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COVID-19 and Education: A Scientometric Assessment of Global Publications during 2020-21

JAIDEEP SHARMA*
B.M.GUPTA**
ANURAG SAXENA***

The study aims to analyse the trends and explore the thematic structures from the global literature on the theme 'Impact COVID-19 on Education' using bibliometric methods and VOS viewer software. Global research on the subject resulted in a total of 1038 publications, which received 2581 citations, involved participation of 107 countries, 272 organisations and 308 authors and appeared across 398 journals. The study observed that the USA leads the global research on this theme accounting for a 12.81%global share, followed by the U.K. (7.90%), Indonesia (7.61%), China (6.36%), Spain (6.26%), Australia (5.39%) and India (5.11%). respectively. The study tracks key research organisations, key authors, key research areas, most significant keywords, most cited papers and most productive source journals and presents their collaborative linkages through visual mapping.

Keywords: *Impact, COVID-19, Education, Bibliometric Methods, Global publications, Scientometrics, Bibliometrics*

1 INTRODUCTION

The detection of the novel coronavirus disease (2019-nCoV), in Wuhan (China) in December 2020. later declared as pandemic by WHO in March 2020) led to an unprecedented global crisis that heavily stressed the global healthcare system causing serious global health problems, significant loss of human life and created unexpected difficulties in the lives of millions of people

* IGNOU, School of Social Science, New Delhi, India

** Formerly with CSIR-NISTADS, New Delhi, India.

*** IGNOU, School of Management Studies, New Delhi, India

worldwide. However, modern technological possibilities have facilitated and enabled a multifaceted fight against COVID-19[1-3]. For example developments in COVID-19 and their awareness happened instantly on mass media and social media, which led to great advantage in the fight against COVID-19. As an example, individuals can communicate with their relatives by phone or via the Internet, many are also able to handle their work commitments remotely or from their homes; thereby minimizing risks associated with the pandemic [4-5].

The COVID-19 pandemic has created a situation, where the need for drastic changes in the organisational structures, curricula, and education policies of all schools, colleges and universities and other higher education institutions was felt in all countries. Many countries were forced to suspend in-person learning and to shift the focus to various forms of online, blended and hybrid education[6, 1], besides developing and implementing distance education programmes in order to ensure continuation of existing education without significant interruption[7]. Besides negative effects, there were positive effects of the pandemic which forced many parents and children to develop computer skills for use of digital devices in order to overcome problems faced by pandemic[8].

11 LITERATURE REVIEW

Although few studies have been conducted at the international level on the effect of pandemic on education, but they focus on topics such as developing new online resources, increasing the skills needed to use new technologies, providing free access to online resources, and developing alternative assessment and evaluation methods[9-10].

From this perspective, determining the effects of the COVID-19 pandemic on education, as well as determining the current situation, has presented an important challenge for educational institutions and policy-makers worldwide.

Moreover, a large number of bibliometric studies have been conducted in support of research on the effects of COVID-19 [11], but only a few studies published during 2020-21 solely examined the relationship between the COVID-19 pandemic and education whilst presenting the thematic structures and trends of selected publications through scientometric analysis. Among such studies Karakose and Demirkol[12] studied the thematic structures and trends of academic publications that examined the relationship between the COVID-19 pandemic and education and to provide a roadmap for future studies on this subject. For this purpose the authors based their analysis on top 100 most-cited publications derived from Web of Science Core Collection (WoSCC) database published between January 1 and December 31, 2020.Yavuz, Kayalý and Tutal [13]revealed the studies' profile for distance education activities in the

Covid-19 period. They examined 220 global studies derived fromn the Web of Science database and analysed the most used keywords, the most cited journals, the most publishing journals, the most publishing countries and the most cited authors using VOS Viewer software. The authors also under took content analysis, where methodological trends (method, sample size, data collection tool, data analysis type) used in the studies were examined. Mustapha and Van indicate[14] that digital technologies are today viewed as a gateway to solve many of the problems arising from the COVID-19 crisis. 82 articles were analysed on overall resources and digital technologies available for education, using Scopus and Web of Science databases. The analysis used text frequency co-occurrence and collaborations between the authors in countries and classified the total literature under (i) Digital education, online teaching and learning, (ii) Digital education and rethinking for sustainable community; (iii) Digital education for medical and healthcare in hospital, etc. These findings are expected to benefit stakeholders studying and working relevant in digital education during and resilient post-Covid-19 pandemic. Marín-Marín[15] analysed the influence of COVID-19 on education using 940 global publications derived from Web of Science database. Structural and thematic development of the field was studied and mapped using co-words.

2 OBJECTIVES

This study seeks to study the global research on 'Impact of COVID-19 on Education' based on key quantitative and qualitative indicators and metrics with the objective to assess and evaluate the status of research on this theme at global, national, institutional, and individual author level. The data for study was sourced from the Scopus database. The study focused on the following parameters such as (i) global publications distribution by source and type, (ii) publications growth — annual and cumulative, (iii) citation impact of overall global publications (iv) contribution and impact of most productive countries, (v) publication distribution by broad subjects and significant keywords, (vi) contribution and impact of most productive organisations and authors and their collaborative linkages, (vii) leading communications channels and (viii) bibliographic characteristics of highly- cited papers.

