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LOTKA'S LAW AND PATTERN OF AUTHOR PRODUCTIVITY IN THE FIELD OF LEARNING DISABILITIES RESEARCH: A BIBLIOMETRIC ANALYSIS

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Abstract

This study analyzed the papers published in the field of learning disabilities between 2011 and 2020 in the Web of Science (WoS) under subject category "Learning Disabilities". The purpose of this research explores the illumination of the growing awareness of students with learning disabilities in current situation. Main objectives are to illustrate the authorship pattern and the degree of collaboration of the scholarly publication on learning disabilities. The data presented in this paper have been accessed from Web of Science database. For searching the data, these keywords have been used i.e. "Learning Disabilities" and time period covered from 2011 to 2020. In this connection, a total of 4504 research papers collectively contributed by 18141 authors and analyzed using the Bibexcel, HistCite and VOSviewer software to highlight the evolution of the research domain. A total of 574 articles were published by a single author and 3930 articles were published by multi authors (i.e. 17567 authors). Vaughn S was the most productive author. As a result, Lotka's inverse square law will not fit the present data.

Keywords: Lotka's Law, Learning Disability, Collaboration Coefficient, Authorship Pattern, Research Output.

1. INTRODUCTION

A learning disability is defined as a cognitive, neurological, or psychological impairment that limits an individual's ability to learn, particularly their communication capability and potential to be effectively taught **(Willis, 2007)**. It is used to represent an assortment of diseases including dyslexia, dyscalculia and auditory processing disorder **(Bastable et al., 2019)**. The term learning disability is used to describe the seemingly unexplained difficulty that a person of at least average intelligence has in acquiring basic academic skills. These skills are essential for success at school and work, and for coping with life in general. "LD" does not stand for a single disorder. It is a term that refers to a group of disorders. Learning Disabilities (LD) encompass a range of conditions characterized by significant difficulties in acquiring and utilizing skills related to hearing,

reading, writing, thinking, and mathematics. These challenges are intrinsic and can emerge at any life stage due to central nervous system malfunction **(Learner, 1989)**. Individuals with LD often require more time to acquire new skills and connect with others **(Borg et al., 2006; Hammill et al., 1987)**. To support children with LD, it's crucial to nurture their talents, understand their limitations, navigate the educational system, collaborate with experts, and develop tailored learning strategies. **Kirk (1975)** defines LD as a mechanism affecting language and academic performance, with underlying causes rooted in neurological or emotional/compartmental factors.

Moreover, childhood disabilities often entail challenges in specific skills like reading and writing, impacting individuals of average intelligence by hindering their ability to process and integrate information across different brain regions, resulting in various manifestations such as language difficulties and coordination issues. Many individuals with learning disabilities may remain undiagnosed, leading to a lifetime of struggling in various aspects of life, as learning disabilities should not be conflated with difficulties stemming from sensory impairments, intellectual challenges, emotional disturbances, or environmental and economic disadvantages.

This learning disability is currently gaining more and more attention. The most obvious value of bibliometrics is that it allows scholars to evaluate certain research fields and draw useful conclusions by looking at co-authorship, regional distribution, and collaborative measures. In the past, bibliometrics was commonly utilised in hotspots **(Yeung et al., 2017a)** in collaboration with others **(Sweileh et al., 2016)**. Simultaneously, the importance of scientometric indicators in informing scientific policies and research management has become clear **(Irvine & Martin, 1989)**. Quantitative studies of science and technology, philosophy of science, and sociology of scientific knowledge, among other topics, were the focus of scientometric research. Hence, this study is undertaken to analyse the publica Our country is a huge well of talents; all we need to do is to recognize.

2. REVIEW OF LITERATURE

Recent scientometric research covers diverse domains, revealing author productivity patterns. **Garg and Singh (2022)** explored Library and Information Science Research papers (1994-2020). **Jahina, Batcha, and Ahmad (2021)** applied Lotka's law to brain concussion and artificial intelligence research, while **Ahmad and Batcha (2020)** focused on dyslexia. **Borgohain, Bhardwaj, and Verma (2022)** mapped artificial intelligence literature in libraries. **Serenko et al. (2010)** delved into knowledge management, and **Umar, Ahmad, and Batcha (2020)** explored the intersection of library and culture. **Naveed et al. (2021) and Siddique et al. (2021)** conducted bibliometric analyses on the library quarterly and library and information science in Pakistan, offering insights into author productivity and trends.

