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A Scientometric Assessment of Global Publications in E-Learning Research during 2003-18

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ABSTRACT

The paper provides quantitative and qualitative assessment of global publications output in the domain of e-learning research (1809 publications). The data was sourced from Scopus database during 2003-18. The study finds that global e-learning research registered 18.92 per cent annual average growth, averaged 6.90 citations per paper in a 16-year window. The distribution of global research in the subject is highly skewed as 10 out of 94 participating countries account for 62.58 per cent global publications share. A total of 449 authors from 387 organisations contributed to global e-learning research. The top 15 organisations collectively contributed 14.81 per cent global publication share and 24.52 per cent global citation share respectively. The top 15 authors contributed 7.89 per cent global publication share and and 33.45 per cent global citation share respectively during the period. Carnegie Mellon University, USA (49 papers) is the most productive organisations in the world, National Cheng Kung University, Taiwan (23.29 and 3.37) is the most cited organisation. M. Vivou (24 papers) is most prolific author in the world and C.M. Chen (103.0 and 14.93) the most cited author in the subject. *Computers and Education* and *Computers in Human Behavior* (20 papers) were the leading journals publishing on this theme.

Keywords: E-Learning; Electronic learning; Virtual learning; Mobile learning; Global publications; Scientometrics; Bibliometrics.

1. INTRODUCTION

E-learning has since evolved as a powerful digital learning platform providing new avenues for imparting formal and informal education and learning, in parallel to traditional classroom education system. Overtime e-learning nomenclature has undergone several iterations starting from internet learning, online learning, computer-based learning, internet-based training, web-based learning, virtual classrooms, to digital collaboration[1]. Computing and internet technologies have catalysed the growth of e-learning systems across the world. E-learning management systems are designed to deliver and manage educational or training content to learners, make the process of learning more dynamic and effective, allow learners self-pace (flexi) learning, real-time learning, and interactive learning. Nowadays, e-learning activities take place in virtual classrooms, giving learners freedom to choose from different content layouts. Such breakthroughs in e-content development combined with suitable instructional design approaches have made teaching and the learning more effective. Adobe Captivate Prime, Docebo LMS, the Academy LMS, and ExpertusOne are some of the top commercial learning management systems available of several platforms. Besides, Moodle, Talent LMS, Forma.LMS, and Eliadem are some of the leading learning management systems available in thr open source domain. Such systems have in-built features that allow online lectures, discussions, receive tasks, submit papers, get grades, share videos, audio, slide shows, and PDF files[2]. E-learning and e-teaching technologies have taken education beyond physical classrooms, opened up new avenues for aspiring students and workforce, enabled them competency-based learning, and have completely transformed the way teaching is traditionally done within the higher education sector.

Research in e-learning has given rise to the growth and development of e-content providers, technology providers, accreditation bodies, and e-learning technologies across the world thereby giving birth to a large and growing market in e-learning industry at national and international level[3]. According to PR Newswire the global market for e-learning industry is likely to grow at a CAGR of 8.5 per cent during 2019-2024. Given these projections on growth in e-learning industry coupled with ongoing growth trends in e-learning research, it is considered appropriate that a scintometric study is undertaken in the subject with a view to ascertain comparative status of e-learning research at global, national, institutional, and individual scientist level.

2. Literature Review

Few studies on the bibliometric/scientometric analysis of e-learning research are available in the literature. Of these, Tibaná-Herrera, Fernández-Bajón and De-Moya-Anegón[5] analysed global knowledge domain of e-learning (comprising 39244 records sourced from Scopus and SCImago Institutional

