Two decades of research on Online Learning published by Springer Link: A bibliometric analysis

Manashjyoti Deka¹, Dibanjyoti Buragohain², Amit Kumar³
¹˒²Mizoram University
³Central University of Gujarat

Abstract: The emergence of online learning has acquired the attention of learners and educators in the 21st century. The need has arisen especially when the world has suffered from the Covid-19 pandemic, the institutions of higher learning have come up with the latest technologies to combat the learning environment scenario. The present study mainly analysis the existing works of literature published on the topic of online learning which is abstracted from SpringerLink. The bibliometrics method of analyzing the data was adopted for the study. The study analysis the components such as the growth of literature,year-wise distribution, annual growth rate (AGR), compound annual growth rate (CAGR), relative growth rate (RGR), and doubling time (DT) of the publications authorship pattern and authors productivity of literature, Study the citation, altmetrics, download and access pattern of literature, the most prominent journals, publisher-wise, country-wise distribution of literature, most productive institutions and top-cited paper in the published literature on "online learning". The study shows that the highest number of publications can be noticed from the conference papers and there is a frequent rise in publications. The annual growth rate of the published literature is 533.34 in 2003 and the number of authors per publication on average was highest in 2017. The study shall contribute to examining the existing scenario of the published literature measurement on online learning and shall encourage more exciting researchers and academicians to work more in this specific field.

1.   Introduction

The concept of "Online Learning" can be explained as the process of learning which occurs over the internet entirely or partially. The Online Learning includes course materials delivery, online interactive sessions, online communications and assessing the students via online (Liu, 2011). Some of the important components associated with online learning/E-learning are accessibility, economical, flexibility, learning pedagogy and life-long learning (Aslam and Sonkar, 2021). One of the important advantages of online learning is it can be easily accessible to the rural and remotes corner where the education can be acquired at minimum cost (Chandwani, Singh and Singh, 2021). Online learning or E- Learning has given birth to new concepts such as blended learning and flipped classroom which enhances the learning capacity of the students (Dhawan, 2020).

The concept of *Online Learning* gains its attention and popularity in the mid- 1990s where there was wide spread of internet and the World Wide Web and it is the newest progress of Distance Education. The university of Wisconsin become the first licensed radio station where the broadcasting were primarily for educational purpose in 1919. In 1930s, the University of Lowa began to conduct the clinical experiment with television for the educational motive (Moore, Dickson-Deane and Galyen, 2011). The wide popularity of online learning emerged when in California; the Western Behavioural Sciences Institute has opened the School of Management and strategies (Kumar et.al. 2021). This online learning process includes several factors such as content delivery, types of communications, anxiety level and skill level of the learners. Although there are merits of this form of learning but there are also disadvantages which are equally important to be taken into consideration. The prime focus of the study is analyzing the types of publications on the topic of "online learning" by using bibliometrics method of analysis.

Online Learning can be defined as "Online learning refers to a mode of education that utilizes the internet and digital technologies as the primary means of delivering educational content and facilitating learning interactions. It involves the use of various online platforms, learning management systems, and virtual learning environments to enable

learners to access educational materials, participate in interactive activities, and engage in collaborative discussions with instructors and peers, irrespective of their geographical location and time constraints. Online learning encompasses a wide range of instructional approaches, including but not limited to fully online courses, blended learning models that combine online and face-to-face elements, massive open online courses (MOOCs), and virtual classrooms." (Allen & Seaman,2020)

1.1 Various factors for the growth of Online Learning

The prevalent situation for the growth of online learning is featured by rapid growth, increasing acceptance and continuous innovation. As the COVID-19 hit globally, the educational institutions, corporate training programs and lifelong learning platforms had felt the need for acceptance of online learning as the one of the best options for the learners. The below points are key aspects for the current state of Online Learning:

a. **Popularity and Accessibility:** One of the prime reasons for the growth of online learning is the accessibility and flexibility. Now the learners can retrieve their content from anywhere and anytime by using varieties of resources such as mobile phone, tablets and other electronic devices. The increasing growth of internet connections and advancement of ICT had led to the widespread access to online learning strategies.

b. **Diverse Learning Modalities:** It is found that online learning encompasses various modalities that ranges from fully online courses to blended learning models that merge both the online and face to face elements. A significant attention is gained by MOOC wherein it offers free and affordable courses from top level universities and institutions across the globe to the learners.

c. **Technological Advancement:** With the development of technology, many concepts such as LMS (Learning Management System) which provides a centralized platform for course delivery, content management and learner interaction. It is also

to be noted that the due to various video conferencing and virtual classroom tools, it provides a good interaction between learners and instructors and at the same time it provides collaboration and engagements. Many innovative technologies such as virtual reality and augmented reality has offered various immense experiences in online learning.

d. **Pedagogical Approaches:** One of the elements that had led to the gradual development of Online Learning due to interactive and learner-centred pedagogies. In the collaborative learning environment, the learners are exposed to group activities and discussions, promoting knowledge among peers and also the problem-solving strategies.

e. **Quality and Accreditation:** With regards to online learning, it is mandate that the quality of online learning is maintain at the rigorous standards by the institutions and accrediting bodies. It is mention worthy that the Accreditation Agencies has been assigned with the responsibilities for developing criteria and guidelines specific to online programs that matches the standards to that of traditional courses. Factors such as quality assurance processes, learner support services and instructor training programs has huge contribution for enhancing the quality of online learning.

These factors emphasise the current state of online learning, which is defined by its widespread use, technological developments, shifting pedagogies, and ongoing efforts to ensure quality and inclusivity. As online learning evolves, it has the potential to alter education and training by offering learners globally with flexible and accessible learning possibilities.

2. A learner perspective on Online Learning

Online learning is believed to be one of the most innovative and interesting ways of learning and teaching methodology. Several studies have been conducted to understand the perception of the students concerning online learning methods and it was found that the students

who had well-rested are more productive in their work and skills as compared to sleep-deprived students. The student gets chances to sleep as they don't have to communicate as compared to the traditional school courses. Another point that was highlighted from the study is that students abstain from distraction as they are alone with some technological devices this has made them focus and ready to learn. Online learning has given the platform for the learner to study at their own pace which indicates greater productivity and development competency (Chandwani ;Singh & Singh, 2021). A person might go through several problems and obstacles in their personal life where this online learning shall help continue their education and make them remain focused on their studies. Online learning provides the platform for a person who might have a passion for some other professions such as music, sports, culinary skills, marketing professionals, and aviation industry professionals which permits them to pursue additional skills.

3.   Review of Literature

To authenticate and get the idea about concept, the following piece of literatures has been consulted for the purpose of the study such as *Tawiah, R. Okyere, GA., Lamptey, R. Oduro,W, and Thompsom M. (2019)* in their study has focus primarily on the policies and programmes which enhanced the E-learning practices awareness among the professors, library professionals, IT professionals and many more in the Kwame Nkrumah University of Science and Technology. The result claim that 84.1% and 87.1% of the academic managers and teaching professionals respectively has projected that there is no policy for introduction of e-learning in the courses. *Sobral (2021)* in his paper has discussed about the production of e- learning in journals published on Elsevier's scopus databases. The results obtained from the data analysis portraits that there is a rapid increase in term of publications which emphasis on e-learning. The analysis has drawn a map of journals, languages, authors, keywords, organisations and countries which were published in the area of e-learning. *Wahid, Ahmi and Alam (2020)* in their paper briefly highlights about the growing importance of MOOCs in global arena by adopting bibliometrics analysis. The analysis was carried out by using 3118 scholarly articles which were related to the

field of MOOCs. The main focus of the study was examination of MOOcs research, key areas, major players of MOOCs research and collaborations. *Yu et al (2020)* in their paper has focus on the publications globally related to Covid- 19 pandemic by adopting bibliometrics analysis method. The results speaks that a total of 3626 publications were identified on Covid-19 publications. A total of 2649 link were appreared in the most frequent keywords which has good connections with the words such as "pneumonia" and "epidemiology". *Nisha and Senthil (2015)* in their study highlight the overview of MOOCs in the changing technology environment and its different beneficial aspects. The paper discuss about the different MOOCs platforms and its availability in Indian context. Various Institutions and companies are associated with the MOOCs across India. The paper also discuss about its limitations and the future which are highly beneficial for the socio-economic development of the nation as a whole. *Tripathi and Jeevan (2010)* in their articles highlight the concepts of E- learning in the arena of Library and Information Science in India. In the context of MOOCs, the paper discusses the various methods and steps necessary to be taken up by the institutions to implement various MOOCs courses. *Amoozegar, Khodabandelou and Ebrahim (2018)* in their articles highlight the major trends of research in the occupancy of Distance Education. For the study purpose, the data were obtained from Web of Science databases covering the time frame of 1980 to 2016. The study mainly covered 500 most cited articles where impact factors, journal DOI and keywords were enumerated and examine. *Sivakumaren and Rajkumar (2019)* in their paper examine about the SWAYAM which is an online platform for imparting online education. The study found out that through there is growing number of MOOC courses in past few years but there seems to be decreasing trends with the growth of the courses.