Meixiao (2014) found a growing emphasis on intervention research, and **Jeyanthi et al. (2015)** noted a 2013 peak in learning disabilities research and **Machado & Quaresma (2016)** advocated for increased interdisciplinary research in disability and quality of life. **Ferreira et al. (2017)** scrutinized political publications in Special Education (1997-2014), revealing an upswing post-2008. **Murugan (2017)** analyzed Nephrology research output (2007-2016), exploring authorship patterns. **Vianna & Pinto (2017)** delved into Information Science literature (2010-2015) on "disability, accessibility, and assistive technology." **Vijayalakshmi & Swaminathan (2017)** used scientometrics to explore "Learning disabilities" publications (2007-2017), noting a concentration among top authors from the USA and sluggish growth in research publications in this field. **Ram (2018)** highlighted the USA as the leading contributor to Dyslexia literature growth (1967-2016) in SCOPUS, and **Li & Wang (2018)** visually analyzed China's international higher education research on disabilities, noting thematic shifts. **Batanero et al. (2019)** emphasized medium-low ICT impact and **Melero-Perez & Gomez-P zuerta (2019)** reported increased research productivity on school students with ASD but raised concerns about attention gaps.

3. PROBLEM IDENTIFICATION

- To analyze the year wise contributions as well as citations
- To examine the Annual Growth Rate (AGR) of articles
- To know about the authorship pattern and to identify the top twenty productive authors
- To identify the top- ranked authors and highly cited articles
- To study the collaborative measures of learning disabilities
- To identify the Author Productivity
- To examine whether the n value confirms Lotka's Law through the K-S test

4. METHODOLOGY

The data presented in this paper have been accessed from Web of Science published by Clarivate Analytics. The basic data related to total publications on learning disabilities published from 2011 to 2020 were collected using Web of Science database. A search on "Learning Disabilities" was conducted using the Basic search feature within the Web of Science Core

Collection, yielding a total of 4,504 research papers authored by 18,141 contributors, encompassing comprehensive bibliographical details. All the searched results were saved in .txt files and then imported into Bibexcel, HistCite and VOSviewer to organize, analyze and generate the tables, graphs, and charts for the final study.

5. ANALYSIS AND INTERPRETATION

5.1. Year wise distribution of learning disabilities output

Table 1 and Figure 1 show the year wise distribution of research output from the year 2011 to 2020. In total 4504 articles were published during this period, out of which 497 (11.03%) articles were published in the year 2019, followed by 492 (10.92%) in 2017 489 (10.86%) in 2020 and, 487 (10.81%) articles in 2018. It showed that a greater number of articles was published in the recent four years with more than 10 % of the articles every year. It is observed that 57,943 citation scores were measured between 2011 and 2020. However, the highest citation score (11977) of the articles was obtained in the year 2011 followed by 2010 with 10080 citation scores. The highest number of average citations per article and h index were observed in 2011 with 29.65 and 54 respectively. It is concluded that the highest number of articles were published in the recent year 2020 with the lowest citation score and the lowest number of articles were published in the beginning year of the study (2011) with the highest citation score along with h-index.

Table-1: Year wise distribution of learning disabilities output

S.No	Year	No. of output	%	Cumulative %	Citation	Average citation per article	h-index
1	2011	404	8.97	8.97	11977	29.65	54
2	2012	409	9.08	18.05	10080	24.65	51
3	2013	443	9.84	27.89	8725	19.70	43
4	2014	413	9.17	37.06	7142	17.29	39
5	2015	431	9.57	46.63	5855	13.58	35
6	2016	439	9.75	56.37	5239	11.93	29
7	2017	492	10.92	67.30	4492	9.13	28
8	2018	487	10.81	78.11	2719	5.58	22
9	2019	497	11.03	89.14	1130	2.74	11
10	2020	489	10.86	100.00	584	1.19	11
Total		**4504**	**100**		**57943**	**12.86**	