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Ranking on bibliometric indicators) to understand the productivity and impact of various contributing countries and institutions in the subject. The authors mapped production and collaboration networks and graphics for the purpose. Tibaná-Herrera, Fernández-Bajón and Moya-Anegón[6] analysed e-learning output across select countries during 2003--2016 and compared it with the knowledge output in other areas with a view to identify comparative evolution of e-learning research across countries. Tibaná-Herrera, Fernández-Bajón and Moya-Anegón[7] in 2018 described e-learning as an emerging discipline in the world system of scientific publications; it comprises 64 descriptors and 219 journals and congresses. The data was sourced from SCOPUS covering the period 2012-2014. Chiang, Kuo and Yang[8] investigated the trends of e-learning literature in terms of growth rate, author productivity, authorship pattern, sub-fields and core journals. The publications data was sourced from SSCI database covering the period 1967-2009. The authors also studied the applicability of Lotka's law and Bradford law to the global literature in e-learning. Hung[9] investigated 589 e-learning research records sourced from the Science Citation Index/Social Science Citation Index database covering the period 2000-2008. The publication data was studied into two domains with four groups/15 clusters, using variables such as subject areas, prolific countries and prolific journals. Mauer and Khan[10] sourced 7759 records from five SSCI indexed journals and two conferences during 2003- 2008, classified papers into 150 concepts/clusters across 14 main research areas. Using visualisation tool, the authors classified records into the most discussed research areas, most prolific researchers, and leading institutions and nations. Shih, Feng and Tsai[11] studied 1027 e-learning papers from five SSCI indexed journals during 2001-2005 on parameters such as publication years, source journals, research topics, and citation counts and highly-cited. Fatima and Abu[12] sourced 9826 records from the Web of Science database covering the period 1989-2018 and analysed them on metrics to identify prominent contributing countries, authorship patterns adopted, the degree of collaboration, collaborative index, prominent sources for publication of research studies, visibility of research in term of citations received/citations per paper, etc. Gupta and Pandey[13] presented an outlook of publication trends in e-learning research in India during 2009-2018. The data comprising 8181 publications was sourced from the Scopus Database was analysed on metrics such as in terms of growth rate, prolific authors, institutions, highly-cited papers, h-index, and citation status.

3. OBJECTIVES

The study seeks to examine the quanitative and qualitative performance of global e-learning research as indexed in Scopus database during 2003-18. The study looks at annual and cumulative publications output in the subject for its growth rate, its distribution by document and source type, its citation impact, as well as its global publications share. The study also seeks to analyse the leading 10 countries, 15 organisations and 15 authors and 15 journals publishing research in the subject. In addition, the study will attempt to determine the most studied sub-fields, most significant keywords for subject search and highly cited papers in e-learning research.

Table 1. E-learning global publications output and citations count during 2003-18

Publication Period	World		
	TP	TC	CPP
2003	28	169	6.04
2004	37	808	21.84
2005	46	573	12.46
2006	71	490	6.90
2007	78	559	7.17
2008	192	1450	7.55
2009	114	1460	12.81
2010	108	647	5.99
2011	98	1117	11.40
2012	96	721	7.51
2013	117	1559	13.32
2014	127	888	6.99
2015	135	871	6.45
2016	183	590	3.22
2017	193	372	1.93
2018	186	202	1.09
2003-10	674	6156	9.13
2011-18	1135	6320	5.57
2003-18	1809	12476	6.90

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

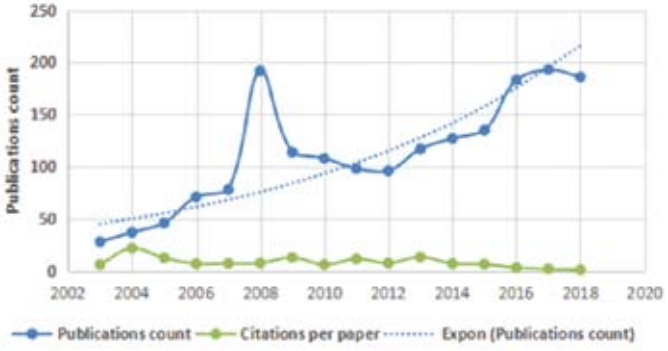

Figure 1. Global e-learning research growth 2003-18.

4. METHODOLOGY

The global publications on e-learning published during 2003-18 were studied by analyzing data indexed in the Scopus database (http://www.Scopus.Com). Keywords used for literature search included "e-learning", "electronic learning", "elearning", "blended learning", "b-learning", "online learning", "m-learning", "mobile learning", "web-based learning", "virtual learning", "adaptive learning", "intelligent tutoring system", "interactive learning", "open online courses", "virtual classroom", "computer-based learning", and "game-based learning". The search strategy was conceptualised using keywords (as shown above), which were suffixed in "TITLE-ABS-KEY tag", using Boolean operators. The search output from the database was subsequently refined by time period '2003-18'. To get publication data on top 10 countries, the search strategy was further refined by country of publication. The global search output was subsequently analysed using analytical provisions in the database. Citations to publications were counted from date of their publication till 21 August 2018.

