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## A bibliometric study on DC, RGT, and DT of Publications and Citations of ISTL Journal during 2010-2020

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### **Abstract:**

*This paper presents a bibliometric study on DC, RGT, and DT of Publications and Citations of ISTL Journal during 2010-2020. The study was based on 224 articles published in ISTL Journal during the years 2010-2020. This paper aims to analyze the Authorship distribution of the publication, degree of collaboration among authors, relative growth rate, and doubling time of publications and citations. It is found from the analysis that the degree of collaboration in ISTL publications is 0.5 i.e., equal to the standard DC. It means the progress of collaborative research neither slow nor so fast. It is in a balanced position. On the other hand, the relative growth rate is not in a stable position during the study period. The doubling time (Dt) rate for different years is increasing compared to the relative growth rate (RTG) during the study period. The relative growth rate of citations for the first three years i.e., 2010-2012 is the highest (mean value 0.45) and the rate of doubling time (Dt) of citations for different years is fluctuating.*

**Keywords:** Doubling time, Relative growth rate, Degree of Collaboration, Co-authorship, Citation, Science librarianship

## Introduction

The reliability of scientific articles depends upon writing articles with co-authorship. Nowadays, a fruitful research output vastly comes from joint authors, especially when researchers from different fields come together. Their combined effort helps to solve the existing problem of the respective field. Any kind of publication involves a lot of intellectuals and finance. Therefore, it is necessary to know the scientific growth rate of any Publications and citations. To know the scientific growth rate of any Publications and citations Information scientist Dr. Mahapatra in 1949 has suggested a method calculating the Relative Growth Rate (RGR) and Doubling Time (Dt) model. The present bibliometric study is based on analyzing the Degree of Collaboration (DC), Relative Growth Rate (RGR), and Doubling Time (DT) of Publications and Citations of ISTL Journal during 2010-2020 to find out the position of the journal among available same category of journals in the world. *Issues in Science and Technology Librarianship* (ISTL) is one of the leading quarterly journals in the field of science librarianship. It started its publications in 1991 by the University of Alberta libraries. (Mondal, 2020)

## Review of Literature:

Lots of studies have been conducted on collaborative research and relative growth rate. A few of them have been highlighted here. Jaina and Batcha have conducted a study on Lotka's Law and Ps Law and Pattern of Author Productivity in the Field of Brain Concussion Research during the period 2008-2017. They identified the trends and characteristics of growth and collaboration pattern of Brain Concussion research output. They found that the increasing growth rate of Brain Concussion is 0.850 and the Collaborative index rate is highest in 2017. They also found that Lotka's Law of authorship productivity is good for the application of Brain Concussion.(Jahina et al., 2021). Lohiya, Cyriac, and Sengar have analyzed the Relative Growth Rate and Doubling Time of productivity of research articles of CSIR-NEERI, India during 1989–2013. They found that the growth of research has steadily increased from 9 articles in 1989 to 117 in 2011& 2012 and again decreased in the year 2013 (81 articles). They also found a fluctuating trend in Relative Growth Rate (RGR) and Doubling Time (Dt) of CSIR-NEERI publications.(Lohiya et al., 2016). Waghmode has conducted a bibliometric study on relative

growth rate (RGR) and doubling time (DT) of biotechnology literature published in the Indian Journal of biotechnology during the period 2007-2016. He found that the value of Relative Growth Rate (RGR) of articles decreased gradually from 0.68 to 0.09 during the study period. On the other hand, Doubling time increases gradually. (Waghmode, 2017). Yadav, Singh, and Verma have evaluated the authorship and collaboration pattern in the SRELS Journal of Information Management during 2008-2017. They counted that the average collaboration index is 1.86, the average collaboration coefficient is 0.36, the average degree of collaboration is 0.66, the average relative growth rate is 0.32 and the average doubling time is 3.40 during 2008-2017. They found that the highest activity index for India is counted in the year 2009 and the lowest activity index is counted in the year 2013. (Yadav et al., 2019)

## **Methodology**

The current study is based on 224 articles published in ISTL Journal during the years 2010-2020. To conduct the study first of all the author has data was collected data from the ISTL journal website. After collecting data these are examined and analyzed with the help of MS-Excel software. To find out the degree of collaboration (DC) and relative growth rate respected equations and formula was used.

