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Global Research Studies on "Electronic Journals" during 1990-2017: A Scientometric Study

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ABSTRACT

A quantitative and qualitative description of global research in "electronic journals" on a series of measures such as annual growth, global publications share, citations per paper, international collaborative papers, relative citation index, and activity index is presented. The study sourced data from SCOPUS database covering the period 1990-2017. Global research in the subject registered a fast 18.46 per cent publications growth, low-level citation rate of 5.28 citations per paper, and contributed just 26 highly cited papers during the period. The paper also describes the characteristics of highly cited papers in the subject. The study finds that the USA is the world leader with highest (45.28 %) global publications share in the subject, followed by U.K. (12.18 %), India (5.49 %), etc. Secondly, the distribution of research across contributing organisations is of most scattered type. For instance, top 20 organisations in the subject contributed just a small 16.58 per cent global publications share during the period. The study concludes that the 'electronic journals' as an area of research is still in its nascent stage of growth and development both in terms of quality and quantity of research.

Keywords: E-journals; E-resources; Libraries; Global publications; Bibliometrics; Scientometrics.

1. INTRODUCTION

Electronic journals are scholarly journals in digital media, accessible via internet or directly on electronic storage media. Electronic journals are also known as e-journals, e-serials or online journals, and they may or may not have in parallel corresponding editions in print[1].

In the 60's, computers were known to have been utilised primarily for printing journals on paper. However, with advancements in computing technologies, publishers gradually started utilising computers for the production and distribution of journals online on the web. Over the years, the move to publishing journals from print to electronic media has also brought about several innovative changes in the scholarly communication system and practices[2].

Beginning mid-nineties, big publishers like Elsevier, Springer, Kluwer, IOP, APS began to launch web accessible electronic journals in parallel to regular journals in print. Much later, electronic journals began to appear exclusively in e-only format without publishing corresponding editions in print. E-journals soon established their importance as a credible resource that allows users fast, direct, and seamless access to the content on the web. Retrieval technologies with search features such as advanced search, cross-database search, web-scale discovery, and full-text search have made e-journals a huge success with users. Millennial users nowadays prefer to access e-journals over print in order to fast meet their information and research related needs. The e-journals trend continued to expand in scope and dimension when publishers and stakeholders started to launch new initiatives such as to convert retrospective print journals into digital media, create web-accessible e-journal archives of select journals, or launch open access e-journals. E-journal publishing has basically progressed along four distinct publishing models: (i) both print and e-journal model, (ii) only e-journal model, (iii) e-journals archival model, and (iv) open access e-journal model[3-8].

Electronic journals are known to have deeply impacted libraries in several ways, in terms of economy in storage, in addressing issues related to library collection policy and programmes, budgetary issues, and legal issues related to journal ownership, copyright, and licensing regulations about availability and use of e-journals, etc. The e-journals paradigm has been instrumental in influencing the growth and development of library and information science as a discipline as well as in spurring the onset of scholarly journals devoted exclusively to e-journals research studies. Some of the early journals that had appeared in the subject include *Electronic Journal of Communication*, Postmodern Culture, and Bryn *Mawr Classical Review*[9]. Over the years, research interests in the

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subject have expanded in scope and dimension leading to the generation of new areas such as e-journals models, e-journals consortium, digital content, licensing agreements, e-journals access technologies, copyright provisions, fair-use provisions, open access, journal archives, resource discovery, etc. Given the impermanence nature of electronic storage media and of the associated retrieval technologies, one of the biggest challenges that has come up before the publishers, libraries and library professionals nowadays is how to store and keep e-journals content safe, secure and searchable in future.

In the context of ongoing R&D developments in e-journals field, it is important and desirable that a scientometric study be undertaken that should seek to summarise global research trends in the subject and map top countries, organisations, and authors across the world in e-journals research.

