculcating the awareness and use of open access especially through enabling infrastructure and enacting policies such as mandatory deposit of scholarly works in open access archives. Another similar study (Emojorho, Ivwighregweta, and Onoriode, 2012) investigated the awareness of Open Access Scholarly Publications among Lecturers in the University of Benin in Edo State, Nigeria. This study found that the majority of lecturers of University of Benin became aware of open access scholarly publications through their colleagues. Although the increased impact and free online access were reported as some of the advantages of open access, however like other developing countries, the erratic power supply and insufficient internet facilities were some of the major challenges in the awareness of open access. The authors however suggested a constant power supply and the establishment of institutional repositories as some of the strategies to enhance Open Access for scholarly publications.

Yet another study (Kurata, 2012) clarified the trends observed in open access in the biomedical field between 2006 and 2010 and explored the possible explanations for the differences in OA rates revealed in recent surveys. The survey found that the OA rates increased significantly between 2006 and 2010. Notably, the OA rate in 2010 (50.2%) was twice than that in 2006 (26.3%). Further, majority of the OA articles were available from OA journal (OAJ) websites, indicating that OAJs have consistently been a significant contributor to OA throughout the period. The author also found that OA availability through the PubMed Central (PMC) repository also increased significantly. In this direction, (European Research Council, 2012) also carried out an analysis to estimate the extent to which journal articles from ERC funded projects are available in an open access. It was found that 62% of journal articles from ERC funded projects are available in open access. However, the share of articles i.e. 70% in Life Sciences, 65% in Physical Sciences and Engineering and approximately 50% in Social Sciences and Humanities in open access varies across different research domains. The study also revealed that a comparison with the data on open access status provided by the grant holders in their mid-term reports shows that self-reporting leads to an underestimation of the proportion of open access articles. On the other hand, (Dulle, 2012) investigated the factors affecting the adoption of open access in research activities within Tanzanian public universities in order to devise a mechanism for enhancing the use of open access. Consequently, majority of the policy makers (90.5%) and researchers (72.1%) were aware of open access. However attitude, awareness, effort expectancy,

and performance expectancy were established as the key determinants for researchers' behavioral intention of open access usage; while age, awareness, behavioral intention, facilitating conditions and social influence were found significantly affecting researchers' actual usage of open access. It was concluded that researchers' and policy makers' general perception about open access was very positive thus signifying the acceptance of open access in the study area. On contrary, current poor research conditions and researchers' low Internet self-efficacy such as inadequate information search and online publishing skills were cited as the major restrictions to use open access. One more study (Sivakumaren et al., 2012) indicated that maximum number of open access journals in Library and Information Science are being published from USA whereas only five journals in this category are published from India. Likewise another study (Husain and Nazim, 2013) analyzed open access scholarly journals by highlighting that 106 journals are listed in DOAJ under the subject heading 'Media and Communication'. Most of the open access journals in this category started during late 1990s and are being published from 34 countries across 6 continents and in 13 different languages. It was revealed that more than 80% open access journals are being published by the not-for-profit sector such as academic institutions and universities. Disappointingly, the study revealed that India's contribution towards OA journals in media and communication is almost nil.

4. Objectives of the study

Although the core objective of present study was to investigate the contribution of OA journals in Chemistry listed in the Directory of Open Access Journals (DOAJ). However, the following objectives were given due consideration during the course of study:

- To explore the subject coverage of open access journals in chemistry.
- Examine the decade and year wise growth of open access chemistry journals.
- Ascertain the country wise distribution of journals.
- Identify the leading publishers of open access journals in DOAJ.
- Access language-wise distribution of OA journals.
- Find out the publishing patterns of OA journals.
- Trace out the Indian contribution to open access journals.

5. Methodology

In order to have an in-depth study, the investigators found survey method suitable to analyse the growth and status of open access chemistry journals. To fulfill the objectives laid down above, the data was collected from online directory of open access journals i.e. DOAJ. Notably, the directory till January 8, 2014 has listed 9804 journals across 124 countries, of which 164 (1.67%) journals are listed under the subject "Chemistry". The data were extracted/ imported from the website in excel format and analysis was carried out on the basis of different parameters viz subject coverage, decade and year, country of origin, publisher, language, format and Indian contribution to OA journals.