## **Objectives of the study**

- To show year-wise Authorship distribution of the publication.
- To find out the degree of collaboration among authors of the ISTL journal.
- To demonstrate relative growth rate and doubling time of publications published in 'Issues in Science and Technology Librarianship' Journal during 2010-2020
- To find out the relative growth rate and doubling time of citations used by the authors for writing their articles published in 'Issues in Science and Technology Librarianship' Journal during 2010-2020.

## Data analysis

Table-1 Year wise Authorship distribution of publication

Authorship	Years											No. of Articles	%	Total authors
	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020			
Single Author	18	17	8	9	11	20	4	7	9	9	1	113	50%	113
Two Authors	6	6	10	3	8	5	10	4	6	7	2	67	30%	134
Three Authors	2	2	3	0	6	3	2	1	2	2	1	24	11%	72
Multiple Authors	4	2	3	1	1	1	1	2	0	4	1	20	9%	111
Total Articles	30	27	24	13	26	29	17	14	17	22	5	224	100%	0
Total Authors	59	45	51	19	50	44	34	27	27	61	13	0	0	430

It is seen from table-1 that out of 224 articles 113(50%) articles were contributed by a single author. The Rest 50% of articles are contributed by two authors (30%), three authors (11%), and multiple authors (9%). If it is seen from the angle of a total number of contributors, 430 authors contributed 224 articles in the ISTL journal between 2010 and 2020.

## Degree of Collaboration

Degree of Collaboration (DC) is the indicator of the potency of collaborative research. The DC of the ISTL publications can be measured by using Subramanyam's (1983) formula as shown below:

$$DC = \frac{NM}{NS + NM}$$

Where, DC = degree of collaboration; NM = number of multi authored papers and NS = Number of single authored papers.

Sl. No	Year	Single Authored (NS)	Multiple Authored (NM)	Total (NS+NM)	Degree of Collaboration
1	2010	18	12	30	0.40
2	2011	17	10	27	0.37
3	2012	8	16	24	0.67
4	2013	9	4	13	0.31
5	2014	11	15	26	0.58
6	2015	20	9	29	0.31
7	2016	4	13	17	0.76
8	2017	7	7	14	0.5
9	2018	9	8	17	0.47
10	2019	9	13	22	0.59
11	2020	1	4	5	0.8
<b>Total</b>		<b>113</b>	<b>111</b>	<b>224</b>	<b>0.50 (Mean value)</b>

Table 2: Degree of Collaboration

It is seen from Table 2 that the degree of collaboration in ISTL publication is highest in the year 2020 with a mean value of 0.8 followed by a mean value of 0.76 in the year 2016. As the DC crossed mean value 0.5, it can be said that the collaborative research in these years is found to be expedited. It is also seen from the table that the year 2010, 2011, 2013, 2015, and 2018 are unable to touch the standard DC (0.5) point. Overall, the degree of collaboration in ISTL publications is 0.5 i.e., equal to the standard DC. It means the progress of collaborative research neither slow nor so fast. It is in a balanced position.

## Relative Growth Rate and Double Time of Publication

### Relative Growth Rate

The Relative Growth Rate (RGR) is nothing but the number of articles or pages that have increased per unit of time. "The growth rate of publication has been calculated based on RGR and Dt model, which is suggested by Mahapatra in 19949." On the other hand, doubling time means how many times required just to double the existing quantity with a given growth rate.

It is applied here for calculating the time required to become double the existing quantity of publications, citations, pages, etc. It has a close relationship with the relative growth rate (RGR).

***The following formula is used for calculating relative growth rate: -***

$$\text{RGR} = \frac{W2 - W1}{T2 - T1}$$

Where, **RGR** = Growth Rate over the specific period of the interval,

**W1** = Loge (natural log of the initial number of contributions)

**W2** = Loge (natural log of the final number of contributions)

**T1** = the unit of initial time

**T2** = the unit of final time

### **Doubling Time (Dt)**

There is a direct relationship existed between the relative growth rate and the doubling time.

To calculate Doubling Time a standard natural logarithm 0.693 is used here.

