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Editorial Correspondence

To
The Editor, 'College Libraries'
West Bengal College Librarians' Association (WBCLA)
Uday Villa, Flat No. "C", Fourth floor
59/1, Harakali Colony, South Dum Dum, Kolkata-700074
E-mail:collegelibraries1983@gmail.com

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Contents

Content Analysis of Contributors of Higher Educational Institutes of Gujarat: with reference to NDLI

Dr. Meghna Vyas

Associate Professor, P. G. Department of Library and Information Science, Sardar Patel University, Gujarat

Dr. Jaydeep Mehta*

University Librarian, Navrachana University, Vadodara, Gujarat

(*Corresponding Author)

Abstract

The purpose of the current study is to analyse the contents of National Digital Library of India (NDLI). The study also searches organisations that have formed their institutional digital repositories and take part through their links to National Digital Library. NDLI is a single window for all digital content and resources. The user according to his educational level can choose the learning material. The searches can be refined by picking diverse options like type of learning resource, educational degree, file formats, languages, etc. The paper's analysis is based on a content analysis of the resources contributed by higher educational institutions in Gujarat to the NDLI platform. To commence the present study, data were collected from the website of NDLI (http://ndl .iitkgn.ac.in) in between 20th and 27th February 2023. The findings of the study will provide insights into the extent to which the NDLI project is being utilised by educational institutions in Gujarat, and the potential impact of the project on the academic community in the region. It is identified from the study that the majority of the resources are uploaded by IIMA. It is also identified from the study that more numbers of institutes have participated by sharing their resources through IDR.

Keywords: Content analysis, Digital library, Higher educational institute, Institutional digital repository, National digital library

1. Introduction

The National Digital Library of India (NDLI) through its National Mission on Education through Information and Communication Technology (NMEICT) project coordinated by Central Library, IIT Kharagpur, West Bengal is an initiative visualised to educate, allow and empower new India with quality knowledge and learning resources globally, using the strength of digital technology. There are several institutes including higher education institutes are content contributors through their institutional digital repositories. This Institutional Digital Repository (IDR) was created using open source software and the same maintained by the respective institution. This IDR has been merged into the NDLI so the contents uploaded by the respective institution can be accessed globally through NDLI.

NDLI boosts contributors or content partners for example educational boards, government institutes, private organisations

to upload their content, metadata and allow them to retrieve their intellectual property in the attentiveness of the people. All the contributors have a directive to create an Institutional Repository (IR) using digital library software if possible Dspace, set their metadata on Institutional Repository (IR). At the same time, it is also noted that NDLI does not store any content it only provides metadata to access. The respective source delivers the full text content.

The NDLI currently has more than 22 lakh subscribers and can also accessed through the NDL app in three different languages English, Hindi and Bengali. To obtain the copyright issue, the NDLI provides access only to the metadata of the e-content which is free from copyright restrictions.

2. Review of literature

It can be observed that several studies have been presented and published on NDLI.

Anasane (2022) highlighted various services offered by NDLI to access to various learning and information sources as well as different languages involved, and different types of files and formats in the content available in the NDLI. In this regard, Biswas and Das Biswas (2023) mentioned that at present NDLI is the best source of OERs in India.

Ashkar, Sarasu and Jelani (2020) tried to find out how students and research scholars of Central University of Tamil Nadu used digital resources and services offered by NDLI.

Bansode and Nikose (2019) described various embedded repositories on one platform which were developed for a specific purpose like Shodhganga, Krishikosh, NPTEL, Libri Vox, NDLI with use cases, NDLI service architecture, embedded LIS resources features in NDLI, social and professional sites and NDLI at a glance.

Bashir, Nasreen and Loan (2019) provided an overview of the NDLI to know its advantages, features and assemblage in the global digital space.

Mangurkar and Chaudhari (2018) presented an analysis of NDLI content. They emphasised various types of information sources facilitate to access for the community and also highlighted language wise distribution, arrangement of subjects in NDLI, and list of educational degrees covered in NDLI. They also did the institutional sources wise analysis of contents and unique facility to choose knowledge material.

3. Significance of the study

This study is significant because it offers information and analysis on the content contributors of higher education institutions of Gujarat and the digital resources contributed by those institutions through their IDRs. As well as to encourage other higher educational institutes to develop the IDR and contribute their contents on NDLI.

4. Objectives

The core objective of the present study is to analyse the content contributors of higher educational institutes of the state of Gujarat.

- To analyse overall content contributors out of all from the higher educational institutes in the state of Gujarat
- To analyse the learning resource contribution types of the higher educational institutes of the state of Gujarat
- To analyse various education levels involved by the content contributors of higher educational institutes in the state of Gujarat
- To analyse the different files and

formats available by contributors of the higher educational institutes of the state of Gujarat

- To find out and analyse the languages used by content of the higher educational institutes in the state of Gujarat
- To encourage the other higher educational institutes of Gujarat to contribute their content for benefit of all stakeholders
- To identify the different subjects available and contribute on NDLI of higher educational institutes of Gujarat
- To explore the various organisations that have provided access to their institutional repositories.

5. Research methodology

To commence the present study, data were collected from the website of NDLI (http://ndl. iitkgn.ac.in) between 20th and 27th February 2023. The data was collected with the help of browse option of home page of NDLI.

The present study is limited to 6 content contributors of higher educational institutes of Gujarat state. The collected data were categorised, analysed and presented by using simple statistical methods.

6. Scope and limitations

Content contribution in NDLI by the higher educational institutes of the state of Gujarat has been assessed in the study. There area total of 252 content contributors in India from all over India and 6 higher educational institutes of the state of Gujarat have participated as content partners. These 6 higher educational institutes are: The Maharaja Sayajirao University of Baroda (MSU), Dhirubhai Ambani Institute of Information and Communication Technology (DAIICT), Indian Institute of Management Ahmadabad (IIMA), Indian Institute of Technology, Gandhinagar (IITG), Navrachana Univesity, Vadodara (NUV), and Parul University, Vadodara (PU).

This study covered only higher educational institutes in Gujarat. Total content contributors are 08 from Gujarat, i.e., 6 higher education institutions mentioned above and Gujarat Secondary Educational Board and INFLIBNET Centre have been excluded in this study.

7. Data analysis

Table 1: Higher educational institutes as content contributors

Sl. No.	University/Institute/Colleges	Total Contents	%	Rank
1	Indian Institute of Management Ahmedabad	10950	47.35	1
2	Parul University, Vadodara	6951	30.06	2
3	Indian Institute of Technology Gandhinagar	3842	16.61	3
4	Dhirubhai Ambani Institute of Information and Communication Technology, Gandhinagar	602	2.6	4
5	Maharaja Sayajirao University of Baroda, Vadodara	543	2.35	5
6	NavrachanaUniversity, Vadodara	238	1.03	6
		23126	**100%**	

The above table 1 shows that there area total of six contributors from higher educational institutes in Gujarat as content partners of National Digital Library of India. It is found that contents contributed by institutes in the following ways: IIM-A (47.35%), Parul University, Vadodara (30.06%), Indian Institute of Technology Gandhinagar (16.61%), DAIICT Gandhinagar (2.6%), MSUB, Vadodara (2.35%) and Navrachana University, Vadodara (1.03%) respectively. However, as per analysis of the contents, it is found during access of NDLI website that one higher educational institute shows maximum contents but majority of contents are not accessible.

Table 2: Total contents partners

Total Contents Partners	Contents Partners Higher Educational Institutes of Gujarat	%
252	**6**	**2.38**

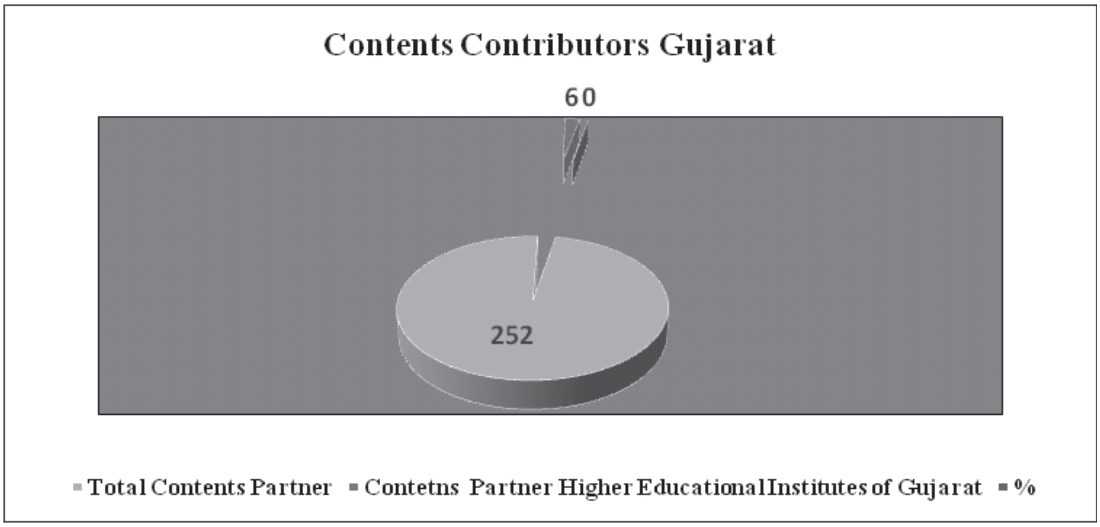

Figure 1: Contents contributors of Gujarat

Table 2 and figure 1 represent the content contributors in NDLI. It is identified thatout of a totalof 252,06 higher educational institutes of Gujarat have functioned as content contributors/partners.

Table 3: Education level

Particular	DAIICT	IIMA	IITGN	MSUB	NUV	PUV	Total	%
UG and PG	0	9925	0	543	238	6951	17657	**94.17067**
Master of Technology	509	0	400	0	0	0	909	**4.848**
Master of Design	55	0	0	0	0	0	55	**0.293333**
Doctor of Philosophy	24	0	82	0	0	0	106	**0.565333**
Master of Science	14	0	9	0	0	0	23	**0.122667**
Total	**602**	**9925**	**491**	**543**	**238**	**6951**	**18750**	**100%**

As per table 3, it is indicated that different contents are available for various education levels, and from the analysis, it is also found that maximum contents are available for UG and PG (94.17%) and minimum contents are available for Master of Science in particular (0.12%).

Table 4: File format

Particular	DAIICT	IIMA	IITGN	MSUB	NUV	PUV	Total	%
PDF	602	9985	671	543	220	6941	18962	93.11987
JPG/JPE	0	962	1	0	14		977	4.797918
MPGE	0	3	0	0	4	306	313	1.537102
HTML	0	0	103	0	0		103	0.505819
Others	0	0	8	0	0		8	0.039287
							20363	**100%**

The homepage of NDL mentions that educational material is available in different file formats. The study has tried to identify all the file formats available from contents contributed by higher educational institutes of Gujarat. The study has further analysed and found that the maximum file format (93.11%) content is in the form of PDF and the minimum file format is in the form of HTML (0.50%) followed by other files (0.039%) available.

Table 5: Language use

Language	DAIICT	IIMA	IITGN	MSUB	NUV	PUV	Total	%
English	602	10950	3839	472	238	6948	23049	99.66704
Others			3	71	0	3	77	0.332959
Total	602	10950	3842	543	238	6948	**23126**	**100%**

From analysis, it can be seen from table 5 that the majority of educational material is available in English (99.66%) and the minimum in other languages (0.33%) like Gujarati, Sanskrit and very feware in other languages available in the contents contributed by higher educational institutes of Gujarat.

Table 6: Content resource type

	DAIICT	IIMA	IITGN	MSUB	NUV	PUV	Total	%
Annual Report	69	48		0	3		120	0.631878
Technical Report/Manual	509		5	0	15		529	2.78553
Article	0	2756	2938	3	174	387	6258	32.95245
Book	0	1352	87	216	3		1658	8.730451
News Paper Article	0	168	2	0	0		170	0.895161
Notes/Presentation	0	2271	245	0	0		2516	13.24838
Thesis	24	291	491	324	28	531	1689	8.893686
Video Lecture					18	306	324	1.706071
Question Paper						5687	5687	29.94576
Others						40	40	0.210626
Total							**18991**	**100%**

The above table 6 shows that there are a total of 10 types of content contributions available from these higher educational institutes of Gujarat including articles (32.99%) followed by question papers (29.94%) as the maximum content resource types. However, it is also identified that question papers available in the institutes are not accessible properly or not open even though it is indicated as open access files by the respective institute. As well as minimum resource type found as annual reports (0.63%) followed by (0.21%) other resource type contents contributed by higher educational institutes of Gujarat.

8. Findings of the study

The present study highlights a statistical picture of the content contributors from the higher educational institutes of Gujarat.

- It has been identified that the maximum contents contributed in NDLI by IIM-A (47.35%) out of all 6 higher educational institutes from Gujarat.
- The breakdown shows that very few higher educational institutes from Gujarat participated as content partners.
- The analysis indicates that different contents are available for various education levels and found that maximum contents are available for UG and PG levels (94.17%).
- It is identified that the maximum file format (93.11%) content is in the form of PDF and the minimum file format is in the form of HTML (0.50%) followed by other files (0.039%) available. So, the commonly accepted file format is in PDF format.
- As per finding, it is shown that the majority of educational material is available in English (99.66%). Hence, the medium of maximum content is in English language and the minimum in other languages including Gujarati (0.33%).
- As per the analysis, it is understood that there is a total of 10 types of content contribution available from these higher educational institutes of Gujarat including articles (32.99%) followed by question papers (29.94%) as maximum content resource types.

- As per the NDLI website's source tab, one university identified that 90% of contents are not available or links are not accessible from its institutional digital repository.

9. Recommendation

The study focuses on contributions made over a specific period and aims to identify trends and patterns in terms of the type of resources contributed, the subject areas covered, and the frequency of contributions. The findings of the study will provide insights into the extent to which the NDLI project is being utilised by educational institutions in Gujarat, and the potential impact of the project on the academic community in the region.

Today's libraries and information centres are facing various kinds of difficulty at every level in the new digital environment and to solve the said problem NDLI has been formed and thus NDLI is the strongest single window platform for academicians, researchers, and for total learner community. The study highly recommended that all the intellectual content information and knowledge sources should be needed to be uploaded at the local level Institutional Digital Repository and also should be a part of the first respective institute IDR and this IDR has to be merged with NDLI for the benefit of all community and the society at large.

Higher educational institutes should take care of copyrights of the resources that are uploaded either on IDR or on NDLI. It is also recommended while uploading the contents on IDR that unnecessary resources should not be uploaded on IDR. It is found while accessing the NDLI website and from the resource link available that few educational institutes uploaded metadata of subscribed physical periodicals and their name only. It is also recommended to recheck the content and its accessibility after or before uploading the resources on IDR or as and when it's merged with NDLI.

Overall, this paper contributes to the growing part of the contents on the NDLI project and its impact on higher education in India. By analysing the contributions of educational institutions in Gujarat, the study sheds light on the potential of the project to support education and research in the region and the challenges that need to be addressed to realise this potential. The findings of this study have important implications for policymakers, educators, and researchers interested in leveraging digital technologies to enhance access to education and knowledge.

10. Conclusion

In the current era due to information overload, users' demands and the current development of ICT, digital content is very important for sharing the same globally. NDLI has continuously increased e-contents/e-learning resources by developing at various levels e-libraries/digital repositories for the benefit of users as well as at the same time for libraries and information centres. The NDL India is currently one of the major pearl troves in the global cyberspace containing information on any branch of knowledge for any user at anytime from anywhere in many languages and formats. At last, the study concludes that all the institutional contents available with the institutions of the state of Gujarat need to be shared on the NDLI platform for the benefit of the user community to enhance their research and academic improvements.

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Application of Geographic Information System (GIS) in Identifying Libraries in the Districts of West Bengal

Prakriti Das

Assistant Professor, Victoria Institution (College), Kolkata

Abstract

Geographic Information System (GIS) is a technology that represents spatial data in an enhanced manner for utilisation in human resource development. This study aims to identify the location of different libraries using ArcGIS and also determine the library health of the districts of West Bengal. Location maps have been prepared showing the location of government libraries, government sponsored libraries, aided libraries, century old libraries and other important libraries in the districts of West Bengal. A choropleth map has been prepared using the ratio between the total number of libraries in each district and the existing literate population of the same district (derived from Census of India, 2011) to depict the library health of that district. A higher ratio value signifies that a greater number of the population depends on the services provided by a limited number of libraries which highlights the poor library health of that district and vice versa. It has been found that Kolkata, Alipurduar and Kalimpong have the lowest library population ratio indicating a very good library health of these districts. However, the situation is very serious in terms of library health in Jalpaiguri, Paschim Bardhaman, East Midnapore, West Midnapore and Bankura where only a few libraries are located to be accessed by a considerably large number of literate population. Therefore, this study recommends increasing the existing number of libraries by constructing new libraries in these districts, so that the people can properly access the library services.

Keywords: District, Geographic information system, Library, Map, Population, West Bengal

1. Introduction

Geographic Information System (GIS) is a technology that is based on computers and used in receiving, storing, analysing and presenting information regarding the different locations on the earth's surface like buildings, markets, airports, forests and others. Such locations can be represented in different ways like latitudinal and longitudinal extension, address and pin codes. The data is handled in the GIS interface in an enhanced manner to create logical patterns, trends and relationships existing in the data. In other words, the spatial data can be captured and maintained by this technology that is ultimately utilised in the development of human resources (Bhatta, 2020).

GIS has emerged as an advanced map-making process that can superimpose data into different layers in this technology. For example: the pollution data of any country can be superimposed with the GDP of that country to find the relation between the rate of development and the pollution level. The maps created by GIS display the numbers, density and concentration of the population, workers or literates of any region. GIS is used to study the changes in any aspect of the earth

with time. Satellite or remote sensing data is used to monitor such changes in glacial cover, forest cover, changes in river courses, expansion of desert areas which forms the base for scientific investigations and developmental planning. Lastly, GIS technology helps in the integration and operation of different communication lines (transport, telephone, internet) and helps to provide better infrastructural connectivity (Elangovan, 2006).

Library is an important component of any educational institution (Biswas, 2022; Pandit & Biswas, 2023). It acts as a storehouse of past and present knowledge and information (in hardcopy/ softcopy) in a systematic manner that can be easily accessed by future generations for advanced research or recreational purposes (ISO, 2006).

There are a variety of services in a library that can be well performed with GIS support like acquiring data, collecting books and journals, locating books on shelves, managing the issue and return of books, etc. Several research papers emphasised these aspects of the application in library management. However, this study aims to identify the location of different libraries using GIS technology.

Hence, Geographic Information System has been developed as an effective tool for spatial analysis by combining two types of data. In identifying the location of the libraries of any region, spatial data is defined as the actual location (address) of the library, while information like the name of the library, working hours, specialisation and capacity of the libraries are included in the attribute data.

2. Review of literature

Several studies highlight the use of Geographic Information System (GIS) in the management of various library services. Formulation of maps has always been an essential component of the application of GIS in library. Howser and Callahan (2004) opined that libraries can work in collaboration with other academic departments to overcome the gap in GIS access and support. Different software in GIS technology can manipulate numeric and geospatial data to create visually representative maps. Xia (2005) pointed out the problem of the library users in locating a library item. So, the author explained how a mapping system was developed by GIS technology which provided a systematic analysis of spatial data of collection locations and represented the analytical results in the form of maps. According to Bishop and Mandel (2010), libraries could use GIS in practice and research which would generate more information in comparison to manual tables and text for spatial analysis of library services. Later, Bishop et al. (2011) discussed the practical issues of GIS for library research based on the knowledge accumulated from ongoing GIS projects in the libraries. Atkins (1999) explained the ability of GIS to use the available information in an efficient way which ultimately reduces the operation cost and makes the services accessible to a larger number of users. Deckelbaum and Bruman (1999) reported that GIS could develop relationships among features that result in problem solving or decision making. In this way, decisions can be made about where to locate a new library in any place or region. Later, Park (2012) studied the importance of physical accessibility to a library. GIS improves physical accessibility by developing a road-network-based distance measure that includes descriptive and statistical analysis. So, GIS can be implemented to study these geography related factors, assist in mapping and finally improve spatial information services in the library. According to Kim and Lee (2021), certain attractive factors need to be analysed to

determine to what extent public libraries are accessible. Lastly, Plassche (2022) also examined the use of maps and geospatial information managed by Geographic Information System (GIS) in identifying the library positions in any country.

3. Significance of the study

From the literature review, it can be well understood that Geographic Information System can play a significant role in the efficient and effective working of the library system. GIS is utilised for easy accessing different items in library by maintaining and updating maps and tables as well as in complex decision making that involves feasibility analysis of the location of library. However, there is a shortage of research regarding the location of libraries in the states of India that can emphasise the accessibility of libraries by the literate population. So, this study focuses on the identification of different types of libraries in West Bengal with the help of GIS that can overcome the existing gap and also find out the districts where new libraries are required for the population.

4. Categories of libraries in West Bengal

Some sources highlight different categories of libraries in any region. However, in this study, five types of libraries have been considered which are located in the 23 districts of West Bengal: Aided Library, Government Library, Government Sponsored Library, Century Old Library and Other Important Library (Department of Mass Education Extension and Library Services, 2023).

4.1 *Government library*

Government is primarily responsible for the infrastructural development and welfare of the people. So, the government established many non-profit libraries which are run by the funds provided by the government itself. The uses of such libraries are education, information, recreation and research. These libraries are situated in the urban areas of the districts of West Bengal and some of them charge nominal fees as caution deposits for the users.

4.2 *Government sponsored library*

These libraries are situated in the urban as well as rural areas of the districts of West Bengal. Sub-divisional library, district library, town library, rural library and primary units are included within the Government sponsored libraries which are managed by the Municipality or the Gram Panchayat Samiti.

4.3 *Aided library*

The name 'Aided Library' suggests that these libraries are supported with funds provided by the government. They have a collection of rare and valuable books and documents along with various texts and reference books which are made accessible to the public for borrowing. Some of these libraries have reading rooms or halls for the students and public during specified times.

4.4 *Century old library*

These libraries were built more than a hundred years ago and so they are considered as the heritage asset of the district. Most of these libraries have significant historical backgrounds and they are storehouses of rare books, journals, manuscripts, periodicals and old newspapers. Some libraries have preserved old coins, paintings and sculptures which attract many tourists to a great extent.

4.5 *Other important library*

These are special libraries that cater to the specific needs of organisations, specialised users, or professions. they are mainly found in government agencies, research institutions, law firms, military bases, medical colleges and museums.

Depending on the priority of the institution, special libraries may or may not be accessible to the general public. Such libraries play an important role in the scientific investigations, innovation and promotion of knowledge within specialised fields.

5. Objectives

- To identify the different types of libraries in the districts of West Bengal
- To locate these libraries in 23 districts of West Bengal with the help of Geographic Information System (GIS)
- To understand the library health of the districts of West Bengal.

6. Methodology

In ArcGIS, geospatial data can be created and stored in different formats. The primary data types are Raster and Vector. Raster data is mainly continuous data without any definite boundaries. It is a type of spatial data that consists of a matrix of cells organised into rows and columns in which each cell represents specific information known as pixels. Raster data also includes remote sensing images like satellite imagery and aerial photos. In the present study, the scanned map of West Bengal with district boundaries is the raster data used. Vector data is represented as either points, lines or polygons. It is a type of spatial data that has discrete boundaries. The location of the libraries identified by a point feature is the vector data here and the district boundaries are marked as polygons (Graser, 2016).

In ArcGIS, shape files have been created from Arc Catalogue. Then the different types of libraries were searched from Google Earth with their names and locations and later symbolised the points. These points are saved in Keyhole Markup Language (kml) and then the kml points are converted in ArcGIS and plotted on the map of West Bengal. Three maps have been created showing the location of different categories of libraries in the districts of West Bengal. A choropleth map has been prepared using the ratio between the total number of libraries in each district and the existing literate population of the same district (derived from Census of India, 2011) to determine the library health of that district.

7. Result and discussion

Table1 has been prepared to show the total number of libraries in the 23 districts of West Bengal.

Table 1: Different categories of libraries in the districts of West Bengal

Sl. No.	DISTRICT	Aided Library	Century old Library	Govt Library	Govt sponsored Library	Other Important Library	Total
1	Alipurduar	-	-	-	1	-	01
2	Bankura	-	-	-	4	-	04
3	Birbhum	-	2	-	10	-	12
4	Koch Behar	-	-	1	7	-	08
5	Dakshin Dinajpur	-	-	-	3	-	03
6	Darjeeling	-	-	1	6	-	07

Sl. No.	DISTRICT	Aided Library	Century old Library	Govt Library	Govt sponsored Library	Other Important Library	Total
7	Hugli	-	12	1	15	-	28
8	Haora	1	11	-	4	-	16
9	Jalpaiguri	-	-	-	4	-	04
10	Jhargram	-	-	-	1	-	01
11	Kalimpong	-	-	-	1	-	01
12	Kolkata	3	22	3	3	5	36
13	Malda	-	-	-	5	-	05
14	Murshidabad	-	2	-	9	-	11
15	Nadia	1	3	-	5	-	09
16	North 24 Parganas	-	8	2	27	-	37
17	Paschim Bardhaman	-	1	-	3	-	04
18	Purba Bardhaman	-	1	-	16	-	17
19	West Midnapore	-	1	-	6	-	07
20	East Midnapore	-	-	1	6	-	07
21	Purulia	-	-	1	5	-	06
22	South 24 Parganas	1	8	-	14	-	23
23	Uttar Dinajpur	-	-	1	3	-	04

(Source:https://www.collegeadmission.in/Other%20Information/Library/India/State_Wise/WestBengal/Government_Libraries.shtml (Accessed on 23rd March 2023).

From table 1, it can be clearly stated that there is an inequality in the total number of libraries found in the different districts of West Bengal. Districts like North 24 Parganas, Kolkata, Hugli and South 24 Parganas have having good number of libraries in comparison to the newly formed districts of Kalimpong, Alipurduar and Jhargram. The number of libraries is also less in Jalpaiguri, Uttar Dinajpur, Dakshin Dinajpur, Malda and Bankura. Kolkata is the only district where all the five categories of libraries are present. In Purba Bardhaman, there are 17 libraries; while in Paschim Bardhaman, only 4 libraries are located.