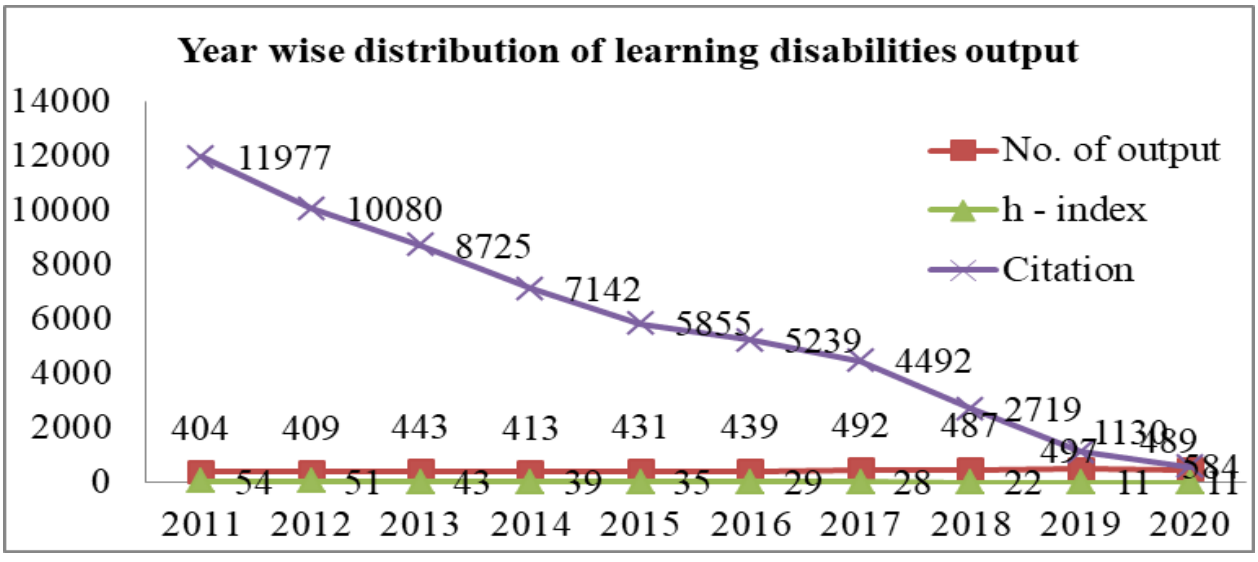

Fig.-1: Year wise distribution of learning disabilities output h-index with citations

ISSN: 2583-7354

5.2 Annual Growth Rate of publications

The annual growth rate in research productivity is known as the Annual Growth Rate (AGR). The AGR was estimated using the formula below, which **Velmurugan and Radhakrishnan (2016)** also employed in their research.

$$AGR = \frac{End\ Value - First\ Value}{First\ Value} X100$$

For instance- For the year 2012,

$$AGR = \frac{409 - 404}{404} X100 = 1.24$$

Table-2: Annual Growth Rate of publications in learning disabilities

S.No	Year	No. of output	Cumulative	%	Cumulative %	Growth Rate %
1	2011	404	404	8.97	8.97	0
2	2012	409	813	9.08	18.05	1.24
3	2013	443	1256	9.84	27.89	8.31
4	2014	413	1669	9.17	37.06	-6.77
5	2015	431	2100	9.57	46.63	4.36
6	2016	439	2539	9.75	56.37	1.86
7	2017	492	3031	10.92	67.3	12.07
8	2018	487	3518	10.81	78.11	-1.02
9	2019	497	4015	11.03	89.14	2.05
10	2020	489	4504	10.86	100	-1.61

Table 2, explained the trend of publication during the study period. The range of annual growth rate for 10 years is between 1.24 and -1.61. (Is it not 12.07 and -6.77). There are some ups and downs in the growth rate. It is noticed that in the year 2017, the AGR is maximum with 12.07% and in 2014 it is minimum with -6.77% of sharing. There are some negative growth rates also found in 2014, 2018 and 2020. Hence it indicated that there is no constant growth of publications in learning disabilities from 2011 to 2020.

5.3 Analysis of authorship pattern

Table 3 illustrates the year-wise distribution of the authorship patterns of learning disabilities. Out of 4504 papers, the authorship pattern up to 10 authors result in a total of 4352 research output remaining 152 papers have been published by more than ten authors.

Single author contributions are accounted for 574 articles (12.74%) during the study period. The highest percentage of 21.40 is recorded by two authors followed by three, four and five authors showing 20.40, 16.21 and 9.92 percentages respectively. However, more than six authors have contributed less than 7 percentages in this study. This analysis of results shows that individual contribution is not at the rate of appreciation compared to collaborative research up to five in the field of learning disabilities. The number of authors engaged in collaborative research is found to be increasing year by year from 2011 to 2020 ranging from 1470 to 2179. It could be noticed that 4.03 % of authors/scientists collectively contributed one paper in the field of learning disabilities.

Table-3: Analysis of authorship pattern among the scientists of learning disabilities

Year	Single	Two	Three	Four	Five	Six	Seven	Eight	Nine	Ten	>Ten	TP	MA	TA
2011	69	87	91	56	30	30	9	12	4	6	10	**404**	1401	1470
2012	56	89	85	82	34	22	8	11	8	5	9	**409**	1450	1506
2013	60	121	90	66	41	29	5	11	7	4	9	**443**	1507	1567
2014	52	98	74	71	38	33	13	4	5	9	16	**413**	1637	1689
2015	52	91	78	79	50	28	18	9	10	5	11	**431**	1719	1771
2016	59	89	78	65	55	31	20	9	10	5	18	**439**	1756	1815
2017	68	110	104	82	32	24	22	14	10	10	16	**492**	1903	1971
2018	51	109	114	71	48	28	10	12	15	7	22	**487**	1973	2024
2019	57	95	107	79	60	31	34	6	7	3	18	**497**	2093	2149