1.1 Literature Review

Not a single research study related to analysis of e-journals field *per se* has so far been contributed to the bibliometric literature. However, the literature does include quite a few studies on 'e-resources research', a topic that is broader in definition and scope compared to the one under study. Chatwal[10] examined the global research on e-resources for the period 2006-2016; the author sourced data from Web of Science. The study analysed data on a series of measures such as annual publication output, prolific authors, journal scattering pattern, high productive organisations, country-wise distribution of global research and highly cited papers. Dhawan, Gupta and Gupta[11] analysed electronic publishing research, data for which was sourced from Scopus, covering the period 2005-14. Their study revealed that e-publishing research registered slow growth of 3.41 per cent CAGR, and registered low-level citation rate, just 1.08 citations per paper. The authors observed that global e-publishing research was still in its infancy stage of growth and development. Kolle, Shettar, Vijay Kumar and Parameshwar[12] analysed global eBooks research (2965 scientific documents), data for which was sourced from Scopus covering the period 2001-16. The authors analysed data on various measures such as document type, language, publication output, citations, authorship pattern, journal pattern, prolific authors, top productive countries, and most frequently appearing words/phrases in the titles of research articles. It is observed from the above described studies that if a quantitative and qualitative study is undertaken on a topic of 'e-journals research', it will certainly add new knowledge to the body of bibliometric/scientometric literature.

2. OBJECTIVES

The study undertakes a scientometric assessment of global output in the area of "electronic journals research" as indexed in Scopus, 1990-2017. The objectives of the study are to: (i) Determine the global growth and distribution of "electronic journals" research; (ii) Ascertain top 10 countries, 20 most productive global organisations and 20 most productive global authors in the subject; (iii) Determine the distribution of research by broad subject areas, (iv) Identify and rank important keywords defining the subject; and (v) Determine the distribution of research output by medium of research communication and (vi) Describe the characteristics of highly cited papers in the subject under study.

3. METHODOLOGY

The study sourced data from Scopus, the database that indexes the largest number of journals over 22500 covering nearly all domains of knowledge. The Scopus database has since been used in the past for undertaking quite a number of scientometric studies on various research topics, such as mobile computing[12], mobile research in India[13], library marketing research[14], and ebooks reseach[11]. The search strategy used for retrieving sample data for this study has been as follows:

(KEY ((("electronic journal*") OR ("E-journal*") OR ("Ejournal*")) OR TITLE ((("electronic journal*") OR ("E-journal*") OR ("Ejournal*"))) AND PUBYEAR > 1989 AND PUBYEAR < 2018.

The metadata of 1747 publication that have so far been published in the subject were downloaded from Scopus in the CSV file format. The select fields downloaded include: title, authors, source, year, citations, keywords and affiliations addresses. Microsoft Excel was used for data analysis and tabulation. The citation data was collected from the date of publication of research paper till 18 September 2018.

Of the 1747 publication records retrieved on the subject, 63.42 per cent (1108) appeared as articles, 11.45 per cent (200) as conference papers, 11.39 per cent (199) as reviews, 4.75 per cent (83) as editorials, 3.39 per cent (61) as book chapters, 1.83 per cent (32) as erratum, 1.37 per cent (24) as notes, 1.03 per

Table 1. Distribution of "e-journals research" during 1990-2017 by publication year

Period	TP	TC	CPP	Period	TP	TC	CPP
1990	3	9	3.00	2006	89	630	7.08
1991	6	56	9.33	2007	69	506	7.33
1992	19	68	3.58	2008	100	562	5.62
1993	9	37	4.11	2009	77	514	6.68
1994	16	53	3.31	2010	91	471	5.18
1995	32	203	6.34	2011	68	256	3.76
1996	50	303	6.06	2012	80	234	2.93
1997	45	282	6.27	2013	84	99	1.18
1998	70	383	5.47	2014	64	125	1.95
1999	69	410	5.94	2015	51	64	1.25
2000	87	424	4.87	2016	46	34	0.74
2001	92	424	4.61	2017	38	15	0.39
2002	90	905	10.06	1990-03	682	4359	6.39
2003	94	802	8.53	2004-17	1067	4881	4.57
2004	102	681	6.68	1990-17	1749	9240	5.28
2005	108	690	6.39				

TP = Total Publications; TC = Total Citations; CPP = Average Citations Per Paper.