6. Results and Discussion

To assess the contribution of open access journals in Chemistry appeared in DOAJ, The parameters such as Subject coverage, Decade wise growth of Journals, Country wise distribution, Publisher wise distribution, Language wise distribution, etc. have been discussed one by one in detail. Each of the broad categories for the better understanding and analysis of the results have been further divided into sub-categories. Based on the collected data, several findings and discussions discussed below have been drawn.

6.1 Subject coverage

Table: 1 Subject coverage of Chemistry Journals

Subject	No. of Journals	Percentage
Chemistry General	113	68.90
Chemical Engineering	17	10.36
Analytical Chemistry	16	9.75
Organic Chemistry	13	7.92
Inorganic Chemistry	5	3.04
Total	**164**	

The Subject-wise distribution of journals shown in table-1 have been categorized into different sub-categories viz chemistry general, analytical chemistry, chemical engineering, inorganic chemistry and organic chemistry. Of these sub-categories, there are 113 journals in chemistry general while chemical engineering which is placed second owns 17 journals. On the other hand, analytical chemistry has got 13 journals while as inorganic chemistry possesses 5 journals.

It may be pointed out here that the chemistry general possessing maximum number of journals i.e. 113 contributes about 68.9% to open access in DOAJ followed by chemical engineering 10.36%, analytical chemistry 9.75%, organic chemistry 7.92% and inorganic chemistry 3.04%.

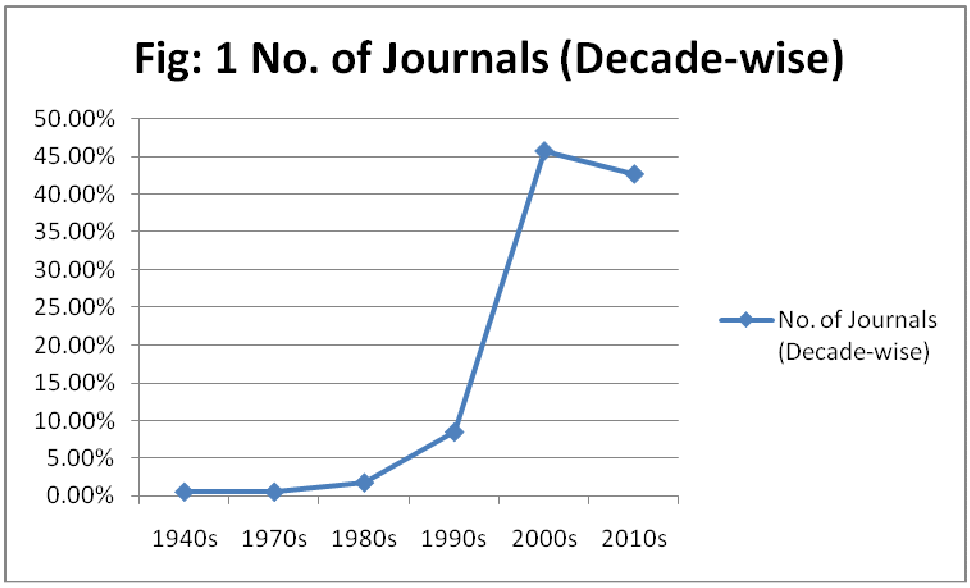
6.2. Growth of Journals

Table: 2 Growth of Chemistry Journals

Decade	Year	No. of Journals (Year-wise)	No. of Journals (Decade-wise)
1940s	1949	1	1 (0.60%)
1970s	1971	1	1 (0.60%)
1980s	1980	1	3 (1.82%)
	1985	1	
	1987	1	
1990s	1990	2	14 (8.53%)
	1996	2	
	1997	4	
	1998	3	
	1999	3	
2000s	2000	7	75 (45.73%)
	2001	4	
	2002	9	
	2003	2	
	2004	7	
	2005	4	
	2006	8	
	2007	10	
	2008	12	
	2009	12	
2010s	2010	11	70 (42.68%)
	2011	30	
	2012	18	
	2013	11	
	Total	**164**	