4.   Study Objectives

Looking at the emerging field of research and its importance for the development of literature over the past two decades, it was decided to perform a bibliometric analysis of scientific output in this particular field. The objectives to be included in the study are the following:

- Look into the growth of literature, followed by category and year-wise distribution on 'Online Learning' published by SpringerLink during 2001-2020;
- Determine the annual growth rate (AGR), compound annual growth rate (CAGR), relative growth rate (RGR) and doubling time (DT) of the publications;

- Study authorship pattern and authors productivity of literature followed by the degree of collaboration, collaborative index (CI) and Collaboration Coefficient (CC);

- Study the citation, altmetrics, download and access pattern of literature published by SpringerLink; and
- Find out the most prominent journals, publisher-wise, country-wise distribution of literature, most productive institutions and top cited paper

5.   Scope and Methodology of the Study

The study is an attempt to review the literature published in on "Online Learning" during the period of 2001-2020 through bibliometric lens by applying its metrics. The retrieved bibliographic details and literature published were collected from SpringerLink database (https://link.springer.com) where the paper has "Online Learning" term in their respective entitled. Then the bibliographical details of literature published were recorded in MS-Excel 2019 sheet for the analysis and interpretation of data. The methodology adopted as given in the following:

Figure: Methodology for the data collection and interpretation
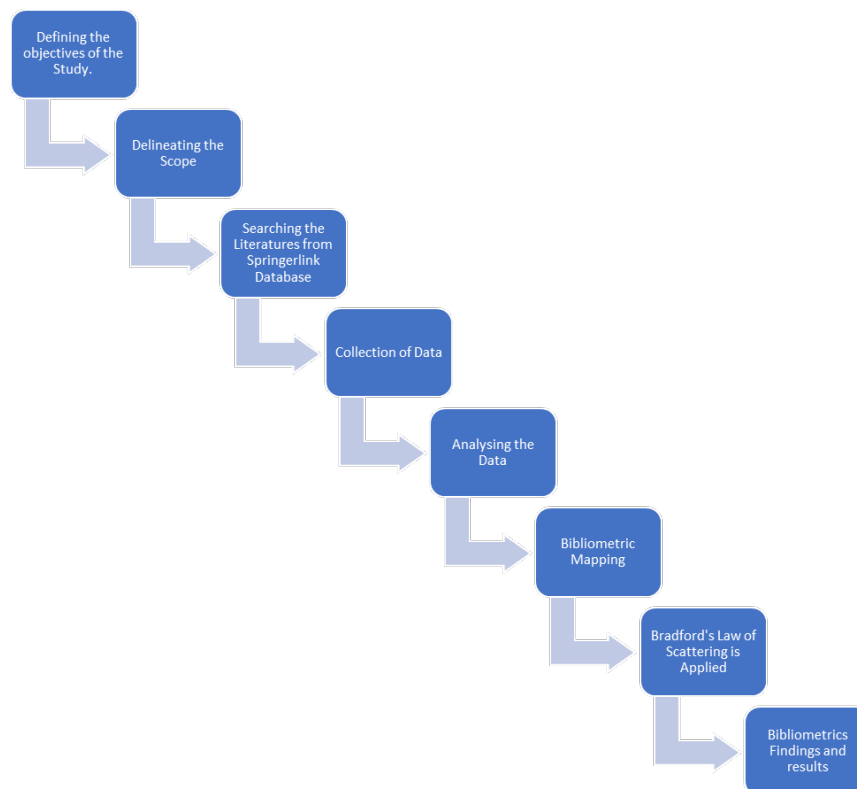
6.   Results and Discussions

Following is the detailed discussion of the study presented through tables, diagrams, and formulas to calculate the metrics.

Categorise-wise Distribution of Literature

The Table 1 and Figure 1 represents categorise-wise distribution of literature published in the SpringerLink database with a total of 629 numbers of literatures. It can be observed that the major source of publications covered by SpringerLink databases on online learning is Conference Paper with 256 (40.69%) publications which is followed by Journal Article with 219 (34.82%) publications. Chapter ranks the third position with 116 (18.45%) publications. Reference work entry and book has 33 (5.25%) and 5 (0.79%) publications respectively in their respective category. The results indicates that most of the research outcome on the topic during the research period are published in conference paper form.

Table 1: Categorise-wise Distribution of Literature Published

S. N.	Categories of Literature	Literature (no.)	Cumulative No. of Literature	%	Cumulative Percentage	Rank
1	Article	219	219	34.82	34.82	2
2	Chapter	116	335	18.45	53.27	3
3	Conference Paper	256	591	40.69	93.96	1
4	Reference Work Entry	33	624	5.25	99.21	4
5	Book	5	629	0.79	100	5
	Total	**629**				
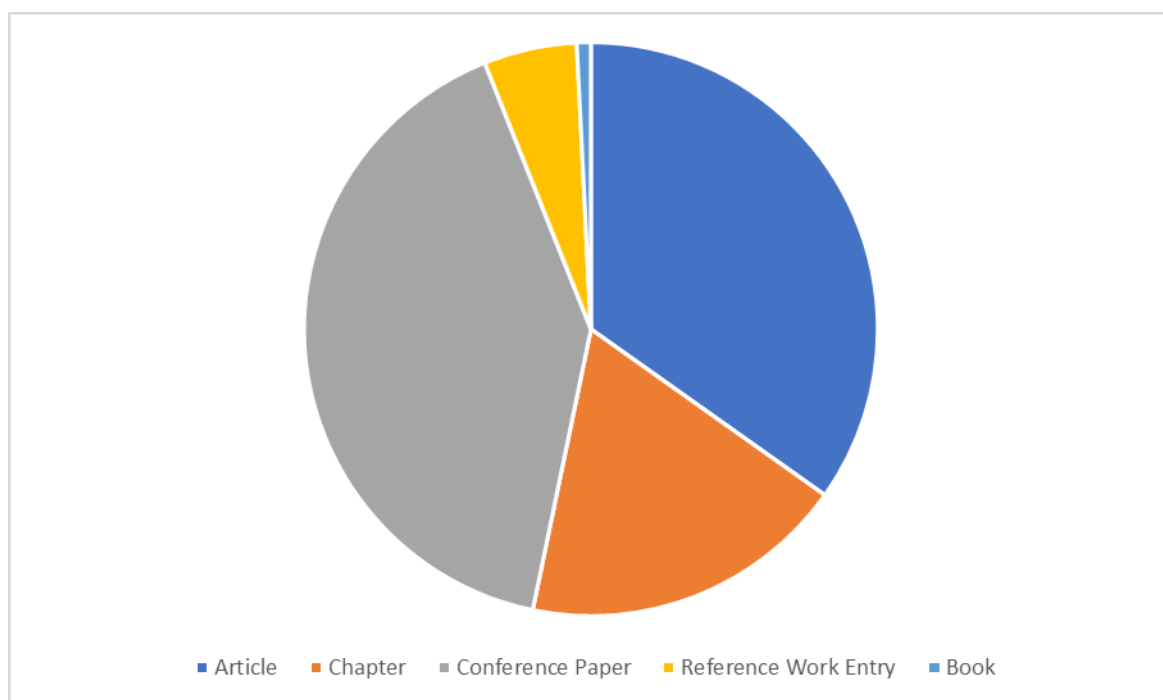
Figure 1: Categorise-wise Distribution of Literature Published

Year-wise Literature

The table 2 and Figure 2 represent year-wise distribution of literature published in the subject of Online Learning from the period of 2001 –

2020. It is observed that the highest number of publications is 100 (15.89%) published in 2020. It is followed by the year 2018 which is rank second in the list with 73 (11.61%) publications. 2001 and 2002 has the lowest publication with 3 (0.47%) each.