***The formula for corresponding Doubling time is:***

$$\text{Doubling Time} = \frac{0.693}{R}$$

Where,

**R** = Relative Growth rate

Table-3 Relative Growth Rate and Double Time of Publication

Year	No. of articles	Cumulative no. of articles	Log1e	Log2e	RGR(P)	Mean RGR(P)	Dt(P)	Mean Dt(P)
2010	30	30	-	3.40	0	0.36	0	0.90
2011	27	57	3.40	4.04	0.64		1.08	
2012	24	81	4.04	4.47	0.43		1.61	
2013	13	94	4.47	4.54	0.07	0.16	9.90	5.57
2014	26	120	4.54	4.79	0.25		2.77	
2015	29	149	4.79	5.00	0.21		3.30	
2016	17	166	5.00	5.11	0.11		6.30	
2017	14	180	5.11	5.19	0.08	0.08	8.66	14.33
2018	17	197	5.19	5.28	0.09		7.70	
2019	22	219	5.28	5.39	0.11		6.30	
2020	5	224	5.39	5.41	0.02		34.65	

Table 3 and figure 1 demonstrate the relative growth rate and doubling time of publications published in 'Issues in Science and Technology Librarianship' Journal during 2010-2020. "The growth rate of publication has been calculated based on RGR and Dt model, which is developed by Mahapatra in 1985." It has been noticed that the relative growth rate is not in a stable position during the study period. The relative growth rate for the first three years i.e., 2010-2012 is the highest (mean value 0.36) and the remaining two blocks of four years mean growth rate is decreasing gradually, and in the last block (the Year 2017-2020) mean growth rate is 0.08. It shows that there is a big difference in comparison to the first block. It means the quantity of published articles is reduced slowly. The rate of doubling time (Dt) for different years is increasing in comparison with the relative growth rate (RTG) during the study period. The mean rate of doubling time has increased gradually in different blocks. The mean value of doubling time is increased from 0.90 to 14.33 from 2010 to 2020. This means the journal takes more period to produce the same number of articles.



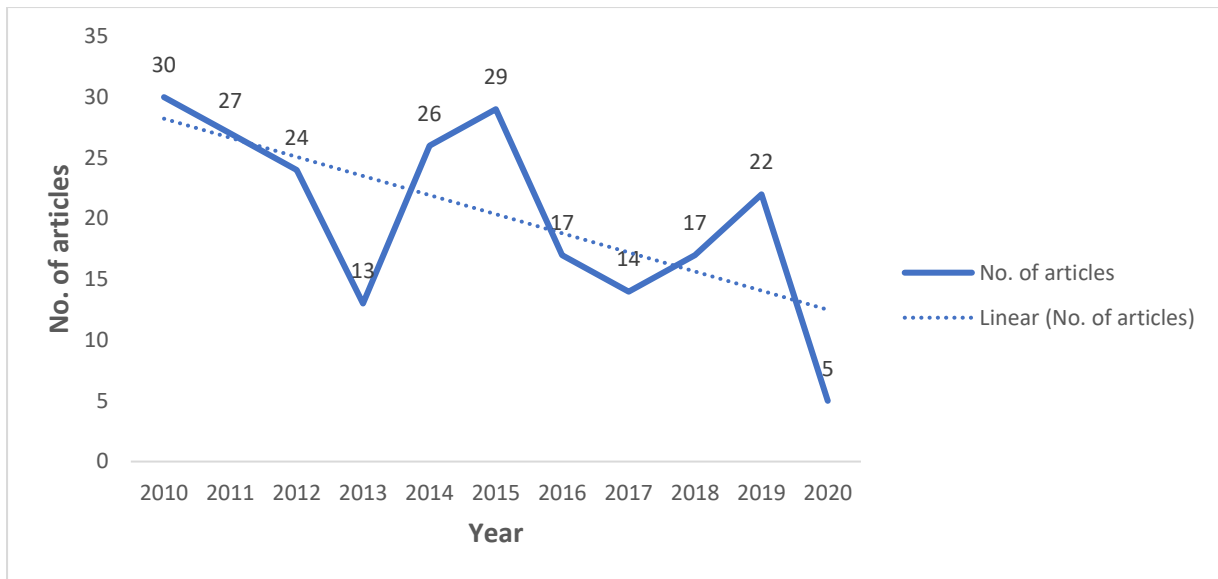


Fig1: Logistic pattern of growth of publications

Figure1 clearly shows the logistic pattern of growth of publications of ISTL journal from 2010 to 2020. The growth rate of publication was declined sequentially during the year 2010-2012. The growth rate highly declines in the years 2013 and 2020. On the other hand, the growth rate was increasing highly in the year 2010 and 2015