Location maps (Map 1, 2 and 3) have been prepared using ArcGIS for better visualisation of the location of Government libraries, Government sponsored libraries, aided libraries, century old libraries and other important libraries in the districts of Wes Bengal.

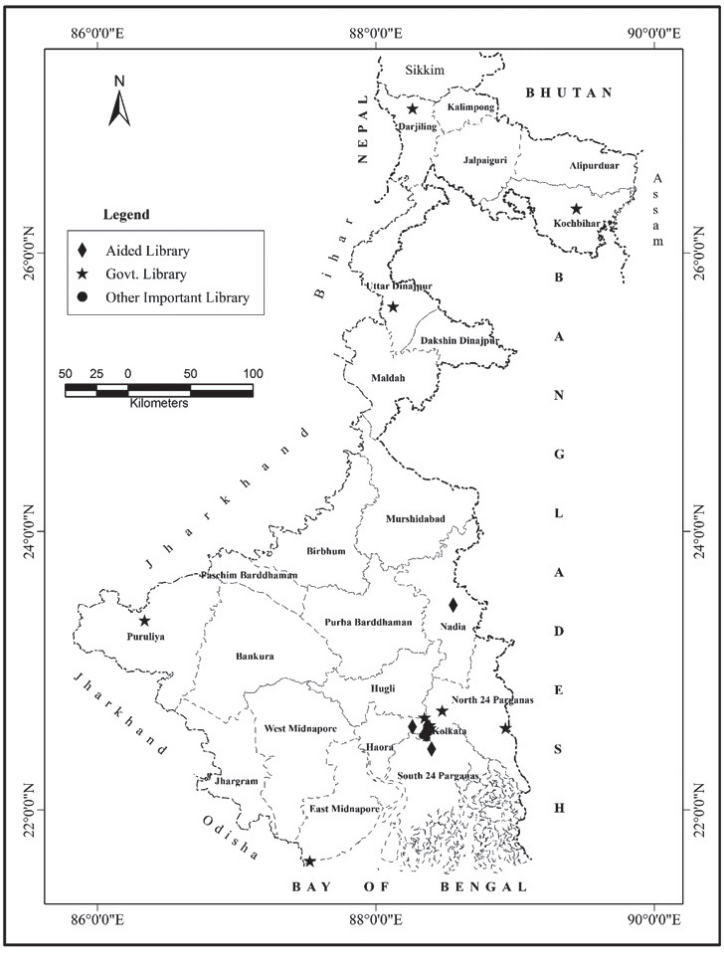
Firstly, map1 shows that there are a few government libraries which are found in Koch Behar, Darjeeling, Hugli, Kolkata, North 24 Parganas, East Midnapore, Purulia and Uttar Dinajpur and aided libraries are found in Haora, Kolkata, Nadia and South 24

Parganas. Moreover, out of the 41 other important libraries of Kolkata, only 5 selected libraries (National Library, Asiatic Society Library, Bangiya Sahitya Parisad, Bidhan Chandra Granthagar and Ramkrishna Mision Institute of Culture Library) have been plotted considering the small area of Kolkata district.

Secondly, map 2 shows that the government sponsored libraries are located in all the 23 districts of West Bengal. There are many government sponsored libraries in the southern districts of Hugli, North 24 Parganas and South 24 Parganas which have clustered along the boundaries of these three districts. However, the government sponsored libraries are well distributed throughout the rest of the districts.

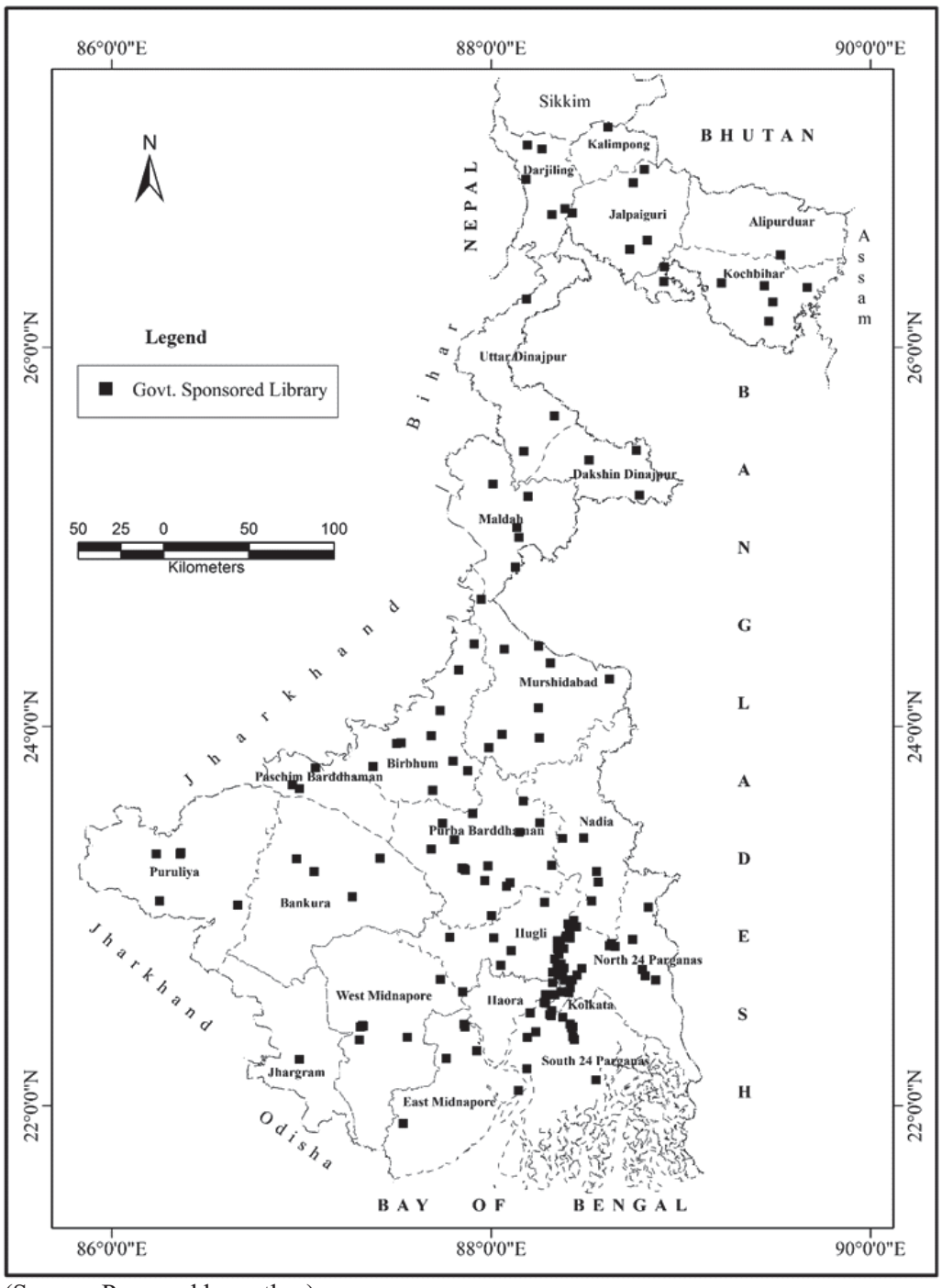
Thirdly, Map 3 shows that there are many libraries in Hugli, Haora and Kolkata which are about a hundred years old and are still serving the population of these districts. A few century old libraries are also located in Murshidabad, Nadia, North 24 Parganas, Purba and Paschim Bardhaman, West Midnapore and South 24 Parganas.

Map 1: Location map of aided, government and other important libraries of West Bengal



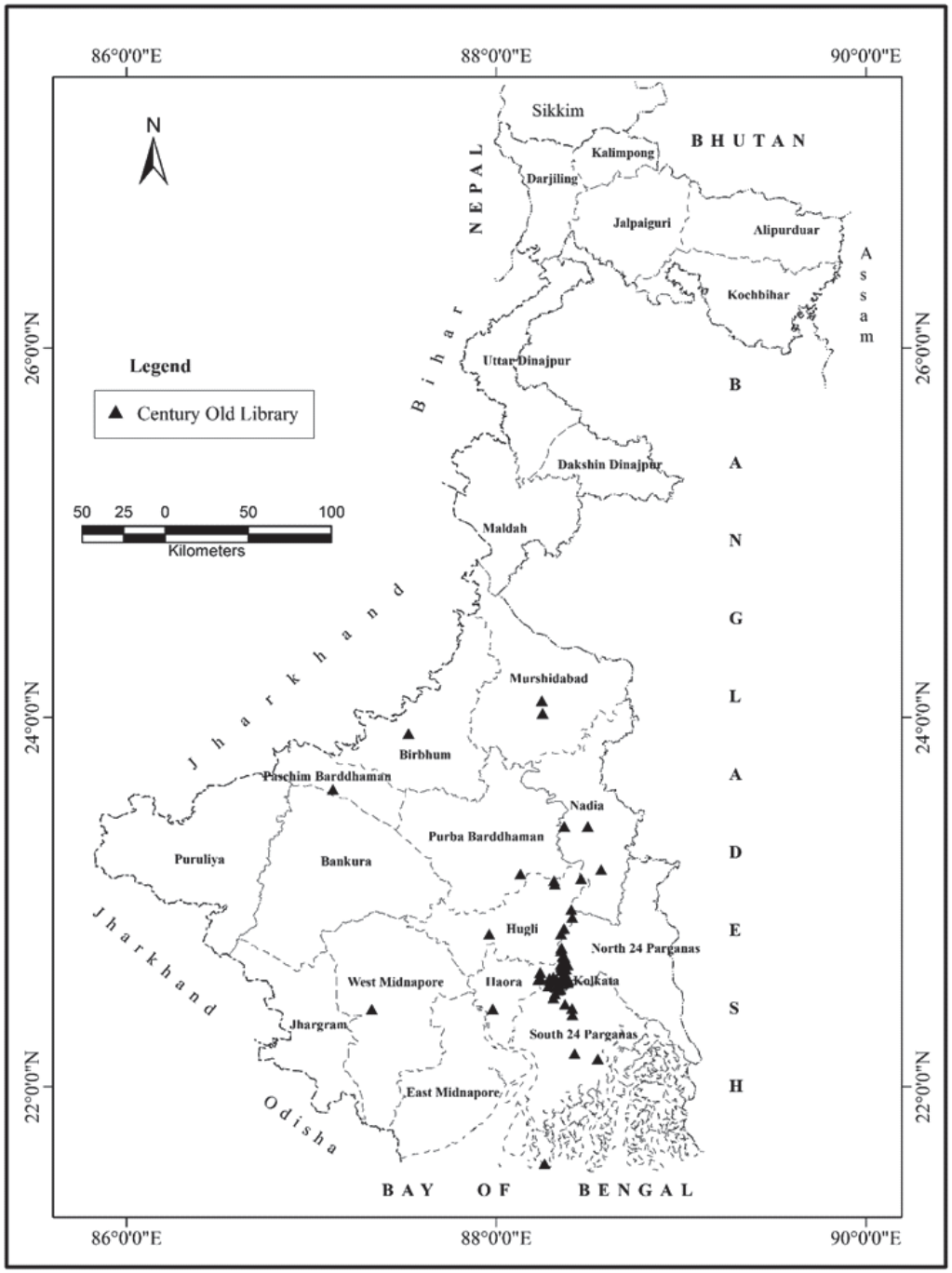
(Source: Prepared by author)

Map 2: Location map of government sponsored libraries of West Bengal



(Source: Prepared by author)

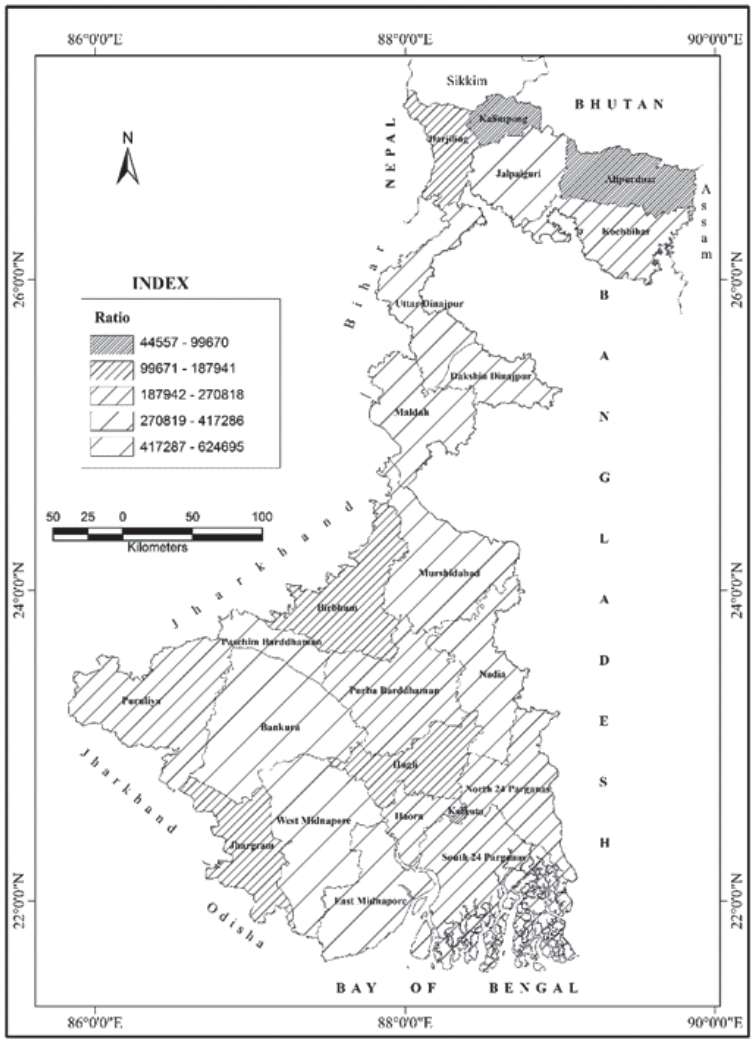
Map 3: Location map of century old libraries of West Bengal



(Source: Prepared by author)

Lastly, a choropleth map (Map 4) has been prepared to show the library population ratio of the districts of West Bengal. A total number of libraries located and the total number of literate population of each district has been taken into consideration for calculating the library population ratio. The library population ratio denotes the library health of the district which indicates whether the existing number of libraries are sufficient to provide the necessary library services to those people who are accessing the library or not. A higher value of the ratio signifies that a greater number of the population depends on the services provided by a limited number of libraries which highlights the poor library health of that district. On the other hand, the lower value of this ratio points to the fact that the people in need of library services are well catered by the existing libraries of that district.

Map 4: Choropleth map showing library population ratio of districts of West Bengal



Source: Prepared by author

Table 2: Library population ratio of the districts of West Bengal

Sl No.	Ratio (Class)	Number of Districts	Name of Districts	Remarks
1	44557 - 99670	3	Kolkata, Alipurduar, Kalimpong	Very good library health
2	99671 – 187941	4	Darjeeling, Birbhum, Jhargram, Hugli	Moderately good library health
3	187942– 270818	6	Koch Behar, PurbaBardhaman, Purulia, Haora, North 24 Parganas, South 24 Parganas	Moderate library health
4	270819– 417286	5	Uttar Dinajpur, Dakshin Dinajpur, Malda, Murshidabad, Nadia	Moderately bad library health
5	417287 - 624695	5	Jalpaiguri, Paschim Bardhaman, East Midnapore, West Midnapore, Bankura	Very bad library health

It is very clear from table 2 that only Kolkata, Alipurduar and Kalimpong are having the lowest library population ratio indicating very good library health of these districts.This is because the highest number of libraries are located in Kolkata which are accessible to the literate population. Both Alipurduar and Kalimpong districts have one library each, but a lower number of the literate population has resulted in good library health in these districts. However, the situation is very serious in terms of library health in Jalpaiguri, Paschim Bardhaman, East Midnapore, West Midnapore and Bankura where only a few libraries are located to be accessed by a considerably large number of literate population. Therefore, it is necessary to increase the number of libraries in these districts by constructing new libraries, so that the people can properly access the library services.

8. Conclusion

Geographic Information System (GIS) can be widely used in identifying complex problems and decision making. It also prioritises the foundation for mapping and analysis in any multidisciplinary research. The maps show the highest and the least number of different types of libraries located in the districts of West Bengal. Moreover, this study has identified the districts that do not have a sufficient number of libraries to accommodate the existing literate population of those districts. The choropleth map gives a proper visualisation of this problem. Availability of libraries in good numbers and providing quality services to the people of any region are essential for the academic as well as overall development of that region.

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Trends in Information Seeking Behaviour Research: a bibliometric study using Scopus database

Medi Vijay Kumar

Research Scholar, Department of Library and Information Science, Osmania University

Dr. K. Bharathi

Associate Professor (Rtd.), Department of Library and Information Science, Osmania University

Abstract

This paper analyses publications on information seeking behaviour using Scopus data. For this study the Scopus abstracting and indexing e-database were searched using the keywords "Information seeking," "Information seeking behaviour," and "Information seeking behavior." A total of 74,101 publications were found as the outcome of the search. The data set of 74,0101 bibliographic records was obtained, containing information such as the distribution of articles by year, authors of the publications, source titles, distribution of publications by nation, and impact of the publications. It is revealed that there is a consistent upward trend in research production over successive decades. This paper highlights the growing importance of understanding and exploring information seeking behaviour, reflecting the increasing significance of information retrieval in our information-driven society. The longitudinal perspective on research productivity provides context for researchers and policymakers to appreciate the evolution and direction of this field of study. These findings have practical implications, as they offer scholars and practitioners a valuable resource to identify primary journals and research publications related to information seeking behaviour. This research empowers researchers to stay informed about the latest developments and insights in this domain, facilitating the dissemination of knowledge to a broader audience. This paper equips individuals and institutions with a valuable tool to navigate the dynamic landscape of information-seeking behaviour in a world that is increasingly reliant on information access and utilisation.

Keywords: Bibliometric Analysis, Information Seeking Behaviour, Publications, Research Output, Scholarly Literature, Scopus

1. Introduction

Information seeking behaviour refers to acquiring desired information and using it to fulfill needs or specific purposes (Shah, 2014). It enfolds people's actions and strategies to find and utilise relevant information. Information seeking behaviour can vary depending on the context and objectives. Each person is constantly looking for information to fulfill some goal in this era of information so that they can survive and perform several tasks or specialised tasks with perfection (Biswas, Chakrabarti, & Das Biswas, 2013). Information seeking behaviour studies and research are happening across all disciplines (Akhter, 2018). This study will provide valuable insights for understanding the current status of information-seeking behaviour research. It will delve deeper into historical

trends and comprehensive details to the research community by providing quantitative analysis of information-seeking behaviour scholarly output. These insights are immensely helpful for scholars, corporates, and library professionals to plan future research agendas. Further, this research can be a reference to the researchers working on information seeking behaviour. This paper aims to provide comprehensive scholarly historical data on information seeking behaviour.

2. Review of related literature

Akhter's (2018) study on information seeking behaviour found a steady increase in productivity over decades, with a whopping 861 papers found in library and information science journals. Akakandelwa's (2016) book chapter revealed the expansion of publications, author collaboration patterns, prominent contributors, publication preferences, preferred journals, and the influence of literature. Patel's (2021) article found fluctuating trends in research activity, with Nicholas D. being the most prolific author and Mckenzie PJ receiving the highest citation count. Shah (2010) and Shah (2014) highlighted the importance of collaboration in information-seeking processes and advocated for the development of systems for collaborative information seeking (CIS) tasks. Kim (2017) explored recent trends in information behaviour research, focusing on content words, highly cited articles, disciplinary categories, and author keywords. Greifeneder (2014) analysed 155 recent publications on information behaviour, revealing persistent trends from 2008 and 2011, including qualitative methods, information seeking, and user needs. Tella (2016) provided international perspectives on digital library issues, focusing on information retrieval, usability, copyright, and legal issues, addressing challenges in countries with limited infrastructure and socio-economic barriers.

3. Significance of the study

Researchers often examine papers from different study fields using tools and databases like Scopus or Web of Science. Nevertheless, their assessments frequently focus on particular periods, topic areas, and selected academic publications. Hence, it is necessary to thoroughly analyse and integrate all the literature on Information Seeking Behaviour in the Scopus database to have a full picture of the current status of the subject. Hence, the main objective of this article is to do a bibliometric analysis and examine the data on publications about information seeking behaviour.

4. Objectives

i. To discover the latest information-seeking behaviour trends

ii. To drive into the world of information seeking behaviour with insights from top authors in the field

iii. To reveal the groundbreaking research conducted by the top universities in the study of information seeking behaviour

iv. To gain valuable insights into information seeking behaviour from experts in the best universities around the world.

5. Methodology

To fulfil the above research objectives, the Scopus database has been identified to analyse the data comprehensively. In this study, Boolean search strategies have been used for collecting extensive data, by using the search terms like, "Information seeking" OR "Information seeking behavior" OR "Information seeking behaviour" to analyse the publications in the information seeking behaviour area. A total of 74,107 publications on information seeking behaviour topics were

found from 1961 to 2023. These publications included major fields like social sciences, medicine, computer science, psychology, business management, and other subjects. Further, we have analysed the following aspects from the data retrieved: growth of literature, author pattern, subject areas, document types, source of the publication, keywords, affiliation, funding agencies, country, and access type.

6. Data analysis

6.1 *Growth of the literature*

The proliferation of scholarly works about the topic of information seeking behaviour has seen significant growth over the years, with a total of 34,450 publications being produced between the years 2010 and 2019 which is almost half of the overall literature. Out of which 27,590 publications have been produced last five years. It is evident that research on information seeking behaviour has grown exponentially over the previous 10 years and will continue to do so in tandem with the explosion of information. Another interesting insight here is that during 2020-21, the publications reached about 7000, the highest peak in a single year.

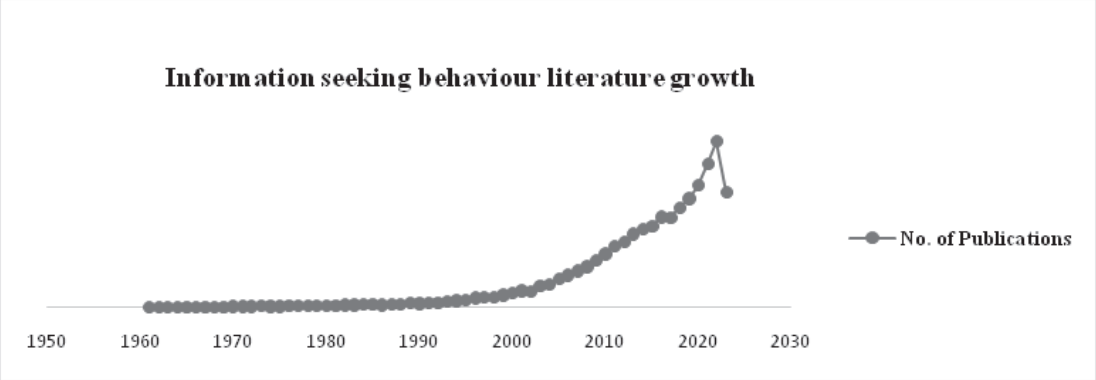

Figure 1: Information seeking behaviour literature growth

6.2 *Sources of the publications*

Lecture Notes in Computer Science (LNCS) including its subseries Lecture Notes in Artificial Intelligence (LNAI) and Lecture Notes in Bioinformatics (LNBI) have published the highest number of publications (1230) on information seeking behaviour topics followed by The Journal of Medical Internet Research (853), Library Philosophy and Practice (647), Journal of Documentation (643), International Journal of Environmental Research and Public Health (614), Health Communication (569), Journal of the American Society for Information Science and Technology (529), PLOS ONE (521), Conference on Human Factors in Computing Systems Proceedings (486), Information Processing and Management (483) are listed in top source of publications.

Among the total of 74,107 papers, it was observed that 24,754 papers were published in 159 sources, each of which had published more than fifty documents. Out of these sources, 8,450 papers were published by core library science journals, medicinal journals published 7,295 papers, 5,621 papers were published by computer science journals, and 3,388 papers were published by social science journals. The

remaining documents are published in journals covering various subject categories.

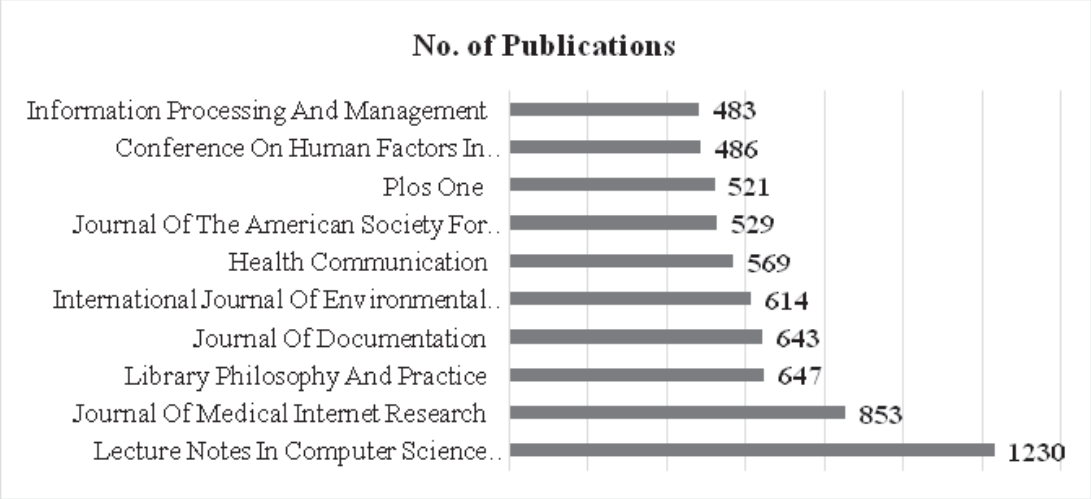

Figure 2: Number of publications

6.3 *Document types*

Out of the total retrieved documents, 59,524 articles were published in peer-reviewed journals, while 7,808 papers were published in Conference Proceedings. Additionally, 4,056 papers were published as books, and 2,637 papers were published as part of book series. A smaller number of sixty-eight papers were published in trade journals, while a mere 14 papers were published in sources that could not be categorised.