3 METHODOLOGY

Using a well designed search strategy, the study identified, retrieved and downloaded the publication data on the theme from the Scopus database (https://www.scopus.com). Two set of search strategies were developed. First search strategy used different synonyms of COVID-19 and which were placed in Keyword and Title (of papers) tags or search and retrieval. The seach yielded

around 2300 records. On physical examination, it was observed the records yielded from search strategy had a very large number of records related to medical education. Then another strategy was developed which used keywords related to COVID 19 and Medical education. These keywords were placed in Keyword and Title (of papers) tags for search and retrieval, yielding around 900 records. Subsequently, another search was developed which is as follows (#1 and Not #2). It eliminated majority of the medical records from the first search. The final output consisted of 1038 records, which was further refined by the country name, one by one, in order to identify most productive countries in the subject. In addition, analytical provisions as provided in the Scopus database was utilized to ascertain the distribution of publications output by broad subject areas, collaborating countries, contributing authors, affiliating organizations and source journals, etc. The citations to publications were counted from the date of their publication till 19.6.2021.

((TITLE (“COVID 19” OR “2019 novel coronavirus” OR “coronavirus 2019” OR “coronavirus disease 2019” OR “2019-novel CoV” OR “2019 ncov” OR covid 2019 OR covid19 OR “corona virus 2019” OR ncov-2019 OR ncov2019 OR “nCoV 2019” OR 2019-ncov OR covid-19 OR “Severe acute respiratory syndrome coronavirus 2” OR “SARS-CoV-2”) OR KEY (“COVID 19” OR “2019 novel coronavirus” OR “coronavirus 2019” OR “coronavirus disease 2019” OR “2019-novel CoV” OR “2019 ncov” OR covid 2019 OR covid19 OR “corona virus 2019” OR ncov-2019 OR ncov2019 OR “nCoV 2019” OR 2019-ncov OR covid-19 OR “Severe acute respiratory syndrome coronavirus 2” OR “SARS-CoV-2”) AND Title (education or learning or student* or teaching or curriculum or training or undergraduate or postgraduate or online education or E-Learning or higher education or college or school or universit* or educational)) and not (TITLE (“COVID 19” OR “2019 novel coronavirus” OR “coronavirus 2019” OR “coronavirus disease 2019” OR “2019-novel CoV” OR “2019 ncov” OR covid 2019 OR covid19 OR “corona virus 2019” OR ncov-2019 OR ncov2019 OR “nCoV 2019” OR 2019-ncov OR covid-19 OR “Severe acute respiratory syndrome coronavirus 2” OR “SARS-CoV-2”) OR KEY (“COVID 19” OR “2019 novel coronavirus” OR “coronavirus 2019” OR “coronavirus disease 2019” OR “2019-novel CoV” OR “2019 ncov” OR covid 2019 OR covid19 OR “corona virus 2019” OR ncov-2019 OR ncov2019 OR “nCoV 2019” OR 2019-ncov OR covid-19 OR “Severe acute respiratory syndrome coronavirus 2” OR “SARS-CoV-2”) AND (Title (education or learning or student* or teaching or curriculum or training or undergraduate or postgraduate or online education or E-Learning or higher education or college or school or universit* or educational) and Title (clinical or dental* or medical or health or biomedical or nursing or phychotherapy or orthop* or anatomy or neurosurg* or surger* or radiology or urology or

dermatology or ehealth or perecardial* or cardiothor* or otolaryn* or spine or opththal* or thoracic* or pathology* or rheumatology* or prosthod* or healthcare or dentist* or dermatolog* or autism or pharm* or microsurg* or echocard* or neuro* or vascular* or epil* or cancer*)))) AND (EXCLUDE (SUBJAREA,"MEDI") OR EXCLUDE (SUBJAREA,"NURS") OR EXCLUDE (SUBJAREA,"HEAL"))

4 ANALYSIS AND RESULTS

41 OVERALL PUBLICATION AND CITATION ANALYSIS

In all, 1038 publications (2 publications in 2019, 538 in 2020 and 497 in 2021) were published in the domain of "Impact of COVID-19 on Education" as indexed in Scopus database during 2019-21. Research on this domain registered a citation impact of 2.486 citations per paper (CPP) since publication.

Of the total output in the subject, articles and conference papers accounts for a major share of the output (71.68% and 15.70%), followed by editorials, reviews, book chapters and notes (from 2.12% to 3.28%), letters, erratum, data papers and short surveys (from 0.19% to 0.67%). English language accounts for the largest share (93.55%) of output, followed by Spanish (3.85%), Portugese (0.96%), Turkish (0.58%), Slovenian (0.48%), Italian (0.19%) and 5 other langauges (a 0.10% share each). Of the total 1038 publications, 133 (12.81%) had appeared as output from research projects sponsored and funded by more than 100 national and international funding agencies. The sponsored research papers (133) received 420 citations, averaging 3.16 citations per paper.

The leading funding agencies supporting research in this are are:European Commission (11 papers), Foundation for Science and Technology (FCT), Portugal (6 papers), Ministry of Education, Portugal (6 papers), National Science Foundation (5 papers), Brazilian Federal Agency for Support and Evaluation of Graduate Education (4 papers), Slovenian Research Agency (4 papers), United States Agency for International Development (4 papers), Australian Research Council (3 papers), The Brazilian National Council for Scientific and Technological Development (3 papers), etc.

42 MOST PRODUCTIVE COUNTRIES

Global research in the domain "Impact of COVID-19 on Education" witnessed an uneven partcipitation of 107 countries: 56 countries contributed 1-5 papers each, 22 countries 6-10 papers each, 12 countries 11-20 papers, 10 countries 21-50 papers each and 7 countries 53-133 papers each.