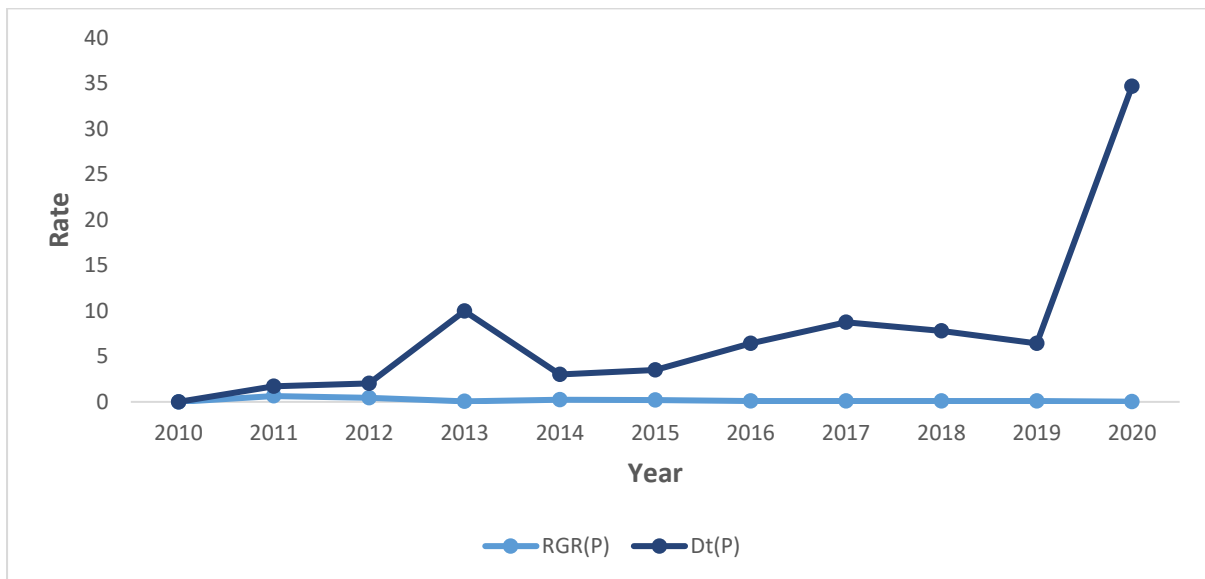


Fig 2: Logistic pattern of Relative Growth Rate (RGR) and Doubling Time (Dt) of publications

Figure 2 shows the relation between Relative Growth Rate (RGR) and Doubling Time (Dt) of publications of ISTL journal. Here deep blue color line indicates Doubling Time and Sky color indicate Relative Growth Rate. It is seen here that the RGR line has gradually declined. On the

other hand, the rate of doubling time (Dt) for different years is increasing in comparison with the relative growth rate (RTG) during the study period.

### Relative Growth Rate and Double Time of Citations

Table-4 Relative Growth Rate and Double Time of citations

Year	No. of citations	Cumulative no. of citations	Log1e	Log2e	RGR(C)	Mean RGR(C)	Dt(C)	Mean Dt(C)
2010	292	292	-	5.68	0	0.45	0	0.78
2011	441	733	5.68	6.60	0.92		0.75	
2012	408	1141	6.60	7.04	0.44		1.58	
2013	174	1315	7.04	7.18	0.14	0.17	4.95	4.18
2014	325	1640	7.18	7.40	0.22		3.15	
2015	342	1982	7.40	7.59	0.19		3.65	
2016	284	2266	7.59	7.73	0.14		4.95	
2017	331	2597	7.73	7.86	0.13	0.11	5.33	8.48
2018	262	2859	7.86	7.96	0.10		6.93	
2019	497	3356	7.96	8.12	0.16		4.33	
2020	156	3512	8.12	8.16	0.04		17.33	

