

OPEN EDUCATION RESEARCH: A SCIENTOMETRIC ANALYSIS

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“Open Education” is a new pedagogical phenomenon in academia, mainly due to the emphasis on digital communication and network-based distribution of education. The present study aims to study the growth and pattern of global literature on Open Education published between 2001 and 2020. The authors analyze 1,119 bibliographic records on “Open Education” extracted from the Scopus database. The authors use various scientometric indicators like publication pattern; growth patterns; collaboration trends; co-authorship maps etc. Co-authorship network maps were prepared using VoSViewer. Further, the study identified the most prolific authors, institutions and countries along with the most preferred journals in research on “Open Education”. The authors conclude that the collaboration should emanate in Open Education.

Keywords: Open Education, Scientometric analysis, Visualization, Co-authorship, Scientific production, Higher education, e-learning

INTRODUCTION

‘Open’ is a buzzword in academia in the 21st century. However, the openness concept in academia is not new. Distance education has existed as part of mainstream education for many years. However, Open Education has provided a new paradigm shift to distance education. In the 17th century, Comenius proposed the openness of education for all through his statement “teaching all things to all men”, which considered the early idea of Open Education (Keatinge, 1907). Open education is not just related to the open sharing of educational resources, tools and practices; it is a pedagogy movement to provide accessible and affordable education to all without discrimination. According to European Commission (2019), open education is seen as: “a way of carrying out education, often using digital technologies. It aims to widen access and participation to everyone by removing barriers and making learning accessible, abundant, and

customizable for all. It offers multiple ways of teaching and learning, building and sharing of knowledge. It also provides a variety of access routes to formal and non-formal education and connects the two.”

Hence, around the world, many higher educational institutions are making their teaching, learning and research resources freely available over the internet under an open license. This enables learners across the globe to access, download and use the resources, from textbooks to video lectures, legally at free of cost. Open Education has become a rapidly growing research area in mainstream education. Remarkably rapid developments in digital communication and network technologies have brought a new prospect to Open Education research. Thus, research opportunities in Open Education have become versatile and diverse. Hence, it is essential to understand the research trends and collaboration patterns in the “Open Education” research field.

LITERATURE REVIEW

Wang et al. (2017) conducted a bibliometric analysis of 910 research publications on Open Education Resources (OER) indexed in the Web of Science (WoS) between 2002 and 2016. The highest number of publications were recorded in 2015, and Spain was the most productive country with 132 publications, followed by USA, England, Romania and China. The *International Review of Research in Open and Distance Learning* was the most preferred journal by the researchers. Wiley D. and Holotescu C. were the most productive authors, and Open University was a highly productive institute. The study also listed highly

cited publications and most used keywords in the OER research. Asadzandi et al. (2019) conducted a study on the authorship networking analysis using the Web of Sciences on Massive Open Online Courses (MOOCs). The authors used co-authorship trends, co-authorship networks of countries and organizations using CiteSpace and Gephi network analysis software. Co-authorship network analysis showed a lesser tendency towards collaborative publications, which does not concur with the nature of multidisciplinary research. Among the country-wise co-authorship analysis, only a few countries contribute, i.e. the USA has the highest degree of tendency; and the UK, France and Australia have stronger collaborations with other countries.

Shettar et al. (2019) analyzed MOOCs’ literature using scientometrics indicators for the period from 2009 to 2017 using 1701 publication records indexed in the Scopus database. The study found that more than half of MOOCs’ publications were conference papers (51.32%), followed by journal articles (36.5%). However, journal articles have received the highest citations (7151) than the conference papers (4931). The study also found a multi-authorship trend (55.67%) for publications. Rajan and Esmail (2020) conducted the bibliometric analysis of publications on Open Educational Resources indexed in the Web of Science database from 1992 to 2020. The authors analyzed 1234 bibliographic records and found a maximum of 86.6% of papers are Research Articles. 75% of publications were collaborative, maximum are double authored papers. Wiley, D. of Brigham Young University is the most productive author, and the Open University (UK)

was the most productive institute. The USA was the most dominating country with the highest number of publications. The *International Review of Research in Open and Distributed Learning* was the most preferred journal among the researchers in e-learning.