Table 2: Year-wise Literature Published

| Year	Literature (in no.)	Cumulative growth of Literature	Percentage	Rank
2001	3	3	0.47	15
2002	3	6	0.47	15
2003	19	25	3.02	11
2004	7	32	1.12	14
2005	13	45	2.07	13
2006	20	65	3.17	10
2007	16	81	2.54	12
2008	16	97	2.54	12
2009	19	116	3.02	11
2010	20	136	3.18	10
2011	37	173	5.88	6
2012	35	208	5.57	7
2013	25	233	3.97	9
2014	34	267	5.41	8
2015	47	314	7.47	4
2016	42	356	6.68	5
2017	37	393	5.88	6
2018	73	466	11.61	2
2019	63	529	10.01	3
2020	100	629	15.89	1
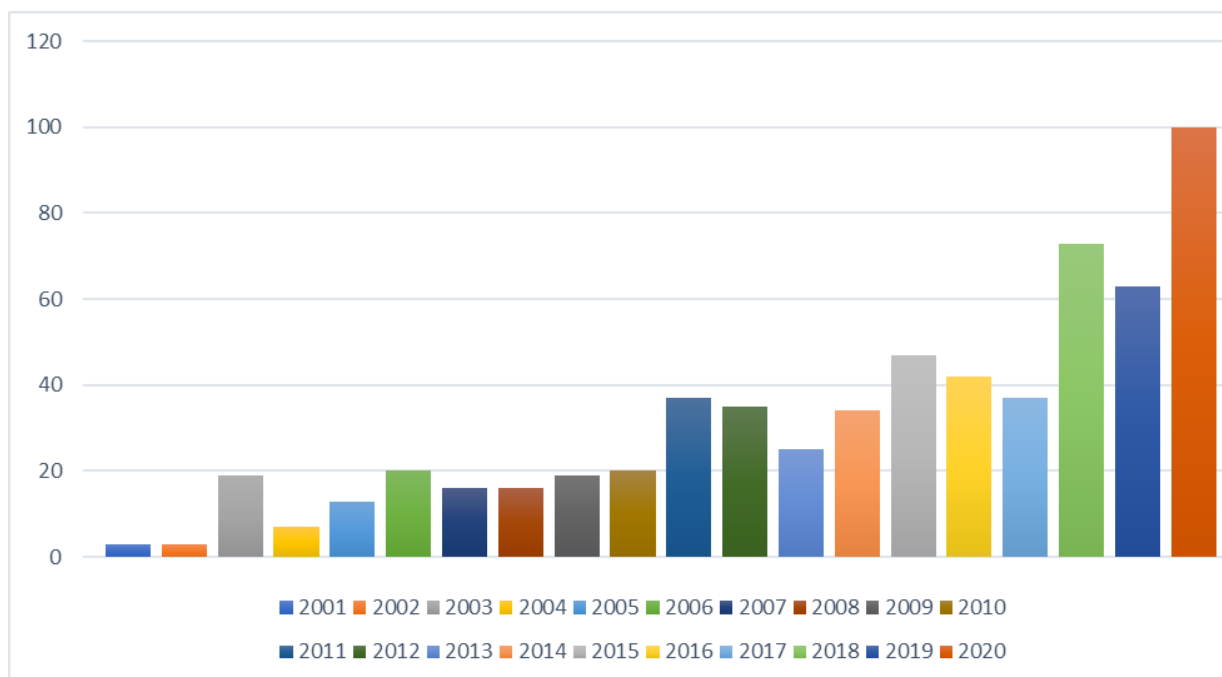
Figure 2: Year-wise Literature Published

Annual Growth Rate (AGR) of Publications

To know the total number of publications in their respective discipline of research, the systematic method for evaluation is followed. The formula that has been applied was used by Kumar and Kaliyaperumal, (2015) to calculate AGR for the period of 2001-2020. The formula is:

$$AGR = \frac{\text{end value - first value}}{\text{first value.}} \times 100$$

The annual growth rate of publication is being presented in Table 3 and Figure 3 from 2001-2020. It is seen from the table that the year 2003 has the highest number of annual growth rate with 533.34. It is followed by 2018 with 97.29 annual growth rates. The year 2004 has the least number of annual growth rate with -63.15.

Table 3: Annual Growth Rate (AGR) of Publications

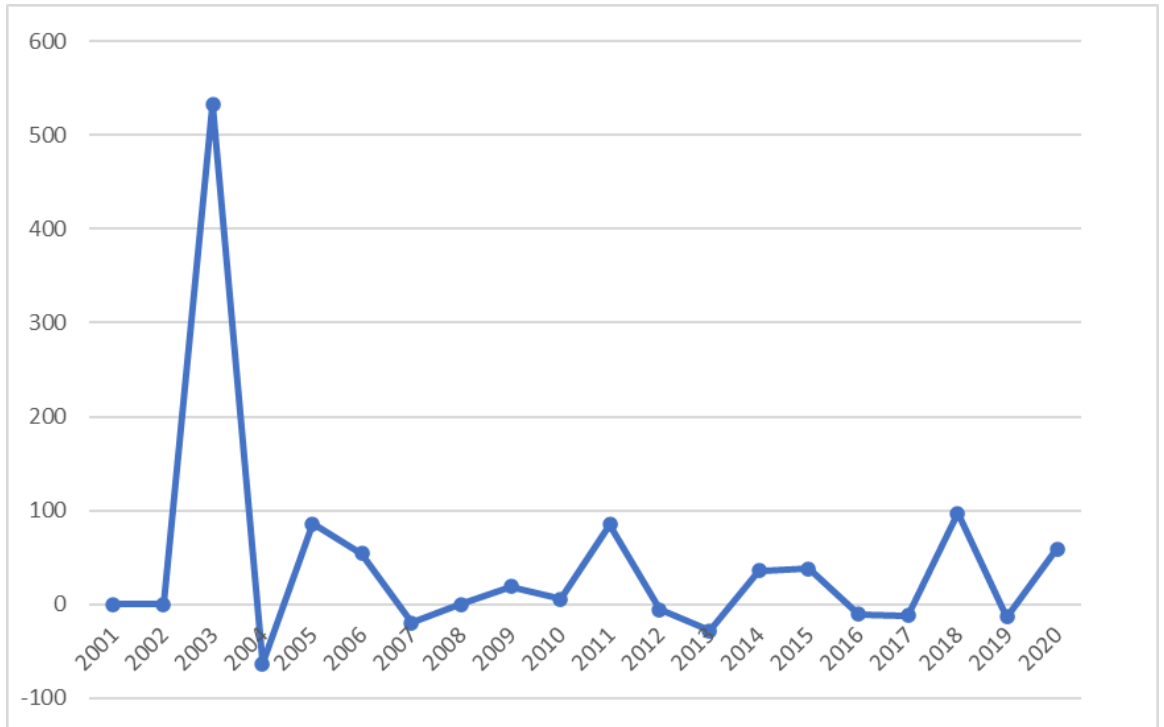| Year	Literature (in no.)	Cumulative growth	AGR (Annual growth rate)
2001	3	3	-
2002	3	6	0
2003	19	25	533.34
2004	7	32	-63.15
2005	13	45	85.71
2006	20	65	53.84
2007	16	81	-20.00
2008	16	97	0
2009	19	116	18.75
2010	20	136	5.26
2011	37	173	85.00
2012	35	208	-5.41
2013	25	233	-28.57
2014	34	267	36.00
2015	47	314	38.23
2016	42	356	-10.63
2017	37	393	-11.91
2018	73	466	97.29
2019	63	529	-13.69
2020	100	629	58.73