Of the 107 countries, the top 10 most productive countries account for

62.14% and 74.89% share of global publication and citations. The USA leads the ranking with the global publication share of 12.81%, followed by U.K., Indonesia, China, Spain, Australia and India (from 7.90% to 5.11%), Turkey, South Africa and Canada (from 3.85% to 3.18%). Four of the top 10 countries registered their relative citation index above the group average (1.20): Canada (3.14), Spain (2.32), India (1.25%) and U.K (1.24). The international collaborative papers as a share of country output varied from 15.19% to 57.32%, with an average of 35.66%(Table 1).

Table 1. Top 10 Countries involved in Research on 'Impact of COVID-19 on Education'

S.No	Name of the Country	TP	%TP	TC	CPP	HI	ICP	%ICP	RCI
1	USA	133	12.81	377	2.83	9	43	32.33	1.14
2	U.K.	82	7.90	254	3.10	8	47	57.32	1.24
3	Indonesia	79	7.61	110	1.39	5	12	15.19	0.56
4	China	66	6.36	173	2.62	6	29	43.94	1.05
5	Spain	65	6.26	376	5.78	8	21	32.31	2.32
6	Australia	56	5.39	144	2.57	7	25	44.64	1.03
7	India	53	5.11	165	3.11	6	21	39.62	1.25
8	Turkey	40	3.85	41	1.03	3	13	32.50	0.41
9	South Africa	38	3.66	35	0.92	3	6	15.79	0.37
10	Canada	33	3.18	258	7.82	6	13	39.39	3.14
	Total of top 10 countries	645	62.14	1933	3.00	6.1	230	35.66	1.20
	Global total	1038	100.00	2581	2.49				
	Share of top 10 countries in global total	62.14	5.99	74.89					

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

Due to overlapping in the output across countries, the sum total of productivity at country level exeeeds the global output

421 COLLABORATIVE RESEARCH

Country of collaboration varied from 3 to 40. Their collaborative linkages at country - to - country level varied from 1 to 9: the U.K - USA (9 linkages), followed by the Germany-Austria (36), USA-Canada (33), USA-.Germany-U.K. (32), USA-Japan (28), U.K. – Australia and U.K. - China (8 linkages each), U.K. – Australia and U.K. - India (6 linkages each), etc.(Table 2). A collaborative network chart covering top 10 countries is presented in Figure 1. The countries with same colour belong to a single cluster. The thickness of links between the countries and the distance between them represent linkages among top 10 countries.

The total collaborative linkages count are presented by the degree of their research collaboration. The bigger the diameter of a network node and its font size, the bigger its weight in research collaboration. Germany dominates in red cluster, followed by the U.K. in green cluster, and Switzerland in blue cluster.

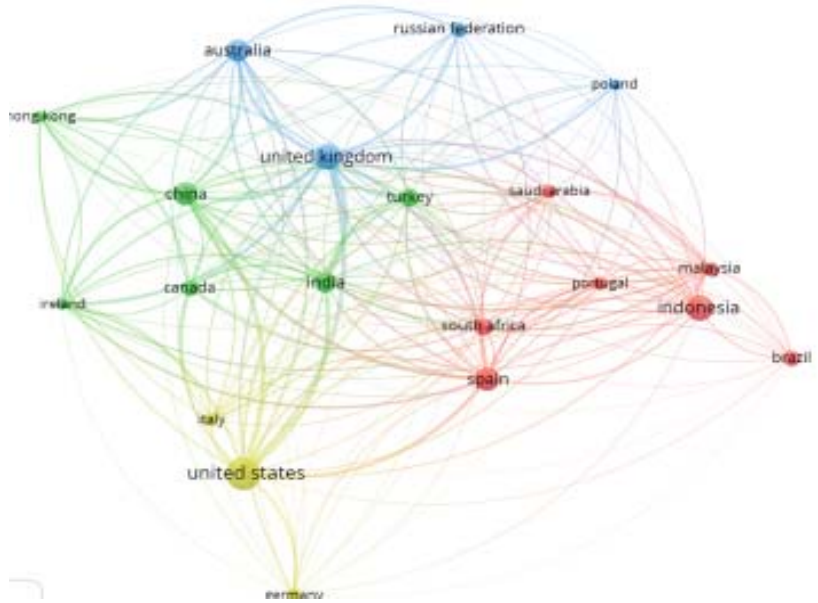


Figure 1. Collaboration Network Chart of Top Countries in 'Impact of COVID-19 on Education'

Table 2. Collaborative Linkages among Top 10 Most Productive Countries

S.No	Name of the Country	Number of collaborative linkages with other top countries	TCL (NOC)
1	USA	2(9), 4(7), 5(3), 6(6), 7(5), 8(3), 9(1), 10(5)	39(8)
2	U.K.	1(9), 4(8), 5(2), 6(8), 7(6), 8(3), 9(1), 10(3)	40(8)
3	Indonesia	4(1), 6(1), 7(1)	3(3)
4	China	1(7), 2(8), 4(1), 5(5), 6(4), 7(2), 8(2), 10(1)	30(8)
5	Spain	1(3), 2(2), 4(5), 6(2)	11(4)
6	Australia	1(6), 2(8), 3(1), 4(4), 5(2), 7(2), 10(1)	24(7)
7	India	1(5), 2(6), 3(1), 4(2), 6(2), 8(4), 9(3)	23(7)
8	Turkey	1(3), 2(3), 4(2), 7(4), 10(1)	13(5)
9	South Africa	1(1), 2(1), 7(3), 10(2)	7(4)
10	Canada	1(5), 2(3), 4(1), 6(1), 8(1), 9(2)	13(6)
TCL(NOC)=Total collaborative linkages (Number of countries)			

43 SUBJECT-WISE DISTRIBUTION

Scopus database classified the topic 'Impact of COVID-19 on Education' under seven main disciplines. Social Sciences is the top subject area with the largest share (73.89%) of the global output, followed by Computer Science (22.64%), Engineering (10.79%) and other four subjects, namely Business, Management & Accounting, Environment Science, Arts and Humanities and Psychology (from 8.19% to 6.55%).Amongst the seven subjects, Business, Management and Accounting registered the highest citations per paper (3.62 CPP) and Arts & Humanities registered the least (0.83 CPP) (Table 3).