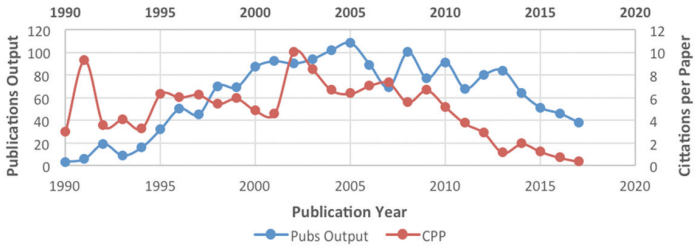

Figure 1. E-Journals research - 1990-2017: Distribution of research output by publication year.

cent (18) as letters, 0.74 per cent (13) as short surveys, 0.23 per cent (4) each as books and conference reviews and 0.06 per cent (1) as article in press.

4. DATA ANALYSIS & RESULTS

4.1 Publications Growth

Global publications output in the field of "electronic journals research" has accumulated 1747 publication in 28-year period 1990-2017. During the period, electronic journals research registered a fast 18.46 per cent annual average growth, moving up in volume from 3 in 1990 to a high of 108 in 2005, and finally falling down to 38 publication in 2017. The subject registered 56.45 per cent absolute growth, up in its 14-year cumulative volume from 682 in 1990-2003 to 1067 publication in 2004-2017 (Table 1, Fig. 1). The average citation impact of 28-year research output in the subject was low, barely 5.28 citations per year (CPP), the highest 10.06 CPP was registered in 2002 and the lowest 0.39 CPP in 2017. Besides, the average citation impact of 14-year cumulative research output in the subject slipped down from 6.39 in 1990-2003 to 4.37 CPP in 2004-2017.

4.2 Most Productive Countries in Electronic Journals Research

A total of 68 countries participated in global "e-journals research" during 1990-2017. Research productivity by country of publication in the subject varied widely from 24 to 801 papers. For instance, 40 countries contributed 1-5 paper each, 8 countries 6-10 papers each, 14 countries 11-30 paper each, 4 countries 31-100 paper each, 2 countries 215-801 paper each during the period. The top 10 in the most productive countries list accounted for 76.84 per cent global publications share (1344 paper) and 88.19 per cent global citations share (8149 citations). The USA tops the list with its highest 45.28 per cent global publications share, followed distantly by United Kingdom (12.18 %), India (5.49 %) and 7 other countries (from 1.32 % to 3.14 %). Canada registered the highest citation impact per paper as well as the highest relative citation index (9.16 and 1.74 respectively), followed by U.K. (8.16 and 1.55), Spain (7.33 and 1.39) and Iran (7.16 and 1.36). Iran registered the highest national-level share to international collaborative publications (28.0 %), followed by Italy (24.0 %). Japan and United States contributed the least share (4.35 % and 3.41 %) (Table 2, Fig 2).

4.3 Subject-Wise Distribution of Papers on Electronic Journals

The global output on "electronic journals research" was classified under ten broad subjects (as defined by Scopus

Table 2. Scientometric profile of top ten countries in "electronic journals research" during 1990-2017

Country	Total Papers			Share of Papers			TC	CPP	ICP	Per cent ICP	RCI
	1990-03	2004-17	1990-17	1990-03	2004-17	1990-17			1990-17		
United States	346	446	792	50.73	41.80	45.28	4612	5.82	27	3.41	1.10
United Kingdom	120	93	213	17.60	8.72	12.18	1738	8.16	25	11.74	1.55
India	7	89	96	1.03	8.34	5.49	369	3.84	7	7.29	0.73
Canada	12	43	55	1.76	4.03	3.14	504	9.16	9	16.36	1.74
Spain	4	42	46	0.59	3.94	2.63	337	7.33	5	10.87	1.39
Brazil	2	33	35	0.29	3.09	2.00	99	2.83	4	11.43	0.54
Germany	12	22	34	1.76	2.06	1.94	157	4.62	6	17.65	0.87
Iran	0	25	25	0.00	2.34	1.43	179	7.16	7	28.00	1.36
Italy	3	22	25	0.44	2.06	1.43	97	3.88	6	24.00	0.73
Japan	2	21	23	0.29	1.97	1.32	57	2.48	1	4.35	0.47
Total of 10 Countries	508	836	1344	74.49	78.35	76.84	8149	6.06	97	7.22	1.15
World total	682	1067	1749				9240	5.28			
Top 10 countries in global output	74.49	78.35	76.84				88.19				

TP =Total Publications; TC =Total Citations; CPP = Citations Per Paper; ICP = International Collaborative Papers; RCI = Relative Citation Index.