The growth in number of journals have been analyzed from 1940-2013 (i.e. for 70 years). In this direction, the data retrieved from DOAJ unveils that there were only 2 journals, one each in the year 1940 and 1970 during 30 years period. However during 1980s, 3 more journals respectively in 1980, 1985 and 1987 were reported to have been added thus accumulating the percentage of contribution to 1.82%. The data further shows that 14 journals were started in the decade of

1990s followed by 75 in 2000s and 70 in 2010s. It may be stated here that the maximum contribution i.e. 75 was noted in the decade of 2000s. This may owe to the fact that e-publishing witnessed wide acknowledgment all over the world due the wide availability of online and internet facilities during this decade. However, this number declined to 70 during 2010s. It was further revealed that though maximum growth of journals was recorded in the decade 2000s, however in terms of year wise distribution, the year 2011 recorded maximum number of journals i.e. 30.



6.3. Country-wise Journals

Table: 3 Country wise distribution of Journals

Country	Frequency	Percentage
Egypt	29	17.68
India	24	14.63
United States	17	10.36
Germany	8	4.87
Brazil	7	4.26
Switzerland	7	4.26
United Kingdom	7	4.26
Croatia	5	3.04
Serbia	5	3.04
Japan	4	2.43
Mexico	4	2.43
Newzealand	4	2.43

Turkey	4	2.43
Indonesia	3	1.82
Iran	3	1.82
Romania	3	1.82
South Korea	3	1.82
Ukraine	3	1.82
Canada	2	1.21
Chile	2	1.21
Colombia	2	1.21
Czech Republic	2	1.21
Pakistan	2	1.21
Poland	2	1.21
Russia	2	1.21
Singapore	2	1.21
Venezuela	2	1.21
Other countries who have contributed to only one journal (Ethiopia, Macedonia, Morocco, Nigeria, Peru, Slovenia)	6	3.65
Total	**164**	

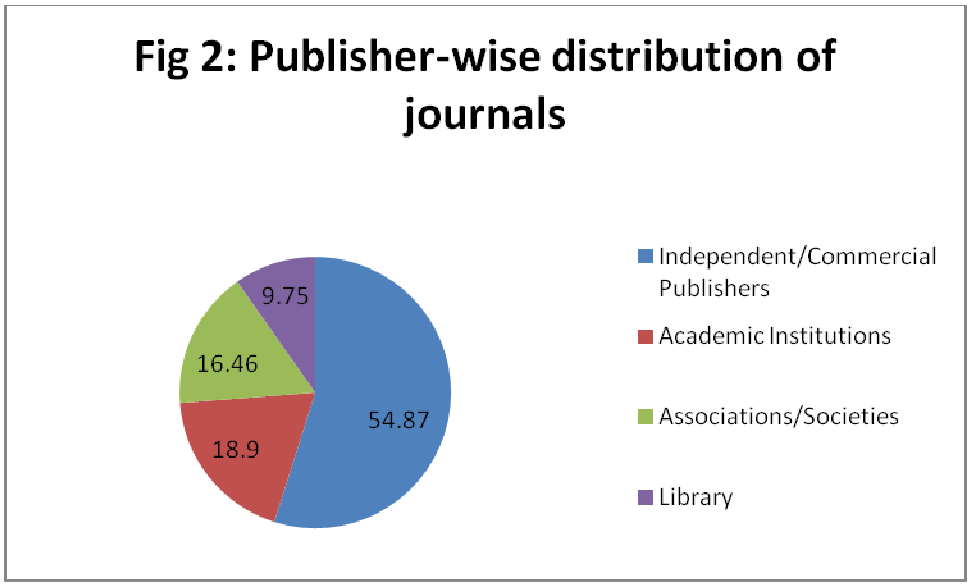
In case of country-wise distribution of open access journals, 33 countries around the world are contributing their chemistry journals in DOAJ. The leading countries in OA publishing are Egypt with 17.68% contribution followed by India with 14.63% and United States with 10.36% contribution. On the other hand, Germany is producing 8 journals thus contributing about 4.87% while as Brazil, Switzerland and U.K. share the equal contribution i.e. 7 journals amounting to 4.26% each. Croatia and Serbia are next in place with 5 journals each. Further, Japan, Mexico, New Zealand and Turkey contribute 4 journals each. The countries such as Indonesia, Iran, Romania, South Korea and Ukraine contribute 3 journals each. This is followed by the countries like Canada, Chile, Colombia, Czech Republic, Pakistan, Poland, Russia, Singapore and Venezuela which contribute a nominal 2 journals in chemistry field to DOAJ. A very minute contribution of 1 journal each comes from countries like Ethiopia, Macedonia, Morocco, Nigeria, Peru and Slovenia.