Table 3.Subject-Wise Breakup of Global Publications on 'Impact of COVID-19 on Education'

S.No	Name of the Subject	TP	%TP	TC	CPP
1	Social Sciences	767	73.89	2181	2.84
2	Computer Science	235	22.64	498	2.12
3	Engineering	112	10.79	127	1.13
4	Business, Management & Accounting	85	8.19	308	3.62
5	Environment Science	82	7.90	194	2.37
6	Arts & Humanities	70	6.74	58	0.83
7	Psychology	68	6.55	209	3.07
	Global total	1038	100.00	2581	2.49

431 SIGNIFICANT KEYWORDS

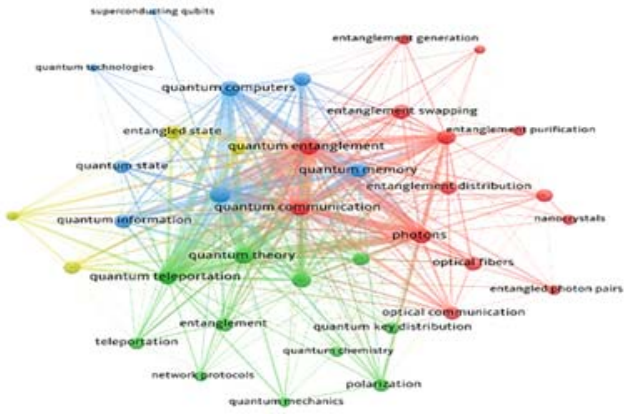
In all 28 significant keywords were identified which identify research areas in "Impact of COVID 19 on Education". The frequency of their co-occurrence highlight research trends in this domain. The frequency of occurrence of keyword 'COVID-19'in the literature in this domain was the highest (581), followed by 'Higher Education' (180), 'E-Learning' (168), 'Education' (143), 'Online Learning' (102), 'Distance Education' (78), 'Teaching' (75), 'Learning' (49), 'Engineering Education' (49), etc (Table 4).

Table 4. List of Top 28 Most Significant Keywords appearing in Global Literature on 'Impact of COVID 19 on Education' during 2001-20

S.No	Name of the Keyword	Frequency	S.No	Name of the Keyword	Frequency
1	COVID-19	581	15	Social Media	21
2	Higher Education	180	16	Digital Transformation	20
3	E-Learning	168	17	Computer Aided Instruction	16
4	Education	143	18	Blended Learning	15
5	Online Learning	102	19	Remote Learning	15
6	Distance education	78	20	Remote Teaching	14
7	Teaching	75	21	Digital Technologies	13
8	Learning	49	22	Electronic Assessment	12
9	Engineering Education	33	23	Crisis Management	11
10	Learning Systems	33	24	Design	11
11	Sustainability	24	25	ICT	11
12	Curriculum	24	26	Digital Divide	10
13	Computing Education	23	27	Learning Process	10
14	Teacher Education	23	28	Professional Development	10

Figure 2 (A & B) were generated through VOSviewer and Biblioshny tools of co-occurrence relationship chart of top 41 keywords. Figure 2A is a networks map of keyword co-occurrence at a glance. Figure 2B presents textual data about keywords co-occurrence in a sample way. Each hub is associated to a keyword and its size is proportional to the number of documents where the keyword appears. The top keywords were divided into 3 clusters.

A.



B.

Figure 2. (A) The top 50 keywords co-occurrence and (B) WordCloud Keyword co-occurrence

44 MOST PRODUCTIVE ORGANISATIONS

In all, a total of 272 organisations have participated in research on 'Impact of COVID 19 on Education': 256 organizations published 1-5 papers each and 16 organizations 6-101 papers each. Of the top 20 most productive global organizations partcipitating on this theme, 4 were from U.K., 3 each from Indonesia and Spain, 2 from China and 1 each from Bahrain, Brazil, Cyprus, Malaysia, New Zealand, Russia Federation, Slovenia and South Africa.The research productivity of top 20 most productive organisations in the subject varied from 5 to 11 publications per organization; together they contributed a 13.20% (137) global publications share and a 26.04% (672) global citations share during the period. A scientometric profile of top 20 most productive organisations is presented in Table 5.