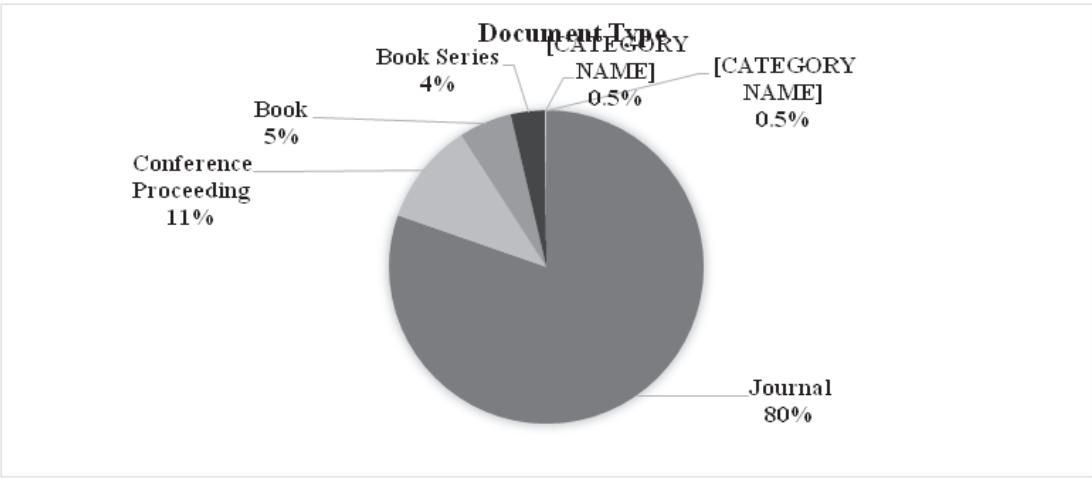

Figure 3: Document type

6.4 *Most contributed authors*

Many authors have made significant contributions to the body of research in understanding information seeking and utilisation. The most prominent authors in the field of information-seeking behaviour are Shah, C, Nicholas, Spink, A., Savolainen, R., Shneiderman, B., Jansen, B.J., White, R.W., Buchanan, G., Dr. Spence., and Belkin. These authors have made significant contributions to the body of knowledge of information seeking behaviour in various contexts, and their work touches on a wide range of themes within the field. Shah's research focuses on information behaviour, digital libraries, and technology's influence on information-seeking activities. Spink's work focuses on web search and user interfaces. Savolainen's work covers topics like information literacy and cultural dimensions. Shneiderman's research focuses on human-computer interaction and information visualisation. Jansen's work focuses on web search behaviour, online information retrieval, and user interactions with search engines. White's work is recognised for web search engines, information retrieval, and user-centric search interfaces. Buchanan's work explores information-seeking behaviour in digital libraries and user interfaces. Dr. Spence's research focuses on social media's influence on information-seeking behaviour and online communication. Belkin's work on information seeking and relevance is notable.

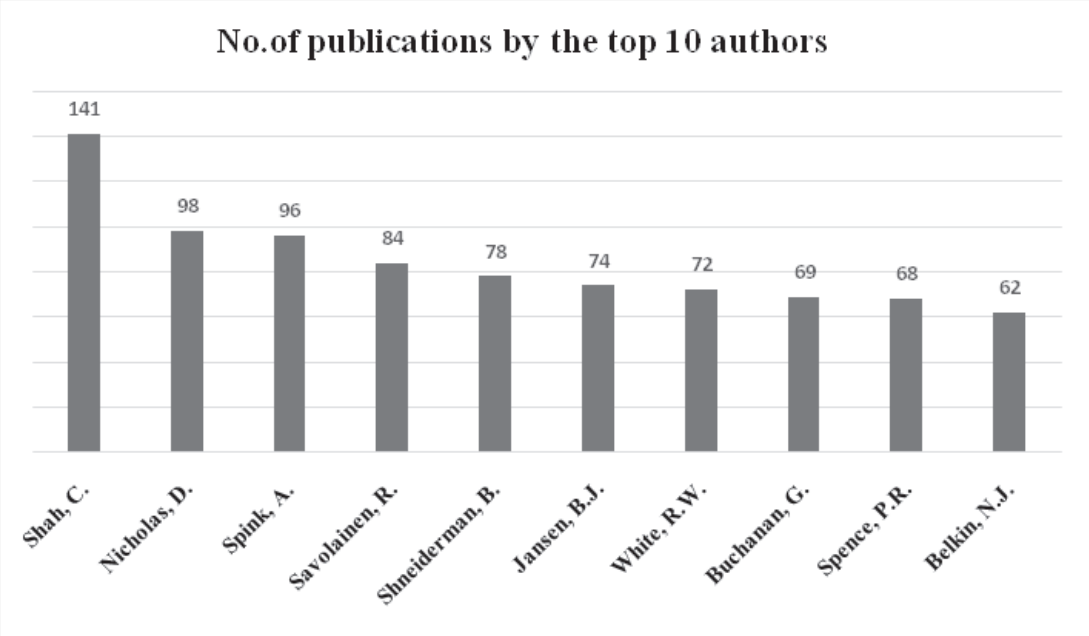

Figure 4: Number of publications by the top 10 authors

6.5 *Top Universities in information seeking behaviour research*

In the dynamic and ever-evolving field of information seeking behaviour research, leading global universities have distinguished themselves as leaders in generating knowledge and advancing the understanding of how individuals seek and utilise information. The table below presents the top universities globally based on the number of publications they have contributed to this crucial study area.

These universities serve as beacons of excellence in information seeking behaviour research. Their contributions to this field have expanded our understanding of how individuals' access and use information and have also informed policy and practice, shaping how we interact with information in the digital age. As the academic landscape continues to evolve, these institutions remain at the forefront of innovative research in this critical domain. University of Toronto tops the list with the most publications, while University College London has with least publications.

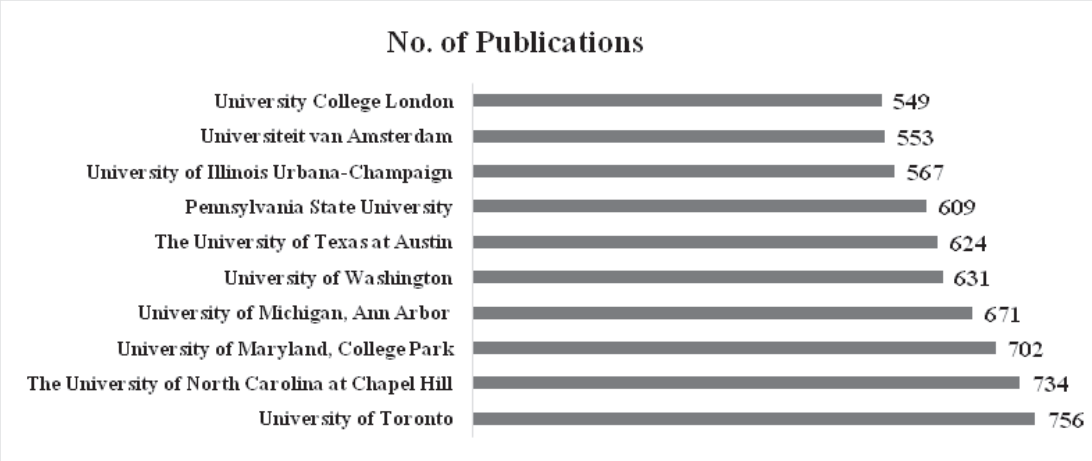

Figure 5: Number of publications

6.6 *Top funding sponsor agencies in information seeking behaviour research*

This bibliometric study analyses and identifies and ranks the top funding sponsor agencies significantly contributing to information-seeking behaviour (ISB) research. By examining the number of publications associated with each agency and their respective countries, we shed light on the key players in advancing our understanding of ISB.

This bibliometric analysis provides valuable insights into the prominent funding sponsor agencies that have driven information seeking behaviour (ISB) research. Their financial support has been instrumental in advancing our understanding of how individuals seek, access, and utilise information in various contexts. These agencies have contributed significantly to the academic discourse and influenced policy and practice in fields where ISB research plays a crucial role. Future research should continue

to explore the evolving landscape of ISB and the role of funding agencies in shaping this dynamic field. It is pertinent to mention here that National Institutes of Health have funded most research projects, while Canadian Institutes of Health Research have funded the least number of publications. It can also be observed that most funding agencies are from the Healthcare, Sciences, and allied sectors.

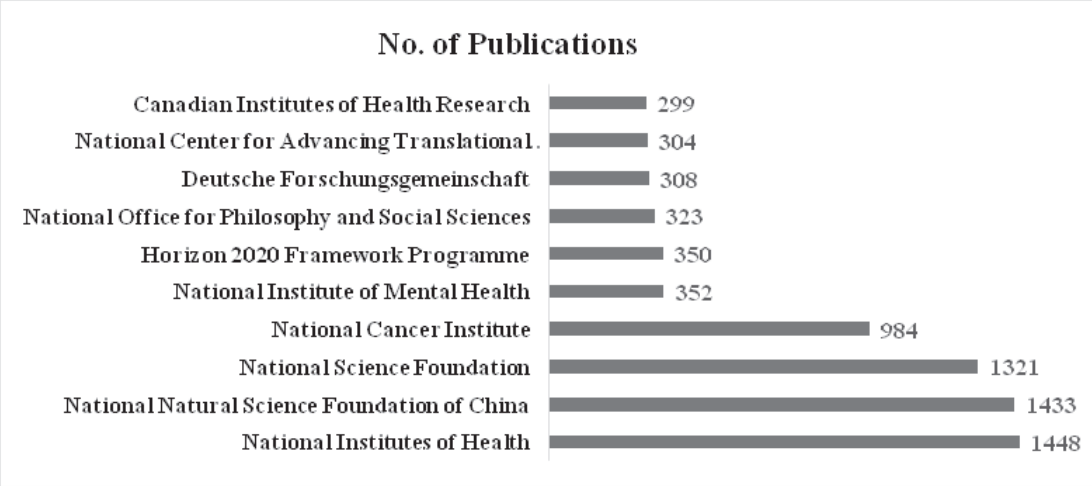

Figure 6: Number of publications

6.7 *Top countries in information seeking behaviour research*

In the realm of information seeking behaviour (ISB) research, a global landscape unfolds, as indicated by the statistics. The United States emerges as a formidable leader with a commanding 29,702 publications, reflecting its prominent role in shaping the discourse around how individuals seek and utilise information.

The United Kingdom, Australia, and Canada follow with 7,684, 4,529, and 4,516 publications, respectively. These countries contribute significantly to the ever-evolving ISB research field, highlighting the topic's importance in diverse cultural and educational contexts. With 4,472 publications, China demonstrates its growing influence in ISB research, reflecting its commitment to understanding information behaviours both within its borders and on a global scale. Germany, the Netherlands, Italy, Spain, and India add to the international chorus of ISB exploration. Their combined 11,898 publications underscore the collaborative and multidisciplinary nature of ISB research.

In these numbers, a global community of researchers and scholars has been witnessed who are dedicated to unraveling information seeking behaviour's intricacies. This international effort enriches our understanding and has practical implications for fields as varied as healthcare, education, technology, and beyond. The statistics bear witness to the shared pursuit of knowledge and the global significance of information seeking behaviour research.

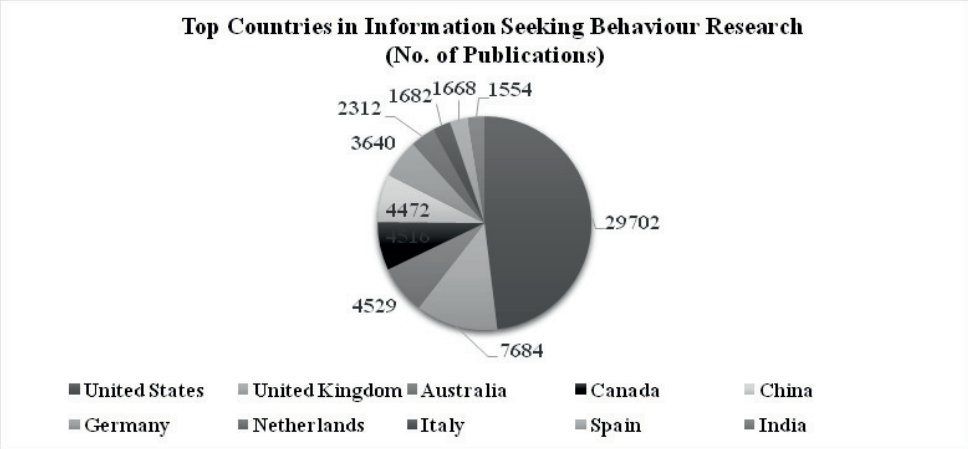

Figure 7: Top countries in information seeking behaviour research

(Source: Scopus Database)

6.8 *Main research areas*

Main subject areas emerging in information seeking behaviour research include IT ability, reading/writing capacity, and resilience, alongside information seeking itself. These areas significantly affect students' academic performance and are considered essential indicators of scholarly accomplishments. Five main research areas in information-seeking behaviour research are diverse, each addressing how individuals and society seek and process information differently.

i. Public Information Coordination Research: Investigating how public information is managed and disseminated.

ii. Public Information Behaviour and Perception Research: Studying how the public seeks, perceives, and uses information.

iii. Health Information Communication Research: Focusing on how health-related information is communicated and how it influences health behaviour.

iv. Risk Communication and Social Media Research: Exploring how risks are communicated on social media platforms and their impact on public perception and behaviour.

v. Information Technology in Emergency Management: Examining the role of IT in managing information during emergencies.

Each area contributes to the broader understanding of information seeking behaviour, highlighting how information is sought, processed, and acted upon in different contexts and through various media and technologies.

7. Conclusion

This analysis explores the expansion, origins, types of documents, authors, institutions, funding agencies, nations, and primary research fields in the domain of information-seeking behaviour. From 2010 to 2019, there was a substantial increase in academic publications, totalling 34,450 articles, with a particularly prominent peak in 2020-21. Lecture Notes in Computer Science (LNCS) including its subseries placed in top

and prominent library science journals, has had a substantial impact. The predominant portion of the papers consisted of publications published in peer-reviewed journals. Some of the major contributors are Shah, Nicholas, Spink, Savolainen, Shneiderman, Jansen, White, Buchanan, Dr Spence, and Belkin. The University of Toronto achieved the top ranking in terms of publications among universities worldwide. The National Institutes of Health emerged as the primary funding agency, with the United States taking the lead in information seeking behaviour research worldwide, followed by the United Kingdom, Australia, Canada, and China. The primary topics of research are the coordination of public information, the behaviour of public information, the transmission of health information, the communication of risks through social media, and the use of information technology in disaster management. Moreover, the field of bibliometric studies and research on information seeking behaviour is constantly evolving, with a continuous increase in publications. It is crucial for researchers to regularly analyse information seeking behaviour research to gain deeper insights into emerging technologies, diverse cultural perspectives, ethical considerations, and a comprehensive understanding of information seeking behaviours in different domains and contexts. Our study provides information on various parameters influencing the ISB studies, and sets agenda for more empirical studies in this field.

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Artificial Intelligence (AI) based Cyber Security Solution during the Period of 2013-2022 : a bibliometric study

Debalina Mukherjee

Librarian, RCC Institute of Information Technology, Kolkata

Dr. Subal Kumar Barui

Deputy University Librarian, University of Calcutta

Abstract

The integration of Artificial Intelligence (AI) and cyber security holds immense promise for shaping the future of digital defence. The inclusion of cyber security in AI, machine learning research is an emerging trend for academic research. This paper presents a bibliometric analysis of AI based cyber security solutions published in the Scopus data base during the past decade (2013-2022). Data was retrieved on 15th July 2023 by using an advanced search query. It has been revealed from the study that the research is in the early stage and after the COVID -19 the work exhibits its acceleration. India is ranked first among the nations, followed by the USA; in terms of publishing papers on AI based cyber security. Anticipating further advancement in the coming years, this study provides valuable insights into the current state of AI driven cyber security research. Future research could investigate optimal approaches to seamlessly integrate AI and cyber security concepts, ensuring that the next generation of professionals will be well equipped to overcome the problems related to cyber threats.

Keywords: Artificial intelligence, AI, Bibliometric analysis, Bibliometric techniques, Cyber security, Cyber security solutions, Scopus

1. Introduction

In today's internet era, there are diverse research topics in cyberspace. AI has the potential to change the field of cyber security. It can offer the flexibility and precision necessary to adeptly counter cyber threats' continuously changing and evolving landscape. Several conferences, workshops, and journals focus on this research area.

The study seeks to provide insights into the evolution of research, identify key contributors, and map out the intellectual structure of this interdisciplinary domain by examining the patterns of scholarly publications, citations, collaborations, and emerging trends.

Due to the rapid development of information technology and dynamic changes of threats in cyberspace, AI and machine learning play significant roles in cyber security.

2. Literature review

Bibliometricis a measurement process that is used to evaluate and predict the trends of development of science and technology using mathematical, statistical analysis. AI study is highly inter disciplinary because a wide range of journals have been published on AI research. Among them, most of the research ersuse bibliometrics to explore the use and spread of cyber security and AI in

their scientific works.

Bircan and Salah (2022) described the Big Data techniques and their computational approaches in social sciences by using bibliometrics. The articles were indexed between 2015 and 2020 in Social Sciences Citation Index (SSCI). Talan (2021) published a paper on artificial intelligence in education indexed in the Web of Science database by using bibliometric analysis. VOS viewer software was used to analyse and visualise all this information. Shukla and Gochhait (2020) studied approximately 2184 records by using Web of Science database and gave a complete idea of the development of cyber security as a research field. Sharma et. al. (2023) presented an extensive bibliometric analysis of cyber security and cyber forensic research published in Web of Science during 2011-2021. Cheng, and Wang (2012) revealed several issues by doing a bibliometric study on AI related publications.

3. Significance of the study

The existing literature review highlighted studies that covered diverse aspects of cyber security and AI research. The present study focuses on a specific intersection - the application of AI in cyber security in a specific period. It addresses a research gap and provides valuable insights into the collaborative efforts between these two domains.

4. Objectives

The objectives of the study are:

- To prepare the chronological distribution of literature and its progress rate
- To identify the contribution of highly active authors in publications and their publications overtime.
- To show the journals with the highest number of publications
- To trace the most active countries and organizations
- To locate the main research are as
- To identify the co-occurrence of author key words

5. Methodology

Data was retrieved on 15th July 2023 using an advanced search query. Microsoft Excel and Biblioshiny (R Tools) software were used for executing science mapping analysis. VOS viewers were used for data visualisation.

Figure 1 shows the inclusion and exclusion criteria for selection of papers (n).

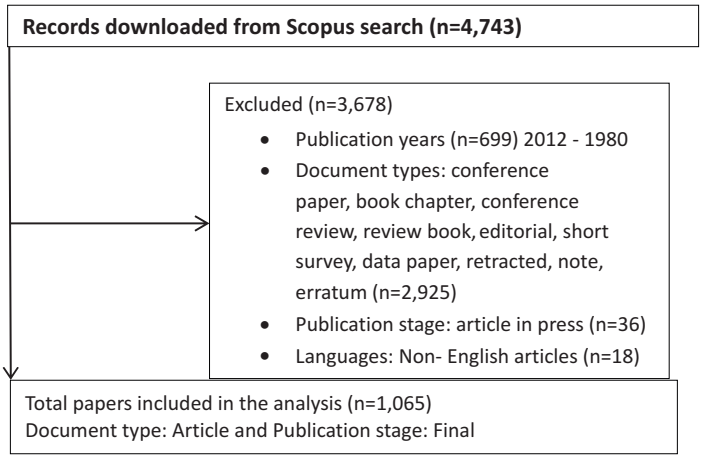

Figure 1: Selection of papers in the Scopus data base

Table 1 shows the main information about extracted data for the research.

Table 1: Main information about data

Description	Results
Time span	Year 2013To2022
Sources (Journals, Books, etc)	391
Total Documents	**1065**
Annual Growth Rate %	97.05
Document Average Age	2.38
Average citations per doc	23.12
References	51244
Document contents	
Keywords Plus (ID)	4698
Author's Keywords (DE)	2609
Authorship Pattern	
Total Authors	3378
Authorsofsingle-authoreddocs	65
Authors Collaborations	
Single - authored docs	70
Co - Authors per Doc	3.84
International co-authorships %	30.05
Document Types	
Total articles	1065

6. Limitations

- The study is based on literature on AI based cyber security indexed in the Scopus data base during 2013-2022.
- Scopus permits to export of 2,000 records at a time but does not allow to splitting of the selected collection into multiple downloads
- The language is limited to English

7. Analysis

There are a total of 1065 articles published in 391 sources contributed by 3378 authors during the year 2013-2022.

7.1 *Distribution, citations and progress rate*

Table 2 shows year wise distribution of publications and citations which displays the trends in publications. In the past 10 years total of 1065 papers were published containing an average of 56.14 citations per article and the average total citation per year was 8.19. Most articles were published in 2022 which is more than 400 times higher than that of the year 2013. The most citations per article were made in the year 2015. The most average total citations per year were made in the year 2015. The most citable year was 2013.

Table 2: Year wise distribution of literature and citations

Year	Average no. of citations per article	Total articles	% of articles published	Average total citations per year	Citable years
2013	3	1	0.09	0.27	11
2014	22.4	5	0.47	2.24	10
2015	207.5	10	0.93	23.06	9
2016	153.46	13	1.22	19.18	8
2017	25.17	18	1.69	3.6	7
2018	54.52	60	5.63	9.09	6
2019	39.58	139	13.05	7.92	5
2020	36.26	156	14.66	9.06	4
2021	13.7	215	20.20	4.57	3
2022	5.82	448	42.06	2.91	2
Total	56.14	1065	100	8.19	

The progress rate of the literature is shown in figure 2. The data shows an increasing trend in research with the upwards looping of publications. The research output has shown a consistent annual increase with a significant surge observed in 2019 and reaching its peak in 2022 with the highest recorded growth.

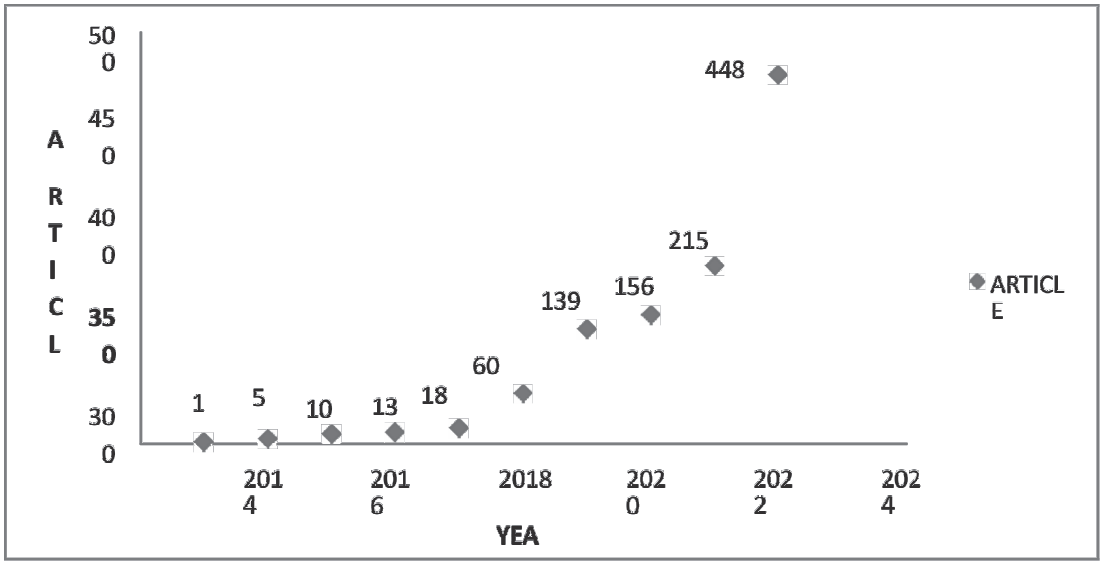

Figure 2: Progress rate of the literature

Rodgers developed the well-known "S Curve" of innovation diffusion theory; innovation diffusion typically displays a distinctive S-shaped curve. Figure 2 shows that diffusion starts very slowly. By accelerating, the curve has reached a certain stage which is called the "critical mass". Innovation speed will be picked up until the research reaches its end point.

7.2 Most active authors

Table 3: Most active authors (top ten)

Author	h_index	g_index	m_index	Total citations	No. articles	Pub. year started
Zhang, J	9	11	1.8	651	11	2019
Liu, Y	7	11	1.4	201	11	2019
Xiang, Y	7	9	1.4	481	9	2019
Alazab, M	6	7	1.2	1433	7	2019
Ferrag, M	6	7	1.5	626	7	2020
Kozik, R	6	8	0.6	219	8	2014
Naeem, H	6	6	1.2	421	6	2019
Pan, L	6	6	1.2	244	6	2019
Pawlicki, M	6	8	1.2	182	8	2019
Chookk, R	5	6	1	274	6	2019

Table 3 lists the top ten authors in order of publications. They have an almost equal number of publications. Among the top ten authors, LIU Y and ZHANG J. have published more than ten papers. Only one author has nine papers among all the top ten authors. Most of the authors have started to publish from the year 2019. Only one author named KOZIKR, published from the year 2014.

The most active author LIU Y's notable achievements include i) the thesis on the machine learning approach to detect cyber-attacks, ii) a novel approach to the detection of cyber-attacks taking inventory of the practical application of information granules, iii) the performance evaluation of intrusion detection algorithm and detection of attacks. Researchers can read following research as each author has a certain direction in their works.

7.3 *Journals with highest publications*

Bradford's law can be used to determine the primary journals on a particular topic. This law demonstrates how scholarly writing is dispersed in journals.