Bai, Li and Liu (2021) adopted a bibliometric method to study the significant research themes and their evolution in the research articles on “e-Learning” published from 1999 to 2018. The authors analyzed e-learning literature published in 10 journals selected from the SCImago Journal Rank (2017), 7214 articles and 21,656 keywords collected. The study found that the research in eLearning has grown multi-fold in the period from 2009 to 2018 (5537 publications) than the period during 1999–2008 (1677 publications). The study also found through keyword analysis that new research topics in e-learning are emerging like computer-aided learning, collaborative learning, human-computer interface, mobile learning, etc. Topics like Web2.0, artificial intelligence, robots, and cloud computing have undergone a rapid evolution in research. The study suggested a healthy expansion and adoption of new techniques in the e-learning research. Li and Wong (2021) conducted a bibliometric analysis of “Smart Education” research trends. The authors analyzed the publications between 2011 and 2020 indexed in the Web of Science and the Scopus databases. The study revealed the patterns in collaboration, key publications, major research areas etc. A total of 1317 publications were published in 746 sources, and 571 (76.5%) sources have published only one article. 52.1% of overall publications were

published in conference proceedings. Researchers from the USA, China, South Korea, India, and Russia were more active.

Sobral (2021) conducted a bibliometric analysis of e-learning in distance learning indexed in the Scopus database from 2000 to 2019. 25330 records were analyzed and published in 413 journals and eleven journals have published more than 200 papers each. The majority of research papers on e-learning were published in the Social Sciences journals, followed by journals in Computer Sciences and Engineering disciplines. *Computers and Education* and *International Journal of Emerging Technologies in Learning* were the most preferred journals. Overall, 14 countries have contributed more than 500 papers each; however, the USA has contributed the highest number of papers, followed by the UK and China. The Open University (UK) was the most productive institute. Shettar, Hadagali and Shokeen (2021) conducted a scientometric study on Open Educational Resources indexed in Scopus database published from 2004 to 2020. The study analyzed 1751 bibliographic records and found fluctuating trends in annual growth rate, but noticed almost linear growth in year-wise growth in the number of publications. The authors further found the trends towards the collaborative publications with a mean Degree of Collaboration of 1.32 and Collaboration Index at 3.11. Edmundo Tovar Caro from the Universidad Politécnica de Madrid, Spain, has contributed the highest number of research papers. The Open University (UK) was the most productive institute based on publications. The United States of America was

the highly contributed country with 24.21% contributions.

SIGNIFICANCE OF THE STUDY

The above reviewed papers are related to various branches of Open Education research like Distance Learning, e-Learning, MOOCs, OERs etc. The current study may be helpful to understand the research pattern and trends in overall research on Open Education using network maps and scientometric results. This study is of potential significance not only to the academicians involved in research on Open Education but also to the policy makers and executives who are involved in the designing educational policy and its implementation.

OBJECTIVES OF THE STUDY

The main objective of the current study is to analyze and identify the productivity on “Open Education” literature published between 2001 and 2020. The specific objectives of the study include:

1. identify the publication patterns of “Open Education” literature;
2. calculate the Annual Growth Rate (AGR), Relative Growth Rate (RGR) and Doubling Time (Dt.) of “Open Education” literature;
3. analyze the various collaborative indicators, i.e. Degree of Collaboration, Collaborative Coefficient and Collaboration Index;
4. identifying the top fifteen most productive journals, authors, institutions and countries; and
5. identify the highly used keywords using keyword mapping and highly cited research publications “Open Education” literature.

MATERIALS AND METHODS

The bibliographic records for the study were extracted from the Scopus database published between 2001 and 2020. A total of 1,119 publication records were extracted in the BibTeX and Comma-Separated Values (CSV) format in the month of December 2021. Extracted data were further analyzed using MS-Excel, BibExcel and VoSViewer and mathematical and statistical formulae.

RESULTS AND DISCUSSIONS

Year-wise distribution of publications

The Table 1 depicts the year-wise distribution of literature on “Open Education” according to publications, citations and average citations per paper. The highest number of publications were recorded in the year 2020, i.e., 175 (15.64 %), due to the increased emphasis on Open Education and also due to the Covid-19 pandemic, followed by 2019 (146) and 2017 (143). The lowest number of publications were recorded in 2001 and 2003 (during the early stages of the Open Education movement). Research papers published in 2017 have received the highest, i.e. 1046 (15.85 %) citations, followed by 2015 (926) and 2013 (657). However, publications in the year 2009 have received the highest, i.e. 12.61 ACPP (Average citations per paper), followed by 2010 (10.61 ACPP) and 2004 (10.33 ACPP). Overall, 1119 research papers have been published during the twenty years period (2001-2020) and have received 6598 citations at the rate of 5.90 average citations per paper.