On further analysis, it was observed that 6 of top 20 organisations contributed publications above their group average productivity (6.85): Beijing Normal University, China (11 papers), Universidad de Salamanca, Spain (10 papers), Univerza v Ljubljani, Slovenia and International University of La Rioja, Spain (9 papers each), Universidad de Valladolid, Spain and Universitas Negeri Malang, Indonesia (8 papers each), UCL Institute of Education, U.K. and University of Cambridge, U.K. (7 papers each); Five organisations registered citation per paper and relative citation index above the group average (4.91 and 1.97): Universidad de Valladolid, Spain (29.0 and 11.65), Universidad de Salamanca, Spain (14.30 and 5.74), Swansea University, U.K. (12.5 and 5.02), University of Auckland, New Zealand (9.0 and 3.61) and Univerza v Ljubljani, Slovenia (6.0 and2.41)

Table 5. Scientometric Profile of Topmost20 Productive Organisations involved in 'Impact of COVID-19 on Education'

S.No	Name of the Organisation	TP	TC	CPP	HI	ICP	ICP (%)	RCI
1	Beijing Normal University, China	11	21	1.91	3	6	54.55	0.77
2	Universidad de Salamanca, Spain	10	143	14.30	3	2	20.00	5.74
3	Univerza v Ljubljani, Slovenia	9	54	6.00	1	0	0.00	2.41
4	International University of La Rioja, Spain	9	3	0.33	1	7	77.78	0.13
5	Universidad de Valladolid, Spain	8	232	29.00	5	0	0.00	11.65
6	Universitas Negeri Malang, Indonesia	8	5	0.63	1	1	12.50	0.25
7	UCL Institute of Education, U.K.	7	15	2.14	2	3	42.86	0.86
8	University of Cambridge, U.K.	7	5	0.71	1	5	71.43	0.29
9	University of Glasgow, U.K.	6	16	2.67	1	6	100.00	1.07
10	Swansea University, U.K.	6	75	12.50	3	3	50.00	5.02
11	University of KwaZulu-Natal, South Africa	6	8	1.33	2	1	16.67	0.54
12	East China Normal University, China	6	7	1.17	1	4	66.67	0.47
13	University of Malaya, Malaysia	6	0	0.00	0	5	83.33	0.00
14	Universitas Sebelas Maret, Indonesia	6	1	0.17	1	0	0.00	0.07
15	Kazan Federal University, Russia Republic	6	24	4.00	2	2	33.33	1.61
16	Universitas Negeri Jakarta, Indonesia	6	8	1.33	2	1	16.67	0.54
17	University of Bahrain	5	0	0.00	0	1	20.00	0.00
18	University of Auckland, New Zealand	5	45	9.00	3	4	80.00	3.61
19	Yakin Dogu Universitaesi Cyprus	5	4	0.80	1	2	40.00	0.32
20	University of Sao Paulom, Brazil	5	6	1.20	2	0	0.00	0.48
	Total of 20 organizations	137	672	4.91	1.75	53	38.69	1.97
	Global total	1038	2581	2.49				
	Share of top 20 organizations in global total	13.20	26.04					

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

Only eight out of top 20 organisations have one-to-one collaborative linkages and their total collaborative linkages varied from 1 to 8 as shown in Table 6. The strongest collaborative linkages (4 each) are between Beijing Normal University, China and International University of La Rioja, Spain, Universidad de Salamanca, Spain and Universidad de Valladolid, Spain, Universidad de Valladolid, Spain and University of Bahrain

A collaborative network chart of top 20 organisations is presented in Figure 3. Themore the number of publications the larger the hub size in the visualization network chart. The collaborative network is divided into 3 clusters.

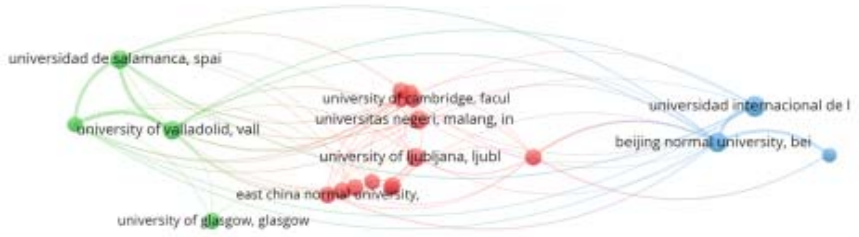


Figure 3. Collaboration Network among Top 20 Organisations

45 MOST PRODUCTIVE AUTHORS

In all, a total of 308 authors have contributed to literature on'Impact of COVID-19 on Education'. Of these, 198 authors published 1 paper each, 89 authors 2 papers each, 12 authors 3 papers each, and 4 authors 4-6 papers each. Of the top 20 authors, 4 were from Spain, 2 each from China and U.K. and 1 each from Hong Kong, Iraq, Indonesia, Ireland, Kuwait, Malaysia, New Zealand, Norway, Poland, Turkey, Yemen and USA. The research productivity of top 20 most productive authors varied from 2 to 6 publications per author. Together they contributed a 6.17% (64) global publications share and a 22.01% (568) global citations share during the period. A scientometric profile of top 20 most productive authors is presented in Table 6. On further analysis, it was observed that four authors contributed publications above their group average productivity (3.2). Five authors registered citation per paper and relative citation index above the group average (8.88 and 3.56).