Table 4: Top ten journals (publications number, frequency, percentage and citation)

Source	Rank	Articles	Cumulative frequency	% of Articles	Citations	Zone
IEEE Access	1	97	97	9.107981	1472	Zone 1
Sensors	2	46	143	4.319249	366	Zone 1
Computers and security	3	32	175	3.004695	297	Zone 1
International journal of advanced computer science and applications	4	31	206	2.910798	256	Zone 1
Electronics (Switzerland)	5	24	230	2.253521	218	Zone 1
Computers materials and continua	6	22	252	2.065728	192	Zone 1
Future generation computer	7	16	268	1.502347	189	Zone 1
Applied sciences (Switzerland)	8	15	283	1.408451	184	Zone 1
Computers and electrical engineering	9	14	297	1.314554	179	Zone 1
Expert systems with applications	10	12	309	1.126761	169	Zone 1
TOTAL 309 29.01408						

1065 research papers were distributed in 391 source journals. Table 4 provides the list of key journals. IEEE Access is found to have a 9.1 percent of total literature with the highest number of publications (97 papers) and citations (1472 records). It is to be noted that the top 10 journals listed in table 4 collectively account for 29% of the total number of articles published across all mentioned journals. Notably, IEEE Access (n=97, 9.11%) and Sensors (n=46, 4.31%) emerged as the leading journals in terms of paper publications, followed by the Journal of Computer and Security (n=32, 3%), International Journal of Advanced Computer Science and Applications (n=31, 2.91%).

Bradford's law states that the primary journals of a field are those that publish 33 percent of the published articles in that field. As a result, the mentioned ten journals have been designated as the key journals.

7.4 *Most active countries and organisations*

Table 5: Top ten (10) country's production

Country	Articles	% of Articles
India	191	17.93
United States	187	17.55
China	137	12.86
Saudi Arabia	94	8.82
United Kingdom	90	8.45
Australia	75	7.04
South Korea	51	4.78
Canada	40	3.75
Italy	39	3.66
Turkey	39	3.66
Total	943	88.5

Table 5 displays the distribution of 943 papers focused on AI in cyber security highlighting the leading nations based on publication. India leads in research activity with 191 articles closely followed by the USA with 187 articles. China is in 3rd position regarding the publication of research articles on AI in Cyber security. A total of 943 articles (88.5% articles) out of 1065 are produced by the top ten active countries. Indian scholars are conducting the most thorough research on AI for cyber security.

A total of 160 institutions contributed to 1065 publications. Table 6 shows here the 10 institutions with the highest number of publications. It can be observed that USA and India have more research works on cyber security. Among the top ten institutions, Saudi Arabia is well deserved leader.

Table 6: Top ten notable organisations

Affiliation	Country	Articles
King Abdulaziz university	Saudi Arabia	16
Prince Sattam Bin Abdulaziz University	Saudi Arabia	15
King Saud University	Saudi Arabia	13
Swinburne University of Technology	Australia	12
Deakin University	Australia	12
Qatar University	Qatar	11
King Khalid University	Saudi Arabia	11
Taif University	Saudi Arabia	10
University of New South Wales	Australia	10
Amrita School of Engineering	Karnataka	9

7.5 *Main research areas*

The top ten research areas in the field of artificial intelligence based cyber security are shown in figure 3. Researchers in computer science (40%) and engineering (27%) fields are primarily interested in research. Rests of the fields are below 10%. Other disciplines like Mathematics, Social sciences, Physics are also involved in research on AI for cyber security.

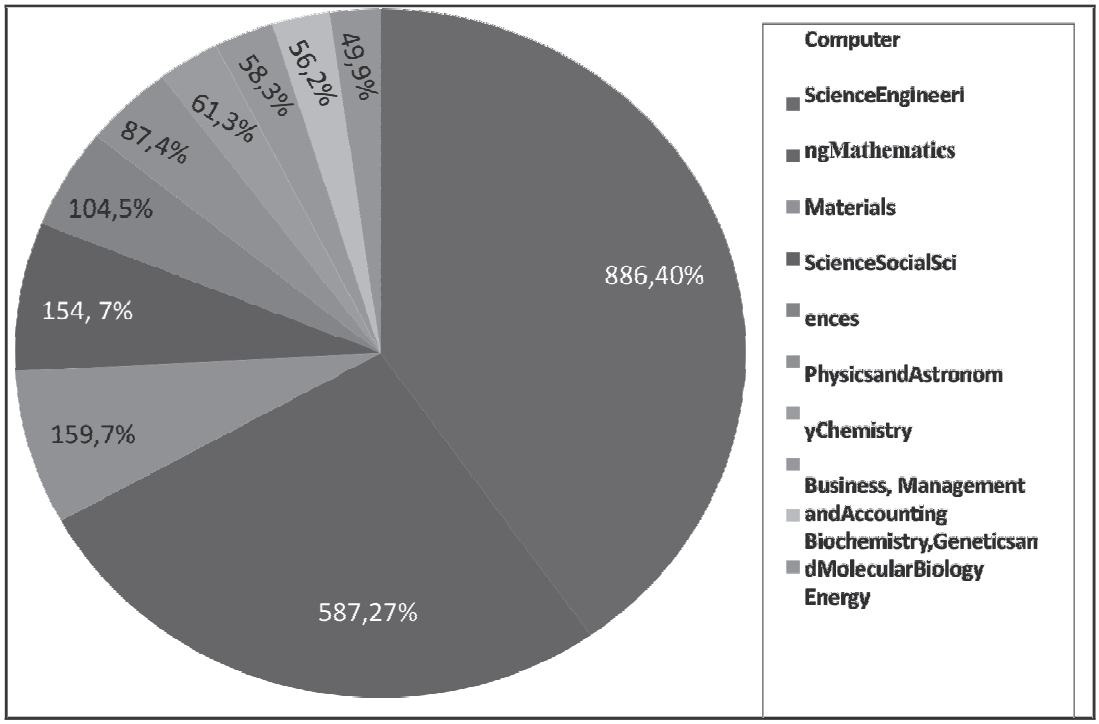

Figure 3: Main research areas

7.6 *Author - keyword co-occurrence analysis*

Visual analysis of author-keyword co-occurrence can provide insight into topics and research trends. 2617 distinct keywords in all are uncovered in the articles. It is found that 21 keywords are most often utilised which indicates that these keywords are directly associated with research. Anomaly detection, artificial intelligence, big data, classification, cyber security, cyber-security, cybersecurity, data mining, deep learning, feature selection and internet of things are the top ten terms. The relationships between those 21keywords are shown in figure 4. The number of keyword co- occurrences can be determined by the size of the nodes in the image. The central nodes of Cluster I (red) contain the keywords: artificial intelligence, classification and cyber security, internet of things, machine learning, malware, malware detection and security. Cluster II (green) includes 7 items, anomaly detection, big data, cyber-security, deep learning and internet of things (IoT), intrusion detection and smart grid. Cluster III (blue) is mainly related to cyber security, data mining, feature selection, intrusion detection systems and network security. A time overlay visualisation in figure 5 demonstrates how in recent years the research has been shifted towards deep learning, machine learning, data mining and IoT.

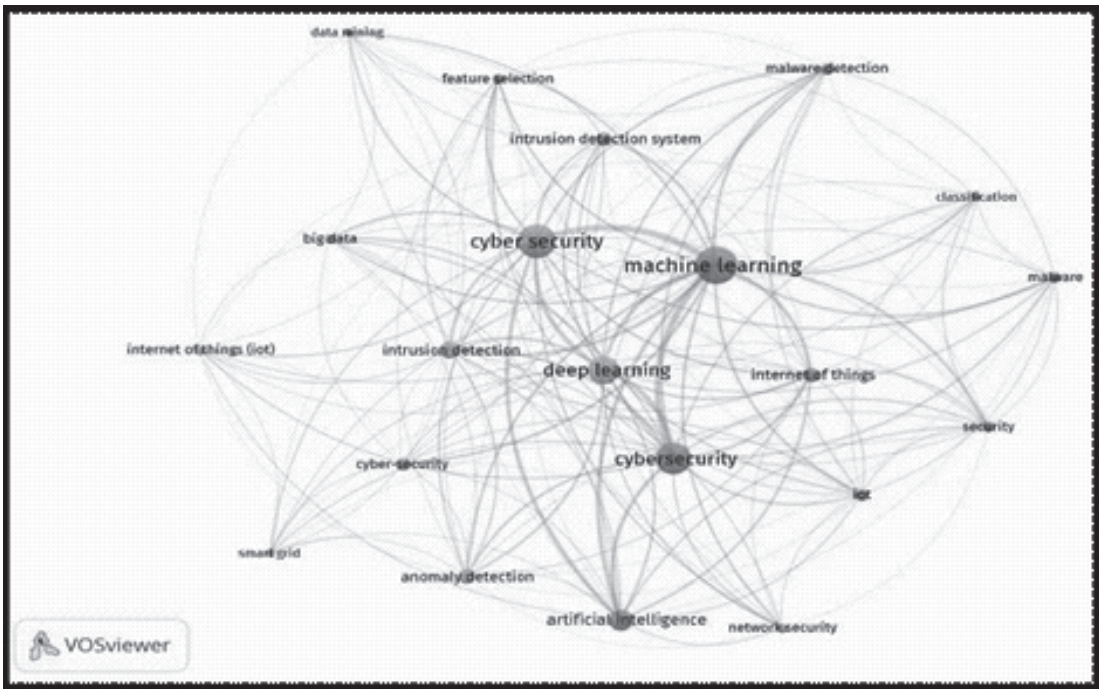

Figure 4: Co-Occurrences of author-keywords

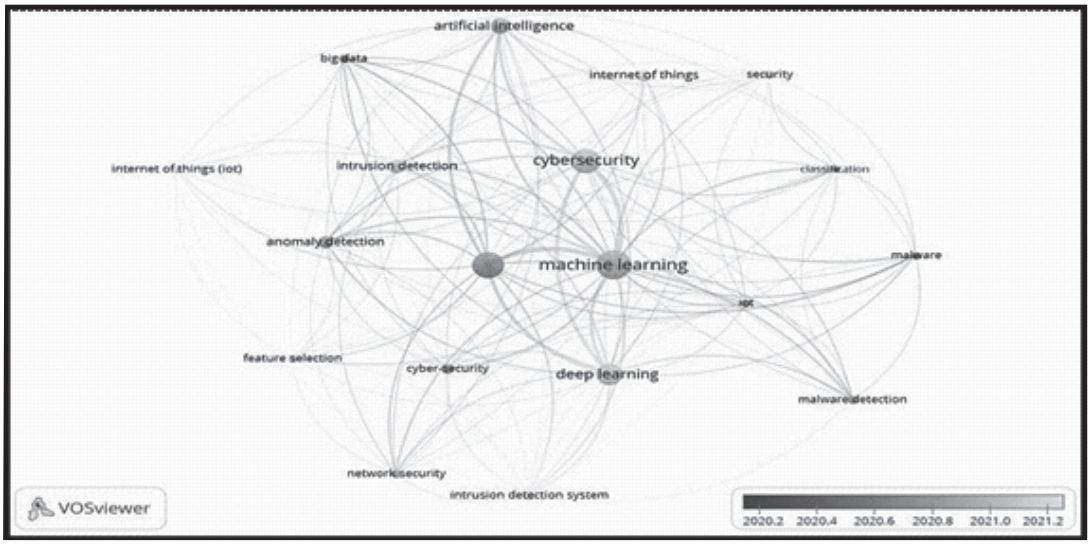

Figure 5: Co-occurrences of author-keywords (overlay visualisation)

8. Major findings

The following findings are drawn based on the analysis of the study conducted on 1065 articles in 391 sources, contributed by 3378 authors during the year 2013-2022.

- The growing trend in research is evident from the statistics. The fact that the number of publications has expanded exponentially over the last ten years suggests that the field is quite active and there is a steady increase in research interest.
- It reveals that IEEE Access, Sensors, Computers and Security are the key journals and got citations of 1472, 366 and 297 respectively. It recommended that researchers go through the aforementioned key journals to obtain a significant amount of information related to the fields.
- Within the countries, India ranks first.
- The Computer Science Department and Engineering are the main departments.
- ZHANG Jand LIU Y are the most productive authors from the year 2019
- Anomaly detection, artificial intelligence, big data, data mining, deep learning and internet of things are the keywords used by the authors
- The research has been shifted toward deep learning, machine learning, data mining and IoT in recent years

9. Conclusion

The paper's primary goal was to evaluate academic works on artificial intelligence based cyber security solutions published in the Scopus data base. The growing trend in research implies that the field is quite active and with the aid of AI, there is a steady increase in research interest in cyber security. The Computer Science Department and Engineering are the main departments conducting major research. It discloses that research into AI based cyber security is still in

its early stages, and further advancement is anticipated in the years to come.

This study gives a useful overview of the current status of AI driven cyber security research. It highlights the literature progress rate, most effective authors, top publishing sources, top associated organisations and essential boundaries of the field. India has actively worked on strengthening its cyber security capabilities due to the increasing importance of digital technologies and the growing threat landscape. It is revealed from the study that multi-disciplinary evaluations of past and current works are required for future research in this area. In the future, researchers may under take comprehensive bibliometric analysis in specific areas of cyber security such as threat intelligence, data protection, security analytics, policy and governance among others.

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Academic Libraries and Their Patrons' Digital Data Privacy: a systematic literature review

Shivangi Singh

Junior Research Fellow, Department of Library and Information Science, Panjab University, Chandigarh

Dr. Khushpreet Singh Brar

Assistant Professor, Department of Library and Information Science, Panjab University, Chandigarh

Abstract

This systematic literature review is performed to analyse the current state and gaps in knowledge of user data security in libraries. It explores the critical issue of digital data privacy for patrons in academic libraries, examining the evolving landscape of information technology and its impact on data security. The data were collected from well-known databases, that as, Library Information Science and Technology Abstracts (LISTA), Library and Information Science Abstracts (LISA), Emerald Insight, Scopus, and Web of Science. It followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines to choose relevant articles with keyword searching. It was identified from the review that this digital expansion raises concerns about the privacy and security of patrons' personal information. Various threats and vulnerabilities are identified, encompassing hardware and software security, network security settings, data security, third-party applications, RFID systems, and the IoT environment. Challenges such as the lack of regulatory policies, limited access to resources, inadequate training and awareness, connectivity issues, and technical challenges are also highlighted. To mitigate these challenges, potential strategies are proposed, including implementing artificial intelligence and block chain technologies, pseudonym and obfuscation techniques, and leveraging authentication systems like Shibboleth, etc. This research addresses a critical and evolving concern in the modern library environment, where the security of user digital data is paramount. The research provides practical recommendations for enhancing digital data security in library settings and has the potential to influence the way libraries approach information security and user privacy.

Keywords: Data and information security policy, Digital data security, Library data security, Patron digital data privacy, Systematic literature review

1. Introduction

Information and communication are the core needs of a society. Thus, to add value to the information it is necessary to provide early and easy access to it. Evolving technologies are dictating over every aspect of human necessity and academic communities. Advanced data analytics and artificial intelligence are propelling us into a realm of predictive and prescriptive analytics (Biswas, 2023), fostering disruptive advancements. These innovations have the potential to revolutionise society, paving the way for a promising future. Such development has compelled and urged us to accept the deluge

of information communication technologies (ICTs).Libraries are no such exceptions to it. The underlying consequence of the prominence of ICT is the threat to users' data.

Modern day libraries have transformed into digital and virtual libraries that serve information and resources mostly in electronic and digital forms and are also not restricted by time or space. Such ongoing expansion in digital libraries around the world brings to attention the shortcomings in addressing privacy and security related issues.

Additionally, the introduction of IoT gadgets in the library suggests a conjunction between various equipment that use the internet as their communication medium which holds great potential to strengthen the concept of "smart" libraries but also poses some threats to the library's administration and patrons (Igbinovia & Okuonghae, 2021). Among the top 10 security issues with IoT devices, according to the OWASP Internet of Things Top Ten Project, HP Security Research discovered an average of 25 vulnerabilities per device. Attackers were able to identify legitimate user accounts through enumeration on seven out of ten of the devices when used in conjunction with their cloud and mobile applications (Chickowski, 2014). This necessitates heightened vigilance and awareness of the security risks inherent in the situation.

In light of the introduction of big data into libraries, it can also jeopardise the privacy of library patrons' personal information such are readers' reading behaviour, personal preferences, social relations, etc., as it can be collected, integrated, analysed, and mined to forecast reader demand and track desired services (Fangjing, 2021).

Incorporating a cloud network into resource sharing between academic institutions and institutional libraries can foster information sharing and offer robust technical support for the specialised services offered by university libraries. Since the services are offered over the Internet thus, it becomes very difficult to assess the physical location of servers and software and scrutinising the security is hard to undertake. Due to these wide range of services and users that a library caters to, it is vulnerable to data security threats.

2. Background of the study

The excessive use and collection of data has resulted in increasing privacy implications within the library and information services, their users and society. According to (IFLA Statement on Privacy in the Library, 2015) commercial internet services, especially those that provide library and information services, gather a lot of information about users and their behaviour. Privacy as described by Universal Declaration of Human Rights under article 12 states that:

"No one shall be subjected to arbitrary interference with his privacy, family, home or correspondence, nor to attacks upon his honor and reputation"(United Nations: Peace, dignity, equality on a healthy planet, 2018).

The dogma of Information Security (IS) seeks confidentiality, integrity and availability (Whitman & Mattord, 2021) and thus every element of a security system in an organisation must serve and implement such principles. A library environment is exposed to both external and internal threats, thus the professionals must possess sufficient knowledge of various cyber-security issues to combat cyber threats (Ibinovia & Ishola, 2023). Furthermore, Sun and Ma (2014) discussed the features of libraries in the Big Data era and their influence on information security of libraries.

In addition to instructional technologies, organisations can and frequently do collect information about user interactions with virtual assistants, smart phones, tablets, wearable gear, computers, sensors, and ID card readers (Kyle et. al, 2020). As pointed out by Megan Oakleaf (2015), to assess and research the relationships between student library interactions and student learning and success measures, librarians may adopt such Library Analytics (LA) practices. Moreover, worms, viruses, plagiarism, flaming, hacking, and misinformation are the threats as a result of dysfunctional human behaviour as identified by Ikolo (2019).

Thus, to address such challenges, a library environment dealing with information and data handling must be holistically secured. Ayofe and Irwin (2010) people and professionals who use the internet for personal and professional tasks should receive training on how to protect their systems from harmful attacks and maintain the security and integrity of their data. Therefore, it is necessary to train and retrain library professionals on cyber security issues to guard against un-authorised access to their patron's data and secure their e-resources.

3. Research objectives

User data security threat is a major problem in all its forms and manifestations. This paper answers the following research questions to:

RQ1. What are the data and information security measures that have been proposed in the existing literature?

RQ2. What gaps and open issues emerge from the analysis of existing literature?

4. Methodology

The systematic review technique promotes thorough and organised ways of reviewing the literature and systematic analysis of published research, which can also be considered as a component of qualitative research (Bearman et. al, 2012). This paper included the utilisation of the Preferred Reporting Items for Systematic Reviews and Meta Analysis (PRISMA) for the review of current literature (Moher et al, 2015).

4.1 *Sources of information*

The search was performed on 5 different well-known databases namely LISTA (Library, Information Science and Technology Abstracts | EBSCO), LISA (LISA: Library and Information Science Abstracts (proquest.com)), Emerald Insights (Discover Journals, Books & Case Studies | Emerald Insight), Scopus (Scopus - Document search) and Web of Science database (https://www.webofscience.com/wos/woscc/basic-search).

To perform the systematic review of literature, different sets of keywords have been applied to carry out the results with the required objectives:

- 'Information security in libraries'
- 'Data privacy'
- 'User data privacy'
- 'Digital information security'
- 'Patron anonymity'
- 'Library security policy'
- 'Information security management policies in Libraries'
- 'Data security measures in libraries'

The publication year was restricted from 2013-2023 and only English language studies were included in the review.

4.2 *Criteria for inclusion*

Only those studies that presented academic libraries were selected for systematic review.

- Book chapters were not included
- Articles without abstract were not included
- Documents or studies with fewer than 4 pages were excluded
- The medium of document included is strictly English
- Only journal articles have been included in the review
- Titles dating back to 2013 have been taken

Other types of libraries, such as those devoted to computer programming languages, are not included in this study.The majority of data security dedicated studies in the fields of IT, business, health, education, and cloud computing were disregarded.

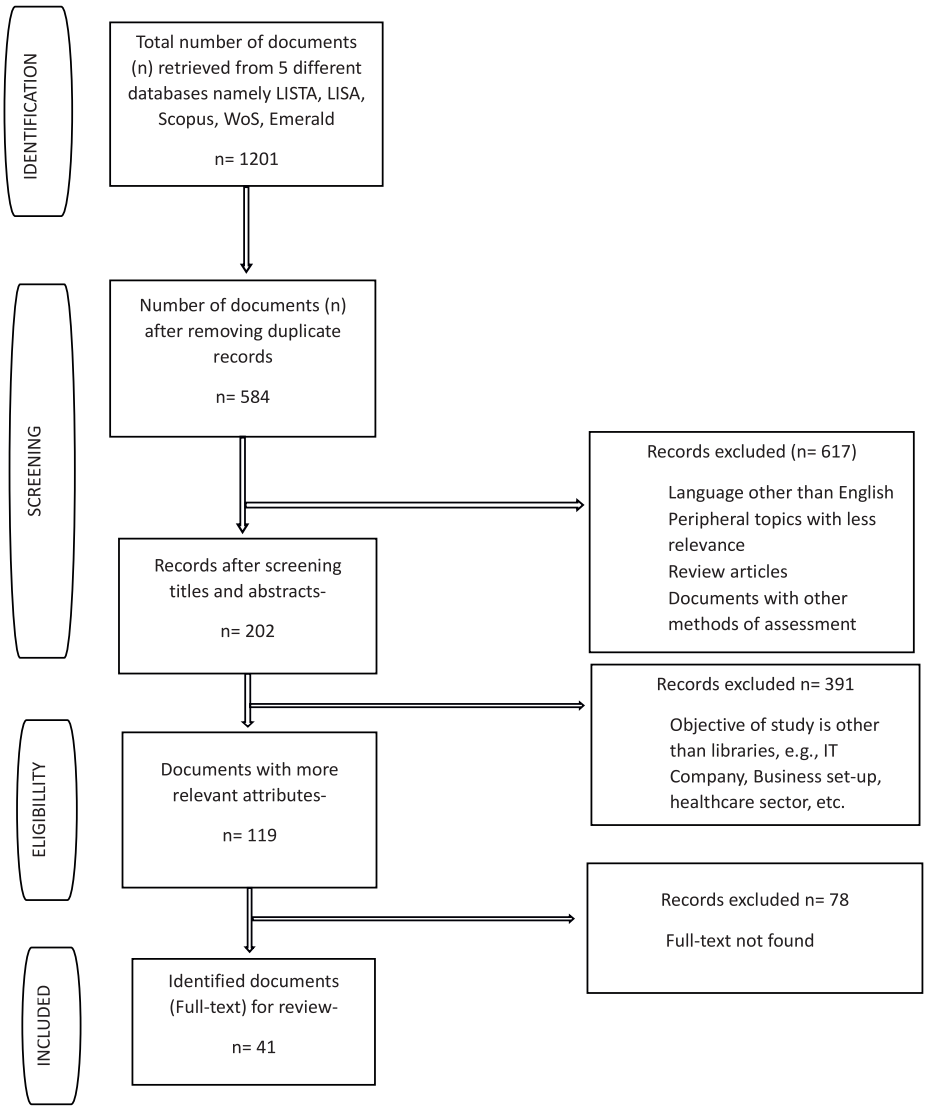

Figure 1: PRISMA chart on data and information security in academic libraries

Figure 1 (PRISMA diagram) shows a flow chart outlining the scanning process as well as the criteria used to exclude research and choose those that qualify. Data scanning included title, abstract, and full-text papers in two stages. 41 studies were chosen for inclusion based on the evaluation of the selection criteria. For each qualified study, a material extraction framework was used to compile information on the Data and Information Security in libraries. For each qualifying study, a data extraction table was created to gather data on the title, author(s), publication year, nation, population, participants, outcomes, difficulties, and conclusions.

5. Result and discussions

Overview of the studies undertaken

A search in five different databases and search engines was conducted, yielding 1201 studies on data and information security in libraries from well-known databases i.e., LISTA, LISA, Scopus, Web of Science and Emerald.

After the removal of duplicates, the number of the remaining studies stood at 584, after initial scanning and exclusion of records based on various reasons, 617 studies were excluded. Criteria were further narrowed down, and only 119 studies were found relevant to the overall data and information security in the libraries. However, 41 studies were ultimately chosen to meet the research objectives and inclusion criteria based on the topic in academic libraries. The selected studies were from 2013 to 2023, and most of the studies were published in Library and Information Science, Information Communication and IT journals, International Conference Proceedings, with some in business and e-commerce industries.

Preferred study designs of selected studies

Of the selected 41 articles under review, USA posed 15 documents that scrutinised user data and information privacy in libraries, followed by China, India and Nigeria. In this review (Figure 2), 12 studies were quantitative in method with survey design and data was collected through a structured questionnaire and most of the respondents were academic librarians and library heads. Qualitative method has only been adopted in 2 studies. Conceptual papers have been provided by 9 studies wherein a conclusion has been drawn after defining and mapping the objectives. Moreover, exploratory, mixed methods, case studies have also been adopted.

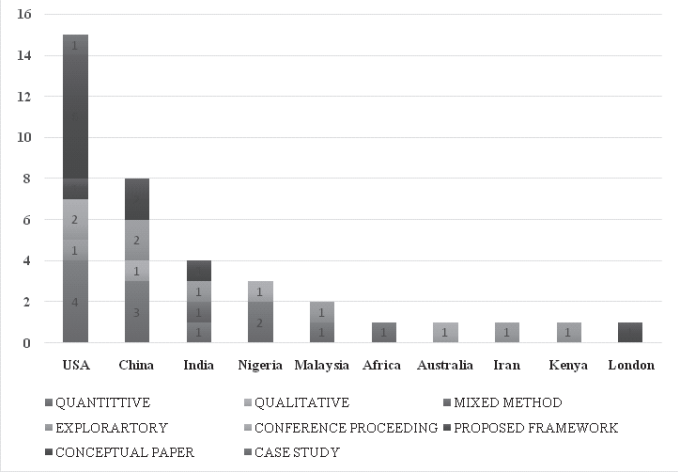

Figure 2: Types of studies published globally, identifying threats to user data and information privacy methodologically

5.1 *Core threats identified in present scenario*

Library in particular deals with two types of patron data which is PII- Personally Identifiable Information and Non PII- Non-Personally Identifiable Document. Security of electronic, physical and users' assets is not strictly a technological requirement but is a foundational element for almost all academic libraries.