ISSN: 2583-7354

2020	50	94	98	79	59	43	20	9	8	6	23	**489**	2129	2179
Total	**574**	**983**	**919**	**730**	**447**	**299**	**159**	**97**	**84**	**60**	**152**	**4504**	17567	18141
%	**12.74**	**21.83**	**20.4**	**16.21**	**9.92**	**6.64**	**3.53**	**2.15**	**1.87**	**1.33**	**3.37**	**100**	AAPP	4.03

5.4 Author Productivity

Average Authors per Paper (AAPP) $= \frac{Number\ of\ Authors}{Number\ of\ Papers}$

Productivity per author $= \frac{Number\ of\ Papers}{Number\ of\ Authors}$

Table No 4 shows the data related to author productivity, which shows that the total average number of authors per paper is 4.028 and the average productivity per author is 0.248. Although the contribution of a total number of authors (2179) and AAPP (4.456) were maximum in the year 2020, the productivity per author was minimum of 0.224. The productivity per author was highest at 0.283 and AAPP was least at 3.537 in the year 2013.

Table-4: Author Productivity (Productivity per Authors)

Sl. No	Year	Total No. of papers	Total No. of Authors	AAPP	Productivity Per Authors
1	2011	404	1470	3.639	0.275
2	2012	409	1506	3.682	0.272
3	2013	443	1567	3.537	0.283
4	2014	413	1689	4.090	0.245
5	2015	431	1771	4.109	0.243
6	2016	439	1815	4.134	0.242
7	2017	492	1971	4.006	0.250
8	2018	487	2024	4.156	0.241
9	2019	497	2149	4.324	0.231
10	2020	489	2179	4.456	0.224
		4504	**18141**	**4.028**	**0.248**

*AAPP – Average author per paper

5.5 Analysis of Collaboration factors

5.5.1 Collaborative Index (CI)

The formula was derived by Lawani (1986) as below:

$$CI = \frac{\sum_{J}^{A=1} jFj}{N}$$

$$CI = \frac{\text{Total authors of multi authored papers}}{\text{Multi authored papers}}$$

5.5.2 Degree of Collaboration (DC)

Degree of Collaboration (DC) is estimated by applying Subramaniam (1983) formula.

It is given below

$$DC = \frac{Nm}{Nm+Ns} = \frac{\text{Number of multiple authored research paper}}{\text{Number of single + No of multiple authored research paper}}$$

Where, DC= Degree of Collaboration

$$DC = \frac{17567}{17567+574} = 0.97$$

5.5.3 Collaborative Coefficient (CC)

Collaborative coefficient can be defined as (**Bastable** et al., 1988)

The formula for calculating CC is given below.

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

5.5.4 Modified Collaboration Co-efficient (MCC)

(Sayanur and Srikanth, 2010) modified the CC and derived MCC as follows:

$$MCC = \frac{A}{A-1}\left[1 - \frac{\sum_{j}^{k} (\frac{1}{j}) fj}{N}\right]$$

Table-5: Analysis of Collaboration factors in learning disabilities publication at global level

Authorship pattern	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	Total
1	69	56	60	52	52	59	68	51	57	50	574
2	87	89	121	98	91	89	110	109	95	94	983
3	91	85	90	74	78	78	104	114	107	98	919
4	56	82	66	71	79	65	82	71	79	79	730
5	30	34	41	38	50	55	32	48	60	59	447
6	30	22	29	33	28	31	24	28	31	43	299
7	9	8	5	13	18	20	22	10	34	20	159
8	12	11	11	4	9	9	14	12	6	9	97
9	4	8	7	5	10	10	10	15	7	8	84
10	6	5	4	9	5	5	10	7	3	6	60
>10	10	9	9	16	11	18	16	22	18	23	152
Total Paper	404	409	443	413	431	439	492	487	497	489	4504
Total Author	1470	1506	1567	1689	1771	1815	1971	2024	2149	2179	18141
CI	4.39	4.27	4.09	4.68	4.67	4.78	4.65	4.64	4.88	4.96	4.62
DC	0.95	0.96	0.96	0.97	0.97	0.97	0.97	0.97	0.97	0.98	0.97
CC	0.96	0.9635	0.9591	0.9641	0.9635	0.9624	0.9563	0.9594	0.9588	0.9609	0.9608
MCC	0.9602	0.9637	0.9593	0.9643	0.9637	0.9626	0.9565	0.9596	0.959	0.9611	0.9610
MCC-CC	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002