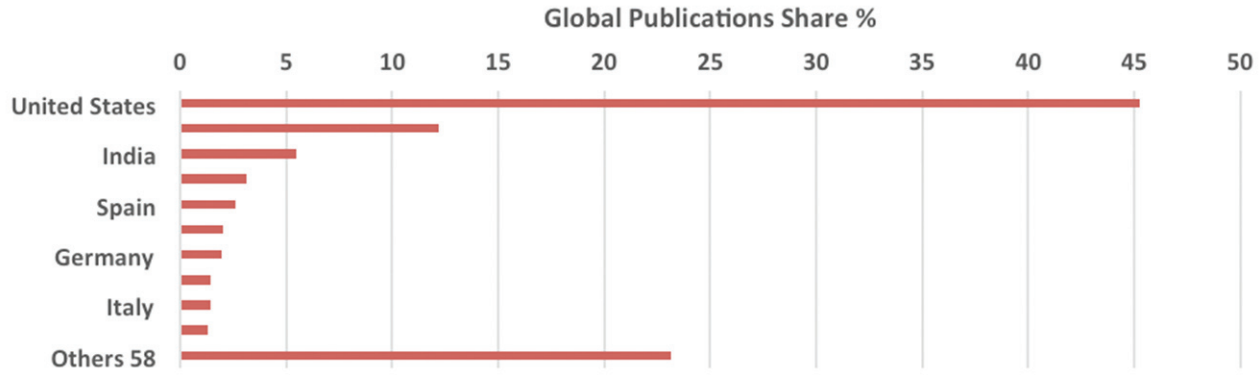

Figure 2. E-Journals research 1990-2017: Distribution of global publications share.

database) with the purpose to understand the distribution of research in reference by subject. Most of 'electronic journals research' papers that appeared during 1990-2017, were related to social sciences information resources. Social sciences thus accounted for the highest 73.36 per cent global publication share, followed by computer science (26.24 %), medicine (8.35 %) and 7 other subjects (from 1.14 % to 4.92 %). The research activity under all 10 broad subject areas was computed on activity index measure in order to understand the change in research activity over time. The change in research activity in each subject was compared in reference to global average activity in the same subject between 1990-2003 and 2004-2017. The subject areas that had witnessed predominant surge in their research activity in reference to global average index of 100 include: arts & humanities, decision science, health profession and psychology. In 6 remaining subject areas, the change in activity index was marginal and insignificant. The study further found that computer science had registered the highest citation impact (8.12 citations per paper) and Mathematics the least (1.94 citations per paper) during the period (Table 3, Fig 3).

Table 3. Subject-wise break-up of global publications on "electronic journals research" during 1990-2017

Subject	Total Papers			Activity Index		TC	CPP	Per cent TP
	1990-03	2004-17	1990-17	1990-03	2004-17			
Social Sciences	486	797	1283	97.14	101.83	7883	6.14	73.36
Computer Science	175	284	459	97.78	101.42	3728	8.12	26.24
Medicine	59	87	146	103.63	97.68	561	3.84	8.35
Engineering	33	53	86	98.41	101.02	381	4.43	4.92
Arts & Humanities	10	65	75	34.19	142.06	161	2.15	4.29
Business, Management & Acctng	20	31	51	100.57	99.64	213	4.18	2.92
Mathematics	17	33	50	87.19	108.19	97	1.94	2.86
Decision Science	2	18	20	25.65	147.53	54	2.70	1.14
Health Profession	2	18	20	25.65	147.53	54	2.70	1.14
Psychology	14	6	20	179.52	49.18	87	4.35	1.14
Total of the World	682	1067	1749					

TP=Total Publications; TC=Total Citations; CPP= Citations Per Paper

4.4 Keywords in Literature on Electronic Resources in Libraries

The study identified 32 keywords that were used frequently to search "electronic journals" literature. These keywords are listed in Table 4 ranked according to the frequency of their occurrence in the Scopus database, 1994-2017. The search 'hit' score for the keyword "Electronic Journals" has been the highest (890), followed distantly by "Electronic Publishing" (294), "Internet" (152), "Digital Libraries" (132), "Publishing" (117), "Libraries" (117), etc. (Table 4).