Table 2. Publication data of top 10 countries in e-learning during 2003-18

Name of the Country	Number of papers			Share of papers			TC	CPP	ICP	% ICP	RCI
	2003-10	2011-18	2003-18	2003-10	2011-18	2003-18			2003-18		
USA	137	263	400	20.33	23.17	22.11	4571	11.43	61	15.25	1.66
Spain	57	70	127	8.46	6.17	7.02	726	5.72	24	18.90	0.83
China	38	74	112	5.64	6.52	6.19	254	2.27	19	16.96	0.33
U.K.	47	42	89	6.97	3.70	4.92	768	8.63	26	29.21	1.25
Taiwan	32	52	84	4.75	4.58	4.64	1650	19.64	8	9.52	2.85
India	17	66	83	2.52	5.81	4.59	299	3.60	4	4.82	0.52
Canada	34	44	78	5.04	3.88	4.31	450	5.77	29	37.18	0.84
Germany	24	38	62	3.56	3.35	3.43	688	11.10	25	40.32	1.61
Greece	17	34	51	2.52	3.00	2.82	486	9.53	7	13.73	1.38
Italy	28	18	46	4.15	1.59	2.54	318	6.91	6	13.04	1.00
Total	431	701	1132	63.95	61.76	62.58	10210	9.02	209	18.46	1.31
World	674	1135	1809				12476	6.90			

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

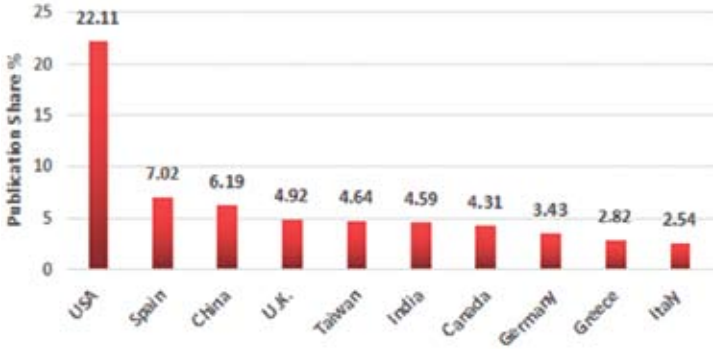

Figure 2. E-learning research distribution of research output by country of publication 2003-18.

The study used a few raw and relative bibliometric indicators for data analysis.

(TITLE-ABS-KEY(E-Learning or Electronic Learning or ELearning or Blended Learning or B-Learning or Online Learning or M-Learning or Mobile Learning or Web-based learning or Virtual Learning or Adaptive Learning or Intelligent Tutoring System or Interactive Learning) OR TITLE-ABS-KEY(Open Online courses or Virtual classroom or Computer-based Learning or Game-based learning)) AND PUBYEAR > 2002 AND PUBYEAR < 2019

5. ANALYSIS AND RESULTS

E-learning global research output consisted of 1809 publications in 16 years during 2003-18, an average of 113 publications per year. E-learning research registered a fast 18.92 per cent growth, increasing in its annual volume from 28 in 2003 to 186 publications in 2018; the highest annual output was 192 in 2008 and the lowest 28 publications in 2003. Eight-year absolute growth in the subject was 68.40 per cent; this fact reaffirms that e-learning research witnessed relatively faster growth in the 2nd half eight-year study period 2011-18 compared to the first-half 2003-2010. The eight-year cumulative output in the subject was 674 in 2003-10 and 1135 publications in 2011-18. The global publications on e-learning averaged 6.90 citations per paper during this period (Table 1).

Of the total publications, 58.71 per cent (1062) appeared as conference papers, 29.41 per cent (532) as articles, 4.92 per cent(89) as conference reviews, 4.37 per cent (79) as book chapters, 1.82 per cent (33) as reviews and others as books (0.55 %), editorials and unidentified (0.11 % each) as shown in (Fig. 1).

5.1 Leading Countries Publications Profile on E-Learning

Ninety four countries participated unevenly in global e-learning research: 55 published 1-10 papers each, 30 countries 11-50 papers each, 6 countries 51-100 papers each, 2 countries 101-127 papers each and 1 country published 400 papers. Around two third of the global research output (62.58 %) in the field came from top 10 countries. The USA leads the world ranking in the subject with 22.11 per cent global publications share, followed distantly by Spain and China (7.02 % and 6.19 % share each). All others countries contributed 2.54 per cent to 4.92 per cent have global share during 2003-18 (Table 2).