Table 1: Year-wise distribution of publications

Year	TP	%	TC	%	ACPP
2001	2	0.18	13	0.20	6.50
2002	4	0.36	2	0.03	0.50
2003	2	0.18	1	0.02	0.50
2004	3	0.27	31	0.47	10.33
2005	6	0.54	24	0.36	4.00
2006	14	1.25	98	1.49	7.00
2007	8	0.71	22	0.33	2.75
2008	14	1.25	101	1.53	7.21
2009	33	2.95	416	6.30	12.61
2010	28	2.50	297	4.50	10.61
2011	35	3.13	213	3.23	6.09
2012	44	3.93	349	5.29	7.93
2013	74	6.61	657	9.96	8.88
2014	55	4.92	351	5.32	6.38
2015	104	9.29	926	14.03	8.90
2016	118	10.55	623	9.44	5.28
2017	143	12.78	1046	15.85	7.31
2018	111	9.92	562	8.52	5.06
2019	146	13.05	442	6.70	3.03
2020	175	15.64	424	6.43	2.42
Total	1119	100	6598	100	5.90

(TP: Total Publications; TC=Total Citations; ACPP: Average Citation per Publication)

Annual Growth Rate (AGR) and Compound Annual Growth Rate (CAGR)

Gracio et al. (2013) proposed the mathematical formula to calculate the Annual Growth Rate (AGR). Annual Growth Rate is a change in the measurement value, i.e., the number of publications over a year, calculated using the growth in a particular period using only two parameters, i.e. First Value and End Value. The Table 2 shows the fluctuating trend in the AGR over the study period. The highest calculated AGR was recorded in the year 2009 (135.71), followed by 2006 (133.33), and the lowest was recorded

for the year 2003 (-50.00), followed by 2007 (-42.86). Choi et al. (2011) adopted the formula to calculate the Compound Annual Growth Rate (CAGR) as one of the standard measures to analyze the growth rate for the overall study period. The Compound Annual Growth Rate (CAGR) for the total study period has arrived at 0.265351.

Relative Growth Rate (RGR) and Doubling Time (Dt.)

The Table 3 displays the year-wise Relative Growth Rate (RGR) and Doubling Time (Dt.) for the study period based on the number of publications in each year on Open Education. The

Table 2: Annual Growth Rate (AGR) of publications

Year	TP	AGR	CAGR
2001	2	0.00	0.265351
2002	4	100.00	
2003	2	-50.00	
2004	3	50.00	
2005	6	100.00	
2006	14	133.33	
2007	8	-42.86	
2008	14	75.00	
2009	33	135.71	
2010	28	-15.15	
2011	35	25.00	
2012	44	25.71	
2013	74	68.18	
2014	55	-25.68	
2015	104	89.09	
2016	118	13.46	
2017	143	21.19	
2018	111	-22.38	
2019	146	31.53	
2020	175	19.86	

(TP: Total Publications; AGR: Annual Growth Rate; CAGR: Compound Annual Growth Rate)

Relative Growth Rate (RGR) calculates the number of publications per unit of time, i.e., year. This RGR calculation method is derived from the studies of growth analysis of individual plants (Hunt, 1982; Poorter & Garnier, 1996; Hoffmann & Poorter, 2002); the same method is adopted to calculate the growth of publications. Doubling time (Dt.) is defined as “the time to be taken to double in the size or value and exists a direct equivalence between the relative growth rate and the doubling time”. The doubling time for a period is calculated by dividing the natural log of 2 by

the RGR derived for the same period. Mahapatra (1985) suggested the mathematical formula to calculate Doubling Time in bibliometrics studies. The Table 3 shows the fluctuating trend in the value of Relative Growth Rate (RGR) throughout the study, and it is noticed that RGR decreased from 1.79 in 2001 to 0.17 in 2020. At the same time, the study also showed an increase in the Doubling Time of research publications on “Open Education” from 0.39 in 2002 to 4.07 during 2020; however, the highest Dt. was recorded in 2018 (4.63).

Degree of Collaboration (DC)

The Degree of Collaboration (DC) is the ratio of collaborative papers to the total number of papers during the study period. Subramanyam (1983) has proposed the mathematical formula to calculate the DC for the unit of time-based on the two parameters, i.e. papers by a single author and collaborated papers. The Table 4 lists out the year-wise degree of collaboration in Open Education research papers. Out of 1119 research papers published, 334 (29.85 %) papers were published by single authors, and 756 (67.56%) papers by two or more collaborated authors at the rate of 0.69 degree of collaboration. This result shows the multi-authorship trends in Open Education research. Although 2003 has only two publications in the year-wise study, both the papers have collaborated papers; hence, 2003 has recorded the highest 1.00 degree of collaboration, followed by publications in 2019 (0.78); and 2016 & 2018 (0.77 each). At the same time, 2001 and 2004 have only single-authored papers and recorded 0 degree of collaboration, followed by 2007 (0.25) and 2009 (0.36).