Table 6. Scientometric Profile of Topmost20 Productive Authors Contributing on 'Impact of COVID-19 on Education'

S.No	Name of the Author	Affiliation of the Author	TP	TC	CPP	HI	ICP	ICP (%)	RCI
1	F.J. Garcia-Penalvo	Universidad de Salamanca, Spain	6	142	23.67	3	1	16.67	9.50
2	D. Burgos	International University of La Rioja, Spain	5	3	0.60	1	5	100.00	0.24
3	A. Tlili	Beijing Normal University, China	5	3	0.60	1	4	80.00	0.24
4	M.W. Romaniuk	The Maria Grzegorzeooska University, Poland	4	5	1.25	2	0	0.00	0.50
5	V.Abella - Garcia	Universidad de Leon, Spain	3	93	31.00	2	0	0.00	12.45
6	C.Connolly	National University of Ireland, Galway, Ireland	3	22	7.33	2	2	66.67	2.95
7	A.Corell	Universidad de Valladolid, Spain	3	136	45.33	3	0	0.00	18.21
8	T.Crick	Swansea University, U.K.	3	6	2.00	1	0	0.00	0.80
9	R.Huang	Beijing Normal University, China	3	1	0.33	1	2	66.67	0.13
10	R.Iyengar	Columbia University, USA	3	10	3.33	2	0	0.00	1.34
11	T.Karakose	Oumlupinar University, Turkey	3	3	1.00	1	0	0.00	0.40
12	B.L. Moorhouse	University of Kong Kong	3	73	24.33	1	0	0.00	9.77
13	R.Scherer	Universitetet i Oslo, Norway	3	9	3.00	1	2	66.67	1.20
14	M.Tesar	University of Auckland, New Zealand	3	41	13.67	3	2	66.67	5.49
15	R.Watermeyer	University of Bristol, U.K.	3	6	2.00	1	1	33.33	0.80
16	A.A, Yassin	Ibb University, Yemen	3	0	0.00	0	3	100.00	0.00
17	A.A.Abdulmahsin	University of Mosul, Iraq	2	0	0.00	2	0	0.00	0.00
18	R.Alhajri	Public Authority of Applied Education & Training, Kuwait	2	0	0.00	0	2	100.00	0.00
19	R.Amelia	Universiti Teknologi Malaysia	2	0	0.00	0	1	50.00	0.00
20	A.Ana	UNiversitas Pendidikan Indonesia	2	15	7.50	1	0	0.00	3.01
		Total of 20 authors	64	568	8.88	1.4	25		3.56
		Global total	1038	2581	2.49				
		Share of top 20 authors in global total	6.17	22.01					
TP=Total Papers; TC=Total Citations; CPP=Citations Per Paper; HI=H-Index; ICP=International Collaborative Papers; RCI=Relative Citation Index									

451 COLLABORATIVE LINKAGES AMONG TOP 20 AUTHORS

Only 10 out of 20 authors have one to one collaborative linkages and their total collaborative linkages varied from 2 to 6.D. Burgos and A. Tlili registered the highest number of collaborative linkages (4), followed by F.J. Garcia-Penalvo an A. Tlili and F.J. Garcia-Penalvo and A.Corell (3 linkages each),etc. A collaborative networks visualization chart of top 20 most authors is presented in Figure 4. The thickness of the box is proportional to its number of collaborative publications. The bigger the box size and its font size, the more the number of collaborative publications. The chart suggests there has been active collaboration amongst the most productive authors.

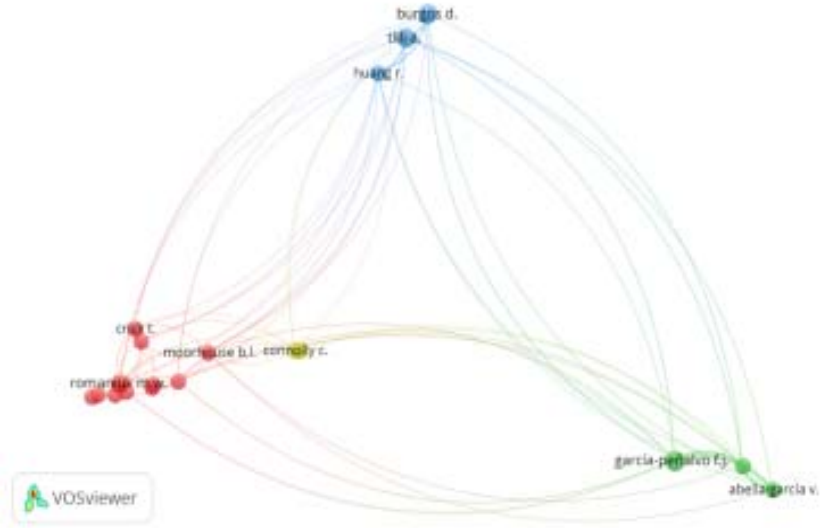


Figure 4. Collaboration Network among Top 15 Authors

46 CHANNELS OF RESEARCH COMMUNICATION

Of the total world output in "*Impact of COVID-19 on Education*", 81.50% (846) share appeared in journals, 14.74% (153) in conference proceedings, 3.37% (35) in book series and the remaining 0.30% (4) in trade journals. A total of 398 journals reported a total of 846 articles. Of these, 375 published 1-5 papers each, 14 published 6-10 papers each, 8 published 11-20 papers each and 1 journal published 44 papers.

The top 20 most productive journals accounted for a 28.49% share of global output in "*Application of "COVID-19 on Education". The top 8 most productive journals are: Sustainability. Switzerland (44 papers), Milli Egitin*

and Prospects (16 papers each), Journal of Chemical Education, Journal of Education for Teaching and Perspectives in Education (14 papers each), International Review of Education (13 papers) and Education & Information Technologies (!2 papers). *The top 8 most impactful journals were: Journal of Education for Teaching* (16.0), *European Journal of Teachers Education* (5.25), *Prospects* (9.19), *Sustainability. Switzrland* (3.95), *Journal of Chemical Education* (3.43), *Educational Philsophy & Theory* (3.0), *Frontiers in Education* (2.75) *and Education Sciences* (2.75).