Gressel (2014) emphasised that libraries must create and put into place rules for the security of user and staff data. Different countries have adopted different policies on information systems and abide by rules for protecting their user's data under national schemes. These policies may cover information systems, data security, data privacy, user registration ID and passwords, data backups and software that steal users' personal information. Hess (2014) in his work pointed out that libraries must follow federal, state, and institutional regulations regarding student privacy and information security in addition to the Library Bill of Rights and related documents.

Patron data anonymity is a growing concern for the library set-up. However, in India no or very few schemes have been implemented to look after the security of the library and its users' data. India in the current scenario is lying back from the other countries as it does not have any dedicated policy to abide by, thus making it exposed to various security threats.

The core threats identified after reviewing the existing literature are mentioned below in table 1.

Table 1: Core threats and sub-threats identified for library and its patron's data privacy-complied by author

Core Threats	Sub-threats
Hardware Security	• Natural calamity that can jeopardise the hardware security, • Accidents such as stealing or vandalism, • Bugs or errors generated from routers or firewall, leading to the defect of hardware, • Malicious intrusion or destruction, • Cases of theft or vandalism, • Faulty equipment • Failure of power supply or communication equipment or services, • It also accounts for lack of maintenance, theft, physical sabotage etc.
Software Security	• Threats to operating systems • Application related threats such as copying software infected from malware (i.e., Computer viruses, ransom ware, worms and Trojan horses) (Shen, 1999) • Abuse of computer access control • Computers installed with spyware and adware • Failure of system software or system corruption • Installation or use of unauthorised programmes or software • Weak authentication mechanism • Use of pirated or unauthorised software • Unauthorised changes to software settings that can compromise the integrity of a computer system (Ibrahim & Umar, 2020)

Core Threats	Sub-threats
Network Security Settings	• Cracking of passwords • Damage to equipment due to uneven power supply • Internet based attacks on internal network resources • Transmission errors (Ajie, 2019) • Website Defacement- which is an attack usually initiated by a system cracker who breaks into a web server and changes the visual appearance of the website.
Data Security Threats	• Interruption of services • Exposure of patron's sensitive data due to web attack • Masquerading of user identity • Social engineering threats such as 1. Phishing, 2. Tailgating, 3. Impersonation, 4. Sniffing, 5. Baiting, 6. Dumpster diving, etc., • Unauthorised access and transfer of data
Third Party Applications on library websites	• Tracking cookies that may beutilised for 1. Advertising 2. Analytics 3. General and Invasive Fingerprinting (Marino, 2021)
RFID Systems	• Privacy of the borrower 1. Tracking 2. Hot-listing 3. Profiling (Butters, 2007) • Threats to the library 1. Digital vandalism 2. Tag-based viruses
IoT Environment	• Lack of updated process or mechanism • Unsecured network services and ecosystem interfaces • Outdated IoT app components

IoT devices are becoming more prevalent in our daily lives and libraries pose no exceptions to the use of such devices. As stated by Ram (2023) privacy-by-design principles should be used in IoT applications for libraries to guarantee data privacy. Strong security mechanisms, user-centric privacy frameworks, and user and stakeholder awareness are all necessary, said by Kumar and Mittal (2016). Moreover, according to HPE Cyber Risk Report 2016, attackers now concentrate majorly on applications rather than servers and operating systems thus, making the third-party library applications on library websites a threat to user data security. Privacy of item-level tagging has also been a concern when using RFID systems in libraries. The COVID-19 pandemic's effects on patronage of academic libraries were the subject of an OCLC survey in 2021. It was revealed that in university libraries, the use of digital resources has significantly increased, with e-books and online journals being the most frequently accessed publications, according to the survey. There is a risk that people's reading preferences could be utilised for purposes that violate their privacy and human rights due to the possibility of data profiling and tracking as stated by Arora (2023).

5.2 *Challenges indentified*

The "Privacy: An Interpretation of the Library Bill of Rights" document, created by the ALA, addresses the challenges of data protection in the digital age stating that:

"Confidentiality extends to, 'information sought or received and resources consulted, borrowed, acquired or transmitted,' including but not limited to: database search records, reference questions, and interview, circulation records, interlibrary loan records, information about materials downloaded or placed on 'hold' or 'reserve,' and other personally identifiable information about uses of library materials, programmes, facilities, or services" (American Library Association, 2006).

This view demonstrates the profession's dedication to upholding strict standards for client privacy, in spite of the challenges brought on by the digital age (Palmer, 2020).

Table 2: Challenges identified in implementing secure environment in library

Themes	Sub-themes
Lack of regulating policy	• For the protection of materials and user information and data, libraries lack a technological and organisational data and information security written policy and do not apply one (Aregbesola & Nwaolise, 2023). • No defined legal framework for regulations • Libraries do not have copyright policies for digital content in modern areas (Hess et. al, 2015)
Limited access to resources	• Developing nations frequently lack the financial and technological resources necessary to implement cyber security safeguards (Ajie, 2019).
Lack of training and awareness in professionals and owner of privacy data (Users)	• Lack of necessary training of the most recent cyber security dangers, safeguards and best practices • Users' un-explicit awareness of malpractices of sites before enclosing their personal data
Connectivity and Infrastructure Limitations	• Inadequate internet access and insecure infrastructure • Lower diffusion of information and communication technologies (Khan et. al, 2021)
Technical Challenges	• Challenges in libraries such as technical measures, data storage, operating and control system, server and password (Farid et. al, 2023)

According to Akporido (2011), a lack of cogent policy can lead to the creation (or continuation of) inefficient infrastructure and resource waste. One of the key findings of Khan (2021) suggested thatLIS practitioners, policymakers, and the government should realise the relevance and importance of data and information security measures within university libraries. Also, in the view of technical challenges, Ali and Soomro (2014) expressed that although ITIL (Information Technology Infrastructure Library) is a comprehensive IT framework but lacks information security management which needs to be catered for effective IT service management.

When it comes to breaches, carelessness is frequently a major issue. All personnel should receive frequent training from their employers on how to spot attacks and weaknesses and what to do next as pointed out

by Sarkar (2018).To ensure data privacy and security, it's crucial to foster awareness and understanding of Data Information Security Management (DISM) and its associated policies within libraries (Farid et. al, 2023). Library staff, administrators, and stake-holders play an active role in advocating for and putting into action DISM policies within their libraries and organisational settings.

5.3 *Possible theories of mitigation*

Enforcing optimal cyber security practices for digital collections can present significant challenges for libraries in developing nations. Since, academic libraries deal with sensitive user information, research data, and academic records. Libraries should implement strong measures to safeguard data privacy, such as ensuring secure transmission of data, obtaining user consent and granting them control, anonymising information, and integrating privacy-focused design principles. However, there is promise in various upcoming technologies and future strategies that can potentially bolster cyber security efforts within academic libraries. Artificial intelligence and Machine learning can automate threat detection and response. Simultaneously, block chain is a structured data arrangement where blocks of information link sequentially to form a chain. Each block is closely linked to its adjacent one, and the data within it is protected using cryptographic methods. When one block remains unchanged, altering other blocks becomes challenging, enhancing the security and dependability of storing library data (Zhao et. al, 2022).Thus, can enable secure and transparent transactions, protect intellectual property rights, and prevent un-authorised access or modifications to critical data (Zhang, 2019).

Besides the conventional technical security strategies like identity verification, access control, and data encryption employed for protecting data in digital libraries, additional measures such as pseudonym techniques (Gao et. al, 2013), obfuscation techniques (Duckham & Kulik, 2005), confusion techniques that provide location privacy, and encryption techniques can also be utilised to ensure the privacy of patrons' behavioural data. Shibboleth which provides a single-sign-on (SSO) service authentication system. This architecture was been defined by Scavo and Cantar (2005) as SAML (Security Assertion Markup Language).Libraries frequently utilise Shibboleth to ensure a smooth and secure user experience when accessing digital materials, databases, and online content. Shibboleth ensures the best data security and privacy protection to the users with the software based on SAML. Remote library services pose a serious challenge and burden beyond those already posed in regular library services. When it comes to safeguarding the privacy of patrons within the library setting, it is essential to give careful thought to consent and defined purposes for data usage, minimising the data collected, as well as employing techniques like anonymisation and pseudonymisation.

6. Conclusion

The review of the literature identified that libraries may be facing challenges without the Data and Information Security Policy as they do not adopt technical measures to secure the hardware, software, tools and networking (Han et. al, 2016). It has also been found that libraries faced issues with technical tools, hardware development, workstations, the Internet, data and network security. Further, in the view of Zongda Wu et. al (2022), as of now, the domain of library sciences still faces a notable gap in conducting thorough and organised research regarding the safeguarding of the privacy of readers' actions within the libraries. When financial resources permit, libraries should incorporate contemporary data breach detection tools to

achieve the highest possible level of security.

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Constructing Dynamic Knowledge Mapping Graph of Quantitative Measures of Research Contributions of David Macmillan from the Chemistry Domain

Apala Chatterjee

Librarian, P. R. Thakur Govt. College, North 24 Pgs., West Bengal, India,

Dr. Sunil Kumar Chatterjee

Professor, Department of Library and Information Science, Jadavpur University

Abstract

This study aims to explore the measures of 216 research contributions of Nobel Laureate David MacMillan through a dynamic knowledge mapping graph in a quantitative way in the field of Chemistry domain. We have used Web of Science database to extract Scientific research articles that are relevant to David Macmillan for a period of 20 years from 2006 to 2022 and 216 research publications have been retrieved. The obtained primary data was exported to Microsoft Excel for further analysis to meet the study's objectives. The level of collaboration, journal collaborative distribution, disciplinary collaborative distribution and country collaboration, inter and intra subject collaboration have been scrutinised. Major findings from the above perspectives have been noted that David MacMillan's majority of papers were written in collaboration, as evidenced by the 0.90 collaboration rate across all publications and 71.30 % are journal articles. Le, Chi Chip co-authored 10.8% of David MacMillan's 216 publications, making her the most prolific co-author. Between 2013 and 2022 his recent work mainly focused on Catalysis (55.95%), Combinatorial chemistry (33.76%), Photoredox catalysis (16.40%), etc. Future graduate students in library and information science as well as other domain researchers and students will find it valuable to investigate David MacMillan's Scientometric profile in Chemistry domain.

Keywords: David MacMillan, Knowledge mapping, Nobel laureate, Relative growth rate, Scientometric study

1. Introduction

Large-scale domain knowledge graphs have been used in numerous fields since Google first suggested the idea of a knowledge graph in 2012. The construction of a dynamic knowledge graph of research contributions of Nobel Laureates through quantitative measures is explored in this work which is also related to "Scientometric portrait" analysis which is a study of a particular scientist or author who is renowned in a certain field or specialty, with a group of related scholars collaborating throughout his or her career. Scientometrics primarily focuses on the quantitative traits and properties of science and scientific inquiry. Measurement of the influence of academic journals and research publications, comprehension of scientific citations, and application of such measurements in management and policy contexts are major research concerns. A Nobel laureate, scientist, or subject matter expert in any discipline is

well renowned for his or her contributions to that field or society. Scientific articles could be produced to contribute to this. Quantitative markers are used in scientometric analysis which may be quite helpful in examining a person's scholarly accomplishments and the numerous social contributions he has made.

2. Author profile

Sir David William Cross MacMillan, a Scottish chemist and Professor of Chemistry at Princeton University, shared the 2021 Nobel Prize in Chemistry with Benjamin List for the development of asymmetric organocatalysis. He obtained his Ph.D. in 1996 and focused on enantioselective catalysis, particularly the creation of Sn(II) boxes. MacMillan's research interests include organic chemistry, catalysis, enantioselective synthesis, organocatalysis, and iminium.

Between 2010 to 2014, MacMillan served as the journal's first editor-in-chief of Chemical Science, the Royal Society of Chemistry's premier general chemistry publication. As of 2021, Google Scholar and Scopus both give MacMillan an h-index of 110 and 100, respectively. Sir David MacMillan has published his research work in different categories such as Chemistry Multi-disciplinary (158), Multi-disciplinary Sciences (34), Organic Chemistry (9), Marine Freshwater Biology (5), Biochemistry and Molecular Biology (3), etc. in various forms of the document i.e. research article (161), patents (30), meeting abstract (48), review article (8), early access (5), editorial material (5), correction (3), proceeding paper (3), biographical-item (2), etc.

3. Significance of the study

In the present paper, the investigators have attempted to study the authorship pattern, domain wise preferred medium of scientific communication, authors' production over time, growth in publications, the rates of collaboration, the impact governing successful scientific careers and to explore the measures of research contributions of Nobel Laureate David Macmillan through dynamic knowledge mapping graph both in a quantitative way in the field of Chemistry domain.

4. Review of related literature

Numerous quantitative research studies about Nobel Laureates and other people have been published. Maurya, A. examined the academic legacy of MIT's Chemistry Nobel Laureates in 2020 and concluded that the university creates extraordinarily prolific scientists. The most accurate measurement of research output that is currently available appears to be found in scientific publications. Nobel Laureate William Shockley was among the first authors to propose the number of research papers as a scientific indicator of research productivity (1957). Lehman (1958) talked about the ages at which scientists in various areas and nations reached their peak productivity as well as scientific inventiveness. He obtained data by counting the publications of scientists at a given age and found chemists' maximum production rate at ages 30 through 34. The publications of Nobel Laureate Jeffrey C. Hall during his 46-year productive life, which began in 1972 and ended in 2017, have been examined by Kumar, Ruhela, and Kumar (2018). Although the author has authored 201 publications, the years 1990-1999 saw a rise in his productivity. The author has 22 single-authored publications and 179 collaboratively published papers. His computed collaboration coefficient is 0.89. Jeffrey C. Hall published his works in 50 esteemed publications with a high impact factor; one of his 1999 studies was cited in 632 distinct papers. M. Rosbash was the most productive author he had worked with out of all the others. A reference curve for an Indian role model scientist has recently been established (Kalyane, Madan, & Kumar,

2001). According to the results of this pilot study, it is feasible to create a model that directly influences the identification of promising scientists and the development of human resources in developing nations by analysing the performance of a nation's role model scientist. Studies on individual scientists, including Nobel Laureates, are the present focus of science metrics. The Nobel Prize is thought to be the highest accolade bestowed upon scientific achievement. Because of the Nobel Prize's immense status, countries, institutions, and its laureates' reputations are all improved (Zuckerman, 1977).

5. Objective of the study

To achieve the goal, the study will precisely attempt:

- To analyse the distribution of research output of David MacMillan by year
- To find out the growth in publications
- To find out the rates of collaboration
- To analyse the domain-wise authorship patterns
- To find out the channels of communication
- To find authors' production over Time
- To find out the citation network
- To find out research article productivity.

6. Methodology

One of the most comprehensive and extensively utilised databases for bibliometric analyses and literature reviews was the Web of Science database, which was employed for this study. We utilised End Note X4 as a bibliographic manager to organise the downloaded data. The articles and reviews were exported from the Web of Science using this application. The information that was looked for to fulfill the goal of this quantitative analysis included the following: author(s), ad-dresses, editor(s), keywords, times cited, source, title, language, and Web of Science category.

First, articles and reviews were selected within the period taken from David MacMillan's 20 year social science citation index from 2006 to 2022, corresponding to the category "Author" of the Web of Science. Nearly 216 articles in the category "Author" were located overall throughout the previous seventeen years when utilising the search parameters (downloaded in February 2023). The degree of collaboration, co-distribution of journals, co-distribution of specialties, and cross-border co-operation between and within subject collaborations have been tested. Transformations in knowledge development, knowledge recency, knowledge refinement, or knowledge enrichment are also considered.

7. Results and discussions

7.1 *Distribution of research output by year*

Table 1 displays the distribution of Sir David MacMillan's whole body of research outputs as taken from the Web of Science databases between 2006-2022. A total of 216 research papers over 18 years were found, with an average of roughly 10 publications each year. According to Web of Science, his first publication came out in the year 2006, when he was 38 years old.

Table 1: Distribution of research output of David MacMillan

Actual age of David MacMillan (1968)	Year of Publication	Number of Publications under several authorships			Cumulative Total	Collaboration rate	Publishing age
		Single Authored	Multi-Authored	Total			
38	2006	1	6	7	1	0.85	1
39	2007	1	9	10	11	0.90	2
40	2008	4	5	9	20	0.55	3
41	2009	2	12	14	34	0.85	4
42	2010	0	14	14	48	1.00	5
43	2011	0	21	21	69	1.00	6
44	2012	2	6	8	77	0.75	7
45	2013	1	12	13	90	0.92	8
46	2014	0	18	18	108	1.00	9
47	2015	1	13	14	122	0.92	10
48	2016	1	10	**11**	133	0.90	11
49	2017	2	12	**14**	147	0.55	12
50	2018	0	12	**12**	159	0.85	13
51	2019	3	8	**11**	170	1.00	14
52	2020	0	11	**11**	181	1.00	15
53	2021	0	11	**11**	192	0.92	17
54	2022	1	17	**18**	208	1.00	18
	Total	19	197	**216**			

7.2 *Collaboration rate*

It is the ratio between multi authored papers and total papers published in a particular year or for a specific period. Sir David MacMillan published 11 single-authored papers throughout his 18-year publishing career, with the highest collaboration rates being in the years 2010, 2011, 2014, 2021, 2019, 2020 and 2022 (1.00), while the lowest rates were in 1993, 2008 & 2017 (0.55). Additionally, table 1 shows that David MacMillan collaborated with others to publish the majority of his works. Out of 216 publications, only 19 (9%) were single-authored studies.

7.3 *Growth of publications*

Table 2: Block wise Relative Growth Rate and Doubling Time(Dt) of publications

Blocks	Year Range	Publications	Cumulative Total	Log_eN1	Log_eN2	$Log_eN2-Log_eN1$	RGR= $Log_eN2 - Log_eN1/T2-T1$	Mean RGR	Dt= 0.693/ RGR	Mean Dt	Received Citations	Avg. Citations/ Publications
1	2006-2008	26	26	-	3.258	-	-	0.016	-	44.134	2,456	94.46
2	2009-2011	49	75	3.258	4.317	1.059	0.041		16.902		3,926	80.12
3	2012-2014	39	114	4.317	4.736	0.419	0.006		115.5		6,187	158.64
4	2015-2017	39	153	4.736	5.030	0.294	0.003	0.002	231	539	9,291	238.23
5	2018-2020	34	187	5.030	5.231	0.201	0.001		693		13,228	389.05
6	2021-2023	29	216	5.231	5.375	0.144	0.001		693		11,309	389.96
		216									46,397	225.08

Table 2 shows the rise of publications over 18 years, divided into six segments. The most publications were from 2009-2011(49 in total). The relative growth rate from 2009-2011 was 0.041, the highest of all the other blocks. Later, from 2015 to 2023, the mean RGR (Relative Growth Rate) was 0.002 with a doubling time of 539 and from 2014 to 2014, it was 0.016 with the value of the doubling time being 44.134. A total of 216 documents received a total of 50,467 citations, averaging 234 citations per document. Table 2 also presents the citation patterns of the documents published in each block. 2005 to 2007 noted the highest number of citations for three years duration with 13,228 citations for 34 documents published at an average of 390 citations for each document.

7.4 *Authorship pattern and most productive authors*

Table 3: Authorship patterns of works by David MacMillan

Sl. No	Authorship Patterns	Number of publications	% of publications	Degree of collaboration
1.	**Single authored**	**19**	**8.80**	(as suggested by Subramanyam, 1983) C = Nm/Nm+Ns = 197/197+19 = 0.91 Where, C = Degree of collaboration Nm = Number of multi-authored papers Ns = Number of single authored papers
2.	**Multiple authored**	**197**	**91.20**	
	Total	**216**	**100**	

According to Wikipedia (dated 18.07.2022), collaborative papers refer to a distributed process of labor involving writing, resulting in the co-authorship of a text by more than one writer. A total of 216 publications have been published by David MacMillan, out of which he published only 19 (8.80%) publications under single authorship and 197 (91.20%) under multiple authorship. The overall collaboration rate has been found 0.91which signifies most of the publications of David MacMillan were written in collaboration (Table 3).

7.5 *Most productive and cited publications by David MacMillan*

Table 4 represents the 10 most cited works of David MacMillan which all have more than 900 citations each since its publication. The most significant number of citations received by the work 'Visible light photoredox catalysis with transition metal complexes' which was a multi-authored contribution from David MacMillan and the documents published in Chemical Reviews in 2013 with 6313 citations till the time of data collection for this study which was in July, 2022. Others are listed below.

Table 4: Most cited publications received by David MacMillan

Sl. No.	Work Details	Total Citations Received (Till 25.07.2022)
1.	Prier, C. K., Rankic, D. A., & MacMillan, D. W. (2013). Visible light photoredox catalysis with transition metal complexes: applications in organic synthesis. *Chemical reviews*, *113*(7), 5322-5363.	**6313**
2.	MacMillan, D. W. (2008). The advent and development of organocatalysis. *Nature*, *455*(7211), 304-308.	**2377**
3.	Ahrendt, K. A., Borths, C. J., & MacMillan, D. W. (2000). New strategies for organic catalysis: the first highly enantioselective organocatalytic Diels− Alder reaction. *Journal of the American Chemical Society*, *122*(17), 4243-4244.	**2100**
4.	Nicewicz, D. A., & MacMillan, D. W. (2008). Merging photoredox catalysis with organocatalysis: the direct asymmetric alkylation of aldehydes. *Science*, *322*(5898), 77-80.	**1993**
5.	Shaw, M. H., Twilton, J., & MacMillan, D. W. (2016). Photoredox catalysis in organic chemistry. *The Journal of organic chemistry*, *81*(16), 6898-6926.	**1772**
6.	Twilton, J., Le, C. C., Zhang, P., Shaw, M. H., Evans, R. W., & MacMillan, D. W. (2017). The merger of transition metal and photocatalysis. *Nature Reviews Chemistry*, *1*(7), 1-19.	**1249**
7.	Zuo, Z., Ahneman, D. T., C hu, L., Terrett, J. A., Doyle, A. G., & MacMillan, D. W. (2014). Merging photoredox with nickel catalysis: Coupling of α-carboxyl sp3-carbons with aryl halides. *Science*, *345*(6195), 437-440.	**1174**
8.	Nagib, D. A., & MacMillan, D. W. (2011). Trifluoromethyla tion of arenes and heteroarenes by means of photoredox catalysis. *Nature*, *480*(7376), 224-228.	**1106**
9.	Nagib, D. A., Scott, M. E., & MacMillan, D. W. (2009). Enantioselective α-trifluoromethylation of aldehydes via photoredoxorganocatalysis. *Journal of the American Chemical Society*, *131*(31), 10875-10877.	**969**
10.	Allen, A. E., & MacMillan, D. W. (2012). Synergistic catalysis: a powerful synthetic strategy for new reaction development. *Chemical science*, *3*(3), 633-658.	**945**

7.6 *Most cited article by David MacMillan*

Out of 216 total papers from the Web of Science database, David MacMillan cited 71 papers from Journal of the American Chemical Society as his top choice, followed by 47 from Science and 15 from abstracts of papers of the American Chemical Society. With 10 publications, US publishers were chosen over UK publishers in these top channels of communication for the publication of journal papers by David MacMillan.

Table 5: Top communication outlets, according to David Macmillan

Sl. No	Journal Name	Country	Published by	No. of Articles
1.	Journal of the American Chemical Society	United States	American Chemical Society	71
2.	Abstracts of Papers of the American Chemical Society	Washington, USA, DC, 20036	American Chemical Society	47
3.	Science	It is based in Washington, D. C., United States, with a second office in Cambridge, UK.	American Association for the Advancement of Science (United States).	15
4.	Angewandte Chemie International Edition	Weinheim, Germany	Wiley-VCH on behalf of the German Chemical Society (Gesellschaft Deutscher Chemiker).	14
5.	Nature	London, England	Nature Research (subsidiary of Springer Nature) (United Kindom)	13
6.	Chemical Science	United Kingdom	Royal Society of Chemistry (United Kingdom)	10
7.	Others			46
	Total			**216**

7.7 *Imparting evolutionary recent research trends by bibliographic coupling network*

Current research targets may be better reflected through the bibliographical coupling network years which is analysed (Figure 1). Bibliographical coupling networks use bibliographical data sets as nodes, differing in co-authors and co-cited reference lists. From deep blue to light green, the nodes representing the articles have been published from 2006 to 2022.

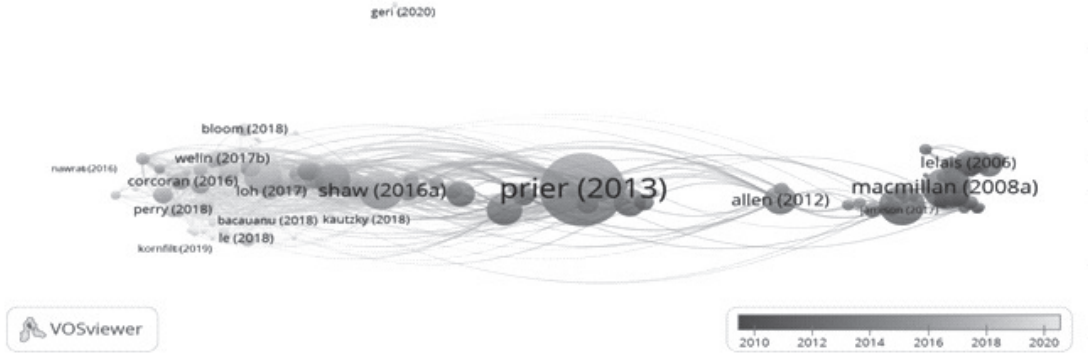

Figure 1: Bibliographical coupling network of the recent years for the articles published by David MacMillan

Many works have been investigated by David MacMillan and it has been noticed some highlighted nodes with big size. On the middle part of figure 1, the work represents "Visible light photoredox catalysis with transition metal complexes: applications in organic synthesis" (Prier et al. 2013). By investigating these representative works, we can notice some highlighted nodes with big sizes. Some recent works on the topic of "Photoderox Catalysis" are also found.