*CI- Collaborative Index, *DC-Degree of Collaboration, *CC - Collaborative Co-efficient, *MCC - Modified Collaborative Co-efficient

Table 5 elucidated diverse joint effort factors for the period of ten years (2011-2020). The analysis of the table incorporates CI, DC, CC and MCC. The table shows that Collaborative Index was highest in the year 2020 and lowest in the year 2013 and the Mean CI during the period of study is 4.62. Subramanyam proposed the Degrees of Collaboration as a metric for calculating and interpreting the proportion of single and multi-author papers. It is found that DC was lowest at 0.95 in 2011 and highest at 0.98 in 2020. In all the years' multi-author papers were in the increasing trend, therefore the average Degree of Collaboration for the research period shows 0.97.

In this study, the lowest CC (0.9563) was noticed in 2017 the highest was 0.9641 in 2014. It shows that there is a strong collaborative rate among the authors. The overall collaborative coefficient value is 0.9608. Hence, it is concluded that the authorship pattern of the research publications of learning disability had a strong collaborative coefficient.

The study found MCC was lowest in 2017 when it was 0.9565. It was at the maximum value of 0.9643 in 2014. The mean MCC during the period of study was 0.9610. It is also observed from the table that the mean difference between CC and MCC i.e. 0.0002 is observed during the year 2011-2020. It is concluded that there was no substantial difference between CC and MCC values and that this difference narrows as the number of authorships increases.

Out of 4504 articles published, single-author share is 574 and multiple paper author shares are 3930. This indicates that the contribution of a single author paper is less than that of multiple-author publications. It can be summarized from the above discussion that very high collaborative research activities are observed in global learning disabilities.

5.6 Authors Co-authorship Analysis

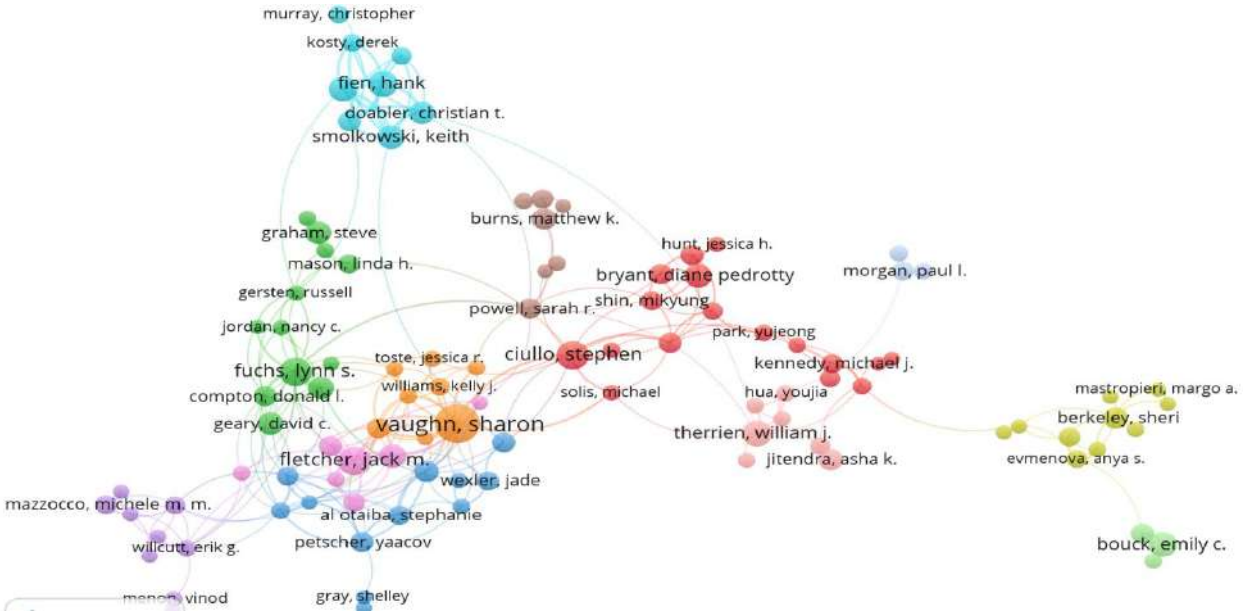

Fig-2: Network Visualization Map of top authors publishing on learning disabilities

The network visualization of authorship in the field of Learning Disabilities is shown in Figure 2. Each circle (or node) represents an author, and the size of the circle indicates the number of papers published. The link connecting two circles stands for the cooperative relationship between two authors, and the thickness of the link represents the intensity of cooperation. Of the 13,182 authors producing top papers, 258 authors met the thresholds, but only 12 authors were connected to each other. Circles denoting authors who are in the same cluster suggested that the authors studied in a similar field and had close cooperation with each other.