Table 3: Relative Growth Rate and Doubling Time of publications

Year	TP	Cumulative no. of publications	W 1	W2	RGR	Dt. (P)
2001	2	2	0.00	0.00	0.00	0.00
2002	4	6	0.00	1.79	1.79	0.39
2003	2	8	1.79	2.08	0.29	2.41
2004	3	11	2.08	2.40	0.32	2.18
2005	6	17	2.40	2.83	0.44	1.59
2006	14	31	2.83	3.43	0.60	1.15
2007	8	39	3.43	3.66	0.23	3.02
2008	14	53	3.66	3.97	0.31	2.26
2009	33	86	3.97	4.45	0.48	1.43
2010	28	114	4.45	4.74	0.28	2.46
2011	35	149	4.74	5.00	0.27	2.59
2012	44	193	5.00	5.26	0.26	2.68
2013	74	267	5.26	5.59	0.32	2.14
2014	55	322	5.59	5.77	0.19	3.70
2015	104	426	5.77	6.05	0.28	2.48
2016	118	544	6.05	6.30	0.24	2.83
2017	143	687	6.30	6.53	0.23	2.97
2018	111	798	6.53	6.68	0.15	4.63
2019	146	944	6.68	6.85	0.17	4.12
2020	175	1119	6.85	7.02	0.17	4.07

(TP: Total Publications; RGR: Relative Growth Rate; Dt.(P): Doubling Time of publications)

Table 4: Degree of Collaboration (DC)

Year	No Authors	%	Single authored (Ns)	%	Multi authored (Nm)	%	Total (Ns + Nm)	Degree of Collaboration
2001	0	0.00	2	0.60	0	0.00	2	0.00
2002	0	0.00	1	0.30	3	0.40	4	0.75
2003	0	0.00	0	0.00	2	0.26	2	1.00
2004	0	0.00	3	0.90	0	0.00	3	0.00
2005	1	3.45	2	0.60	3	0.40	5	0.60
2006	0	0.00	6	1.80	8	1.06	14	0.57
2007	0	0.00	6	1.80	2	0.26	8	0.25
2008	1	3.45	4	1.20	9	1.19	13	0.69
2009	0	0.00	21	6.29	12	1.59	33	0.36
2010	0	0.00	10	2.99	18	2.38	28	0.64
2011	1	3.45	10	2.99	24	3.17	34	0.71
2012	1	3.45	21	6.29	22	2.91	43	0.51
2013	3	10.34	30	8.98	41	5.42	71	0.58
2014	0	0.00	23	6.89	32	4.23	55	0.58
2015	4	13.79	27	8.08	73	9.66	100	0.73
2016	3	10.34	27	8.08	88	11.64	115	0.77
2017	6	20.69	40	11.98	97	12.83	137	0.71
2018	1	3.45	25	7.49	85	11.24	110	0.77
2019	5	17.24	31	9.28	110	14.55	141	0.78
2020	3	10.34	45	13.47	127	16.80	172	0.74
Total	29	100.00	334	100.00	756	100.00	1090	0.69

Collaborative Coefficient (CC) and Collaboration Index (CI)

The Table 5 illustrates that collaborative publications (67.56%) dominate over single-authored publications (29.85%) and research papers are with no authors names (2.59%). The authorship pattern shows that the number of publications by single-authored papers dominated with 334 (29.85%) publications, followed by double authored papers with 248 (22.16%) publications and triple authored papers with 211 (18.86%) publications. According to Ajiferuke et al. (1988), the Collaboration Coefficient (CC)

lies between 0 and 1, with 0 corresponding to single-authored papers. If the calculated CC value is more than 0.5, then the collaboration rate among the authors will be treated better. For the current study, CC ranges between 0 and 0.65. The overall mean of collaboration coefficient (0.47) during the survey is below 0.5, which imply the dominance of single-authored research papers on Open Education.

Lawani (1980) has suggested the mathematical formula to calculate the Collaboration Index (CI), which provides the mean number of authors per paper for the study

Table 5: Collaborative Coefficient (CC) and Collaboration Index (CI)

Year	No Authors	Single Author	Two Authors	Three Authors	Four Authors	Five & above	Total	Collaboration Coefficient	Total Authors of Multi Authored Papers	Collaboration Index
2001	0	2	0	0	0	0	2	0.00	0	1.00
2002	0	1	2	1	0	0	4	0.42	7	2.00
2003	0	0	1	0	0	1	2	0.65	8	4.00
2004	0	3	0	0	0	0	3	0.00	0	1.00
2005	1	2	1	2	0	0	6	0.47	8	1.67
2006	0	6	5	2	1	0	14	0.33	20	1.86
2007	0	6	2	0	0	0	8	0.13	4	1.25
2008	1	4	5	2	1	1	14	0.46	26	2.14
2009	0	21	7	3	2	0	33	0.21	31	1.58
2010	0	10	7	6	4	1	28	0.40	53	2.25
2011	1	10	10	7	6	1	35	0.46	71	2.31
2012	1	21	10	10	1	1	44	0.32	59	1.82
2013	3	30	14	13	7	7	74	0.40	139	2.28
2014	0	23	7	8	10	7	55	0.40	123	2.65
2015	4	27	21	22	16	14	104	0.50	277	2.92
2016	3	27	30	26	16	16	118	0.51	305	2.81
2017	6	40	31	28	16	22	143	0.49	345	2.69
2018	1	25	29	20	13	23	111	0.51	341	3.30
2019	5	31	35	24	22	29	146	0.54	423	3.11
2020	3	45	31	37	19	40	175	0.51	514	3.19
Total	29	334	248	211	134	163	1119	0.47	2754	2.76