Table - 4 and figure - 3 demonstrate the relative growth rate and doubling time of citations used by the authors for writing their articles published in 'Issues in Science and Technology Librarianship Journal during 2010-2020. It has been noticed that the relative growth rate is not in a stable position during the study period. The relative growth rate citations for the first three years i.e., 2010-2012 are the highest (mean value 0.45) and the remaining two blocks of four years mean growth rate is decreasing gradually, and in the last block (the Year 2017-2020) mean growth rate is 0.11. It shows that there is a big difference in comparison to the first block. It means the quantity of using citations by the authors in his/her published paper is reduced gradually. On the other hand, the doubling time (Dt) rate for different years is increasing compared to the relative growth rate (RTG) during the study period. The mean rate of doubling time has increased gradually in different blocks. The mean value of doubling time is increased from 0.78 to 8.48 from 2010 to 2020. This means the use of citation by the authors has declined slowly.

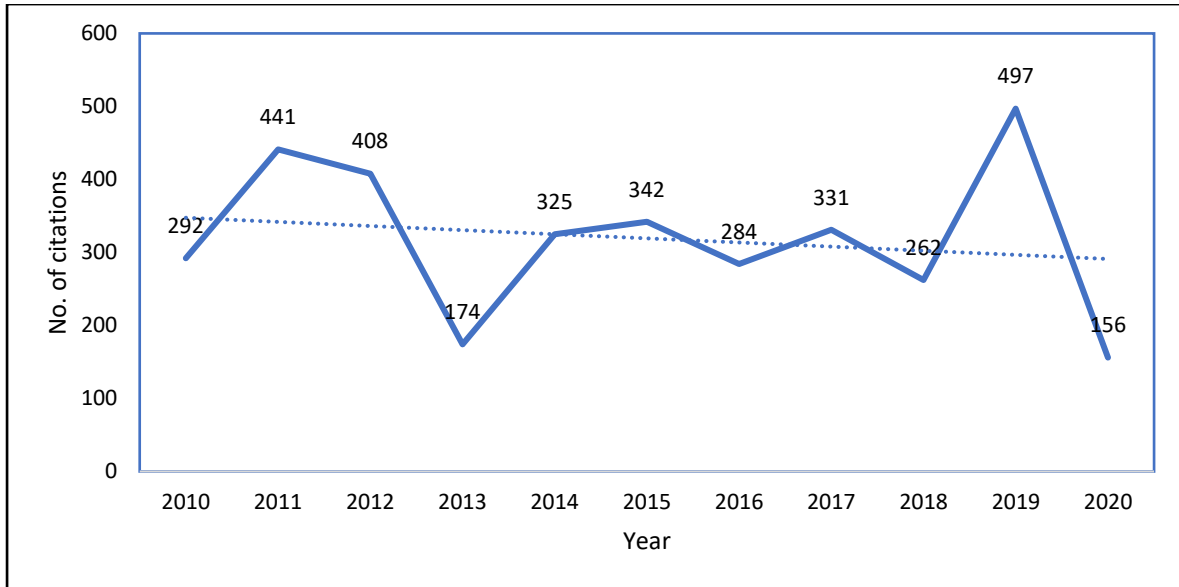


Fig- 3: Logistic patterns of growth of citations

Figure-3 clearly shows the logistic pattern of growth of citations of ISTL journal from 2010 to 2020. The growth rate of citation was very less in the year 2013 with 174 citations. After that, the growth rate of citation is increased very slowly and it reaches a high in the year 2019 with 497 citations. Again, it turns down in 2020.