5.7 Most productive authors

Table-6: Year wise distribution of most productive authors in learning disabilities

S.No	Author	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	Total	Citations	h-index
1	Vaughn S	4	4	4	6	5	4	2	4	4	2	39	1053	17
2	Fuchs LS	-	5	3	1	4	3	1	-	3	1	21	758	14
3	Ciullo S	-	2	1	1	5	4	3	1	1	3	21	314	11
4	Fletcher JM	1	2	4	4	1	1	3	1	1	2	20	453	12
5	Gates B	-	-	-	2	2	3	3	4	4	2	20	205	8
6	Swanson HL	2	3	2	3	1	1	-	1	2	3	18	317	10
7	Bryant DP	-	-	-	-	7	3	2	-	-	6	18	195	9
8	Therrien WJ	3	3	-	-	3	1	2	3	-	2	17	222	7
9	Fien H	1	1	-	-	2	1	1	4	2	5	17	160	6
10	Cornoldi C	1	-	3	3	3	-	3	2	2	-	17	278	11
11	Bouck EC	2	2	1	2	2	1	2	2	2	1	17	298	11
12	Mammarella IC	-	1	2	2	1	2	2	3	1	2	16	267	17
13	Clarke B	1	-	-	-	3	1	1	3	2	5	16	159	6
14	Rose J	2	3	1	1	2	1	1	2	1	1	15	125	7
15	Smolkowski	1	-	-	1	2	1	-	1	3	6	15	139	5

	K													
16	Langdon PE	1	-	3	1	2	3	2	1	-	2	15	228	8
17	Hassiotis A	2	2	3	-	1	3	1	1	2	-	15	180	8
18	Desoete A	-	5	4	-	1	-	1	2	1	1	15	337	9
19	Roberts G	2	-	2	1	2	4	-	1	-	2	14	500	10
20	Mckenna JW	-	1	-	-	4	2	3	-	1	3	14	190	9

The Table 6 presents year wise distribution of most productive authors who have contributed to learning disabilities. It is observed that Vaughn had contributed the highest number of articles i.e. 39 publications having total citations of 1053 with h-index of 17 for his research work. The second highest contribution was made by Fuchs LS and Ciullo S with a publication of 21 research articles each. Fuchs LS had total citations of 758 with h-index of 14 and Ciullo S had total citations of 314 with h-index of 11. Fletcher JM and Gates B were published 20 research articles. On the other hand, researcher Swanson HL, Bryant DP and Therrien WJ, Fien H, Cornoldi C and Bouck EC have also made significant contribution by contributing 18 and 17 research articles on learning disabilities. However, other authors namely Mammarella IC, Clarke B, Rose J, Smolkowski K, Langdon PE, Hassiotis A, Desoete A, Roberts G and McKenna JW have also made moderate contributions. Bryant DP has made the highest article i.e.7 in the year 2015. Among the top 20 authors, 4 authors contributed articles every year during the study period on learning disabilities namely Vaughn S, Fletcher JM, Bouck EC and Rose J.

5.8 Analysis of Lotkas's law

Table-7: Analysis of Lotkas's exponent value on learning disabilities research output

S.No	x	y	X	Y	XY	X^2	X^n	$1/X^n$
1	1	10617	0	4.02600	0.00000	0.00000	1.00	1.00000
2	2	1533	0.30103	3.18554	0.95894	0.09062	7.4975	0.13338
3	3	452	0.47712	2.65514	1.26682	0.22764	24.3616	0.04105
4	4	186	0.60206	2.26951	1.36638	0.36248	56.2118	0.01779
5	5	108	0.69897	2.03342	1.42130	0.48856	107.5193	0.00930
6	6	71	0.77815	1.85126	1.44056	0.60552	182.6496	0.00547
7	7	38	0.84510	1.57978	1.33507	0.71419	285.8860	0.00350
8	8	26	0.90309	1.41497	1.27785	0.81557	421.4448	0.00237
9	9	23	0.95424	1.36173	1.29942	0.91058	593.4859	0.00168
10	10	13	1.00000	1.11394	1.11394	1.00000	806.1206	0.00124
11	11	4	1.04139	0.60206	0.62698	1.08450	1063.4172	0.00094
12	12	7	1.07918	0.84510	0.91201	1.16463	1369.4065	0.00073
13	13	3	1.11394	0.47712	0.53149	1.24087	1728.0844	0.00058
14	14	6	1.14613	0.77815	0.89186	1.31361	2143.4163	0.00047
15	15	5	1.17609	0.69897	0.82205	1.38319	2619.3386	0.00038
16	16	2	1.20412	0.30103	0.36248	1.44990	3159.7616	0.00032
17	17	4	1.23045	0.60206	0.74080	1.51400	3768.5714	0.00027
18	18	2	1.25527	0.30103	0.37787	1.57571	4449.6311	0.00022
19	20	2	1.27875	0.30103	0.38494	1.63521	6043.8486	0.00017
20	21	2	1.32222	0.30103	0.39803	1.74826	6964.6317	0.00014
21	39	1	1.59106	0.00000	0.00000	2.53149	42098.8443	0.00002
		13105	**19.99837**	**26.69889**	**17.52881**	**21.85654**	**77895.13**	**1.22003**