period, i.e., nothing but an average number of authors per paper for a unit of time. The formula considers the total number of authors involved in the overall publications, including the single and collaborative authors, and the total number of publications. For the present study, 1,119 research publications were penned by 3,088 authors, hence Collaborative Index for the study period is 2.76.

Top fifteen most productive journals

1119 research publications on Open Education were published in 567 (50.67%) journals. These 567 scholarly publications were published across 285 journals by the researchers in Open Education. The data in the table 6 shows that the *International Review of Research in Open and Distance Learning* (published by

Athabasca University) found to be the most preferred journal with 71 publications, followed by the *Turkish Online Journal of Distance Education* (34) and *Communications in Computer and Information Science* (22). According to the number of citations received, the ranking of journals is topped by the *International Review of Research in Open and Distance Learning* with 1034 citations, followed by *Distance Education* (275) and *Open Learning* (258).

Out of the top fifteen productive journals in Open Education research, Routledge and Springer have published two journals each; eleven different publishers publish the remaining. Five journals were published by the universities which show that the higher educational institutions promote Open

Table 6: Top fifteen most productive journals

Journal Title	Publisher	Country	TP	TC	ACPP	Cite Score
<i>International Review of Research in Open and Distance Learning</i>	Athabasca University	Canada	71	1034	14.56	5.8
<i>Turkish Online Journal of Distance Education</i>	Anadolu Universitesi	Turkey	34	111	3.26	2.2
<i>Communications in Computer and Information Science</i>	Springer	Germany	22	61	2.77	0.8
<i>Learning, Media and Technology</i>	Routledge	UK	14	210	15.00	5.7
<i>Journal Of Interactive Media in Education</i>	Ubiquity Press	UK	13	47	3.62	2.4
<i>Open Learning</i>	Taylor and Francis	UK	13	258	19.85	3.3
<i>Distance Education</i>	Routledge	UK	12	275	22.92	4.7
<i>Sustainability Switzerland</i>	MDPI AG	Switzerland	10	87	8.70	3.9
<i>International Journal of Emerging Technologies in Learning</i>	Kassel University Press	Germany	7	48	6.86	2.6
<i>On The Horizon</i>	Emerald	UK	7	32	4.57	1.7
<i>Research In Learning Technology</i>	Association for Learning Technology	UK	7	121	17.29	2.6
<i>Journal Of Computing in Higher Education</i>	Springer	USA	6	129	21.50	6.7
<i>Journal of E-Learning and Knowledge Society</i>	Italian e-Learning Association	Italy	6	32	5.33	1.9
<i>Knowledge Management and E-Learning</i>	University of Hong Kong	China	6	11	1.83	3.3
<i>Turkish Online Journal of Educational Technology</i>	Sakarya University	Turkey	6	4	0.67	NA

(TP: Total Publications; TC=Total Citations ACPP: Average Citation per Publication)

Education. Among these top-15 journals, six journals are published from the United Kingdom, followed by two from Germany and Turkey. The *Journal of Computing in Higher Education* has the highest 6.7 CiteScore, followed by the *International Review of Research in Open and Distance Learning* (5.8) and *Learning, Media and Technology* (5.7).

Top fifteen most productive authors

A total of 3,088 authors contributed 1,119 papers together. The Table 7 depicts the top fifteen productive authors in the research field on Open Education. Among the top fifteen authors, Diana

Andone of the Universitatea Politehnica Timisoara, Timisoara, Romania, has published the highest, i.e. 15 papers with 68 citations to her credit, followed by Daniel Burgos and Fabio Nascimbeni, both are from the International University of La Rioja, Logrono, Spain who have published 12 research papers each. However, Marco Kalz of Pädagogische Hochschule Heidelberg, Germany, has received the highest, i.e., 250 citations from his 11 publications and has the highest h-index (7) among the authors in the field of “Open Education”.