The results indicate that Egypt is the most productive country in terms of publishing OA journals. While interestingly India is placed second after Egypt and contributes about 24 OA journals to DOAJ. It may be pointed out here that in case of developing countries, the small

contribution to open access may owe to the fact that there is often erratic power supply due to their weaker economies.

6.4. Publisher-wise distribution of Journals

The authors also made an attempt to find out the publisher wise contribution of OA journals in Chemistry that have appeared in DOAJ. Against this background, 164 journals were published by 102 publishers with independent/commercial publishers occupying the top position. This is followed by the academic institutions which are placed second with 16.46% journals. The Association/societies publish about 27 journals in chemistry whereas 16 journals are published by libraries which are less in number as compared to other contributing categories in DOAJ.



6.5 Language wise distribution of Journals

Table: 4 Language wise distribution of Journals

Language	No. of Journals	Percentage
English	142	86.58
Spanish	8	4.87
Portuguese	3	1.82
Russian	3	1.82

Other languages in which only one journal is published (Chinese, Croatian, Czech, Indonesian, Japanese, Korean, Polish, Ukranian)	8	4.87
Total	**164**	

In case of Language wise distribution, the data shown in Table-4 reveals that English with 86.58% journals is the most popular language of the total open access journals in chemistry field that have appeared in DOAJ. However, Spanish language with 8 journals constituting 4.87% of the total open access journals in chemistry is next popular language. This is followed by the Portuguese and Russian languages that constitute 3 journals each and contribute about 1.82% each in open access journals in chemistry. Other countries languages including China, Croatia, Czech Republic, Indonesia, Japan, Korea, Poland and Ukraine have contributed only one journal in chemistry field in DOAJ.

6.6. Format of Open Access Journals

Table 5: Format of Open Access Journals

Format	No. of Journals	Percentage
Both Print and Online	80	48.78
Online Only	84	51.21
Total	**164**	

In the backdrop of objectives of the present study, the authors also investigated the publishing pattern of OA journals. In this regard, the data depicted in table-5 suggests that more than 51% of the journals available in DOAJ are accessible in online or e-format only whereas the rest of them i.e. 48.78% are published both in print as well as in online format.

6.7. Indian Contribution

Table: 6 Indian Contributions to OA Journals

Name of Journal	Publisher	Subject	Starting Year	Language
Advanced Materials Letters	VBRI Press	Chemistry (General)	2010	English
American Chemical Science Journal	Science domain International	Chemistry (General)	2011	English

Annalen der Chemischen Forschung	Ingenious Knowledge Solutions	Chemistry (General)	2013	English
Carbon: Science and Technology	Applied Science Innovations Pvt Ltd	Chemistry (General)	2008	English
Chemical Science Reviews and Letters	Aufau Periodicals	Chemistry (General)	2012	English
Der Chemica Sinica	Pelagia Research Library	Chemistry (General)	2010	English
Heterocyclic Letters	Raman Publications	Chemistry (General)	2011	English
Indian Journal of Chemistry : A	NISCAIR	Chemistry (General)	2007	English
Indian Journal of Chemistry : Section B	NISCAIR	Organic Chemistry	2006	English
International Research Journal of Chemistry	International Research Journal of Chemistry	Chemistry (General)	2013	English
International Research Journal of Pure and Applied Chemistry	Science domain International	Chemistry (General)	2011	English
International Journal of Analytical and Bioanalytical Chemistry	Universal Research Publications	Analytical Chemistry	2011	English
International Journal of Chemical Research	Bioinfo Publications	Chemistry (General)	2009	English
International Journal of Chemical Sciences	Sadguru Publications	Chemistry (General)	2009	English
International Journal of Chemistry and Pharmaceutical Sciences	International Journal of Chemistry and Pharmaceutical Sciences	Chemistry (General)	2013	English
International Journal of Chemistry Research	Academic Sciences	Chemistry (General)	2010	English
International Journal of Green and Herbal Chemistry	Scientific and Academic Publications	Chemistry (General)	2012	English
International Journal of Research in Chemistry and Environment	International Journal of Research in Chemistry and Environment	Chemistry (General)	2011	English
Journal of Applicable Chemistry	St. Mary's College of B. Pharmacy	Chemistry (General)	2012	English