Among top 10 countries, four countries namely Taiwan (2.85), USA (1.66), Germany (1.61) and Greece (1.38) scored relative citation index above the group average (1.31). Compared to the world average citation impact (6.90 citations per paper) in the subject, the top 10 countries averaged higher citation impact of 9.02 citations per paper. Besides, it was noted that the top 10 countries published 4.82 per cent to 40.32 per cent share of their respective national output as international collaborative papers, with an average share of 18.46 per cent per country. Evidently, the top 10 countries in the world ranking list did play a major role in raising the quality and quantity of e-learning research as shown in (Fig. 2).

5.2 Subject-Wise Distribution of Research Output

Computer science and social sciences are the most favored subject areas in pursuit of e-learning research (with 71.81 per cent and 42.79 per cent publications share respectively), followed by engineering and mathematics (21.61 % and 15.81 % share respectively), and a few other subject areas appeared

Table 3. Breakup of global publications by subjects in e-learning during 2003-18

Subject*	Number of Papers (TP)			Activity index		TC	CPP	% TP
	2003-10	2011-18	2003-18	2003-10	2011-18	2003-18		
Computer Science	508	791	1299	104.96	97.05	9191	7.08	71.81
Social Sciences	246	528	774	85.30	108.73	7099	9.17	42.79
Engineering	144	247	391	98.85	100.68	3158	8.08	21.61
Mathematics	153	133	286	143.58	74.12	1399	4.89	15.81
Decision Sciences	24	40	64	100.65	99.61	203	3.17	3.54
Arts & Humanities	11	45	56	52.72	128.08	657	11.73	3.10
Business, Management and Accounting	21	34	55	102.48	98.53	118	2.15	3.04
Medicine	13	36	49	71.21	117.10	402	8.20	2.71
Psychology	11	27	38	77.69	113.25	697	18.34	2.10
World Output	674	1135	1809			12476	6.90	

There is overlapping of literature covered under various subjects.
TP=Total Papers; TC=Total Citations; CPP=Citations Per Paper.

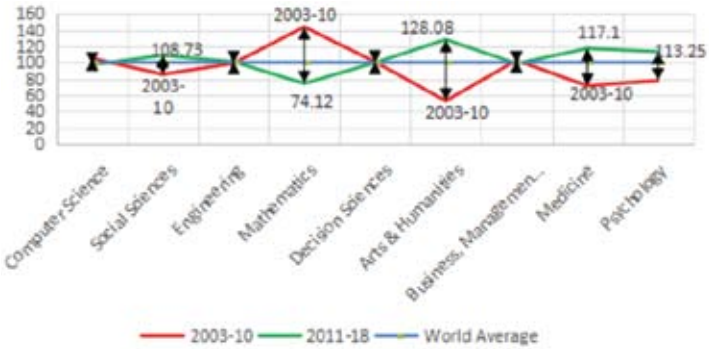

Figure 3. E-learning research activity index chart 2003-10 to 2011-18.

distant cousins due to their low publication share ranging from 2.10 per cent to 3.54 per cent during the period 2003-18 (Table 3).

The scopus database classification defines e-learning into 9 sub-fields. These sub-fields had witnessed fluctuations in their activity index computed during 2003-10 and 2011-18. The world average activity index of each sub-field by default is 100. The activity index of most sub-fields changed from below the world average in 2003-10 to above world average in 2011-18 (social sciences, engineering, arts & humanities, medicine and psychology). On the other hand, mathematics witnessed significant decline in its activity index, whereas activity index in other remaining sub-fields like computer science, decision sciences, business and management & accounting was negligible as it remained very close to the world average 100 in the subjects under reference during both periods under study (Fig 3).

Psychology and arts & humanities recorded the highest citation impact per paper of 18.34 and 11.73 and decision sciences and mathematics the least 2.15 and 3.17 respectively.

5.3 Important Keywords

Keywords are considered as useful indicators to understand research trends in a subject. E-learning, computer-aided-instructions, intelligent tutoring system have been seen as the most productive keywords in searching e-learning research from Scopus database. In all, 50 identified keywords are presented in decreasing frequency of their occurrence in literature during 2003-18 (Table 4).