Figure 3: Annual Growth Rate (AGR) of Publications

Compound Annual Growth Rate (CAGR):

To understand the compound annual growth rate (CAGR) of the total publication from 2001-2020, the following formula has been used which was earlier incorporated by Kumar and Kaliyaperumal in 2015:

$$CAGR = \left\{ \frac{\text{end value}}{\text{first value}} \right\}^{(1/\#\text{of years})} - 1$$

In table 4 and figure 4, it is observed that the compound annual growth rate is highest in 2002 with 100 and the year 2020 ranked the lowest among the other years i.e. 10.16. It is found from the analysis that there's a rise within the range of publication from 2001-2020 however the compound rate of growth of total publication keeps on degrading with the increasing range of year.

Table 4: Compound Annual Growth Rate (CAGR)

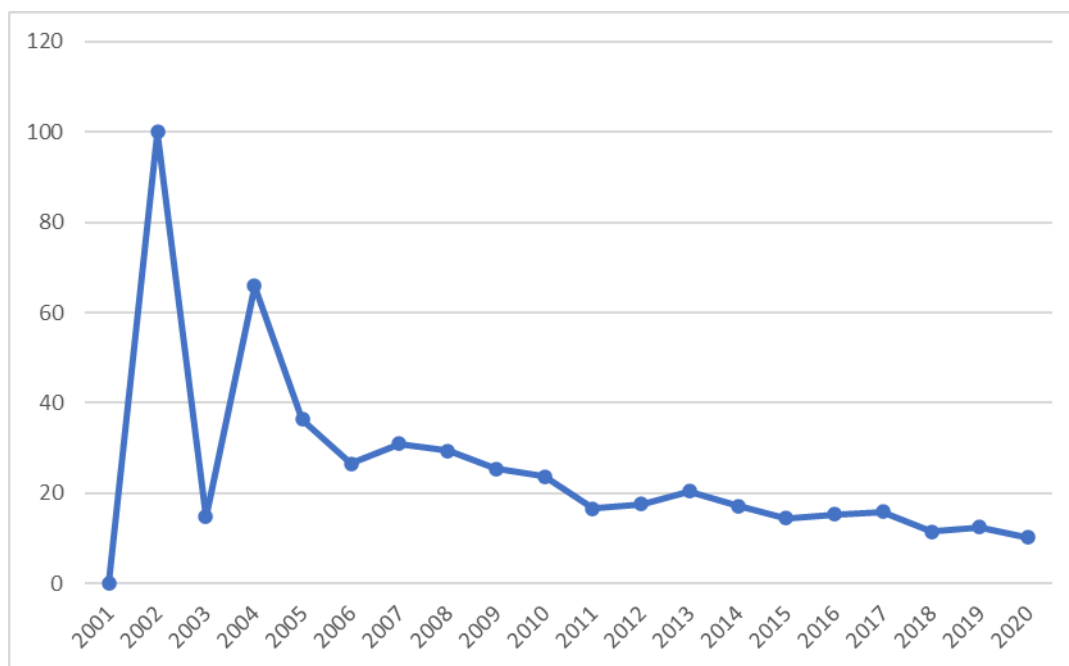| Year	Literature (in no.)	Cumulative growth	CAGR
2001	3	3	-
2002	3	6	100.00
2003	19	25	14.71
2004	7	32	65.96
2005	13	45	36.41
2006	20	65	26.58
2007	16	81	31.03
2008	16	97	29.36
2009	19	116	25.37
2010	20	136	23.73
2011	37	173	16.67
2012	35	208	17.58
2013	25	233	20.44
2014	34	267	17.18
2015	47	314	14.52
2016	42	356	15.31
2017	37	393	15.91
2018	73	466	11.52
2019	63	529	12.54
2020	100	629	10.16

Figure 4: Compound Annual Growth Rate (CAGR)

Relative Growth Rate (RGR) and Double Timing (DT)

To formulate the publications growth rate, the Mahapatra's RGR and DT model, developed by him in 1985 has been used (Mahapatra, 1985). The following formula is used to measure the relative growth rate, $RGR = W2-W1 / T2-T1$

Where,

- RGR denotes the growth rate over a given interval span,
- W1 denotes the loge of the interval (natural log of the initial number of contributions)
- W2 = Log (natural log of the final number of contributions)
- T1 is the initial time unit.
- T2 denotes the final time unit

The Table 5 and Figure 5 represent the relative growth rate and double timing of the total number of publications from 2001-2020. It was noticed from Table 5 and figure 5 that the relative growth rate (RGR) has been decreasing with the passing of the year. The highest relative growth rate is seen in 2003 with 1.42712 and the lowest is seen in 2017 with

0.09887. Through the publication has increase, it has been observed that there is decline of relative growth rate relatively.

In table 5, the doubling time of the total growth rate of publication is given and observed that there exists a direct equivalence between the doubling time and the relative growth rate. The formula for the calculation of doubling time is:

Doubling Time (DT) = 0.693/R

where R is the Relative Growth Rate.

It is noticed from the table 5 and figure 5, that the doubling time has significantly increased with the approaching of every cumulative year. The highest is seen in 2017 with 7.00921 and the lowest is seen in 2003 with 0.48559.

Table 5: Relative Growth Rate (RGR) and Doubling Time (DT)

Year	Literature (in no.)	Cumulative growth	W_1	W_2	RGR (relative growth rate)	DT (Doubling time)
2001	3	3	-	1.09861	-	-
2002	3	6	1.09861	1.79175	0.69314	0.99979
2003	19	25	1.79175	3.21887	1.42712	0.48559
2004	7	32	3.21887	3.46573	0.24686	2.80725
2005	13	45	3.46573	3.80667	0.34094	2.03261
2006	20	65	3.80667	4.17438	0.36771	1.88463
2007	16	81	4.17438	4.39445	0.22007	3.14899
2008	16	97	4.39445	4.57471	0.18026	3.84445
2009	19	116	4.57471	4.75359	0.17888	3.87411
2010	20	136	4.75359	4.91265	0.15906	4.35684
2011	37	173	4.91265	5.15329	0.24064	2.87982
2012	35	208	5.15329	5.33753	0.18424	3.76139
2013	25	233	5.33753	5.45103	0.11350	6.10572
2014	34	267	5.45103	5.58724	0.13621	5.08773
2015	47	314	5.58724	5.74939	0.16215	4.27382
2016	42	356	5.74939	5.87493	0.12554	5.52015