Figure 2 represents the strongest citation bursts which are an indicator of a most active area of research. Citation burst is a detection of a burst event, which can last for multiple years as well as a single year. Figure 3 also figures out about top 6 keywords which depict strongest citation bursts.

Top 25 References with the Strongest Citation Bursts

References	Year	Strength	Begin	End	2012 - 2022
Twilton J, 2017, NAT REV CHEM, V1, P0, DOI 10.1038/s41570-017-0052, DOI	2017	6.68	2018	2022	
Zhang P, 2016, J AM CHEM SOC, V138, P8084, DOI 10.1021/jacs.6b04818, DOI	2016	4.56	2018	2022	
Nicewicz DA, 2008, SCIENCE, V322, P77, DOI 10.1126/science.1161976, DOI	2008	4.44	2012	2015	
Le C, 2018, SCIENCE, V360, P1010, DOI 10.1126/science.aat4133, DOI	2018	4.17	2019	2022	
Le CC, 2017, ACS CENTRAL SCI, V3, P647, DOI 10.1021/acscentsci.7b00159, DOI	2017	4.14	2020	2022	
Schultz DM, 2014, SCIENCE, V343, P985, DOI 10.1126/science.1239176, DOI	2014	4	2014	2016	
Terrett JA, 2015, NATURE, V524, P330, DOI 10.1038/nature14875, DOI	2015	3.77	2016	2018	
McNally A, 2011, SCIENCE, V334, P1114, DOI 10.1126/science.1213920, DOI	2011	3.73	2013	2014	
Pirnot MT, 2013, SCIENCE, V339, P1593, DOI 10.1126/science.1232993, DOI	2013	3.67	2014	2016	
Narayanam JMR, 2011, CHEM SOC REV, V40, P102, DOI 10.1039/b913880n, DOI	2011	3.67	2014	2016	
Shaw MH, 2016, J ORG CHEM, V81, P6898, DOI 10.1021/acs.joc.6b01449, DOI	2016	3.65	2017	2022	
Tucker JW, 2012, J ORG CHEM, V77, P1617, DOI 10.1021/jo202538x, DOI	2012	3.63	2014	2015	
Jeffrey JL, 2015, SCIENCE, V349, P1532, DOI 10.1126/science.aac8555, DOI	2015	3.41	2016	2017	
Flamigni L, 2007, TOP CURR CHEM, V281, P143, DOI 10.1007/128, 2007, 131, DOI	2007	3.39	2013	2015	
Liang YF, 2018, NATURE, V559, P83, DOI 10.1038/s41586-018-0234-8, DOI	2018	3.31	2020	2022	
Shaw MH, 2016, SCIENCE, V352, P1304, DOI 10.1126/science.aaf6635, DOI	2016	3.17	2016	2018	
Kalyani D, 2011, J AM CHEM SOC, V133, P18566, DOI 10.1021/ja208068w, DOI	2011	3.11	2015	2018	
Nagib DA, 2009, J AM CHEM SOC, V131, P10875, DOI 10.1021/ja9053338, DOI	2009	3.01	2013	2015	
Sarver PJ, 2020, NAT CHEM, V12, P459, DOI 10.1038/s41557-020-0436-1, DOI	2020	2.89	2020	2022	
Dombrowski AW, 2020, ACS MED CHEM LETT, V11, P597, DOI 10.1021/acsmedchemlett.0c00093, DOI	2020	2.89	2020	2022	

Figure 2: References producing strongest citation bursts

Top 6 Keywords with the Strongest Citation Bursts

Keywords	Year	Strength	Begin	End	2012 - 2022
activation	2012	3.28	2014	2015	
aldehyde	2013	2.53	2014	2015	
arylation	2013	2.5	2014	2017	
merging photoredox	2015	2.96	2015	2018	
aryl halide	2015	2.71	2015	2018	
photoredox	2018	2.75	2018	2022	

Figure 3: Keywords producing strongest citation bursts

7.8 *Most bountiful authors*

7.8.1 Authors with most collaboration

Table 6 shows the list of co-authors who have written two or more two documents with collaboration with David MacMillan till 2023. There are 10 co-authors listed with five publications at least.

Table 6: Collaboration of authors

Sl. No.	Co-authors Name	Journal Articles	Total	Affiliation	Designation	Research Interests
1.	Le, Chi 'Chip'	11	11	Princeton University, Princeton, New Jersey, United States.	Senior Scientist, Medicinal Chemistry	Chemistry; Microbiology; Gut Microbiome.
2.	C. Conrad, Jacinta	8	35	University of Houston, Houston, Texas, United States.	American soft matter physicist	Soft matter; Complex fluids; Colloids; Polymers; Bacteria
3.	Simonovich, Scott	6	10	Princeton University, Princeton, New Jersey, United States.	Director of Medicinal Chemistry at Princeton University	supramolecular chemistry and catalysis, Medicinal Chemistry
4.	Scholes, Gregory D.	6	621	Princeton University, Princeton, New Jersey, United States.	Professor of Chemistry at Princeton University	Spectroscopy; Physical Chemistry
5.	Zhang, Xiaheng	6	12	Fudan University, Yangpu District, Shanghai, China	Organic Chemistry, Assistant Professor, Yangpu District, Shanghai, China	Photoredox catalysis. Transition metal catalysis. Total synthesis of structually and biologically interesting natural glycoconjugates.
6.	Prier, Christopher. K	5	18	Princeton University, Princeton, New Jersey, United States.	**Director of Enzyme Catalysis at Debut (a biotechnological research company), San Diego, California & Princeton University.**	Applications of photoredox catalysis, in which visible light is employed to promote chemical reactions.
7.	Seath, Ciaran P.	5	6	UF-Scripps Biomedical Institute, Jupiter, FL, USA.	Assistant Professor of Chemical Biology; Department of Chemistry, Wertheim UF-Scripps Biomedical Institute, Jupiter, Florida USA.	Biochemistry and Cell Biology; Clinical and translational science; Pediatric brain tumors.
8.	Terrett, Jack A.	5	31	Genentech Inc, South San Francisco, California, United States of America	Senior Scientist in the Discovery Chemistry group at Genentech	Medicinal chemistry, Oncology, Photoredox catalysis, Organic synthesis
9.	Vander Wal, Mark	5	14	University of California, Berkeley. Department. Department of Chemistry.	Medicinal Chemist/Scientist	Therapeutics, Neurology, Biochemistry & Molecular Biology Science & Technology - Other Topics Education & Educational Research
10.	Jui, Nathan T.	5	59	Loxo Oncology at Lilly; Boulder, Colorado, United States	Principal Scientist at Loxo Oncology at Lilly ; Boulder, Colorado, United States	Chemistry Pharmacology & Pharmacy Biochemistry & Molecular Biology Science & Technology - Other Topics Neurosciences & Neurology

7.10 *Growth of publications*

From 2006 to 2022, a span of 17 years of research output of Nobel Laureate David MacMillan has been measured. To understand the pattern of growth figure 7 describes the growth of publica-tions with cumulative total of the publications, where the linear line indicates that the growth of publication was below till 2010 but then it was above the line till the end date of the study. Among the 17 years of each block, i.e. the year between 2018 to 2020 has noted the highest number with 28 research publications. This block has also received the highest number of citations, which accounted for 13,314 citations at an average of 1551 citations per publication. A total of 50,467 citations were received by David MacMillan's 216 publications during the period. The average number of citations received per publication accounted for 234. 2018 to 2020 has been identified as the peak years of received average citations per paper with 749 citations. The graph of average citation noted an increasing ratio which proves that the publications have an impact as much as earlier publications.

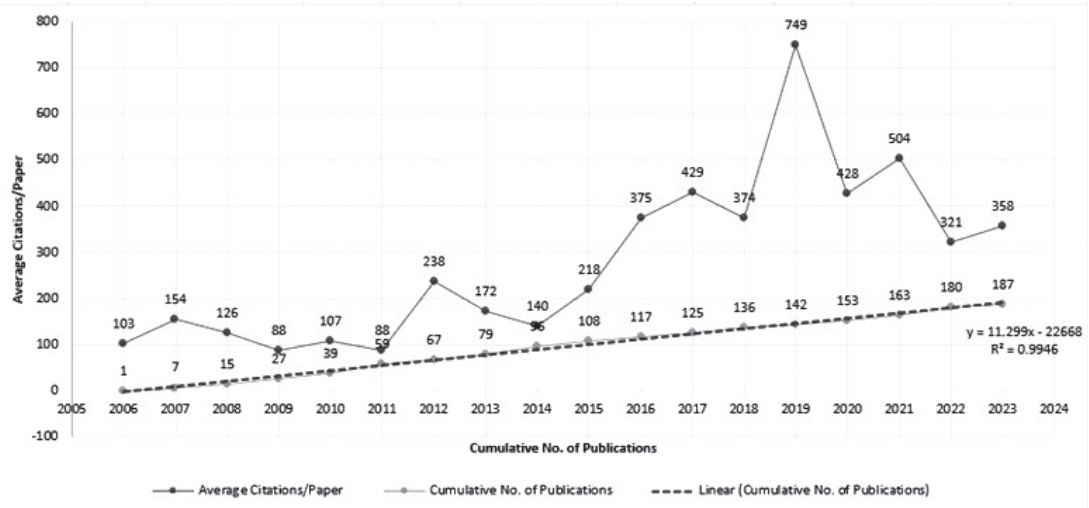

Figure 4: Growth of publications and average citation pattern

8. Major findings

Major findings of this research paper are listed below: -

- Out of 216 publications, 71.30 percent are journal articles indexed in Web of Science.
- From 2015 to 2022, the relative growth rate declined to 0.002 and the time for doubling climbed to 539, respectively, from 2015 to 2014 when the mean relative growth rate of his articles was 0.016 and the doubling time was 44.134.
- Le, Chi Chip co-authored 10.8% of David MacMillan's 216 publications, making her the most prolific co-author.

The majority of his papers were written in collaboration, as evidenced by the 0.90 collaboration rate across all publications and published much of his studies were published in the United States based journal. Most of his top-cited

journals came from the US, UK and Netherlands with medium to high impact factor Journals.

- According to Web of Science citation counts, in May 2023, the h-index counted 107 due to the large number of papers he created that earned a lot of citations.

9. Conclusion

David MacMillan's first publication productivity was discovered in 2006, when he was 38 years old, and up to 2022 he had produced 216 works according to Web of Science database; the ma-jority of which were journal articles. Many of his works have received a significant number of citations, and as of the time the data for this study were collected (June 2023), his h-index was 109. The mean relative growth rate was strong up until 2014, then in comparison, it started to decline. As a result, it took longer for publications to double later in the study period. David MacMillan has published most of his documents in collaboration with other authors, with only 19 documents published as single authored. He pioneered and specialized in the domain of Organic Synthesis and Catalysis. He received innumerable awards and honors including the Nobel Prize in 2021 at the age of 53 years. This pattern suggests that honours and awards a scientist receives may attract more collaborators resulting in accelerating publication productivity.

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Users' Satisfaction with Library Resources and Services in Digital Environment: a case study of Pachhunga University College, Aizawl

Lalrokhawma

Research Scholar, Department of Library and Information Science, Mizoram University

Manoj Kumar Verma*

Professor, Department of Library and Information Science, Mizoram University
(*Corresponding Author)

Abstract

User satisfaction is the main objective and purpose of every library and library professional. This study sought users' satisfaction with library resources and services of the UG students of Pachhunga University College Aizawl. The present study aims to identify the frequency of library visits, to degree the contentment level of library users with library resources and services, recognise the preferred information sources of users, and identify the challenges encountered by users in gathering their information. The study adopted a survey method of research using a questionnaire as a research data collection tool and a structured questionnaire was distributed to 80 library users randomly and received a total of 70 responses from the respondents. Results revealed that the majority of the respondents preferred text books for their source of information, and were highly satisfied with their textbook but most of the respondents were not satisfied with the services and facilities like reprography, poor internet connectivity, seating capacity and respondents also suggested to provide drinking water in the library. Based on findings, it also included some suggestions and recommendations hoping that it will be fruitful for library professionals to improve their service quality and increase user satisfaction.

Keywords: Digital environment, Library facilities, Library resources, Library services, Library users, User satisfaction

1. Introduction

User satisfaction is the main objective and purpose of every library and library professional. Library plays a very important and significant role in providing information to its users in their studies and research work. Academic library is established with the objectives to assist students, research scholars and teachers in their academic activities by providing the right information, to right users at right time. The library builds their collections, made reachable to their defined users through their different library services in physical or digital platforms and through this process directly the libraries are elevating and giving the backup of the education curriculum activities of the institutions and it helps to develop a meaningful resource based actions and inquiry among the users specially young students and cultivate the lifelong learning culture among them. There are many synonymous words used for library users (i.e. patrons, borrowers, clients, members, customers, etc.) but anyone who uses the library for his information needs is a library user. There are different opinions about the

concept of library users and Oxford English Dictionary explained the meaning of users as "a person who uses or operates something". According to Michael Gorman-"Information seekers who make use of library are library users," while Kenneth Whittaker defined a library user as "a person who uses one or more of a library's services at least once a year".

All the users need to be content with their library and fulfill their information needs with the resources and services of their respective libraries. User satisfaction is recognised as an imperative measure of library performance in all respect (Biswas, Nausheen, & Chakrabarti, 2011). According to Cambridge dictionary satisfaction means "A pleasant feeling that you get when you received something you wanted or when you have done something you wanted to do". In a broader sense, user satisfaction can be defined as the satisfaction level to meet the demands of the user. Thus, the present paper focuses and emphasises on user satisfaction with library resources and services in UG students of Pachhunga University College, the oldest and biggest college of Mizoram State having A+ grades in NAAC and ranked 34th in the NIRF ranking-2023 among the college category in country.

2. Review of literature

Ahmed and Amjad (2014) evaluated the scholar's satisfaction with electronic resources in library on different parameters and recognised the main problems faced by scholars in accessing the e-resources and which are lack of training, internet connection and anxiety with e-resources, etc. Verma and Parang (2015) examined the satisfaction of PG students of the school of physical sciences with library services and reported that PG students are happy and satisfied with the resources and services rendered by library. Kunwar Singh and Ramesh Kuri (2017) investigated IITs library user's satisfaction with resources and services. They adopted a survey research method to collect the research data to fulfil the research objectives. Mahjabeen Ali (2018) carried out this study to analyse the level of user satisfaction with services and resources at the Khan Bahadur Hassanally Effcndi Library, Sindh Madrcssatul Islam University, Karachi. Results exposed that though students were satisfied with the existing level of services and resources at library, however, there is more room for significant improvements regarding library services and resources. Lawal Mohammed Tukur (2020) examined user satisfaction with information resources, and library facilities by faculty members in Three Agriculture University Libraries in Nigeria; Major findings testify that the current agricultural information resources and facilities available, accessible and utilised are insufficient in agriculture University libraries sampled in Nigeria.

3. Significance of the study

As educational institutions are increasingly moving towards digital platforms, it becomes important to understand users' satisfaction with library resources and services to enhance the overall learning experience. The purpose of this research is to find out the specific needs and preferences of users, evaluate the effectiveness of existing digital resources and address any short comings in the current system. By pointing out these issues, the study intends to contribute valuable insights to the field of library science, enabling administrators and educators to make informed decisions to improve the digital library environment and, consequently, enhance the overall academic experience for the Pachhunga University College community.

4. Objectives

The present study has the following main objectives:

i. To know the purpose and library visit frequency of respondents

ii. To find out the preferred information sources used by selected users

iii. To quantity the users' satisfaction level with library resources and services

iv. To know the awareness level of N-LIST services among respondents

v. To measure the users' satisfaction with library facilities and infrastructure.

5. Methodology

For the present study, a survey method research was found suitable. Based on research objectives, a structured questionnaire was designed comprising questions related to research objects and randomly distributed to 80 library users of Pachhunga University College. A total of 70 filled questionnaires were received for data interpretation of the present study. Collected data was scrutinized, processed and tabulated for analysis using MS Excel tool.

6. Data analysis

6.1 *Frequency distribution of gender-wise respondents*

Table 1: Gender wise distribution of respondents

Gender	No. of Samples	Percentage
Male	31	45%
Female	39	55%
Total	70	100%

Gender analysis is a part and parcel of any research of social sciences to see the gender representation in the study. Table1 shows the gender wise representation of respondents of this study and it is observed that the majority of the respondents under study were female 39(55%) whereas, male respondents were 31(45%). It means the female are leading position in response rate of data.

6.2 *Frequency of library visits*

Table 2: Frequency of library visit

Frequency	Frequency	Percent
Daily	16	22.5%
Weekly	14	20%
3 times in a week	31	45%
Once in a week	4	5%
Occasionally	5	7.5%

The frequency of library visits is very vital indicator and important significance in library user satisfaction. Accordingly, an effort was made to know how often the students visited the library and was provided five scales occasional, once in a week, 3 times in a week, weekly and daily and presented in table 2. It is depicted from the respondent's responses and revealed that the total frequency of library visits under study was very poor and only 16 (22.5%) respondents visited the library daily, 31 (45%) respondents visited the library three times in a week and 14(20%) respondents visited the library weekly while 5 (7.5%) respondents visited occasionally.

6.3 *Purpose of library visit*

Table 3: Frequency of library visit

Purpose of Library visit	Number	Percentage
Study	41	59%
Reading	23	31.43%
Borrow and Return	38	54.28%
To do assignment	29	41.43%
Recreation	10	14.28%
To do photocopy	26	37.14%
Internet uses	5	7.14%
Collection of old questions	25	35.72%
Research work	12	17.14%

Different reasons and different purposes students visit the library, differ from student to student. Based on the eight-point scale the respondents were asked about their purpose in visiting library and all the responses are presented in table 3. The analysis revealed the majority of respondents 41(59%) visited the library for study purposes followed by circulation of books (Issue and return of books) the issue and return (borrowing/ return) followed by study purposes 38(54.28%). To do assignment 29(41.43%) and for the purpose of photocopy 26(37.14%). Only 7.14% and 17.14 of the respondents visited the library for the usage of Internet and research purposes. Further, it is also observed from the study that 37.14% of the respondents used the library for consulting old questions.

6.4 *Preferred information sources of users*

Table 4: Preferred information sources

Preferred information sources	Number of Respondents	Percentage
Textbook/Course book	64	92.5%
E-Resources	3	2.5%
Reference	3	5%
Newspaper/ magazines	-	-
Journal	-	-
Total	70	100%

The library is recognised to be the temple of knowledge and this knowledge is presented in the library. Student's preferences of information sources were evaluated based on five parameters and presented in table 4 and after analysis, it is observed that most of the respondents preferred textbook/course book 64(92.5%). Only 4.2% of the respondents preferred e-resources and references.

6.5 *Satisfaction of library resources*

Table 5: Satisfaction of library resources

Library Resources	Highly Satisfied	Satisfied	Fairly Satisfied	Unsatisfied	Highly unsatisfied
Books	35%	55%	5%	5%	-
Reference	27.5%	47.5%	22.5%	2.5%	-
Journals	12.5%	60%	25%	3%	-
Newspapers	30%	52.5%	12.5%	5%	-
E-resources	10%	55%	32.5%	2.5%	-
Magazines	17.5%	60%	17.5%	5%	-

The scholar further asked questions to the respondents whether they were satisfied or not regarding library resources. To ensure the satisfaction level, the scholar provided five parameters highly satisfied, satisfied, fairly satisfied, unsatisfied, and highly unsatisfied in five different areas of a library collection that is books, references, journals, newspapers, e-resources and magazines. The table under shows that 55% were satisfied and 35% were highly satisfied among the respondents in the area of collection of books. Respondents of 27.5% and 47.5% were satisfied and highly satisfied with library resources, there 60% and 52% of the total respondents were satisfied with the collection of journals and newspapers. 55% of the respondents were also satisfied with the collection of e-resources.

6.6 *Satisfaction with library services*

Table 6: Satisfaction with library services

Library service	Highly Satisfied	Satisfied	Fairly Satisfied	Unsatisfied	Highly unsatisfied
Circulation	50%	47.5%	-	2.5%	-
Reference	22.5%	62.5%	15%	-	-
Reprographic	17.5%	47.5%	30%	2.5%	-
Internet	12.5%	32.5%	40%	12.5%	2.5%

Library Service is a service to its users, it is also a performance of all activities of a library in connection with organising library materials and providing and making them available to its clientele. To ensure the satisfaction level of library services, the researcher used a five-point scale i.e. highly satisfied, satisfied, fairly satisfied, unsatisfied, and highly unsatisfied and respondent opinion was presented in table 6.

As far as the satisfaction of library service is concerned, the following table revealed that except for Internet services majority of the respondents were satisfied in the area of circulation, reference, and reprographic service.

6.7 *Awareness about the subscription of N-LIST*

Table 7 A: Awareness of N-LIST

Are you aware of N-LIST	Frequency	Percent
Yes	17	25%
No	53	75%
Total	70	100%

Table 7 B: Awareness about subscription of N-LIST

If yes, does your college library subscribe N-LIST	Frequency	Percent
Yes	17	25%
No	53	75%
Total	70	100%

N-LIST stands for National Library and Information Services Infrastructure for scholarly content. The N-LIST is an online database developed by INFLIBNET. N-LIST provides electronic resources to the student's researchers and faculty such as e-books, e-journals and research articles, etc. from colleges and other beneficiary institutions through server. To that extent N- LIST plays a significant role in every institution, hence, the researcher also asked a simple question to the respondents about the awareness and subscription of N-LIST in the college library and their response was tabulated in table 7A and 7B. Astonishingly, it was found out from the result that 75% of the respondents were not aware of N-LIST and also 75% of the respondents did not know whether they subscribed N-LIST or not in the college.

6.8 *Satisfaction of library facilities and Infrastructure*

Table 8: Satisfaction of library facilities and Infrastructure

Particulars	Highly Satisfied	Satisfied	Fairly satisfied	Unsatisfied	Highly unsatisfied
Appropriate Lighting	60%	37%	2.5%	-	-
Washroom is available and clean	5%	32%	45%	12.5%	5%
Space for group/individual study	35%	52.5%	10%	2.5%	-
Space that facilitates quietness	37.5%	40%	17.5%	5%	-
Safety features are available	22.5%	60%	12.5%	5%	-
Good functional furniture	35%	57.5%	7.5%	-	-
A good network ICT space	7.5%	42.5%	42.5%	7.5%	
Drinking water is available	15%	17.5%	17.5%	40%	10%
Library Seating capacity	17.5%	47.5%	20%	12.5%	2.5%

The library facilities and infrastructure playa very important role in determining the users' satisfaction. If the library has good basic facilities and infrastructure, it will add a lot of plus points in user satisfaction. The users' perception of the PUC library was tabulated in table 7 and the analysis resolved that highly satisfied with the lighting, space that facilitates quietness, space for group/individual study furniture while washroom facilities, drinking water, good network, and library seating capacity need to be improved.

7. Discussion

The analysis of the survey data provides valuable insights into various aspects of users' satisfaction with library resources and services at Pachhunga University College, Aizawl. The frequency distribution analysis revealed crucial insights into the demographic composition of the respondents, with a particular focus on gender representation. Table 1 indicates that the majority of the participants were female, constituting 55% of the total sample, while males comprised 45%. This finding underscores the significance of considering gender dynamics in library studies, as it unveils the dominance of female respondents in the study context. Moving on to the frequency of library visits (Table 2), the analysis exposes a noteworthy pattern in user behaviour. A substantial portion of respondents, 45%, visited the library three times a week, while only 22.5% visited daily. The purpose of library visits (Table 3) provides a diversified perspective, with a significant 59% visiting for study purposes and 54.28% for borrowing and returning books. Moreover, the preferred information sources (Table 4) elucidate that a staggering 92.5% of respondents favored traditional textbooks/course books over electronic resources and references. The satisfaction analysis of library resources (Table 5) and services (Table 6) unveils an overall contentment among respondents, with a majority expressing satisfaction in various categories. However, areas such as internet services and reprographic services in table 6 require attention for improvement. The study also brings attention to the awareness and subscription status of N-LIST (Table 7), indicating a lack of awareness among 75% of respondents and uncertainty about subscription status. Lastly, the satisfaction of library facilities and infrastructure (Table 8) showcases contentment in areas like lighting, study spaces, and furniture, but highlights the need for improvement in washroom facilities, drinking water availability, and library seating capacity. Overall, this comprehensive analysis provides a roadmap for Pachhunga University College to address specific areas of concern, capitalise on strengths, and enhance overall user satisfaction with library resources and services in the digital environment.

8. Conclusion

The primary objective of a library is to collect, organise, preserve, disseminate, and provide access to knowledge and information to its users. User's perceptions and satisfaction with library resources and services have largely been ignored by researchers and practitioners of Library and Information Science. The present study was conducted to evaluate the library resources and services offered by PUC College library and the level of satisfaction and service quality. Though PUC library is the biggest, largest and most renowned college in the state in terms of collection, areas and infrastructure, still there are many issues and challenges and there many room for improvement. Therefore, the overall findings of the study, can be concluded that the majority of the respondents under study were satisfied with library resources and services but on the other hand, some areas like library facilities and physical infrastructure need to improve and take appropriate strategies for the development of the library. In addition, there is a need for

targeted interventions to enhance library services, promote digital resources, and improve overall user satisfaction at Pachhunga University College.

9. Suggestions

During the study researcher acquired many suggestions and recommendations through observation and also from respondents to improve library resources, services and facilities. The following valuable suggestions were recommended for more satisfaction for library resources and services:

i. To meet the user's needs, the library should improve the physical infrastructure by providing adequate reading space, seating capacity and facilities for washroom and drinking water.

ii. More computer systems should be facilitated and also internet service should be improved.

iii. Library should conduct a user awareness programme/ information literacy programme for the users to educate them about what e-resources are available in the library and how to make maximum use of these e-resources for academic purposes.

iv. The ICT infrastructure and services need to be equipped and furnished in the library for the smooth functioning and welfare of the students and teachers alike.