5.4 Publication Indicators of 15 Leading Global Organisations

Three hundred eighty seven (387) organisations unevenly participated in e-learning research: 322 published 1-5 papers each, 48 organisations 6-10 papers each, 14 organisations 11-20 papers each, 2 organisations 21-30 papers each and 1 organisation 49 papers during 2003-18. The top 15 organisations productivity varied from 11 to 49 publications per organisation. Their combined output contributed 14.81 per cent (268) global publications share and 24.52 per cent (3059) global citations share during 2003-18. Their scientometric profile is presented in Table 5.

- The publication productivity of 4 organisations were above the group average (17.87): Carnegie Mellon University, USA (49 papers), University of Piraeus, Greece (27 papers), University of Pittsburg, USA (24 papers) and University of Split, Croatia (19 papers) during 2003-18;.
- The citation impact per paper and relative citation index of only six organisations were above the group average (11.41 and 1.65): National Cheng Kung University, Taiwan (23.29 and 3.37), University of Pittsburg, USA (16.04 and 2.32), Carnegie Mellon University, USA (15.63 and 2.27), Worcester Polytechnic Institute, USA (15.08 and 2.19), University of Memphis, USA (12.88 and 1.87) and University of Piraeus, Greece (12.67 and 1.84) during 2003-18

5.5 Publication Indicators of 15 Leading Global Authors

Four hundred forty nine (449) authors participated unevenly in global e-learning research: 415 authors published 1-5 papers each, 28 authors 6-10 papers each, 5 authors 11-20 papers each and 1 author 24 papers during 2003-18. . The top 15 author's productivity varied from 8 to 24 publications per

Table 4. List of important keywords appearing in global e-learning literature during 2003-18

Name of the keyword	Frequency	Name of the keyword	Frequency
E-learning	1205	E-learning systems	41
Computer-aided instructions	742	Learning style	41
Intelligent tutoring system	547	Adaptive learning	38
Engineering education	167	Cognitive systems	36
Artificial intelligence	160	E-learning platforms	35
Massive online learning course	204	Flipped classrooms	34
Distance education	131	Learning algorithms	34
Online systems	119	Online courses	34
Internet	98	Personalized learning	33
Multimedia systems	94	Virtual learning environment	33
Tutoring systems	89	Bayesian networks	31
Virtual reality	83	Knowledge acquisition	31
Online learning	79	Mobile learning	31
Online social networking	74	Computer software	30
Intelligent systems	71	Knowledge representation	30
Ontology	66	Expert systems	28
Multi agent systems	64	Learning analytics	28
Data mining	61	Adaptive systems	28
Human computer interactions	60	Interactive learning systems	26
Blended learning	58	Medical education	26
Learning management systems	57	Active learning	25
Information systems	56	Learning objects	24
Knowledge-based systems	54	Tutoring systems	24
Collaborative learning	53	Fuzzy logic	23
Distance learning	43		
Learning environment	43		

author. Their combined output contributed 9.78 per cent (177) global publications share and 33.45 per cent (4173)global citations share during 2003-18. Their detailed bibliometric profile is presented in Table 6.

- The publication productivity of 6 authors were above the group average (11.8): M. Vivou (24 papers), M. Ivanovic and B. Vesin (15 papers each), V. Aleven (14 papers), Z. Budimac and A. Klasnja-Milicevic (12 papers each) during 2003-18;.
- The citation impact per paper and relative citation index of only five authors were above the group average (23.58 and 3.42): C.M. Chen (103.0 and 14.93), Z. Budimac (38.92 and 5.64), A. Klasnja-Milicevic (36.67 and 5.31), B. Vesin (31.73 and 4.60) and M. Ivanovic (31.67 and 4.59) during 2003-18

5.6 Channels of Communication

Of the total 1809 world publications in e-learning research, only 564 appeared as articles in 116 journals. Of the 116 source journals in the subject, 101 published 1-5 papers each, 5 published 6-10 papers each, 9 published 11-20 papers each, 1 published 44 papers during 2003-18.