Figure 5 represents a co-citation network visualization chart of top most 20journals. The chart was generated using VOSviewer tool. The network chart is divided into 7 clusters. Cluster 1 has 11 sources followed by cluster 2 have 10 sources, cluster 3 has 5 sources and cluster (4, 5, 6 and 7) have1 source each.

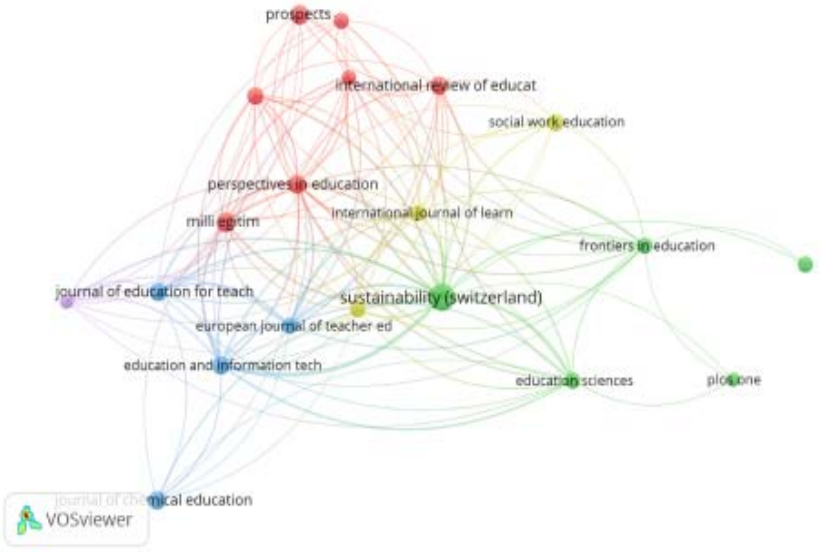


Fig 5. Co-citations Networks Map of Top 20 most productive journals

47 HIGHLY-CITED PAPERS

Of the total 1038 global publications on 'Imapct of COVID-19 on Education", 18 papers (a 1.73% share) registered 51 to 294 citations per paper. These 133 papers are assumed here as highly- cited papers and together received 1289 citations, since their publication, with an average of 71.61 citations per paper. The distribution of 18 highly cited papers is highly skewed: 14 papers each registered citations in the range 51-90, 2 papers in citation range 103-131 and 2 papers in citation range 201-294. Among the 18 highly cited papers (11

articles, 3 reviews, 2 letters, 1 each as editorial and note), 10 involved zero collaboration, 4 national and 4 international collaboration. Among 18 highly cited papers, USA contributed the highest number of papers (8), followed by U.K. (4 papers), Canada (3 papers), Australia (2 papers), and Brazil, Greece, Hong Kong, Ireland, New Zealand and Singapore (1 paper each). The 48 organizations and 78 authors participated in these 18 high cited papers. These 18 high cited papers are published in 15 journals.

5 SUMMARY AND CONCLUSION

This study examined the global research output (1038 records) on 'Impact of COVID-19 on Education' indexed in Scopus database. It evaluated research performance of this theme using quantitative and qualitative matrices. The study examines productivity of leading participated countries, organisations, authors and journals and presented an analysis of collaborative networks linkages between them.1038 global publications received 2581 citations, with an average 2.486 citations per paper (CPP) since publication. The extramural and sponsored research papers accounted for a 12.81%) share of its total publications and it performed better on citation metric with a score of 3.16 citations per paper, and above the global average of 2.486 CPP.

Although participation in research on theme "Application of COVID-19 on education" is global, but only a small group of 10 countries out of the 107 that account for the most global share in publications and citation (62.14% and 74.89%). USA occupied the first rank in global output among most productive countries, with a global share of 12.81%. The quantitative performance of next 6 countries, U.K., Indonesia, China, Spain, Australia and India in terms of global share lies from 5.11% to 7.90%), etc respectively. In terms of qualitative performance measured on the citation per paper and relative citation index metrix, only 4 countries performed well above group average of 1.20:Canada (3.14), Spain (2.32), India (1.25%) and U.K (1.24). The share of international collaborative papers in publication output of top 10 countries varied from from 15.19% to 57.32%, with an average of 35.66%

Social Sciences is the most popular subject in research on the theme "Application of COVID-19 on Education", which accounts for a 73.89% global share, followed by Computer Science (22.64%), Engineering (10.79%) and other four subjects, namely Business, Management & Accounting, Environment Science, Arts & Humanities and Psychology (from 6.55% to 8.19%).

272 organisations and 308 authors partcipitated in global research on "Impact of COVID-19 on education", of which the top 20 most productive

organizations and authors contributed a 13.20% and 6.17% global publications share and a 26.04% and 22.01% global citations share. The top 5 most productive organizations are Beijing Normal University, China (11 papers), Universidad de Salamanca, Spain (10 papers), Univerza v Ljubljani, Slovenia and International University of La Rioja, Spain (9 papers each). The top 5 most impactful organizations in terms of citation per paper and relative citation index are Universidad de Valladolid, Spain (29.0 and 11.65), Universidad de Salamanca, Spain (14.30 and 5.74), Swansea University, U.K. (12.5 and 5.02) and University of Auckland, New Zealand (9.0 and 3.61). The five most productive authors are F.J. Garcia-Penalvo (6 papers), D. Burgos and A. Tlili (5 papers each), M.W. Romaniuk (4 papers) and V.Abella – Garcia (3 papers). The five most impactful authors are A.Corell (45.33 and 18.21), V. Abella – Garcia (31.0 and 12.45), B.L. Moorhouse (24.33 and 9.77), F.J. Garcia-Penalvo (23.67) and M.Tesar (13.67 and 5.49).