From 2011 to 2020, a comprehensive analysis was conducted on 4,504 research papers, revealing a total of 13,105 distinct authors. Table 7 provides an insightful breakdown of these authors based on their productivity levels. In this table, 'x' represents the count of publications, while 'y' signifies the number of authors with x publications. The primary objective of this study is to investigate whether the productivity distribution of these authors adheres to Lotka's law. To achieve this, the initial step involves determining the values of 'n,' 'c,' and the critical value (C.V.) using the dataset from our research.

$$n=\frac{N\sum XY-\sum X\sum Y}{N\sum X^2-(\sum X)^2}$$

The value of 'n' can be calculated using the above formula

$$n=\frac{21*17.52881-19.99837*26.69889}{21*21.85654-(19.99837)^2}$$

n =2.9064

'C' will be calculated with following formula

$$\mathbf{C}=\frac{1}{\sum\frac{1}{x^n}}=\frac{1}{1.22003}=0.819652=\mathbf{0.82}$$

Critical value can be calculated with $CV=\frac{1.63}{\sqrt{\sum yx+\sqrt{\frac{\sum yx}{10}}}}$

$$CV=\frac{1.63}{\sqrt{13105+\sqrt{\frac{18105}{10}}}}=\frac{1.63}{120.0646}=0.013576$$

CV= 0.0136

From the above mathematical calculation n=2.9064, C=0.82, CV=0.0136

5.9 K-S test on observed and expected distribution of authors

Table-8: K-S test on observed and expected distribution of authors

x	y	Observed =yx/∑yx (or) y/∑y **Col.1**	Value = ∑(yx/∑yx) Cum. **Col.2**	(Constant Value Present Study) Expected Freq.fe=C(1/xn) Col.3	Value of Freq./Cum. Col.4	Diff (D) ∑fe (Col.2-Col.4) **Col.5**	C=0.6079 (Lotkas Constant Value) Expected Freq. fe=C(1/x^n) Col.6	Value of Freq./Cum. Col.7	Diff (D) ∑fe (Col.2-Col7)
1	10617	0.81015	0.81015	0.82	**0.82**	-0.00985	0.6079	0.6079	**0.20225**
2	1533	0.11698	0.92713	0.1093716	0.929372	-0.00224	0.15198	0.75988	0.16725
3	452	0.03449	0.96162	0.033661	0.963033	-0.00141	0.06754	0.82742	0.13420
4	186	0.01419	0.97581	0.0145878	0.97762	-0.00181	0.03799	0.86541	0.11040
5	108	0.00824	0.98405	0.007626	0.985246	-0.00119	0.02432	0.88973	0.09432
6	71	0.00542	0.98947	0.0044854	0.989732	-0.00026	0.01689	0.90662	0.08285
7	38	0.00290	0.99237	0.00287	0.992602	-0.00023	0.01241	0.91902	0.07335
8	26	0.00198	0.99435	0.0019434	0.994545	-0.00019	0.0095	0.92852	0.06583
9	23	0.00176	0.99611	0.0013776	0.995923	**0.00019**	0.00751	0.93603	0.06008
10	13	0.00099	0.99710	0.0010168	0.99694	0.00016	0.00608	0.94211	0.05499
11	4	0.00031	0.99741	0.0007708	0.99771	-0.00030	0.00502	0.94713	0.05028
12	7	0.00053	0.99794	0.0005986	0.998309	-0.00037	0.00422	0.95135	0.04659
13	3	0.00023	0.99817	0.0004756	0.99878	-0.00062	0.0036	0.95495	0.04322