Journal of Chemical Sciences	Indian Academy of Sciences	Chemistry (General)	2005	English
Oriental Journal of Chemistry	Oriental Scientific Publishing	Chemistry (General)	2008	English
Proceedings of Indian Academy of Sciences: Chemical Sciences	Indian Academy of Sciences	Chemistry (General)	2000	English
Rasayan Journal of Chemistry	Rasayan Journal of Chemistry	Chemistry (General)	2008	English
Research and Reviews: Journal of Chemistry	Shastri Educational Trust	Chemistry (General)	2012	English

Regarding Indian contribution, out of the total number of 164 journals from Chemistry discipline in DOAJ, 24 journals are contributed from India. Of these 24 journals, 1 journal is from analytical chemistry, 1 from organic chemistry and the rest 22 belongs to chemistry general. On contrary, the publisher-wise categorization indicates that International Journal of Analytical and Bioanalytical Chemistry is published by Universal Research Publications whereas Indian Journal of Chemistry : Section B, a journal in Organic and Medicinal Chemistry is being published from NISCAIR along with Indian Journal of Chemistry : A, which publishes papers in synthetic and structural inorganic chemistry, bio-inorganic chemistry, inorganic reaction mechanisms, solid state chemistry, thermodynamics, spectroscopy, theoretical and quantum chemistry, nuclear chemistry, polymers, catalysis and analytical chemistry. The Journal of Chemical Sciences and Proceedings of Indian Academy of Sciences: Chemical Sciences are published by Indian Academy of Sciences, Bangalore. While as the American Chemical Science Journal and International Research Journal of Pure and Applied Chemistry are published by Science domain International. The other journals as mentioned elsewhere in the paper are published by different publishers. The findings further reveal that all the journals published from India appear in English language only. It may be pointed out here that the Proceedings of Indian Academy of Sciences: Chemical Sciences is reported to be the oldest Indian journal on DOAJ that has started publishing since 2005.

7. Conclusion

The last couple of decades have made remarkable development in the open access movement which has made the scientific findings and scholarly communication freely and speedily accessible to the academic world without any time lag. The study found commercial publishers as the leading publishers of open access journals in DOAJ. Interestingly, India is not behind in this direction as it contributes a number of journals in open access format in primer directories of open access across the world. Appreciably, it shares around 24 open access journals in chemistry discipline to DOAJ and is placed second only after Egypt in producing chemistry open access journals. Further, NISCAIR (National Institute of Science Communication and Information Resource) and Indian Academy of Science also contribute two journals each in DOAJ. The study, however, suggests that more open access journals are likely to come up in near future with the efforts and initiatives taken by the academic and research institutions of the country. This study also emphasized that efforts should be taken at national level to encourage open access publishing in the country by realizing the remarkable potential of open access journals. Furthermore, the study recommended that the entire academic and research institutes should pool their efforts together and try to highlight their pioneering work and research output across the world by providing an open access to their content so that the knowledge is promptly disseminated to the society at large for its overall growth and development. Significantly, such initiatives would resolve the issues of accessibility, visibility, paucity of funds and escalating prices for subscribing journals in print format. The study also foresighted a non-stop growth of OA Journals in near future, if Research and Development organizations and academia would proactively participate and work in proper coordination in the current dynamic and transitional digital environment.

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