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Evaluating Web Presence of Technological Institutions in India: a webometrics analysis

Dr. Sonali Dapsi

Librarian, Raja Peary Mohan College, West Bengal

Abstract

The article attempts to study the websites of thirty-five selected technological institutes in India for inclusion in the NIRF (National Institutional Ranking Framework) 2022 ranking based on their online impact factor, fostering effective education and community development through enhanced utilisation of diverse teaching sectors in India. Web Impact Factors (WIF) are calculated and links are analysed using tools in this webometric research. Different search engines a vital part in collecting data in the webometric study were used for collecting data from July 18 to July 30, 2022. Data were collected using Google's search engine based on advanced query syntax for the approximate number of various link pages from the websites of selected technical institutions. The major finding is that in the self-link web impact factor IIT Madras occupies the first place with 76200 self-link pages and 134000 webpages with 0.568657 SWIF (Simple Web Impact Factor) followed by Sathyabama Institute of Science and Technology (sl. no. 31).This study involves quantitative data analysis of 35 technological institutes in India. This study serves as a valuable tool for library professionals, aiding them in assessing and leveraging online impact factors of various technological institutes for improved library services.

Keywords: Higher education, NIRF ranking, Technological institute, Web indicator, Webometric study

1. Introduction

Webometrics, as a field of study, encompasses the quantitative analysis of web-related data, evaluating different aspects of websites and online presence. It involves examining parameters like the number of external links (in-links) to a website, its size measured by the number of webpages, visibility in search engine results, and various metrics to gauge impact, influence, and online visibility. This methodology is frequently employed to rank and compare the performance of academic institutions, especially universities and research centers, by assessing the presence and impact of their web content.

This term first came in 1997 by Almind and Ingwersenand the link analysis came in 1998 by Peter Ingwersen. Web impact factor is the web version impact factor. Web impact factor is inaugurated by ISI, Philadelphia. (Kunosic,2019). Comparing the previous literature review, it is evident that webometrics studies various website information and their web search indicators. Presently, we aim to derive insights from website analysis and web impact factors across various technological institutes. Hence, the study emphasises quantitative techniques and diverse link analyses of websites belonging to different technological institutions.

2. Literature review

Webometrics involves quantitatively

assessing a website's effectiveness and efficacy analysis of links. This study specifically focused on conducting webometric analysis on the websites of the top ten oldest NITs (Chakraborty, 2003). Webometrics link analysis of NAAC Accredited degree college in West Bengal was shown by Ghosh and Roy (2019).The Literature reviews of this study indicated the main focus on web indicators of the ranking sector of higher education (Jalal and Biswas,2009).The current research seeks to comprehensively evaluate the impact and visibility of IIT websites through a webometric approach and to demonstrate their impact rate and visibility, utilising metrics like Web Impact Factor, in-links, and Web Indicators for Science, Technology, and Innovation Research (Prakash,2012). Hanuskodi (2012)indicated the webometrics analysis of national level institutes like NIT, IIT, etc. Ranking of National Institutes of Technology (NITs) of the northeast region of India was also done based on web impact factor (Verma and Brahma, 2017). Tunga (2021) also focused on the national-level institute website rankings, assessing various links and features for their evaluation. The entirety of this study entails conducting an analytical examination of web indicators utilising web-based platforms.

3. Significance of the study

Comparing the previous literature review, it is evident that webometrics studies various website information and their web search indicators. Presently, we aim to derive insights from website analysis and web impact factors across various technological institutes. Hence, the study emphasises quantitative techniques and diverse link analyses of websites belonging to different technological institutions.

4. Objectives of the present study

This article is to critically investigate the following objectives:

i. To find out various types of links and explore the web presence of 35 selected technological institutions

ii. To calculate web impact factors of the websites of selected technological institutions

iii. To visualise link page mapping among the technological institutions in India by using the tool SocSciBot4 (http://socscibot.wlv.ac.uk/)

5. Methodology

This analytical study is restricted to 35 technical institutes in India that are ranked nationally in 2022 according to the NIRF based on their online impact factor, fostering effective education and community development through enhanced utilisation of diverse teaching sectors in India. Web Impact Factors are calculated and links are analysed using tools in this webometric research. Different search engines a vital part in collecting data in the webometric study were used during July18 to July30, 2022. Data were collected using Google's search engine based on advanced query syntax for the approximate number of various link pages from the websites of selected technical institutions as follows:

5.1 *Data collection through searching*

For each of the websites of 35 technical institutions the following search queries or syntax used to collect data are under:

- site: URL-this will extract the total number of webpages to the websites under the URL.
- domain: URL- this will extract the total number of webpages to the websites under the URL
- link domain: URL- this will retrieve

the total number of webpages linking to the websites i.e. hyperlink pages.

- link: URL AND site:URL-it will provide a complete report of several webpages under the websites that provide links from the same websites i.e. Self-Link pages.
- link: URLAND NOT site: URL - it will provide a complete report of several webpages not under the websites which provide links from the other websites i.e. External-Link pages.
- link: URLNOT site: URL - it will provide a complete report of a number of links incoming from other websites.

5.2 *Calculation of Web Impact Factors (WIF)*

Most of the webometric study is based on the web impact factors (WIFs) of either simple WIF (WIFs) or revised WIF (WIFs).

5.3 *The calculation of WIF is as follows*

1. Simple WIF = Total number of link webpages (LWP)

   (SWIF) = Total number of webpages (NWP)

2. Self-link WIF = Total number self-link webpages

   (SLWIF) = Total number of webpages (NWP)

3. External-link WIF = Total number of external-link webpages

   (ELWIF) = Total number of webpages (NWP)

4. In Link/Revised WIF = Total number of in-link webpages

   (ILWIF/RWIF) = Total number of webpages (NWP)

Where A = Total number of webpages of a given site; B = Total number of external back links to a given site; C = Total number of self-link of a given site; D = Total number of links to a given site.

6. Data analysis and interpretation

6.1 *WIF for each NITs and IITs in India*

WIF for each NITs and IITs in India has been calculated based on the formula which is given in section 5.3 in four different ways. These are Simple WIF i.e. a ratio of the number of total link pages and the number of webpages; Self-link WIF which denotes a ratio of the number of total self-link pages and the number of webpages; External link WIF is a ratio of the number of total external link pages and number of webpages; Revised link WIF is a ratio of number of totals in-link pages and number of webpages which reflex of the degree of impact of the domain spaces on the WWW. A matrix may represent the calculation of WIF of different web spaces in different levels shown in table 1.

Table 1: Link analysis and web impact factor of NITs and IITs in India

Sl. No	Name	URL	WP	SIMP link	Self Link	Extl link	In link	SIM_WIF	SFLWIF	EXTL WIF	INL_WIF
1	Birla Institute of Tech & Sci.	bits-pilani.ac.in	37000	213000	13400	14000	2220	5.756757	0.362162	0.378378	0.06
2	Cochin University of Science and Tech	cusat.ac.in	99600	36300	4960	4870	3120	0.364458	0.049799	0.048896	0.031325
3	Dr. B R Ambedkar NIT, Jalandhar	nitj.ac.in	9860	12900	4390	4450	1320	1.308316	0.445233	0.451318	0.133874
4	IIT (Banaras Hindu University) Varanasi	iitbhu.ac.in	13400	46700	2120	2010	1040	3.485075	0.158209	0.15	0.077612
5	IIT (Indian School of Mines)	iitism.ac.in	10200	15200	2060	1800	899	1.490196	0.201961	0.176471	0.088137
6	IIT Bhubaneswar	iitbbs.ac.in	24300	48000	3860	4410	740	1.975309	0.158848	0.181481	0.030453
7	IIT Guwahati	iitg.ac.in	40800	86900	15400	17000	2370	2.129902	0.377451	0.416667	0.058088
8	IIT Hyderabad	iith.ac.in	33400	102000	4400	3570	2350	3.053892	0.131737	0.106886	0.070359
9	IIT Indore	iiti.ac.in	27300	1650000	3680	3160	2010	60.43956	0.134799	0.115751	0.073626
10	IIT Kanpur	iitk.ac.in	450000	169000	60300	64100	24200	0.375556	0.134	0.142444	0.053778
11	IIT Madras	iitm.ac.in	134000	99100	76200	59700	17100	0.739552	0.568657	0.445522	0.127612
12	IIT Ropar	iitrpr.ac.in	24700	53900	3410	2930	847	2.182186	0.138057	0.118623	0.034291
13	IIT, Bombay	iitb.ac.in	211000	8	51000	47800	17300	3.79E-05	0.241706	0.22654	0.081991
14	IIT, Delhi	iitd.ac.in	129000	62600	35200	38800	10600	0.485271	0.272868	0.300775	0.082171
15	IIT, Gandhinagar	iitrpr.ac.in	24700	53900	3410	2930	847	2.182186	0.138057	0.118623	0.034291
16	IIT, Kharagpur	iitkgp.ac.in	154000	199000	12700	10900	6110	1.292208	0.082468	0.070779	0.039675
17	IIT, Mandi	iitmandi.ac.in	27100	14300	4840	5650	2090	0.527675	0.178598	0.208487	0.077122
18	IIT, Patna	iitp.ac.in	11,400	41500	3140	3640	1060	3.640351	0.275439	0.319298	0.092982
19	IIT, Roorkee	iitr.ac.in	77300	151000	6470	6420	2200	1.953428	0.0837	0.083053	0.028461
20	Indian Inst of Engi Sci and Tech, Shibpur	iiests.ac.in	16300	15900	1790	1780	487	0.97546	0.109816	0.109202	0.029877
21	Institute of Chemical Technology	ictmumbai.edu.in	2,300	11000	933	798	240	4.782609	0.405652	0.346957	0.104348
22	Kalinga Institute of Industrial Technology	kiit.ac.in	25000	98300	4510	3980	1220	3.932	0.1804	0.1592	0.0488
23	Malaviya NIT	mnit.ac.in	10100	26000	2240	2150	1100	2.574257	0.221782	0.212871	0.108911
24	NIT Durgapur	nitdgp.ac.in	6,760	8600	941	1090	690	1.272189	0.139201	0.161243	0.102071
25	NIT Karnataka, Surathkal	nitk.ac.in	86000	45200	7620	8200	2970	0.525581	0.088605	0.095349	0.034535
26	NIT Rourkela	nitrkl.ac.in	68,600	13100	12900	13000	6440	0.190962	0.188047	0.189504	0.093878
27	NIT Warangal	nitw.ac.in	8470	71500	2380	2410	898	8.441558	0.280992	0.284534	0.106021
28	NIT, Silchar	nits.ac.in	4800	1490000	1260	879	332	310.4167	0.2625	0.183125	0.069167
29	NIT, Tiruchirappalli	nitt.edu	20200	204000	8530	8220	1640	10.09901	0.422277	0.406931	0.081188
30	S.R.M. Inst. of Science and Technology	srmist.edu.in	52,900	16200	9390	8450	1970	0.306238	0.177505	0.159735	0.03724
31	Sathyabama Institute of Sci.e and Technology	sathyabama.ac.in	3,880	25500	2130	2410	1240	6.572165	0.548969	0.621134	0.319588
32	Shanmugha Arts Science Tech.& Research Academy	sastra.edu	30700	509000	1980	2150	462	16.5798	0.064495	0.070033	0.015049
33	Thapar Institute of Engineering and Technology	thapar.edu	41700	295000	4190	4190	738	7.074341	0.10048	0.10048	0.017698
34	Vellore Institute of Technology	chennai.vit.ac.in	4320	368000	1180	1100	261	85.18519	0.273148	0.25463	0.060417
35	Visvesvaraya NIT, Nagpur	vnit.ac.in	19800	22100	6010	5100	4600	1.116162	0.303535	0.257576	0.232323

Note: NWP=No. of Web Page, WP=Webpage SL=Simple Link, SEL=Self Link, EL=External link, IN-LWP =In-Link, SIM IF =Simple Impact Factor,SEL IF =Self Link Impact Factor, EL IF= External link Impact Factor, IN-L IF= In-Link Impact Factor

Table 1 shows the link analyses and WIF of selected NITs and IITs from around India.

With 310.4167% SWIF, NIT, Silchar (Sl. no. 28) holds the top position. Vellore Institute of Technology (Sl. no. 34) and IIT Indore (Sl. no. 09) are conferred the second and third places, respectively.

IIT Kanpur (sl. no. 10), IIT Bombay (sl. no. 13), and IIT Kharagpur (sl. no. 16) have more webpages than the three Technical Institutes of India, but they are placed 31st, 35th, and 23rd, respectively, based on their SWIF since they have less simple link pages than other IITs. IIT Madras (sl. no. 11) holds the top position in the self-link web impact factor with 76200 self-link pages and 134000 webpages with a SWIF of 0.568657.With SWIFs of 0.548969% and 0.445233%, Sathyabama Institute of Science and Technology (sl. no. 31) and Dr. B R Ambedkar NIT, Jalandhar (sl. no. 3) are positioned second and third, respectively. Although IIT Kanpur (Sl. no. 10), IIT Bombay (sl. no. 13), IIT Kharagpur (sl. no. 16), and IIT Delhi (sl. no. 14) have more webpages than any other accredited college. They still occupy the 27th, 14th, 33rd, and 12th positions in the ranking, respectively, because their number of link pages is much lower than that of their webpages. According to the External Link Web Impact Factor (ELWIF) ranking among technical institutes in India, Sathyabama Institute of Science and Technology (sl. no. 31) is in first position with 3880 webpages, 2410 link pages, and an ELWIF of 0.621134%.

The EWIF placed the Dr. B. R. Ambedkar NIT, Jalandhar (sl. no.3), IIT Madras (sl. no. 11), and IIT Guwahati (sl. 7) in the second, third, and fourth positions, respectively, with scores of 0.451318, 0.445522, and 0.416667, respectively.

Revised or In-link web impact factor of the 35 Technical institutions of India which has been calculated by putting the following formula i.e. In-link or Revised Web Impact Factor=E/A Where E=Internal Link webpage and A=Number of webpage. Sathyabama Institute of Science and Technology(sl.no.31) again ranked first position with 3880 Webpages and 1240 in-link webpages and 0.319588 RWIF; followed by Visvesvaraya NIT, Nagpur (sl. no. 35) with 19800 webpages and 4600In Link webpages and 0.232323 RWIF. Dr. B R Ambedkar NIT, Jalandhar (sl. no. 3) occupied 3rd position with 0.133874% in-link impact factor. Though IIT Kanpur (sl. no. 10) and IIT, Bombay (sl. no. 13) having maximum number of In Link Pages (i.e. 24200&17300) compared to all technical institutions of India they stood at 23rd and 13th position due to their less impact factor.

6.2 *Top five out links per page for NITs and IITs in India*

It will provide a complete report of a number of pages, out links of top five institute of India.

Table 2: Top five out links per page for NITs and IITs in India

Site	Pages	Out links	Out links Per Page
bits-pilani.ac.in/	1	0	0
chennai.vit.ac.in/	1	1	1
cusat.ac.in/	1	1	1
home.iitd.ac.in/	1	1	1
ictmumbai.edu.in/	1	1	1
iiests.ac.in/	0	0	0
iitb.ac.in/	1	1	1
iitbbs.ac.in/	0	0	0
iitbhu.ac.in/	1	1	1
iitg.ac.in/	1	1	1
iith.ac.in/	56	3020	53.92857
iiti.ac.in/	1	1	1
iitism.ac.in/	0	0	0
iitk.ac.in/	350	66727	190.6486
iitm.ac.in/	0	0	0
iitmandi.ac.in/	1	1	1
iitp.ac.in/	0	0	0
iitr.ac.in/	1	1	1
iitrpr.ac.in/	1	1	1
iitrpr.ac.in/	1	1	1
kiit.ac.in/	1	1	1
mnit.ac.in/	1	1	1
nitdgp.ac.in/	1	1	1
nitj.ac.in/	2	12	6
nitk.ac.in/	1	1	1
nitrkl.ac.in/	1	1	1
nits.ac.in/	211	18389	87.15166
nitt.edu/	2	181	90.5
nitw.ac.in/	89	90	1.011236
sastra.edu/	1	0	0
sathyabama.ac.in/	1	1	1
srmist.edu.in	1	1	1
thapar.edu/	2	122	61
vnit.ac.in/	0	0	0
.iitkgp.ac.in/	1	0	0

The above table reflects Indian Institute of Technology, Kanpur and National Institute of Technology, Tiruchirappalli (nitt.edu) is having the highest number of outlines as well as outlines per page (190.6486 and 90.5) followed by National Institute of Technology, Silchar (87.151) and The Thapar Institute of Engineering and Technology (61).

6.3 *ADM and link analysis for NITs and IITs of India*

Academic purposes of web spiders extensively scan each webpage within the prescribed limitations (Jalal et al., 2010). The ADM technique is suggested by Mike Thelwall to collect data without bias (Ghosh, 2021).

Table 3: ADM count summary of NITs and IITs in India

URL of NITs & IITs	Page in links	Directory in links	Domain in links	Site in links	Page out links	Directory out links	Domain out links	Site out links
iitm.ac.in/	354	12	8	1	0	0	0	0
iitb.ac.in/	0	0	0	0	0	0	0	0
home.iitd.ac.in/	0	0	0	0	0	0	0	0
iitk.ac.in/	0	0	0	0	534	21	15	3
iitkgp.ac.in/	181	10	8	2	0	0	0	0
iitr.ac.in/	0	0	0	0	0	0	0	0
iitg.ac.in/	1	1	1	1	0	0	0	0
iith.ac.in/	0	0	0	0	0	0	0	0
chennai.vit.ac.in/	0	0	0	0	0	0	0	0
nitt.edu/	0	0	0	0	0	0	0	0
nitk.ac.in/	0	0	0	0	0	0	0	0
ictmumbai.edu.in	0	0	0	0	0	0	0	0
iitbhu.ac.in/	0	0	0	0	0	0	0	0
iiti.ac.in/	0	0	0	0	0	0	0	0
bits-pilani.ac.in/	0	0	0	0	0	0	0	0
kiit.ac.in/	0	0	0	0	0	0	0	0
iitrpr.ac.in/	0	0	0	0	0	0	0	0
srmist.edu.in	0	0	0	0	0	0	0	0
iitrpr.ac.in/	0	0	0	0	0	0	0	0
iitism.ac.in/	0	0	0	0	0	0	0	0
nitrkl.ac.in/	0	0	0	0	0	0	0	0
iitmandi.ac.in/	0	0	0	0	0	0	0	0
nitw.ac.in/	0	0	0	0	0	0	0	0
sastra.edu/	0	0	0	0	0	0	0	0
thapar.edu/	0	0	0	0	0	0	0	0
iitp.ac.in/	0	0	0	0	0	0	0	0
iitbbs.ac.in/	0	0	0	0	0	0	0	0
iiests.ac.in/	0	0	0	0	0	0	0	0
sathyabama.ac.in	0	0	0	0	0	0	0	0
vnit.ac.in/	0	0	0	0	0	0	0	0
cusat.ac.in/	0	0	0	0	0	0	0	0
nitdgp.ac.in/	0	0	0	0	0	0	0	0
nits.ac.in/	0	0	0	0	105	48	5	2
nitj.ac.in/	0	0	0	0	0	0	0	0
mnit.ac.in/	103	46	3	1	0	0	0	0

The ADM counts for the Indian IITs and NITs are mentioned in table 3. The details in the table are extracted using SocSciBot 4. It has been found from the above figure that there is an inter-relationship among Indian IITs and NITs.

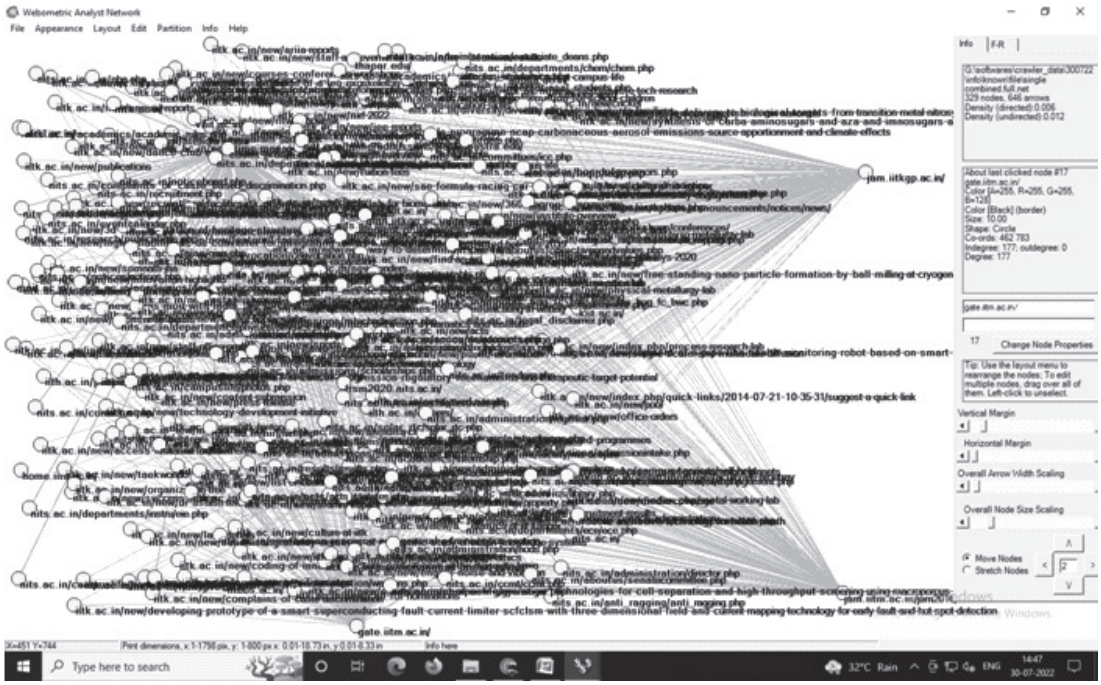

Figure 1: Link topology for NITs and IITs in India

7. Major findings

- In the self-link web impact factor IIT Madras occupies the first place with 76200 self-link pages and 134000 webpages with 0.568657 SWIF followed by Sathyabama Institute of Science and Technology (sl. no. 31), and Dr. B R Ambedkar NIT, Jalandhar are ranked 2nd and 3rd place with SWIF of 0.548969% and 0.445233% respectively.
- Sathyabama Institute of Science and Technology (sl. no. 31) occupies the first place with 0.621134% ELWIF followed by Dr. B R Ambedkar NIT, Jalandhar (sl. no. 3) and IIT Madras (sl. no. 11), and IIT Guwahati (sl. no. 7). Sathyabama Institute of Science and Technology (sl. no. 31) again ranked first position with 3880 webpages and 1240 in-link webpages and 0.319588 RWIF; followed by Visvesvaraya NIT, Nagpur (sl. no. 35) with 19800 webpages and 4600 InLink webpages and 0.232323 RWIF.
- Table 2 reflects Indian Institute of Technology, Kanpur occupies the first position followed by National Institute of Technology; Tiruchirappalli (nitt.edu) with the highest number of outlinks as well as out links per page (190.6486 & 90.5). National Institute of Technology, Silchar ranked third position with (87.151). The figure1 has shown Link topology of NITs and IITs in India.

8. Conclusion

The article on Webometrics represents all ranking categories in India according to the National Institute Ranking Framework, 2022. However, this study doesn't encompass every

institute included in the ranking framework, leaving out certain institutions. This study serves as a valuable tool for library professionals, aiding them in assessing and leveraging online impact factors of various technological institutes for improved library services. Therefore, future researchers are encouraged to complete the assessment of the remaining categories and institutes within the ranking parameters.

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Information Consumption Behaviour of School Students: a case study of Patrasayer block secondary and higher secondary schools at Bankura district in West Bengal

Mithun Das

Ex-M.Phil Scholar, Department of Library and Information Science, The University of Burdwan, West Bengal

Dr. Rajesh Das*

Assistant Professor, Department of Library and Information Science, The University of Burdwan, West Bengal
(*Corresponding Author)

Abstract

This paper focuses on the information consumption behaviour of school students in the Patrasayer block of the Bankura district in the state of West Bengal, India. The purpose of the study is to help the school students who use school libraries and other libraries by assessing how far they are satisfied using their school library and other libraries. For this study, 380 students were taken as a sample from nineteen secondary and higher secondary schools from the block. The methodology includes data collection and data analysis. A structured questionnaire has been provided to all 380 students of those nineteen schools. There, lots of parameters have been studied and critically analysed to assess the information use pattern of the school students. It is found that a lot of indicative results on different parameters set for the data analysis. The major finding is 1. 98.15% of students preferred the Bengali language; 45% of students visit the library once a week; 43.94% of students are getting their resources and articles for higher studies from the Internet. This type of information is available in the school library and other libraries, but 14.21% of students visit their library to access this information. A library has an important role for school students and the young generation. It is the school library that inculcates reading habits and motivates students to find out the appropriate ways to access information and knowledge to satisfy different needs in the future.

Keywords: Indian school, Information consumption behaviour, Information seeking behaviour, Information use pattern, Patrasayer block, Reading habits, School library

1. Introduction

At present, information is a vital component in every academic institution. A school library serves as the heart of academic and intellectual life within an educational institution. It is a hub of knowledge, offering a diverse collection of books, resources, and technologies to support students' learning and development. Beyond being a repository of information, a school library is a dynamic space where students engage in independent research, collaborative projects, and exploration of diverse topics. It plays a pivotal role in promoting literacy, critical thinking, and digital skills while fostering a culture of curiosity and lifelong learning. With guidance from knowledgeable librarians, school libraries empower students to navigate the vast sea of information, evaluate sources critically, and become informed, engaged citizens in an increasingly complex world.

Keeping in view the vital role of school library, this study deals with students of secondary and high secondary schools of Patrayer block in the Bankura district.