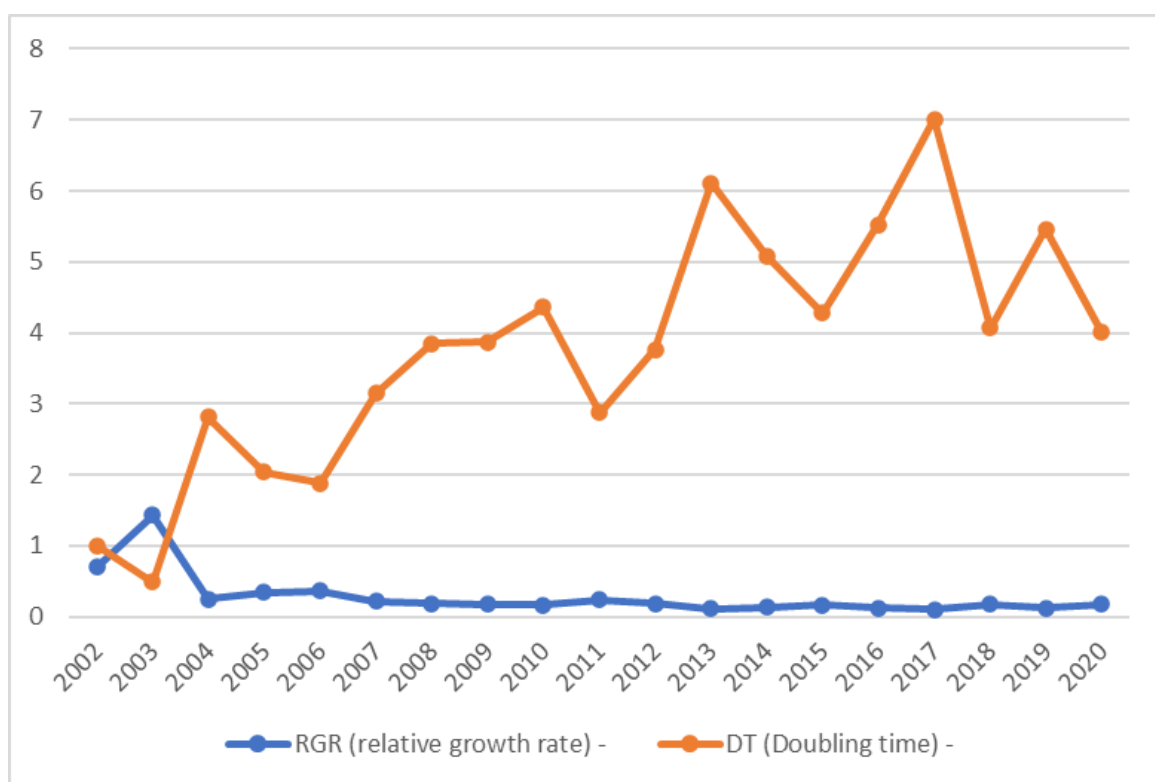| 2017 | 37 | 393 | 5.87493 | 5.97380 | 0.09887 | 7.00921 |
2018	73	466	5.97380	6.14418	0.17038	4.06737
2019	63	529	6.14418	6.27098	0.12680	5.46529
2020	100	629	6.27098	6.44413	0.17315	4.00231

Figure 5: Relative growth rate (RGR) and Doubling Time (DT)

Authorship Pattern

To determine the percentage of single and multiple authors and their ranking, the authorship pattern was analysed. From the Table 6 and Figure 6 it is observed that out of 629 literatures, maximum of 178 (28.29%) literature were produced by two authors, followed by three authors 139 (22.09%). A number of 119 (18.92%) literatures were produced by single author. It was observed that the trend of multiple authorships prevails among the authors of the literature published on the concept of online learning.

Table 6: Authorship Pattern

S.N.	Authorship Pattern	No. of Items	Percentage	Rank
1	Single Author	119	18.92	3
2	Two Authors	178	28.29	1
3	Three Authors	139	22.09	2
4	Four Authors	106	16.85	4
5	Five Authors	48	7.63	5
6	More than Five Authors	39	6.20	6
Total		**629**		
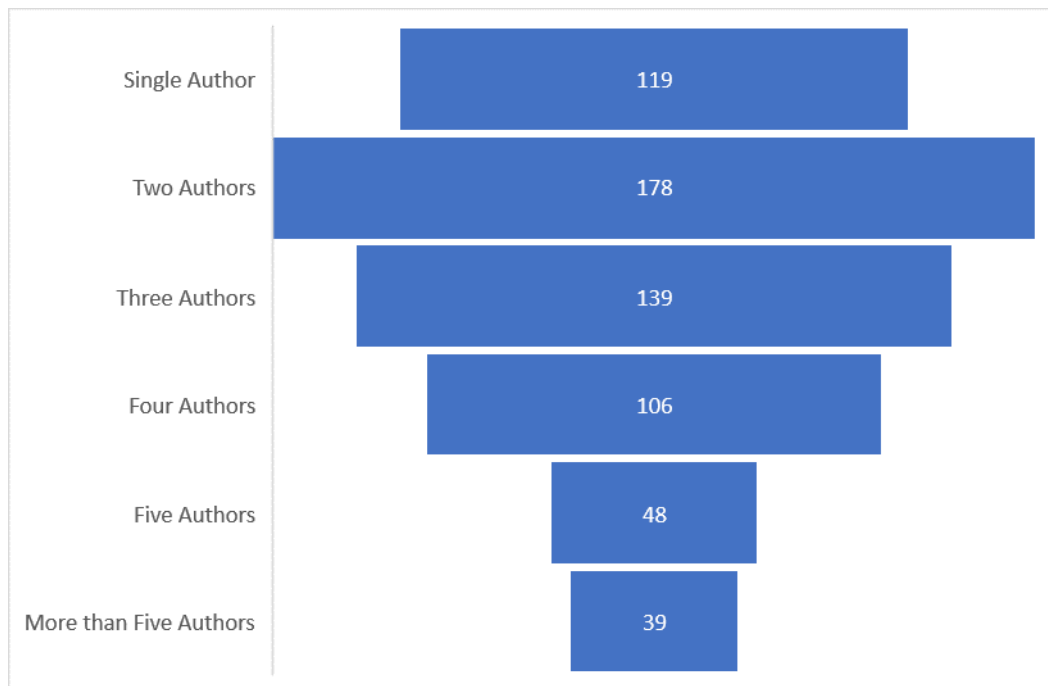
Figure 6: Authorship Pattern

Co-Authorship Pattern

Degree of Collaboration (DC): The definition of degree of collaboration is the ratio between the total number of collaborative research articles and the total number of research articles during a given period of time. The following formula was suggested by Subramanyam (1983) by which he used to calculate DC.

$$C = \frac{N_m}{N_m + N_s}$$

Where,

C = Degree of collaboration.

N_m = Number of multi-authored research papers published during a year.

N_s = Number of single authored research papers in the discipline published during a year.

In table 7 and Figure 7, the co-authorship pattern of the literatures published was discussed. The highest degree of collaboration was 0.92 in 2013 and the lowest degree of collaboration is 0.57 in 2004.

Collaborative Index (CI): This is one of the early measures of degree of collaboration derived by Lawani (1980)

$$\textbf{CI} = \sum_{f} = \frac{A \quad {}^1\!/\!fi}{N}$$

It is a measure of mean number of authors. Although it is easily computable, it is not easily interpretable as a degree, for it has no upper limit moreover; it gives a non-zero weight to single-authored papers, which involve no collaboration. (Neelamma and Gavisiddappa, 2018).

It is observed from the table 7 and figure 7 that collaborative index (CI) of 2017 has the highest number of authors pattern with 3.16 which is followed by 3.14 in 2020. The lowest number of collaborative index was seen as 2.00 in 2001 and 2004.

Collaboration Coefficient (CC): the purpose of it is to remove the shortcomings pertaining to Degree of collaboration and collaborative index. The following formula given by Savanur & Srikanth (2010) is adopted for calculation:

$$CC = 1 - \frac{\sum_{j=1}^{k}\left(\frac{1}{j}\right)f_j}{N}$$

Where, '*j*' denotes the authorship in an article; '*fj*' denotes the number of j authored articles; '*k*' is the greatest no. of authors per paper; and '*N*' denotes the total number of articles published in a year.

Collaborative coefficient is a number between 0 and 1, whatever the number is closer to 1 indicates more collaboration between authors.

The table 7 and figure 7 represents collaboration co-efficient of co-authorship pattern from the total number of publications of literature. It is observed that the year 2013 has the highest collaboration co-efficient of 0.60. It is followed by 2020 with 0.58 and 2018 with 0.57 respectively. The least number of co-efficient was found in 2004 with 0.35.