The 35.82 per cent of total 564 journal articles in the subject was contributed by top 15 leading journals. The source journal that topped the most productive journals list was Computers and Education (with

Table 5. Bibliometric profile of 15 leading global organizations in e-learning research during 2003-18

Name of the organisation	TP	TC	CPP	ICP	% ICP	RCI
Carnegie Mellon University, USA	49	766	15.63	10	20.41	2.27
University of Piraeus, Greece	27	342	12.67	2	7.41	1.84
University of Pittsburg, USA	24	385	16.04	3	12.50	2.32
University of Split, Croatia	19	161	8.47	2	10.53	1.23
University of Vigo, Spain	17	129	7.59	2	11.76	1.10
University of Memphis, USA	16	206	12.88	4	25.00	1.87
University of Salerno, Italy	15	120	8.00	0	0.00	1.16
National Cheng Kung University, Taiwan	14	326	23.29	0	0.00	3.37
Political University of Madrid, Spain	14	81	5.79	1	7.14	0.84
University of Montreal, Canada	13	46	3.54	2	15.38	0.51
Worcester Polytechnic Institute, USA	13	196	15.08	1	7.69	2.19
Charles III University of Madrid, Spain	12	87	7.25	4	33.33	1.05
Norwegian University of Science & Technology, Norway	12	75	6.25	7	58.33	0.91
The National Distance Education University, Spain	12	96	8.00	4	33.33	1.16
Open University of Catalonia, Spain	11	43	3.91	3	27.27	0.57
Total of 15 organizations	268	3059	11.41	45	16.79	1.65
Total of World	1809	12476	6.90			
Share of top 15 organizations in World total output	14.81	24.52				

Table 6. Bibliometric profile of 15 leading authors in e-learning research during 2003-18

Name of the Author	Affiliation of the Author	TP	TC	CPP	HI	ICP	% ICP	RCI
M. Vivou	University of Piraeus, Greece	24	329	13.71	9	1	4.17	1.99
M. Ivanovic	High School of Professional Business Studies, Serbia	15	475	31.67	8	5	33.33	4.59
B.Vesin	High School of Professional Business Studies, Serbia	15	476	31.73	8	4	26.67	4.60
V.Aleven	Carnegie Mellon University, USA	14	312	22.29	6	5	35.71	3.23
Z.Budimac	High School of Professional Business Studies, Serbia	12	467	38.92	7	2	16.67	5.64
A.Klasnja-Milicevic	High School of Professional Business Studies, Serbia	12	440	36.67	7	5	41.67	5.31
R.Nkambou	University of Quebec, Montreal, Canada	11	89	8.09	4	2	18.18	1.17
N.T.Heffernan	Worcester Polytechnic Institute, USA	11	191	17.36	5	1	9.09	2.52
E.Alepis	University of Piraeus, Greece	10	59	5.90	4	0	0.00	0.86
J.C. Burgquillo	University of Vigo, Spain	9	92	10.22	4	1	11.11	1.48
C.M.Chen	National Chengehi University, Taiwan	9	927	103.00	8	0	0.00	14.93
C.Frasson	University of Montreal, Canada	9	42	4.67	4	0	0.00	0.68
A.Grubisic	University of Split, Croatia	9	126	14.00	4	1	11.11	2.03
S.Stankov	University of Split, Croatia	9	129	14.33	4	1	11.11	2.08
F.Colacee	University of Salerno, Italy	8	19	2.38	2	0	0.00	0.34
Total		177	4173	23.58	84	28	15.82	3.42
Total of World		1809	12476	6.90				
Share of 15 Authors in World Total Output		9.78	33.45					

TP=Total Papers; TC=Total Citations; CPP=Citations Per Paper; HI=h-index; ICP=International Collaborative Papers; RCI=Relative Citation Index

Table 7. E-Learning Research Most Productive Journals during 2003-18

Name of the journal	Number of papers		
	2003-10	2011-18	2003-18
Computers and education	14	30	44
Computers in human behavior	3	17	20
Expert systems with applications	6	14	20
Ieee transactions on learning technologies	8	6	14
International journal of emerging technology in learning	2	12	14
Computer applications in engineering education	0	13	13
Educational technology and society	6	6	12
International journal of distance education technologies	4	8	12
International journal of artificial intelligence in education	2	9	11
International review of research in open and distance learning	6	5	11
Wseas transactions on information technology and applications	7	0	7
Distance education	0	6	6
Interactive learning environment	2	4	6
International journal of engineering education	2	4	6
Turkish online journal educational technology	0	6	6
15 Journals total	62	140	202
Total journal global output	154	410	564
The top 15 journals share in global journal output	40.26	34.15	35.82

44 papers), followed by Computers in Human Behavior and Expert Systems with Applications (20 papers each), IEEE Transactions on Learning Technologies and International Journal of Emerging Technology in Learning (13 papers each), etc. during 2003-18 (Table 7).