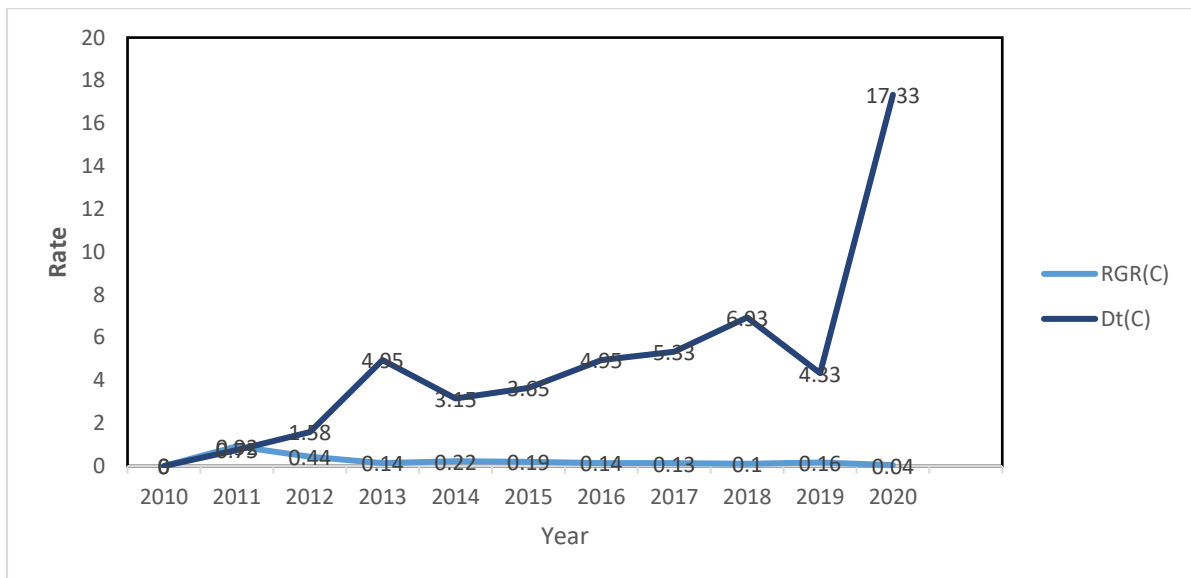


Fig 4: Logistic pattern of Relative Growth Rate (RGR) and Doubling Time (Dt) of citations

Figure 4 shows the relation between Relative Growth Rate (RGR) and Doubling Time (Dt) of citations of ISTL journal. Here deep blue color line indicates Doubling Time and Sky color

indicate Relative Growth Rate. It is seen here that the RGR line has gradually declined. On the other hand, the rate of doubling time (Dt) of citations for different years is fluctuating. From the graph, it can be concluded that the Doubling Time (Dt) of citations is increasing in comparison with the relative growth rate (RTG) during the period of study.

## **Findings**

1. Out of 224 articles, 113(50%) articles were contributed by a single author. A total number of 430 authors contributed 224 articles in the ISTL journal from 2010 to 2020.
2. Overall, the degree of collaboration in ISTL publications is 0.5 i.e., equal to the standard DC. It means the progress of collaborative research neither slow nor so fast. It is in a balanced position.
3. It has been noticed that the relative growth rate is not in a stable position during the study period. The rate of doubling time (Dt) for different years is increasing in comparison with the relative growth rate (RTG) during the study period. The mean rate of doubling time has increased gradually in different blocks. The mean value of doubling time is increased from 0.90 to 14.33 from 2010 to 2020. This means the journal takes more period to produce the same number of articles.
4. The relative growth rate citations for the first three years i.e., 2010-2012 are the highest (mean value 0.45) and the remaining two blocks of four years mean growth rate is decreasing gradually, and in the last block (the Year 2017-2020) mean growth rate is 0.11.
5. The rate of doubling time (Dt) of citations for different years is fluctuating.

## **Conclusion**

After deep analysis for finding out authorship pattern, degree of collaboration, growth rate, and doubling time of publications and citations it is concluded that most of the articles of ISTL journals were written by single authors. Overall, the degree of collaboration in ISTL publications is 0.5 i.e., equal to the standard DC. It means the progress of collaborative research neither slow nor so fast. It is in a balanced position. The relative growth rate of publications is not in a stable position. It takes more period to produce the same number of articles. The Doubling Time (Dt) of citations is increasing in comparison with the relative

growth rate (RTG) during the period of study. The scope of the journal should be enlarged so that authors may get a chance to publish varieties types of articles here. It needs to give more emphasis on collaborative works.

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