Table 7: Co-Authorship Pattern

| Year	Total	1 (Author)	2	3	4	5	5<	DC	CI	CC
2001	3	1	1	1	-	-	-	0.67	2.00	0.39
2002	3	1	1	-	1	-	-	0.67	2.34	0.42
2003	19	7	6	2	3	1	-	0.63	2.21	0.39
2004	7	3	2	1	1	-	-	0.57	2.00	0.35
2005	13	3	3	5	1	1	-	0.76	2.53	0.49
2006	20	7	6	2	3	-	2	0.65	2.45	0.42
2007	16	2	9	-	4	1	-	0.87	2.31	0.52
2008	16	6	2	-	5	2	1	0.62	2.87	0.45
2009	19	4	6	2	4	2	1	0.78	2.84	0.51
2010	20	5	7	4	3	1	-	0.75	2.40	0.47
2011	37	9	10	7	6	3	2	0.75	2.56	0.50
2012	35	5	10	12	3	3	2	0.85	2.85	0.56
2013	25	2	9	5	4	4	1	0.92	3.08	0.60
2014	34	5	11	9	7	1	1	0.85	2.73	0.55
2015	47	10	13	9	12	2	1	0.78	2.71	0.51
2016	42	9	9	6	14	1	3	0.79	2.95	0.54
2017	37	9	4	9	5	7	3	0.76	3.16	0.53
2018	73	9	19	27	8	3	7	0.87	2.97	0.57
2019	63	9	18	19	11	2	4	0.85	2.85	0.56
2020	100	13	32	19	11	14	11	0.87	3.14	0.58
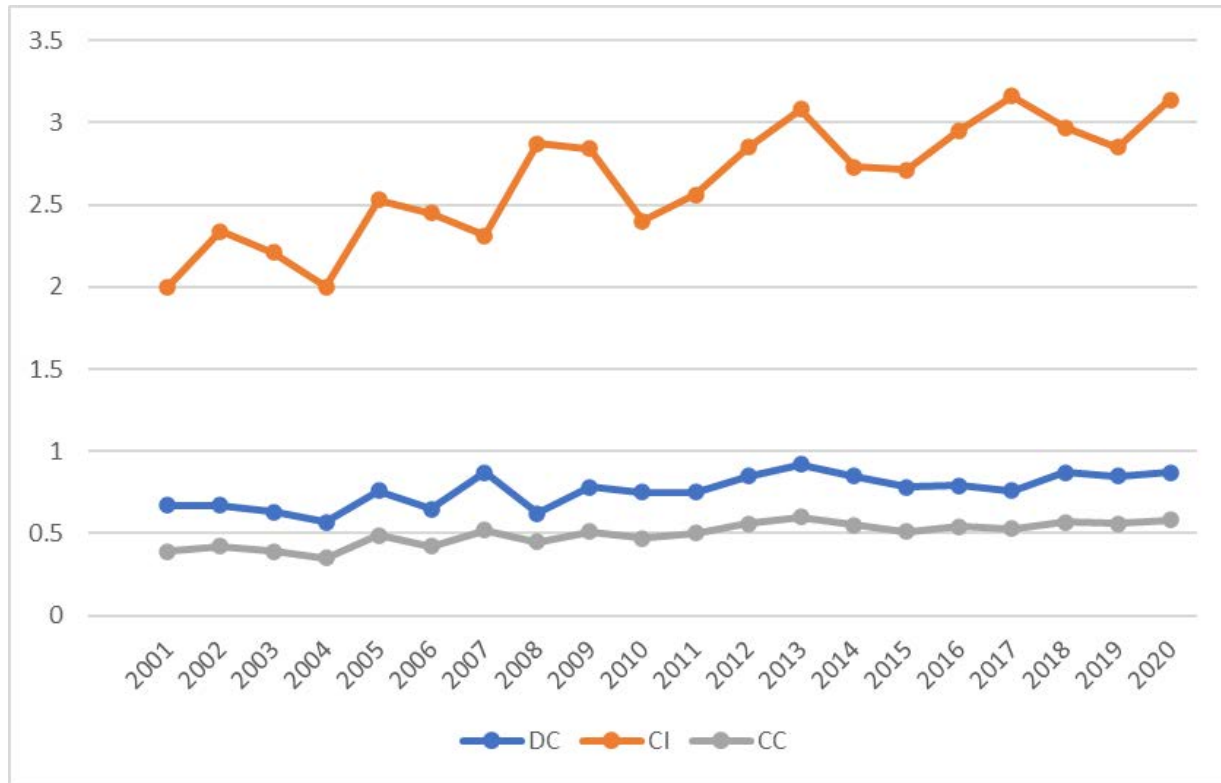
Figure 7: Co-Authorship Pattern

Author Productivity

The formula which was given by Yoshikane et al. (2009) to calculate average author per paper (AAPP) and productivity per author has been used as below:

> Average author per paper = Number of authors / Number of papers
>
> Productivity per author = Number of papers / Number of authors

Table 8 and Figure 8 portrays the average number of authors per paper and the productivity per author of research publications from 2001 to 2020 in SpringerLink The average number of authors per publication was highest in the year 2017 i.e. 3.08. The productivity per author was highest in the year 2001 and 2004 i.e. 0.50.

Table 8: Author productivity

| Year	Total no. of Papers	Total no. of Authors	Average Author per Paper	Productivity per Author
2001	3	6	2	0.50
2002	3	7	2.34	0.42
2003	19	42	2.21	0.45
2004	7	14	2	0.50
2005	13	33	2.53	0.39
2006	20	47	2.35	0.42
2007	16	41	2.56	0.39
2008	16	45	2.81	0.36
2009	19	53	2.78	0.35
2010	20	48	2.40	0.41
2011	37	99	2.67	0.37
2012	35	98	2.80	0.35
2013	25	76	3.04	0.32
2014	34	92	2.71	0.36
2015	47	126	2.68	0.37
2016	42	121	2.88	0.34
2017	37	114	3.08	0.32
2018	73	210	2.87	0.34
2019	63	176	2.79	0.35
2020	100	303	3.03	0.33
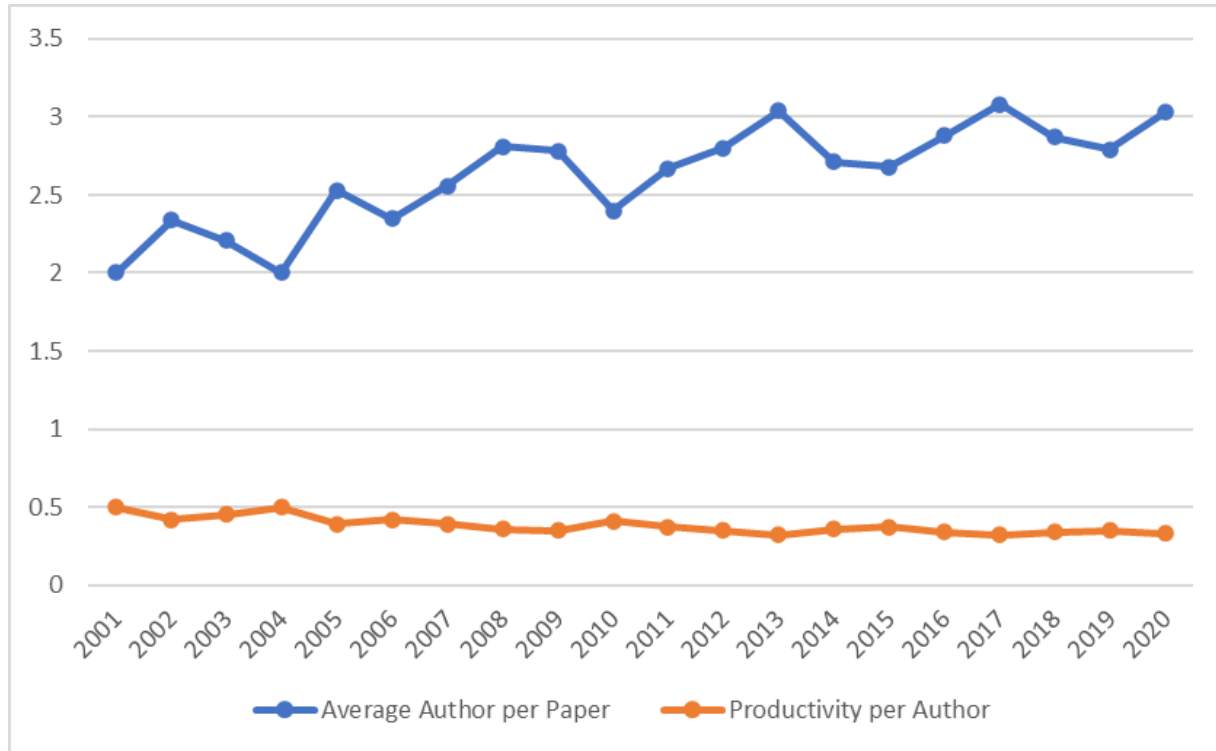
Figure 8: Author productivity

Citation Pattern

The Table 9 and figure 9 shows that 534 (84.89%) publications had citation in between 0-10. Next followed by 48 (7.63%) publications in 11-20 citation category and also total no. of 18 (2.86%) publications had citations in between 21-30 and a 29 (4.61%) were in the above 30.