The top 5 most productive journals are: *Sustainability. Switzrland* (44 papers), *Milli Egitin* and *Prospects* (16 papers each), *Journal of Chemical Education* and *Journal of Education for Teaching*. The top 5 most impactful journals in terms of citations per paper are: *Journal of Education for Teaching* (16.0), *European Journal of Teachers Education* (5.25), *Prospects* (9.19), *Sustainability. Switzerland* (3.95) and *Journal of Chemical Education* (3.43).

The study concludes that despite global participation in research by as many as 107 countries, the productivity of research on 'Impact of Covid-19 on Education has been low. Besides, only a select few countries have actively partcipitated, with output less than 10% and also low in terms of citation impact The analysis presented in this study should be of interest to policy-makers and other stake holders, especially to those in developing countries. It will help to understand the status of research in their respective countriesand guide them in evolving strategies to plan investments in this theme aimed at strengthening research infrastructure, and initiating new programmes for manpower development and collaboration in the domain.

REFERENCES

1. Karakose, T. and Malkoc, N. Behavioral and interpersonal effects of the COVID-19 epidemic on frontline physicians working in Emergency Departments (EDs) and Intensive Care Units (ICUs). *Acta Medica Mediterranea*, 2021, 37, 437-444. https://doi.org/10.19193/0393-6384_2021_1_68
2. Qiu, J., Shen, B., Zhao, M., Wang, Z., Xie, B. and Xu, Y.. A nationwide survey of psychological distress among Chinese people in the COVID-19

epidemic: implications and policy recommendations. *General Psychiatry*, 2020, 33(2), Article e100213. https://dx.doi.org/10.1136%2Fgpsych-2020-100213

3. Torales, J., O'Higgins, M., Castaldelli-Maia, J. M. andVentriglio, A. The outbreak of COVID-19 coronavirus and its impact on global mental health. *International Journal of Social Psychiatry*, 2020, 66(4), 317-320. https://doi.org/10.1177%2F0020764020915212
4. Ferrel, M. N. and Ryan, J. J. The impact of COVID-19 on medical education. *Cureus*, 2020, 2(3), e7492. https://dx.doi.org/10.7759%2Fcureus.7492
5. He, H., and Harris, L. (2020). The impact of Covid-19 pandemic on corporate social responsibility and marketing philosophy. *Journal of Business Research*, 2020, 116, 176-182. https://doi.org/10.1016/j.jbusres.2020.05.030
6. Chick, R. C., Clifton, G. T., Peace, K. M., Propper, B. W., Hale, D. F., Alseidi, A. A. and Vreeland, T. J. Using technology to maintain the education of residents during the COVID-19 pandemic. *Journal of Surgical Education*, 2020, 77(4), 729-732. https://doi.org/10.1016/j.jsurg.2020.03.018
7. Murphy, M. P.. COVID-19 and emergency eLearning: consequences of the securitization of higher education for post-pandemic pedagogy. *Contemporary Security Policy*, 2020, 41(3), 492-505. https://doi.org/10.1080/13523260.2020.1761749
8. Lee, S. J., Ward, K. P., Chang, O. D. and Downing, K. M. Parenting activities and the transition to home-based education during the COVID-19 pandemic. *Children and Youth Services Review*, 2021, 122, Article 105585. https://doi.org/10.1016/j.childyouth.2020.105585
9. Karakose, T., Yirci, R., Basyigit, H., & Kucukcakir, A. Investigation of associations between the effects of COVID-19 fear on school administrators and nutrition and problematic eating behaviors. *Progress in Nutrition*, 2021, 23(2): e2021187. https://doi.org/10.23751/pn.v23i2.11656
10. Longhurst, G. J., Stone, D. M., Dulohery, K., Scully, D., Campbell, T. and Smith, C. F. Strength, weakness, opportunity, threat (SWOT) analysis of the adaptations to anatomical education in the United Kingdom and Republic of Ireland in response to the Covid 19 pandemic. *Anatomical Sciences Education*, 2020, 13(3), 301-311. https://doi.org/10.1002/ase.1967
11. Gupta, B.M, Dhawan, S., Mueen Ahmed, K., and Mamdapur, G. M. Global Research on COVID-19 disease: A scientific assessment of publications during 2020–21. *International Journal of Medicine and Public Health* 2021, 11(2), 76–84. https://doi.org/10.5530/ijmedph.2021.2.14

12. Karakose, T. and Demirkol, M. Exploring the emerging COVID-19 research trends and current status in the field of education: A bibliometric analysis and knowledge mapping. *Educational Process: Internationa Journal*, 2021, 10(2): 7-27. DOI: 10.22521/edupij.2021.102.1
13. Yavuz, M., Kayalý, B. and Tutal, Ö. Trend of distance education research in the Covid-19 period: A bibliometric and content analysis. *Journal of Educational Technology & Online Learning*, 2021, 34(2), 256-279.
14. Mustapha,Ishamuddin, Van, Nguyen Thuy, Shahverdi,Masoumeh,Qureshi, Muhammad Imran and Khan, Nohman. Effectiveness of digital technology in education during COVID-19 pandemic. A bibliometric analysis. *iJIM. International Journal of Interactive Mobile Technologies* 2021, 15(8)
15. José-Antonio Marín-Marín. COVID-19 and education . https:// encyclopedia.pub/10881 (Accesed on 5.7.21)