4.5 Top 20 Most Productive Global Organisations

Three hundred eighty eight (388) global organisations that contributed 1749 publications in the field of "electronic journals research" in 28-year during 1990-2017 were analysed for their individual research productivity. Broadly, their research productivity varied from 9 to 27 paper. Of the 388 organisation, 332 individually contributed 1-5 paper each, 37 organisation 6-10 paper each, 18 organisation 11-20 papers each and 1 organisation 27 paper during the period. Certainly, institutional productivity in e-journals research has been low, barely 4.5 paper per institution in a long 28-year research period.

The top 20 in the most productive global organisations list contributed 16.58 per cent global publications share (290 paper) and 37.72 per cent global citations share (3485 citation) in the subject during the period under study.

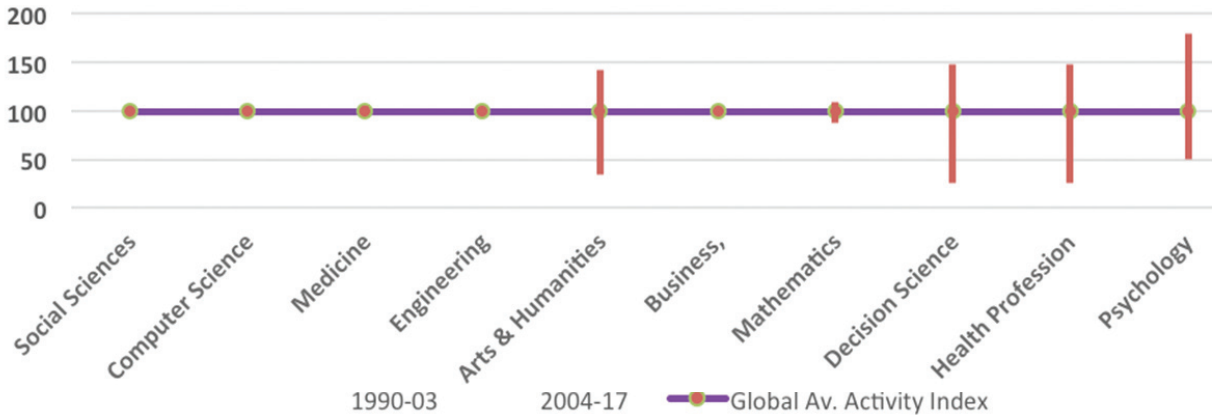

Figure 3. Activity index change in e-journals research between 1990-2003 and 2004-2017

Table 4. Significant keywords on "electronic journals research" during 1990-2017

Keyword	Frequency	Keyword	Frequency
Electronic Journals	890	Databases	26
Electronic Publishing	294	Information Management	26
Internet	152	Information Processing	26
Digital Libraries	132	Metadata	26
Publishing	117	Online Systems	26
Libraries	117	Search Engines	25
World Wide Web	81	Copyright	23
Academic Libraries	70	E-Books	21
Information Retrieval	70	Digital Preservation	20
Open Access	66	User Interfaces	20
Database Systems	65	Scholarly Publishing	20
Electronic Resources	57	E-Resources	19
Medical Literature	62	Electronic Document Exchange	19
Information Services	56	Costs	18
Information Technology	53	Licensing	18
Information Dissemination	52	Usage Statistics	18