Table 7: Top fifteen productive authors

Author	Affiliation	City	Country	TP	TC	h-index
Andone, Diana	Universitatea Politehnica Timisoara	Timisoara	Romania	15	68	5
Burgos, Daniel	International University of La Rioja	Logrono	Spain	12	130	5
Nascimbeni, Fabio	International University of La Rioja	Logrono	Spain	12	128	5
Kalz, Marco	Pädagogische Hochschule Heidelberg	Heidelberg	Germany	11	250	7
Bonk, Curtis Jay	Indiana University School of Education	Bloomington	United States	10	205	6
Mihăescu, Vlad	Universitatea Politehnica Timisoara	Timisoara	Romania	9	30	3
Piedra, N.	Universidad Tecnica Particular de Loja	Loja	Ecuador	9	115	5
Tlili, Ahmed	Beijing Normal University	Beijing	China	9	77	2
Tóvar Caro, Edmundo	Universidad Politécnica de Madrid	Boadilla del Monte	Spain	9	90	4
Chvanova, Marina S.	Moscow State University of Technologies and Management	Moscow	Russian Federation	8	11	2
Cui, Tingru	School of Computing and Information Systems	Melbourne	Australia	8	30	4
Reeves, Thomas Charles	University of Georgia	Athens	United States	8	82	4
Reynolds, Thomas H.	National University	San Diego	United States	8	83	4
Shen, Jun	University of Wollongong	Wollongong	Australia	8	30	4
Sun, Geng	ZteIct University	Chongqing	China	8	30	4

(TP: Total Publications; TC=Total Citations ACPP: Average Citation per Publication)

The institutes such as the International University of La Rioja, Logrono, Spain and the Universitatea Politehnica Timisoara, Romania, have two authors representations in the top15 most productive authors. Among the top15 authors, three authors each belong to Spain and USA; and two each from Australia, China and Romania. The co-authorship map of highly productive authors on Open Education is depicted in Figure-1. Out of 336 authors, 81

authors who have a minimum of one collaboration with each other were included in the map, who have a minimum of two papers to their credit. The Group of authors is divided into ten clusters. The authors with more co-authorship with each other were included in the same cluster. The circles' size shows the magnitude of the paper number, and the thickness of lines shows that of the co-authorship rate. The total link strength is 474.

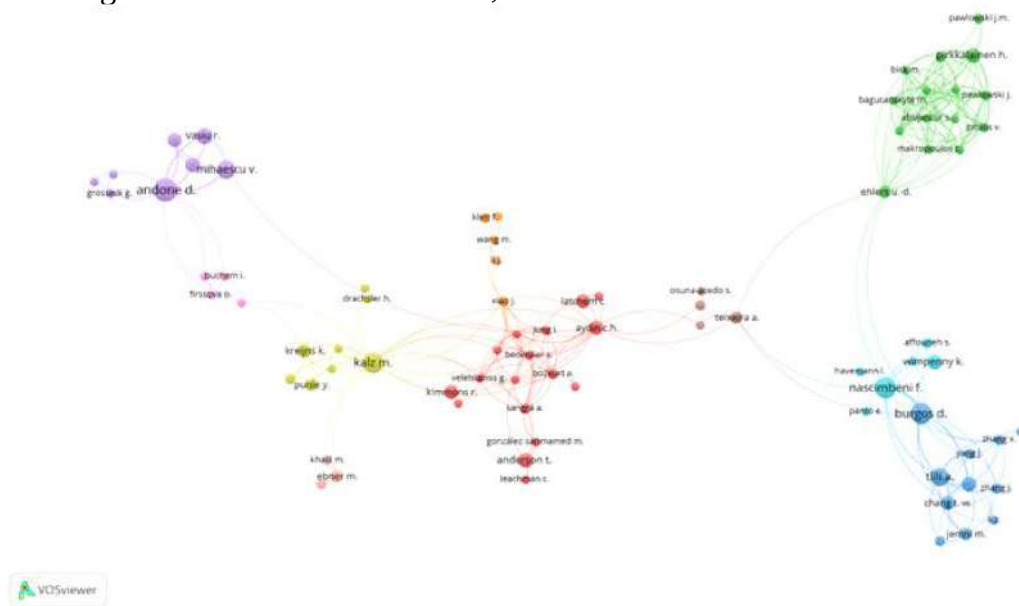


Figure 1: Co-authorship map of highly productive authors

Top fifteen prolific institutions

The Table 8 lists the top fifteen most prolific institutions in the field of “Open Education” research. Among the listed institutions, the Open University (United Kingdom) and Anadolu Üniversitesi (Turkey) have published the highest papers, i.e., 38 each, followed by the Open Universiteit (Netherlands) with 21 publications ranked first to third. Out of the top fifteen institutions, three institutions are based in Spain alone, and two each from Australia, China and the

United States. Among these listed institutes, the Open Universiteit (Netherlands) has received the highest citations (344) and highest h-index (7), followed by the Open University (United Kingdom) with 268 citations and 9 h-index.