5.7 Highly Cited Papers

Among 1809 global publications on e-learning research, only 19 emerged as highly cited papers. Such papers that registered 101 to 371 citations per paper were described as highly cited contributions. Highly cited papers accumulated a total of 17231 citations during 2003-18, averaging to 172.31 citations per paper. The distribution of 19 highly cited papers is highly skewed. Fourteen out of these 19 highly cited papers registered citations in the range 101-192 per paper, 3 papers in the range of 201-286 citations per

paper, and 2 in the range of 302-371.

- 10 out of 19 highly cited papers were non-collaborative papers and in the remaining were collaborative papers:7 national and 2 international.
- USA had highest participation (11 papers) in high cited papers, followed by Taiwan (3 papers), Germany (2 papers), U.K. (25 papers), Germany (18 papers), Argentina, France, Germany, Greece, Serbia and Turkey (1 papers each).
- 57 authors and 32 organisations participated in 19 highly cited papers.
- Among 19 highly cited papers, 16 appeared in 10 journals: 6 papers in Computers and Education, 2 papers in International Review of Research in Open and Distance Learning and 1 paper each in Academic Medicine, Communications of the ACM, Computers in Human Behavior, Educational Technology and Society, Expert System with Applications, Journal of Science Education and Technology, Teachers College Record and User Modeling and User Adapted Interaction.

6. SUMMARY

This paper describes status of e-learning research at global, national, institutional and individual research scientist level. The study is based on 16-year global research data in the subject (covering 1809 publications) sourced from Scopus database during 2003-18. The e-learning research registered 18.92 per cent annual average growth, published an average of 113 papers per year, averaged 6.90 citations per paper (CPP) in a 16-year citation window, and registered barely 1.05 per cent of total publications output as highly cited papers.

During 2003-18, a total of 94 countries participated in e-learning research. The bulk of global publication productivity in the subject is attributed to top 10 productive countries which accounted for 62.58 per cent global world share. The USA had highest global share of 22.11 per cent. Computer science was the leading subject area contributing research in e-learning research studies with 71.81 per cent global publications share. Psychology recorded the highest citation impact per paper of 18.34 and decision sciences the least, 2.15 citations per paper.

In all 449 authors from 387 global organisations from 94 countries unevenly participated in e-learning research. Together the 15 leading organisations and authors contributed 14.81 per cent and 9.78 per cent global publication share respectively and 24.52 per cent and 33.45 per cent global citation share respectively during 2003-18.

Carnegie Mellon University, USA (49 papers) topped in global research productivity in the subject with highest papers (49). National Cheng Kung University, Taiwan topped the world for the highest citation impact (23.29) and the highest relative citation index (3.37). M. Vivou topped the world list of most productive authors with highest papers (24). C.M. Chen topped the world list of most cited authors with highest citations per paper (103) and with highest relative citation index (14.93). Computers and Education tops the list of most productive source journals publishing highest number of papers (44) in the subject during the period.

7. CONCLUSIONS

Research pursuits in e-learning studies are though quite global in nature, but leadership in research productivity in the subject is highly skewed dominated by select few countries. Bulk of the global research output (63 %) originated in top 10 countries. USA tops the world ranking of most productive countries with highest 22 per cent global publications share. However, the other 9 of top 10 ranking countries have been weak in their global publications share, ranging between 2.54 per cent and 7.02 per cent. The study also concludes that research institutions/authors in particular from countries like UK, Germany, China, and India have been underperforming in terms of research productivity, even as these countries rank among top 10 highly productive countries. Not a single institution or individual author from these top ranking countries appeared in the list of top 15 most productive organisations/ authors in the world. The challenge before these highly potential countries in e-learning research is how to transform their research organisations into leading centers of excellence in the subject at national and international level. The other issue of major concern is how such countries should build their potential to improve the quality and impact of their research performance in the subject.

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