- Of the 20 top organisations, 9 registered their research productivity rate above the group average of 14.5: Loughborough University, U.K. (27 papers), Texas A & M University, USA (19 papers), Mississippi State University, USA and University College London, U.K. (18 papers each), Pennsylvania State University , USA (16 papers), Colorado State University, USA, Drexel University, USA, University of Tennessee, Knoxville, USA and Indiana University, USA (15 papers each);
- Of the 20 top organisations, 8 registered citation impact and relative citation index (RCI) above the group average of 12.02 citation per paper and 2.28 RCI: University of Tennessee, Knoxville, USA (33.07 and 6.26), Indiana University, USA (30.93 and 5.86), University of Pittsburgh, USA (28.09 and 5.32), University College London, U.K. (26.78 and 5.07), Cornell University, USA (22.64 and 4.29), Drexel University, USA (17.2 and 3.26), University of North Carolina at Chapel Hill, USA (16.0 and 3.03) and University of Barcelona, Spain (13.0 and 2.46).
- Of the 20 top organisations, 6 contributed their individual-level share to international collaborative papers above the group average of 8.28 per cent: University College London, U.K. (44.44 %), Library of Congress, USA (23.08 %), University of Tennessee, Knoxville, USA (20.0 %), Loughborough University, U.K. (14.81 %), Pennsylvania State University , USA (12.5 %) and University of Pittsburgh, USA (9.09 %) (Table 5).

4.6 Top 20 Most Productive Global Authors

Four hundred fifty two (452) global authors that contributed 1748 publication on "electronic journals research" in 28-year during 1990-2017 were analysed for their individual research productivity. Broadly, their publications productivity varied from 5 to 19 paper. Of 452 author, 435 author individually contributed 1-5 paper each, 10 authors 6-10 papers each and 7 authors 11-20 paper each during 1990-2017. Certainly, author productivity in e-journals research has been low, barely 3.8 paper per author in a long 28-year research period.

The top 20 in the most productive global authors list contributed 11.15 per cent global publications share (195 paper) and 43.92 per cent global citations share (4058 citation);

Table 5. Scientometric profile of top 20 most productive organisations on "electronic Journals research" during 1990-2017

Name of Organisation	TP	TC	CPP	HI	ICP	Per cent ICP	RCI
Loughborough University, U.K.	27	226	8.37	9	4	14.81	1.59
Texas A & M University, USA	19	83	4.37	5	0	0.00	0.83
Mississippi State University, USA	18	25	1.39	3	0	0.00	0.26
University College London, U.K.	18	482	26.78	13	8	44.44	5.07
Pennsylvania State University , USA	16	118	7.38	5	2	12.50	1.40
Colorado State University, USA	15	46	3.07	4	0	0.00	0.58
Drexel University, USA	15	258	17.20	8	0	0.00	3.26
University of Tennessee, Knoxville, USA	15	496	33.07	8	3	20.00	6.26
Indiana University, USA	15	464	30.93	9	1	6.67	5.86
University of Barcelona, Spain	14	182	13.00	7	0	0.00	2.46
Massachusetts Institute of Technology, USA	14	59	4.21	5	1	7.14	0.80
Library of Congress, USA	13	10	0.77	2	3	23.08	0.15
University of Illinois at Chicago, USA	13	106	8.15	6	0	0.00	1.54
University of Malaya, Malaysia	13	64	4.92	5	1	7.69	0.93
University of North Carolina at Chapel Hill, USA	12	192	16.00	3	0	0.00	3.03
North Carolina State University, USA	11	26	2.36	4	0	0.00	0.45
Cornell University, USA	11	249	22.64	7	0	0.00	4.29
University of Pittsburgh, USA	11	309	28.09	6	1	9.09	5.32
EBSCO Information Services, USA	11	16	1.45	2	0	0.00	0.28
University of Illinois at Urbana-Champaign, USA	9	74	8.22	6	0	0.00	1.56
Total of 20 Organizations	290	3485	12.02	5.85	24	8.28	2.28
Global Total	1749	9240	5.28				
Share of 20 organizations in Global Total	16.58	37.72					

TP=Total Publications; TC=Total Citations; CPP= Citations Per Paper; HI= H-Index; RCI= Relative Citation Index.