Top fifteen most productive Countries

The Table 9 presents the top fifteen countries in “Open Education” research. 96 countries have contributed 1119 papers in ‘Open Education’ research. Among the top fifteen nations, the USA

Table 8: Top fifteen prolific institutions

Affiliation	City	Country	TP	TC	h-index
The Open University	Milton Keynes	United Kingdom	38	268	9
Anadolu Üniversitesi	Eskişehir	Turkey	38	172	6
Open Universiteit	Heerlen	Netherlands	21	344	11
Universidad Politécnica de Madrid	Madrid	Spain	17	178	7
Universitatea Politehnica Timisoara	Timis	Romania	16	68	5
International University of La Rioja	Logrono	Spain	16	135	5
University of Cape Town	Cape Town	South Africa	12	79	6
Athabasca University	Athabasca	Canada	12	135	7
Beijing Normal University	Beijing	China	12	80	2
Universidad Nacional de Educación a Distancia	Madrid	Spain	12	72	7
University of Georgia	Athens	United States	12	108	5
University of Illinois Urbana-Champaign	Urbana	United States	11	101	4
University of Southern Queensland	Toowoomba	Australia	11	58	4
Hong Kong Metropolitan University	Hong Kong	China	11	55	4
University of Wollongong	Wollongong	Australia	10	33	4
Dublin City University	Dublin	Ireland	10	15	3
Universidad Técnica Particular de Loja	Loja	Ecuador	10	118	5

(TP: Total Publications; TC=Total Citations ACPP: Average Citation per Publication)

Table 9: Top fifteen most productive Countries

Country/Territory	TP	%	TC	h-Index
United States	201	17.96	1699	20
United Kingdom	102	9.12	943	19
Spain	97	8.67	811	16
China	84	7.51	332	11
Russian Federation	84	7.51	239	8
Australia	63	5.63	404	12
Turkey	60	5.36	254	7
Canada	51	4.56	408	12
Germany	47	4.20	307	9
Netherlands	38	3.40	489	12
Romania	30	2.68	106	6
India	26	2.32	88	6
Italy	26	2.32	325	6
South Africa	25	2.23	174	7
New Zealand	19	1.70	114	5

(TP: Total Publications; TC=Total Citations ACPP: Average Citation per Publication)