Table 9: Citation Pattern

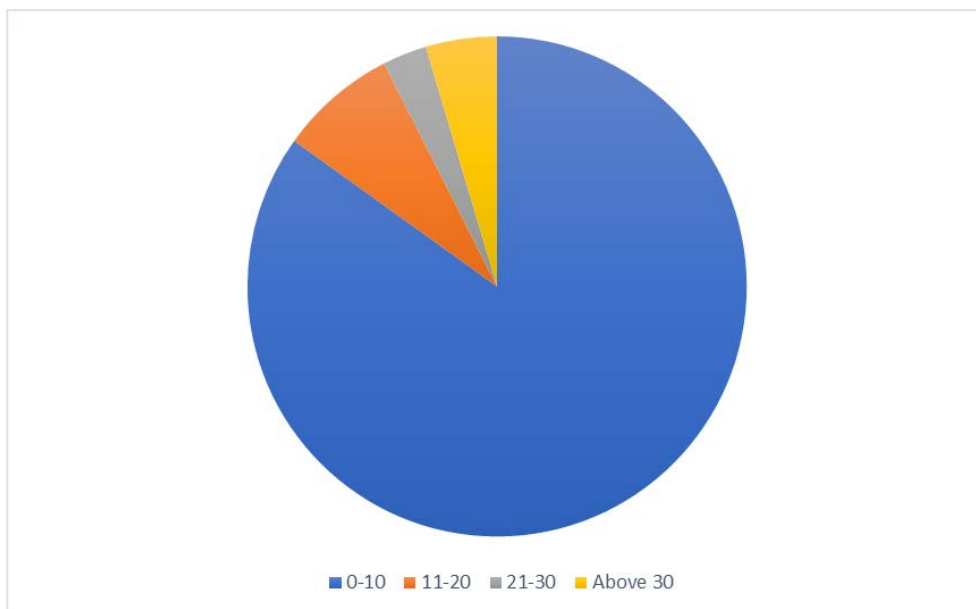| S.N	No. of Citation	No. of Items	Percentage	Rank
1	0-10	534	84.89	1
2	11-20	48	7.63	2
3	21-30	18	2.86	4
4	Above 30	29	4.61	3
	Total	**629**		

Figure 9: Citation pattern

Altmetrics Pattern for Journal Article

The Table 10 indicated altmetrics pattern of the literature published by Springer Link in terms of number with their rank and percentage. A total number of 0-10 had the highest majority with 93.61% (205), followed by 11-20 also had a literature of 2.74% (6), and in between 21-30, a total no. of 1.37% (3) were available. In addition, 2.28% (5) were in the above 30.

Table 10: Altmetric Pattern for Journal Article

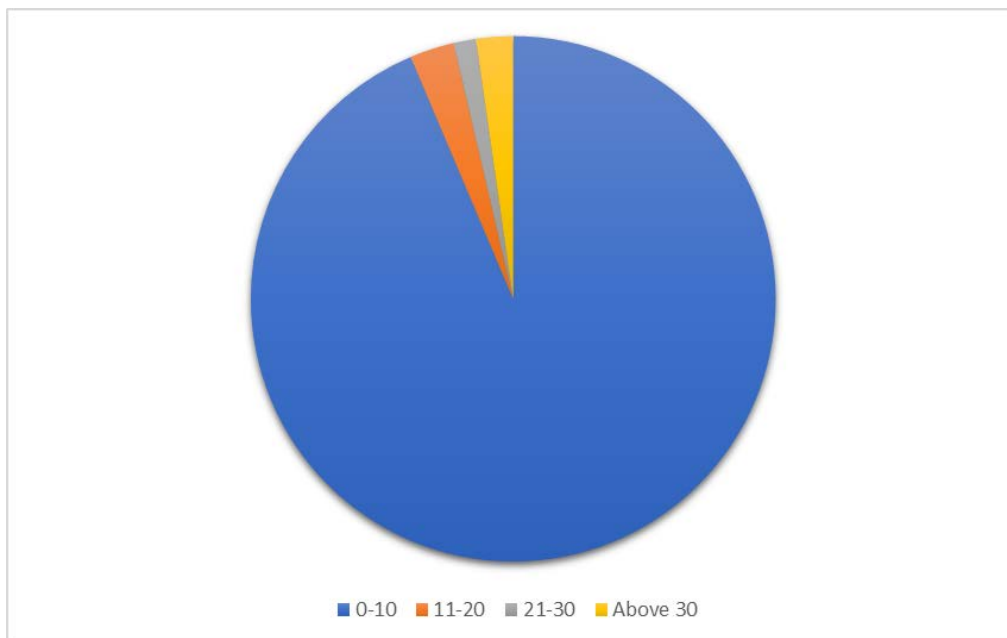| S.N.	No. of Altmetric	No. of Items	Percentage	Rank
1	0-10	205	93.61	1
2	11-20	6	2.74	2
3	21-30	3	1.37	4
4	Above 30	5	2.28	3
Total		**219**		

Figure 10: Altmetric Pattern for Journal Article

Ranking of Journals

The table 11 represent the ranking of journals with the number of literatures published by different journal in SpringerLink Database. 21 articles were published under TechTrends which occupies the highest rank journal in the Springer Link followed by Education Technology Research and Development with 19, Education and Information Technologies with 18 and Neural Computing and Applications with 10 publications respectively.

Table 11: Ranking of Journals with Literature (in no.) Published

S. N.	Name of the Journals	No. of Articles	Rank
1	TechTrends	21	1
2	Education Technology Research and Development	19	2
3	Education and Information Technologies	18	3
4	Neural Computing and Applications	10	4
5	International Journal of Education Technology in Higher Education	8	5

6	Journal of Computing in Higher Education	7	6
7	BMC Medical Education	6	7
8	Multimedia Tools and Applications	5	8
9	International Journal of Computer-Supported Collaborative Learning	4	9
10	Neural Processing Letters	4	9
11	Smart Learning Environments	3	10
12	Autonomous Robots	3	10

Ranking of Publishers in SpringerLink Database

The table 12 represent the ranking of publishers in the Springer link database with the number of literatures published. The author(s) considered Chapters, Conference Papers, Book and Reference Work Entry to determine the publisher distribution under the SpringerLink. The table 12 reveals that the highest ranked publisher was Springer Cham with 181 publications whereas 126 literature published by Springer, Berlin, Heidelberg after that Springer, Singapore secured third rank with 36 of literature.