- Of the top 20 global authors, 8 registered their productivity rate above the group average of 9.75 paper: C. Tenopir(19 paper), D. Nicholas (17 paper), D.W. King (15 paper), H.R. Jamali (14 paper), F. Rowland (13 paper), P.H. Huntington and C.H. Montgomery (11 paper each) and Meadows (10 paper);
- Of the top 20 global authors, 10 registered citation impact and relative citation index (RCI) above the group average of 20.81 citations per paper and 3.94 RCI: R. Kling (46 and 8.71), S.P. Harter (43 and 8.14), D.W. King (40.53 and 7.68), P.M. Davis (39 and 7.39), C. Tenopir (32.68 and 6.19), P.H. Huntington(30.55 and 5.79), I. Rowlands (30 and 5.27), D. Nicholas (27.82 and 5.27), A. Borrego (23.8 and 4.51) and H.R. Jamali (22.86 and 4.33);
- Of the top 20 global authors, 5 contributed their individual-level share to international collaborative papers above the group average of 18.97 per cent: H.R. Jamali (71.43 %), I. Rowlands (62.5 %), D. Nicholas (52.94 %), P.H. Huntington (45.45 %) and J. Meadows (20.0 %) (Table 6).

4.7 Channels of Research Communication

Of the global publications output (1749) on 'electronic journals research' during 1990-2017, 85.86 per cent (1500) appeared in journals, 7.38 per cent (129) in conference proceedings, 3.61 per cent (63) as books, 2.23 per cent (239) as book series, 0.86 per cent (15) as trade publications and 0.06 per cent (1) as undefined. Of the 200 journals that had reported 1500 papers in the subject, 149 journal individually reported 1-5 paper each, 22 journal 6-10 paper each, 19 journal 11-20 paper each, 6 journal 21-50 paper each and 2 journal 154-226 paper each. Certainly, scattering of e-journals related research across reporting journals has been very wide. The top 20 in the most productive journals list contributed 15 to 226 paper each; and together they contributed 767 paper (51.13 % share of 1500 research paper in journals) (Table 7).

4.8 Highly Cited Papers

Of the 1749 global publications on "electronic journals research", only 26 (1.49 % share of total output) received high citations from 51 to 133 citations

Table 6. Scientometric profile of top 20 most productive authors on "electronic journals research" during 1990-2017

Author	Affiliation	TP	TC	CPP	HI	ICP	Per cent ICP	RCI
C. Tenopir	University of Tennessee, Knoxville, USA	19	621	32.68	11	3	15.79	6.19
D. Nicholas	University College London, U.K.	17	473	27.82	13	9	52.94	5.27
D.W. King	University of North Carolina at Chapel Hill, USA	15	608	40.53	10	0	0.00	7.68
H.R. Jamali	University College London, U.K.	14	320	22.86	10	10	71.43	4.33
F. Rowland	Loughborough University, U.K.	13	60	4.62	4	2	15.38	0.87
P.H. Huntington	University College London, U.K.	11	336	30.55	10	5	45.45	5.79
C.H. Montgomery	Drexel University, USA	11	195	17.73	6	0	0.00	3.36
J. Meadows	Loughborough University, U.K.	10	82	8.20	6	2	20.00	1.55
M.Collins	Missippi State University, USA	9	58	6.44	5	0	0.00	1.22
E.F. Duranceaau	Massachusetts Institute of Technology, USA	9	39	4.33	5	0	0.00	0.82
L. Hawkins	Library of Congress, USA	9	4	0.44	2	0	0.00	0.08
C. McKnight	Loughborough University, U.K.	8	76	9.50	5	1	12.50	1.80
T. Moothart	Colorado State University, USA	8	20	2.50	3	0	0.00	0.47
I. Rowlands	University College London, U.K.	8	240	30.00	7	5	62.50	5.68
L.Ashcroft	Liverpool John Moores University, U.K.	7	113	16.14	6	0	0.00	3.06
P.M. Davis	Cornell University, USA	6	234	39.00	6	0	0.00	7.39
V.A. Lingle	Penn State College of Medicine, USA	6	15	2.50	2	0	0.00	0.47
A.Borrego	University of Barcelona, Spain	5	119	23.80	5	0	0.00	4.51
S.P.Harter	Indiana University at Bloomington, USA	5	215	43.00	5	0	0.00	8.14
R.Kling	Indiana University at Bloomington, USA	5	230	46.00	5	0	0.00	8.71
Total of 20 Authors		195	4058	20.81	6.3	37	18.97	3.94
Total of World		1749	9240	5.28				
Share of 20 authors in global output		11.15	43.92					