					5				
14	6	0.00046	0.99863	0.0003854	0.99917	-0.00054	0.0031	0.95805	0.04058
15	5	0.00038	0.99901	0.0003116	0.999482	-0.00047	0.0027	0.96075	0.03826
16	2	0.00015	0.99916	0.0002624	0.999744	-0.00058	0.00238	0.96313	0.03603
17	4	0.00031	0.99947	0.0002214	0.999965	-0.00050	0.0021	0.96523	0.03424
18	2	0.00015	0.99962	0.0001804	1.000146	-0.00053	0.00188	0.96711	0.03251
20	2	0.00015	0.99977	0.0001394	1.000285	-0.00051	0.00168	0.96879	0.03098
21	2	0.00015	0.99992	0.0001148	1.0004	-0.00048	0.00152	0.97031	0.02961
39	1	0.00008	1.00000	0.0000164	1.000416	-0.00042	0.00138	0.97169	0.02831
	1310 5	**1.0000**	**Present study's**		**D.Max = 0.0019**		Lotka's	**D.Max = 0.20225**	

Kolmogorov – Smirnov (K-S) Test (n=2.9064, c= 0.82 and n=2, c= 0.6079)

While theoretical Lotka's value is a = 2.00

Theoretical value of 'n' 2.9064 is matched with table value of R. Rosseau for getting C.V. value 0.82

Constant Value of Present Study	**n Value**
0.82	2. 9064
Lotka's Constant Value	**n Value**
0.6079	2

D-Max Value Present Study =0.0019

D-Max Value of Lotka's Study =**0.20225**

The K-S goodness-of-fit test was employed to evaluate the applicability of Lotka's law to the dataset. This test compared the observed frequency of authors to the expected frequency of author productivity, and the results are presented in the table. Notably, the maximum deviation, denoted as Dmax, was found to be 0.0019 in the first case, with corresponding values of n=2.9064 and c=0.82. In the second case, which pertained to Lotka's inverse square law, Dmax was significantly higher at 0.20225, with values of n=2 and c=0.6079.

In the first scenario, where Dmax=0.0019, this value was lower than the critical value of 0.0136. The difference between these two values was calculated to be 0.0117. Therefore, it can be concluded that the K-S test indicates that Lotka's law is a suitable fit for the dataset in the field of learning disabilities, with a significance level of 0.01.

Conversely, in the second scenario involving Lotka's inverse square law, the Dmax value was notably higher at 0.2023, surpassing the critical value of 0.0136. Furthermore, the difference between these values amounted to 0.1887, which exceeded the predefined significance level of 0.01. Consequently, Lotka's inverse square law does not align with the present dataset.

Table 8 visually represents the Lotka's plot, illustrating the fraction of observed and expected authors. Notably, both lines in the plot exhibit similar trends, further supporting the applicability of Lotka's law in the context of learning disabilities at the chosen significance level of 0.01.

6. FINDINGS

The year 2020 witnessed the highest publication volume, albeit with the lowest citation score, while the study's initial year, 2011, had the fewest articles published but achieved the highest citation score and h-index. Between 2011 and 2020, the publication trend in the field of learning disabilities did not exhibit consistent growth; instead, there were instances of negative growth in 2014, 2018, and 2020. Additionally, a notable observation is that only 4.03% of authors or scientists collectively contributed just one paper in this domain during the same period. In 2013, the highest author productivity reached 0.283, while the lowest average articles per author (AAPP) stood at 3.537. Since multi-author papers were in the increasing trend. The authorship pattern of the research publications of learning disability had a strong collaborative coefficient. There was no substantial difference between CC and MCC values and that this difference narrows as the number of authorships increases. Network visualization map showed that the authors studied in a similar field had close cooperation

with each other. Four authors contributed articles every year during the study period on learning disabilities namely Vaughn S, Fletcher JM, Bouck EC and Rose J. Lotka's inverse square law will not fit the present data.

7. CONCLUSION

This study presents an analysis of the authorship patterns and collaborative measures within learning disabilities publications spanning from 2011 to 2020. It is observed from the study that multi-authored contributed 87.26% of total publications whereas 12.74% of publications were contributed by a single author and the average author per paper is 4.03. The majority of the papers were written by multi authors. It is noted that the maximum number of authors were found in the year 2020 and the least number of authors found in 2011. Collaborative Index is noted to be the highest range in the year 2020 with 4.96. The mean CI during the period of study is 4.62. This is also supported by the mean degree of collaboration at a percentage of 0.97. The mean CC observed is 0.9608. There is a strong collaborative coefficient with the authorship pattern. It is identified that 'Vaughn S' is the most productive author with 39 research publications having total citations of 1053 with h-index of 17 for his research work. The present study demonstrated some general inferences on the basic bibliometric attributes like authorship pattern, a research collaboration of the learning disabilities. Publications showed a consistent and gradual rise over the years. The present study does not follow Lotka's generalised inverse square law with the K-S test in terms of author productivity. The analysis proves the strength and aim of the journal to encourage publications from outside institutions and not to dilute the quality by publishing their articles.

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