Table 12: Ranking of Publisher in SpringerLink Database

S.N	Name of Publishers	No. of Literature	Rank
1	Springer, Cham	181	1
2	Springer, Berlin, Heidelberg	126	2
3	Springer, Singapore	36	3
4	Springer, Boston, MA	28	4
5	Springer, Dordrecht	14	5
6	Springer, New York, NY	10	6
7	Palgrave Macmillan, Cham	3	7
8	Springer, London	3	7
9	Palgrave Pivot, London	2	8
10	Springer, New Delhi	1	9
11	Springer VS, Wiesbaden	1	9
12	Palgrave Macmillan, New York	1	9
13	Palgrave Macmillan, London	1	9
14	Physica, Heidelberg	1	9

| 15 | SensePublishers, Rotterdam | 1 | 9 |
| 16 | Apress, Berkeley, CA | 1 | 9 |

Geographic Distribution of Literature

The Table 13 shows that the distribution of literature of different countries by Springer Link in the field of online learning during 2001-2020. It is seen from the table that the country with the greatest output in terms of research on Online Learning is USA with 163 publications, followed by China, Australia and Canada with a total of 95, 54 and 40 publications respectively.

Table 13: Geographic Distribution of Literature

S.N	Country	No. of Literature	Rank
1	USA	163	1
2	China	95	2
3	Australia	54	3
4	Canada	40	4
5	Germany	38	5
6	UK	37	6
7	France	19	7
8	Taiwan	18	8
9	Spain	18	8
10	Japan	16	9
11	The Netherlands	14	10

Identification of Most Productive Institutions

Table 14 shows only top five ranking institutions in terms of research publications on Online Learning. Findings revealed that Deakin University, Australia with 8 publications is the most productive institutions in the field of online learning literature followed by Nanyang Technological University, Singapore with 7 publications, Beijing Normal University, China and Bielefeld University, Germany with 5 publications each.

Table 14: Most Productive Institutions

S.N.	Institution	Country	No. of Publication	Rank
1	Deakin University	Australia	8	1
2	Nanyang Technological University	Singapore	7	2
3	Beijing Normal University	China	5	3
4	Bielefeld University	Germany	5	3
5	University of California	USA	4	4
6	University of Illinois	USA	4	4
7	The Pennsylvania State University	USA	4	4
8	Monash University	Australia	4	4
9	Tsinghua University	China	4	4
10	Open University of the Netherlands	Netherlands	3	5
11	University of Melbourne	Australia	3	5
12	University of Freiburg	Germany	3	5
13	Brigham Young University	USA	3	5
14	McGill University	Canada	3	5
15	Griffith University	Australia	3	5

Highly Cited Research Paper

The table 15 depicts the picture of the most cited research paper in the field of "Online Learning". The article entitled 'Barriers and solutions to online learning in medical education-an integrative review' has the highest citations with 156 points. It is followed by another title with 131 citations by Philip C. Abrami, Eva M. Bures,Robert M. Bernard, Rana M. Tamim & Eugene Borokhovski. The least number of citations received among the top cited articles is "A primal-dual perspective of online learning algorithms" with 53 citations in aggregate.

Table 15: Top Cited Research Paper

S.No.	Title	Authors	Citation
1	Barriers and solutions to online learning in medical education-an integrative review	Diane O'Doherty, Marie Dromey, Justan Lougheed, Ailish Hannigan, Jason Last & Deirdre McGrath	156
2	Interaction in distance education and online learning: using evidence and theory to improve practice	Philip C. Abrami, Eva M. Bures, Robert M. Bernard, Rana M. Tamim & Eugene Borokhovski	131
3	Online learning in higher education: exploring advantages and disadvantages for engagement	Amber D. Dumford & Angie L. Miller	88
4	Online Learning Algorithms	Steve Smale & Yuan Yao	83
5	Analytic Frameworks for Assessing Dialogic Argumentation in Online Learning Environments	Douglas B. Clark, Victor Sampson, Armin Weinberger, Gijsbert Erkens	76
6	Cognitive presence in online learning	Heather Kanuka & D. Randy Garrison	64
7	Co-reflection in online learning: Collaborative critical thinking as narrative	Joyce Yukawa	62
8	Developing online learning resources: Big data, social networks, and cloud computing to support pervasive knowledge	Muhammad Anshari, Yabit Alas, & Lim Sei Guan	61

| 9 | Multi-Target Tracking by Online Learning a CRF Model of Appearance and Motion Patterns | Bo Yang & Ramakant Nevatia | 60 |
| 10 | A primal-dual perspective of online learning algorithms | Shai Shalev-Shwartz & Yoram Singer | 53 |

7.   Findings and Conclusion

The study includes the following findings:

- It was observed that the vital source of publications covered by SpringerLink databases on online learning is Conference Paper with 256 (40.69%) publications followed by Journal Article with 219 (34.82%) publications. Chapter ranks the third position with 116 (18.45%) publications.

- It was also noticed that the principal number of publications is 100 (15.89%) published in 2020. It is followed by the year 2018 which is rank second in the list with 73 (11.61%) publications.

- It is seen from the analysis that the year 2003 has the highest number of annual growth rate with 533.34. It is followed by 2018 with 97.29 annual growth rates. The year 2004 has the least number of annual growth rate with -63.15.

- There's a rise within the range of publication from 2001-2020, however the compound rate of growth of total publication keeps on degrading with the increasing range of year.

- It was reveal that the highest relative growth rate is seen in 2003 with 1.42712 and the lowest is seen in 2017 with 0.09887.

- The doubling time has enormously increased with the approaching of every cumulative year. The highest is seen in 2017 with 7.00921 and the lowest is seen in 2003 with 0.48559.

- It was found out that among 629 literatures, maximum of 178 (28.29%) literatures were bring out by two authors, three authors 139 (22.09%) respectively. A number of 119 (18.92%) literatures were generated by single author.

- The highest degree of collaboration was 0.92 in 2013 and the lowest degree of collaboration is 0.57 in 2004.The highest number

of authors pattern with 3.16 which is followed by 3.14 in 2020. The lowest number of collaborative index was seen as 2.00 in 2001 and 2004.

- The highest collaboration co-efficient is seen in 2013 i.e. 0.60. Subsequently, it is followed by 2020 with 0.58 and 2018 with 0.57 respectively. The least number of co-efficient was found in 2004 with 0.35.

- The average number of authors per publication was highest in the year 2017 i.e. 3.08. The productivity per author was highest in the year 2001 and 2004 i.e. 0.50.

- It was found that 48 (7.63%) publications in 11-20 citation category and also total no. of 18 (2.86%) publications had citations in between 21-30 and a 29 (4.61%) were in the above 30.

- A total number of 0-10 had the highest majority with 93.61% (205), followed by 11-20 also had literatures published with 2.74% (6), and in between 21-30, a total no. of 1.37% (3) were available. Furthermore, 2.28% (5) were in the above 30.

- There are around 21 articles which were published under TechTrends which occupies the highest rank journal in the Springer Link followed by Education Technology Research and Development with 19, Education and Information Technologies with 18 and Neural Computing and Applications with 10 publications respectively.

- It also reveals that the highest ranked publisher was Springer Cham with 181 publications whereas 126 literatures published by Springer, Berlin, Heidelberg after that Springer, Singapore secured third rank with 36 of literature.

- It was observed that the USA has the highest research output on Online Learning is USA with 163 publications, followed by China, Australia and Canada with a total of 95, 54 and 40 publications respectively.

- The findings revealed that Deakin University, Australia with 8 publications is the highest productive institutions in the field of online learning literature followed by Nanyang Technological University, Singapore. The article entitled 'Barriers and solutions

to online learning in medical education-an integrative review' has the highest citations with 156 points.

The concept of online learning has paved the attention of academicians and Researchers to pay its importance in usability and the significance. Its application was highly noticed during the pandemic situations like COVID-19 that the world has gone through. The continuity of education either may be primary, secondary, or higher education was possible due to the use of online platform scaffoldings such as SWAYAM, Google meets, zoom and many more wherein the students and teachers can exchange information rather than teaching and learning process. The pandemic was a new lesson where the new methods and technologies were adopted and used to impart education. More research is carried out, especially in this area. The online learning platforms for many to study at their own pace. It has opened the opportunity for the learners who have a passion for other extracurricular activities and it had removed distractions among the students as they don't have to visit the traditional schooling system. Some professionals can also continue their education besides their business.

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