TP=Total Publications; TC=Total Citations; CPP= Average Citations Per Paper; HI= H-Index; RCI= Relative Citation Index

per paper since their publication during 1990-2017. These 26 highly cited papers accounted for a total of 1855 citations, with an average of 71.35 citation per paper. Among the 26 highly cited papers, the country-wise participation in bringing out collaborative research output was the largest from USA (14 paper), followed by Canada and U.K. (4 paper), Germany (2 paper) and Brazil, Finland, Greece, Israel, Singapore, Spain and Taiwan (1 paper each). Among the 26 highly cited papers (20 article, 5 review and 1 conference paper), 12 were single-institution papers (no collaboration), 9 were national collaborative papers and 5 as international collaborative papers. These 26 paper involved 64 global authors and 33 global organisations. Of these 33 global organisations, University of Tennessee, USA and Indian University, USA contributed 4 paper each, University of Pittsburgh, USA (3 paper), University of Western Ontario, Canada and University College London, U.K. (2 paper each) and rest of the organisations 1 paper each. The 26 highly cited papers appeared across 15 journal; 5 paper appeared *in Journal of the American Society for Information Science & Technology*, 3 in *Journal of Academic Libraries*, 2 each in *ASLIB Proceedings, D-Library Magazine*, *Journal of Documentation, Journal of Medical Library Association* and *Library and Information Science Research* and 1 each in *Annual Review of Information Science & Technology, College & Research Libraries, First Monday, Information Society, Journal of Information Science, Learned Publishing, New Library World and Online Information Review.*

Table 7. Top 20 most productive journals on "electronic journals research" during 1990-2017

Name of Serial	Number of papers		
	1990-03	2004-17	1990-17
Serial Librarian	91	135	226
Serials Review	84	70	154
Journal of Electronic Resources in Medical Libraries	2	42	44
Inter-Lending & Document Supply	18	26	44
Electronic Library	8	33	41
Information Services & Use	17	8	25
Science & Technology Libraries	10	12	22
Journal of American Society for Information Science & Technology	15	7	22
D Lib Magazine	15	5	20
Journal of Documentation	3	15	18
Journal of Information Science	13	5	18
Library Collection Acquisition & Technical Services	9	9	18
Collection Building	6	10	16
New Library World	6	10	16
College & Research Libraries	11	4	15
Journal of Library Administration	5	10	15
Vine	15	0	15
Library Philosophy & Practice	0	14	14
Information Research	5	7	12
Journal of Electronic Resources in Libraries	0	12	12
Total of top 20 journals	333	434	767
Total global journal output	633	867	1500
Share of top 20 journals in global journal output	52.61	50.06	51.13

5. CONCLUSIONS

Even though research studies on 'electronic journals' related issues were found to have been undertaken across as many as 68 countries over the last three decades, but the volume of global research output that these countries contributed to the subject has been small and insignificant, barely 1747 publication during 1990-2017. Annual global research productivity in the subject witnessed high volatility, from 3 in 1990 to 108 in 2005, and finally down to 38 in 2017. Institutional productivity in the subject too has also been found to be low, barely 4.5 paper per institution, and author productivity just 3.8 papers per author. Besides, the citation impact of the research too has been low, barely 5.28 citation per paper, and the volume of highly cited papers in the subject also being low, limited to just 1.49 per cent share. Given this context, the study concludes that 'e-journals' as an area of research is still in its nascent stage of growth and development both in terms of quality and quantity of research. Besides, the study observes that e-journals research activity by country of research publication is highly skewed, dominated mainly by the USA followed by UK and Spain but mostly as distant cousins. The USA is the global leader in research productivity in the subject (41.8 % global share), as well as the home of most number of high productivity organisations, and also of high productivity authors in the subject. Recognizing that e-journals media possess enormous potential to shape the future of scholarly communications, it is only important and desirable that research studies in e-journals area must be catalysed and encouraged. A long term strategy is therefore recommended at national level across all leading countries in the subject for policy and financial support to e-journals research.

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