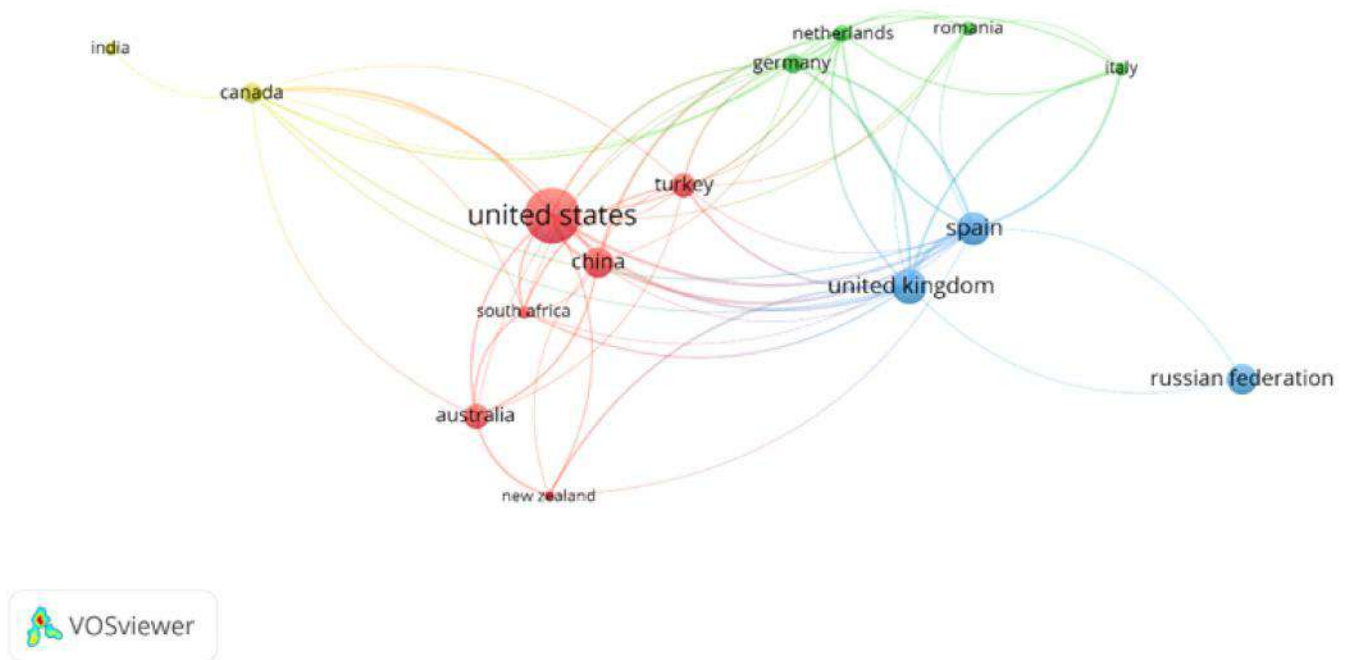


Figure 2: Co-authorship map of countries collaborating

has published the maximum, i.e. 201 research publications (17.96%) of the total publications, followed by the United Kingdom (102; 9.12%), Spain (97; 8.67%). The top fifteen countries together have contributed 85.17% of the total publications. The Figure 2 depicts the co-authorship map of countries with at least 19 papers co-authored by the researchers, which listed 15 countries scattered across 4 clusters in different colours, with 60 links and 172 link strengths. The circles' size demonstrates the publication number's magnitude and line thickness of the co-authorship rate in the co-authorship map.

Mapping of Keyword Co-occurrence

For 1,119 publications, 2,373 different keywords were used in the research publications on Open Education. The Keyword co-occurrence

map visualizes the top 34 author keywords that have appeared at least ten times in all research publications on "Open Education". These co-occurrence maps of 34 highly used keywords are divided into seven clusters with 2208 links and 8708 link strength. The size of the circle shows the number of appearances. The line between the keywords represents the co-occurrence of both the keywords and the thickness of the line reflects a few co-occurrences. Keyword Co-occurrence (Figure-3) determines the nature of research and research hotspots in the research literature on "Open Education". The highly used keywords are 'Open Education' with 368 occurrences with a link strength of 472, followed by Open Educational Resources with 125 occurrences (170 link strength) and higher education with 91 occurrences (162 link strength).

tools” by Fini A. published during 2009 in *International Review of Research in Open and Distance Learning* has received the highest citations (224), whereas, the conference papers titled, “Learning is not a spectator sport: Doing is better than watching for learning from a MOOC” by Koedinger K.R., et al. (5 Authors) published in L@S 2015 - 2nd ACM Conference on Learning at Scale (2015) has received 137 citations.

CONCLUSION

Open education has become an essential part of mainstream education research. Technological advances in digital content development and ease of data transmission via the internet have opened up new opportunities for the global audience to learn and teach from any part of the globe. Open education has brought a new archetype shift in the way education was disseminated earlier. Thus, this study helps to understand the importance of ‘Open Education’ research as an alternative pedagogical approach to education. In the present study, the authors have analyzed research publications on ‘Open Education’ indexed in Scopus databases of the last two decades from 2001 to 2020. A total of 1119 bibliographic records were published during the study period, at the rate of 56 research papers per year. These publications have received 6598 citations at the rate of 5.9 citations per paper. The number of research publications have witnessed 0.265351 Compound Annual Growth Rate; the Relative Growth Rate decreased from 1.79 in 2001 to 0.17 in 2020. The study found the collaborative trends among the authors as the average degree of collaboration during the period

was 0.69. However, the Collaborative Co-efficient during the period was 0.47 with an average of 2.7 authors per research publications on “Open Education”.

Journal articles were the most preferred form of publications among the researchers of ‘Open Education’ as more than half of the publications during the study were Journal Articles. Among the 285 journals published on ‘Open Education’, the *International Review of Research in Open and Distance Learning*, published by the Athabasca University, Canada, is the most preferred journal. Diana Andone of the Universitatea Politehnica, Timisoara, is the most prolific researcher who has published the highest number of research papers and the Open University (UK) and Anadolu Üniversitesi (Turkey) are the prominent institutions in the field of Open Education. The USA dominated among the 96 countries which are contributed the research papers. The study also analyzed the most prolific keywords used by the authors through network analysis.

This scientometric study on the research publications on ‘Open Education’ helps the researchers, educationists, policymakers, content developers, and end-users identify the research trends. However, looking at the versatility of the ‘Open Education’ research domain, there is an ample opportunity to adopt collaborative efforts from the researchers from different disciplines like educationists, technologists, behavioural analysts, social scientists, economists, psychiatric, content developers, database managers etc. Hence, there

is a need for more collaborative research and cooperation among the researchers from different economic, cultural, and institutional backgrounds to foresee excellent research on Open Education for better educational opportunities.

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