2. Review of related literature

Sinha (2015) studied the use pattern of public library users of Barak Valley in South Assam. The results revealed that 47% of users are 16-25 years old. It was observed that the maximum number of users (40.29%) preferred to spend at least one hour in the public library. More than 82 percent of users were satisfied in terms of resources by the public libraries. Chakraborty, Tamang and Biswas (2023) also identified that the most preferred resources of study in public libraries in Mirik subdivision were books that were used for educational purposes. Kamba (2017) investigated the information use patterns of school teachers in rural areas of Nigeria. Its objectives were to identify the type of information sources and resources used for teacher's teaching and learning. He found that the most popular resource in his study is books. He recommended that more awareness be needed to increase the library usage. Mahajan (2011) highlighted the status of a public library in Chandigarh and pointed out its collection and services being provided. The study analysed the information user pattern and the satisfaction of the users in terms of its collection and services. It also provided some valuable suggestions. Vijayalaxmi (2001) conducted a study on university libraries that described different aspects such as - types of information required, purpose/s of using information, methods used for keeping up-to-date, awareness, use and usefulness of information sources, information searching undertaken and the methods used for searching, use, etc. of Gulbarga University, Gulbarga. They concluded that there was a need for information education for post-graduate students in the university. Doraswamy (2013) conducted a study to provide information about the role of libraries in the information needs of students in his research paper. The main aim of his paper was to survey to evaluate the role of the library in the information needs of the students in engineering colleges. The results showed the students need ready information for their examinations, the core information for their knowledge purposes, and standard information for their research purposes. Selvaraj and Rathinasabapathy (2014) studied for information usage that a part of library professionals from the twentieth century. The purpose of the study was to identify the effective usage of information resources.

3. Objectives of study

In general, the purpose of the study is to study the school students who use the school library and other libraries. The specific purposes are stated below:

i. To identify how the students come to know about their relevant information

ii. To identify the users' satisfaction with library services

iii. To identify the frequency of users' library visits

iv. To identify those libraries or other sources that are visited frequently by the students other than their school libraries

v. To identify how the readers get advanced information and/or resources on their subjects that are not locally available

vi. To identify the readers' suggestions about the betterment of library services

4. Statement of the problem

The studied literature has highlighted different functions of the school library and its vital role in inculcating reading habits at the tender age which will provide the platform for lifelong learning. However, the existing literature has not exhaustively focused on school libraries in comparison with the published literature on other academic libraries like college or university libraries. Therefore, this study has taken an attempt to highlight the situation of school libraries in the remote area of Bankura district in West Bengal.

5. Methodology

The methodology includes various steps and methods for this research study. In the following section, the methodologies are discussed in detail.

The Patrasayer block is divided into two circles: (a) Patrasayer circle and (b) Patrasayer West circle

There are 219 schools (Government and public) situated in these two circles. The details are given in table 1.

Table 1: Number of schools in Patrasayer circle and Patrasayer west circle

Sl. No.	Circle	Primary schools	Upper Primary schools	Secondary and Higher Secondary (H.S.)	S.S.K. and M.S.K. Schools	Public Schools	Total
1	Patrasayer circle	77	08	11	22	05	**123**
2	Patrasayer West circle	66	08	08	12	02	**96**
Total		**143**	**16**	**19**	**34**	**07**	**219**

5.1 *Data collection*

Data are an important key factor of any research. In this research, we have selected 19 schools and collected data from them. The steps of data collection have been discussed below:

Step 1: Selection of schools

In table 1, we found that there are six kinds of schools in both Patrasayer Circle and Patrasayer West Circle. Primarily, 19 secondary and Higher Secondary (H.S.) schools have been selected because it has been found that every H.S. school has its own library, and students from H.S. schools can understand the use and value of the library. Other kinds of schools, like primary schools, upper primary schools, and S.S.K. (Sishu Shiksha Kendra) and M.S.K. (Madhyamik Shiksha Kendra) schools, have no library. The public schools in these circles have libraries, but students are too little and not much more interested in libraries. Only students from H.S. schools could understand the usability of the library. So, finally, the proposed research study has selected 19 secondary and H.S. schools of Patrasayer Circle and Patrasayer West Circle, followed by a stratified sampling method.

Step 2: Identification of population size

In 19 schools, the number of students (Class-V to Class-XII) is 18073 as per information collected from the schools. The total number of students of Class-IX to Class-XII from 19 schools is 8219. The students of Class-XI and Class-XII do not regularly attend the schools due to their final examinations. So, the students of Class- IX and Class X have been selected as populations

for the research work based on stratified sampling. The total number of students in Class-IX and Class-X is 5068. The number of female students is 3013 and male students is 2055. This 5068 is the size of the population.

Step 3: Selection of sample size

In step 2, we have found the population size of 5068 students of Class-IX and Class-X from 19 schools of Patrasayer block. Primarily, we have taken ten students from each class (Class-IX and Class-X) from 19 schools as samples of the research work. Then, the size of the sample will be 380 (10x2x19) for the research work. We have further divided the sample size into two groups - 190 female students and 190 male students- and the data have been collected using the random stratified sampling method. In all, three hundred eighty students' questionnaires have been received with a response rate of 100%.

Step 4: Questionnaire

Two questionnaires have been constructed for data collection through the survey. The first questionnaire is for students, and another is for the librarian / library-in-charge. The questionnaires for the student section contain details of library usage, reading habits, and library services. The other questionnaire for librarian/library-in-charge contains the growth of collection development, book procurement procedure, and library budget and funds in school libraries, housekeeping activities and library staff.

Schramm's model of communication

We have utilised Schramm's model of communication for our methodology. This model is based on three basic components: a source, a destination, and a message. The process starts with an idea in the mind of the source. This idea is then encoded into a message using signs and sent to the destination. The destination needs to decode and interpret the signs to reconstruct the original idea (https://en.wikipedia.org/wiki/Schramm)

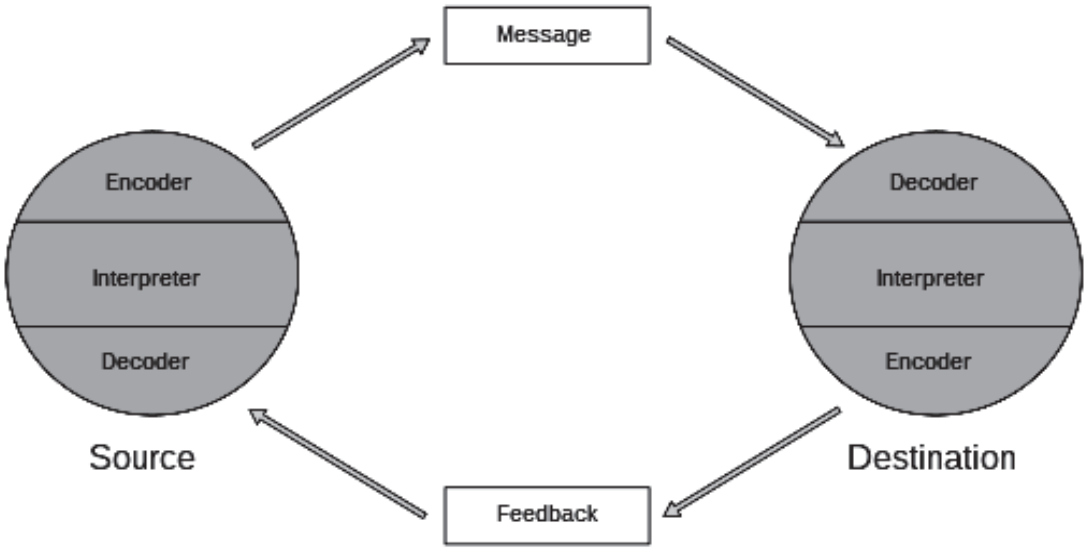

Figure 1: Schramm's model of communication includes a feedback loop and the processes of encoding, decoding, and interpretation.

6 Analysis and interpretation of data

6.1 *Language is known by the users*

Table 2: Language known by the users

Students	Number of students	Bengali	English	Any other language
Boys (male students)	190	185	5	0
Girls (female students)	190	188	2	0
Total	380	373	7	0
Percentage	100%	98.15%	1.85%	0%

It is observed in table 2 (language known by the users) that out of 380 students, users prefer the Bengali language is 373 (98.15%) and English language is 7 (1.84%).

6.2 *Frequency of library visit*

The frequency of library visits by school students indicates their use of the library. It denotes the following two things:

1. To what extent are the users willing to keep abreast of their subject?
2. To some extent, it also indicates the status of a particular type of library in satisfying the users' requirements.

Table 3: Frequency of library visit

Frequency of library visit	School library	Public library	Other library / place
Once in a week	171 (45%)	20(5.26%)	17(4.47%)
Once in a fortnight	120(31.57%)	6(1.5%)	3(0.78%)
Once in a month	49(12.89)	0(0%)	0(0%)
Any other frequency	40(10.52)	0(0%)	0(0%)

It is observed in table 3 (frequency of library visit) that out of 380 students, the number of students that visit a library in a week is 171 (45%); on the other hand, the number of students that visit public libraries is 20 (5.26%) and the users that use other libraries are 17 (4.47%). The number of students that visit the library once in two weeks is 120 (31.5%). On the other hand, the number of students that visit public as well as other libraries is 6 (1.5%) and 3 (0.78).

6.3 *Users' comments about the book collections*

Table 4: Users' comments about the book collection

	Students	Percentage
Adequate	148	38.94%
Partially adequate	122	32.10%
Partially inadequate	90	23.68%
Totally inadequate	20	5.26%

It is observed in table 4 (users comment about the book collection) that the number of adequate students is 148 (38.94%), and the number of partially adequate students is 122 (32.10%). The number of partially inadequate students is 90 (23.68%). The number of totally inadequate students is 20 (5.26%).

6.4 *Source of getting copies of articles that are not available in the school library*

It is seen that the school library fails to render information service when the demand of the users does not match the collection due to the non-availability of information sources. Thus, the users have to depend on the collection of other libraries. For this reason, they depend on various sources.

Table 5: Sources for getting advanced information/resources on their subjects that are not available in school libraries

	Students	Percentage
Through Internet	167	43.94%
Directly from another library	54	14.21%
Through Organisational sources	16	4.21%
Any other sources	143	37.63%

It is observed in table 5 (source of getting copies of articles that are not available in the school library) that the number of students who collected it through the Internet is 167 (43.94%) students. The number of students who collected it directly from another library is 54 (14.21%). The number of students who collected it through the National Scientific Documentation Center is 16 (4.21%). The number of students who collected it from any other sources is 143 (37.63%).

6.5 *Users' comments on present library services*

Table 6: Users' comments on present library services

	Students	Percentage
Most satisfactory	20	5.26%
Satisfactory	249	65.52%
Inadequate	91	23.94%
Totally inadequate	20	5.26%

It is observed in table 6 (users comment on present library service) that out of 380 students, the number of most satisfied students is 20, which means 5.26%. The number of satisfactory students is 249, which is 65.52%. The number of inadequate students is 91, which is 23.94%. The number of totally inadequate students is 20, which is 5.26%.

6.6 *Use of public libraries by school students*

There are three public libraries situated in the Patrasayer Block. Public libraries are used by different types of people. This study has pointed out that school students also use public libraries frequently. The study was conducted with 380 students as a sample. It is

found that 171 (45%) students are using school libraries, 20 (5.26%) of them are using these three public libraries a week, and 6 (1.5%) students are using those public libraries once a fortnight. School students who use public libraries can be treated as advanced library users in society. They can understand the value of public libraries and also gain extra knowledge that may be used in their education.

7. Major findings

It has been found from table 2 that 373 (98.15%) students out of 380 have preferred the Bengali language. The number of students who use the English language is only 7 (1.84%). No data has been found for students to use other languages.

It has been observed in the frequency of library visits that 174 (45%) students visit the library once a week. On the other hand, the number of students that visit public and other libraries is 20 (5.26%) and 17 (4.47%). Among the users, 120 students (31.57%) visit the library twice a week. On the other hand, the number of people that visit public as well as other libraries is 6 (15%) and 3 (3.78%). The number of students who visit the library at any other frequency is 49 (12.89%) and 40 (10.52%) users. This means there is a gap in the frequency of library visits among the users (collected from table 3).

From the users' comments about the book collection, the number of adequate users is the highest, at 148 (38.94%). The partially adequate number is 122 users (32.10%). Partially inadequate is 90 (23.68%). The total inadequate score is 20 (5.26%) (collected from table 4).

The number of users who collect copies of articles from the Internet after not getting them from the Internet is the highest at 167 (43.94%). The number of users who receive it from teachers and friends is 143 (37.63%). The number of users that collect from another library is 54 (14.21%). The number of users that receive it through the National Institute Documentation Center is 16 (4.21%) (collected from table 5)

It is observed in users' comments on the present library service that among 380 users, the number of satisfactory users is the highest at 249 (65.52%). The number of inadequate users is 91 (23.94%). Most satisfactory and inadequate are 20 (5.26%) and 20 (5.26%). (Collected from table 6).

8. Suggestions

In this context, a few suggestions for the improvement of the school library have been given below:

- The government should quickly engage librarians and library staff so that the users don't have any problem in using the library.
- The library should be open from the start to the end of the school.
- The procurement of books should be processed as per syllabus and requisition from the students.
- Every activity of the school should be connected with the school library (like books, exhibitions, drawings, etc.).
- In every school, particularly the library, the timetable for every class should be arranged.
- The library should run with the help of modern technology.
- The school libraries should provide photocopy facilities for the users.

From the above discussion, we can further suggest that school libraries should be visited by the inspector of schools as well as the district inspector of schools frequently and

they will be aware of the problems and issues of the school libraries (via librarian) and will forward these to the state government authority.

9. Conclusion

From the above study, it is evident that the students from the schools use public and other libraries very little. It has also been observed that the use of English is very poor, and other languages, like Hindi, are not used by the students. In those school libraries, the teachers seek advanced resources only. It is also found that the maximum number of students visit their school library once a week. The collection in those school libraries was adequate, as the students commented. It has been observed that all those school libraries are closed-access systems. If they have an open access system, usability will be increased. As per users' feedback, the skill of professional staff should be increased for better library services. As per data analysis, it is seen that the number of satisfactory school libraries is good, but the number of inadequate is also not lagging.

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Empowering Communities: the role of district libraries in supporting resources, services and government information in online mode

Mintu Halder

Research Scholar, Department of Library and Information Science, University of Calcutta

Dr. Arabinda Maity

Professor, Department of Library and Information Science, University of Calcutta

Abstract

Public libraries are a social organisation that helps society by providing various social, cultural, political, and economic information. In present days all the state governments are providing e-governance facilities to provide quick and reliable services to the citizens and West Bengal may not be an exception to this general phenomenon. This study highlights West Bengal district libraries to explore their resources, services, various sections, and government information for the community. The required data has been collected from 26 district libraries of West Bengal through the survey method. The purposive sampling technique was applied for selecting the sample unit from the study area to fulfil the objectives. It is found that eight district libraries are in a satisfactory position regarding services, collections, as well as government services. This study has created a value added tapestry by weaving various resources, services and government information in online mode to bring a positive impact on the lives of common people.

Keywords: District libraries, E-government, Information and communication technology, Library automation, Library operations

1. Introduction

The library is the fourth pillar of education. Different types of libraries (public, academic and special) play a pivotal role in making a society, knowledgeable. The public library is an organisation established, supported and funded by the public community, either through local, regional or national government or through some other form of public organisation. They provide equal access to all types of community members and stretch their coordination through every part of society.

In present days government is the provision of government information and services through the online environment, including such diverse interactions as applying for Medicare prescription drug plans, GIS for municipalities, paying taxes, and e-mailing a public official. E-government content is generated at the local and state levels in West Bengal. E-government interactions can occur over multiple devices, such as computers, personal digital assistants, smartphones, and other mobile devices. A new but extremely important social role for district libraries is ensuring that all citizens have access to and assistance using e-government information and services.

Some of the important strategies in e-governance can be narrated as follows:

- Improves delivery and efficiency of government services
- Improves interaction of government with business and industry
- Empowerment of citizens through access to information
- Less corruption and more transparency in administration
- Greater convenience to citizens and business
- Growth of revenue and reduction of costs
- Increased legitimacy of government
- Flattens the organisational structure
- Improved coordination between various levels of government
- Improved relations between government and various functionaries like media and civil society
- Restructuring of administrative processes and functions

In the state of West Bengal, the major e-government initiatives are:

- West Bengal State Data Centre (WBSDC)
- West Bengal State Wide Area Network (WBSWAN)
- West Bengal e-District Mission
- State Portal & Service Delivery Gateway (SSDG)
- Crime & Criminal Tracking & Network System (CCTNS)
- Centralised e-Office
- e-Municipality
- e-Panchayat
- e-Land & Land Records
- e-Procurement
- Smart Card
- Computerisation of Court Cases (CONFONET)

District libraries try to access and introduce new materials for the public interest. They help citizens with necessary information and services. Common people and young generations come to the library to access their personal interests, viz., availing various public services, career guidance, preparation for competitive examinations and government information.

2. Review of related literature

Bijali (2022) attempted to outline the strategies for effective outreach activities that public libraries usually undertake at their end to promote the library's resources and services beyond conventional practices and accelerate the number of users and usage. Jana (2022)mentioned that public libraries recognised their roles to satisfy the information needs of all the people in society and the government at the state level and national level has taken initiatives to make public libraries important sources of information for all kinds of people. Talawar, Patil and Kumbar (2022) attempted to study the user's perspective on public library multicultural resources and services and its role in maintaining social harmony. The results of the study revealed that the majority of the respondents were satisfied with resources (89.24%) and services (95.7%) of CCL Belagavi. Mishra and Kumar (2022) conducted a study to assess user satisfaction with library resources and services in government district library, Almora, Uttarakhand and suggested that district

library of Almora should carry out user studies at regular intervals to identify and search for the required information. Agbo, Idoko and Babarinde (2022) observed that collection and development practices were vital to achieving user satisfaction in public libraries in Enugu state and for that reason, they recommended to enhance funding and to recruit more professionals in the library. David (2021) investigated public library services in Cross Rivers State Library Board and concluded that public libraries should fulfill their obligations by meeting the information needs of people and recommended that librarians should encourage users to independently collect information from the library. Shikoh and Haridasan (2021) examined the current status of district-level public libraries, and one State Central Library located in Ambala (Haryana), in terms of its collection, staff, information and communication technology (ICT) applications and automation processes. Abumandour (2021) investigated the role of Bibliotheca Alexandrina public libraries in supporting e-learning and disseminating life long education concepts in the community. Khanchandani (2021) explored the functions of public libraries in the development of digital Bharat towards Atmanirbhar Bharat. The study focused on knowing how public libraries help to achieve the goals of digital Bharat and to know the user's daily information needs regarding e-government initiatives in India and the key challenges faced by libraries in providing these services. The author suggested that government should make a suitable plan and policy to provide e-government services among citizens through public libraries. Das Biswas (2022) also discussed the existence of e-governance in West Bengal.

3. Objectives

In this backdrop, the major objectives of the study are:

i. To overview the collections and services of district libraries in West Bengal.

ii. To identify the types of e-government information provided by the district libraries to the community

iii. To develop strategies for the betterment of e-services by the district libraries of West Bengal.

4. Methodology

The present study covered twenty six district libraries these are Additional District Library, Siliguri (ADLS), Bankura District Library (BADL), Birbhum District Library (BIDL), Burdwan Udaychand District Library (BUDL), Burdwan Udaychand Library (BUL), City Central Library, Durgapur (CCLD), Cooch Behar District Library (CBDL), Dakshin Dinajpur District Library (DDDL), Deshbandhu Govt. District Library (DGDL), Edward VII Memorial District Library (EMDL), Hoogly District Central Library (HODCL), Howrah District Central Library (HWDL), Jalpaiguri District Library (JDL), Kolkata Metropolitan Library (KML), Malda District Library (MDL), Murshidabad District Library (MUDL), Nadia District Library (NDL), North 24 Parganas Govt. District Library (NTFGDL), Paschim Medinipur District Library (PMDL), Purba Medinipur District Library (PUMDL), Purulia District Library (PDL), Ramkrishna Mission Boys' Home District Library (RMBHDL), South 24 Parganas District Library (STFDL), Taki Govt. District Library (TGDL), Uttar Dinajpur District Library (UDDL), and Uttarpara Joykrishna Library (UJPL) in West Bengal. Data were collected through a survey with the help of interviews along with schedule methods. Open-ended and close-ended both types of questions were set up for data collection. The purposive sample was used in this research for selecting

the sample unit from the study area to fulfil the objectives. Data were collected from twenty six district libraries with the help of respected librarians or library professionals. Descriptive statistical and checklist method was used for the analysis of collected data and findings. Researchers calculated the Mean value for considering the better library services. A formula of simple Arithmetic Mean has been used to calculate the Mean value, that is

$$\bar{x} = \frac{1}{n} \sum_{i=1}^{n} x_n$$

Where $\bar{x}$ = Mean, n = Number of items in the sample, Xn = Sum of all Values.

5. Importance of the study

Based on the above objectives, the present study tries to demonstrate the services, collection, and e-government of district libraries in West Bengal. The findings of the study will help to implement a better plan and policy for district libraries and reduce the barriers to providing free library services according to the information needs of users. This study will also provide an effective role for further related research.

6. Data analysis and interpretations

Table 1: Distribution of different sections maintained by the district libraries in West Bengal

Different Sections	ADLS	BADL	BIDL	BUDL	BUL	CCLD	CBDL	DDDL	DGDL	EMDL	HODCL	HWDCL	JDL	KML	MDL	MUDL	NDL	NTFGDL	PMDL	PUMDL	PDL	RMBHDL	STFDL	TGDL	UDDL	UJPL
Acquisition	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Technical	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Circulation	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Periodical	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Reference	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Stack area	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Binding	X	✓	X	✓	X	X	✓	X	X	X	X	X	X	X	X	X	X	X	X	X	X	✓	✓	X	X	X
Electronic data	X	✓	X	✓	X	X	✓	X	X	X	✓	X	X	X	X	X	X	✓	X	X	X	X	✓	X	X	✓
Audio visual	X	X	X	✓	X	✓	X	X	✓	X	X	X	X	X	✓	X	X	X	X	✓	X	X	X	✓	X	X
Digital library	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Office	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Total	7	9	7	10	7	8	9	7	8	7	8	7	7	7	8	7	7	8	7	8	7	8	9	8	7	8

Table1 shows that Burdwan Udaychand District Library maintains ten sections. Three libraries, i.e., Bankura District Library, Cooch Behar District Library and South 24 Parganas District Library have nine sections and City Central Library, Durgapur, Deshbandhu Govt. District Library, Hooghly District Library, Murshidabad District Library, North 24 Parganas Govt. District Library, Purba Medinipur District Library, Ramkrishna Mission Boys' Home District library, Taki Govt. District Library and Uttarpara Joykrishna Library have eight sections respectively. Out of these twenty-six libraries, no one library provides a digital library section to their users.

Table 2: Distribution of resources available in different district libraries in West Bengal

Information Resources	ADLS	BADL	BIDL	BUDL	BUL	CCLD	CBDL	DDDL	DGDL	EMDL	HODCL	HWDL	JDL	KML	MDL	MUDL	NDL	NTFGL	PMDL	PUMDL	PDL	RMBDL	STFDL	TGDL	UDDL	UJPL
Text Books	↘	↘	↘	↘	↘	↘	↘	↘	↘	↘	↘	↘	↘	↘	↘	↘	↘	↘	↘	↘	↘	↘	↘	↘	↘	↘
Reference books	↘	↘	↘	↘	↘	↘	↘	↘	↘	↘	↘	↘	↘	↘	↘	↘	↘	↘	↘	↘	↘	↘	↘	↘	↘	↘
Government publication	↘	↘	↘	↘	↘	↘	↘	↘	↘	↘	↘	↘	↘	↘	↘	↘	↘	↘	↘	↘	↘	↘	↘	↘	↘	↘
Competitive exam books	↘	↘	↘	↘	↘	↘	↘	↘	↘	↘	↘	↘	↘	↘	↘	↘	↘	↘	↘	↘	↘	↘	↘	↘	↘	↘
Braille Collection	X	--	--	↘	↘	X	↘	X	↘	X	↘	X	↘	↘	↘	↘	↘	X	X	X	↘	↘	↘	X	X	↘
Audio tapes	X	--	↘	↘	↘	X	↘	↘	X	X	X	↘	↘	X	X	X	--	X	↘	X	X	X	X	X	X	↘
Atlases,	↘	↘	↘	X	↘	↘	↘	↘	↘	↘	↘	↘	↘	↘	↘	↘	↘	↘	↘	X	↘	↘	↘	X	↘	↘
Globes	↘	↘	↘	↘	X	↘	↘	X	↘	↘	↘	↘	↘	↘	↘	↘	↘	↘	X	X	↘	↘	X	X	X	↘
Chart	X	↘	↘	↘	X	X	↘	↘	X	X	X	X	↘	↘	↘	↘	↘	X	X	↘	X	↘	X	↘	X	↘
Photographs	X	↘	↘	↘	↘	X	↘	X	X	X	X	X	↘	↘	X	X	X	↘	X	X	↘	↘	X	X	X	↘
Diagram	X	↘	↘	↘	X	X	↘	↘	X	X	X	X	↘	↘	X	X	↘	X	X	X	X	X	X	X	X	↘
Posters	X	↘	X	↘	X	↘	↘	↘	X	X	--	↘	↘	↘	X	↘	↘	↘	X	X	X	↘	X	↘	X	X
News Papers	↘	↘	↘	↘	↘	↘	↘	↘	↘	↘	↘	↘	↘	↘	↘	↘	↘	↘	↘	↘	↘	↘	↘	↘	↘	↘
Gram phone Records	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
CD's	↘	↘	↘	↘	↘	↘	↘	↘	↘	↘	X	↘	↘	↘	X	↘	X	↘	↘	X	↘	↘	X	X	X	↘

Information Resources	ADLS	BADL	BIDL	BUDL	BUL	CCLD	CBDL	DDDL	DGDL	EMDL	HODCL	HWDL	JDL	KML	MDL	MUDL	NDL	NTFGL	PMDL	PUMDL	PDL	RMBDL	STFDL	TGDL	UDDL	UJPL
Indian Journal	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Foreign Journal	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
General Periodicals	✓	X	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Magazines	✓	X	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
E-Books	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Online Journals and Magazines	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Total	11	13	15	16	13	12	17	14	12	11	11	13	17	16	12	14	14	13	11	09	13	15	10	10	09	16

Table 2 shows the collections of the libraries. Cooch Behar District Library and Jalpaiguri District Library have the highest types of collections. Burdwan District Library, Kolkata Metropolitan Library and Uttarpara Joykrishna Public Library have 16 types of collections. 15 types of collections are available in Birbhum District Library and Ramkrishna Mission Boys' Home District Library.

Table 3: Distribution of information services available in the district libraries in West Bengal

Services/ Facilities available in the DL	ADLS	BADL	BIDL	BUDL	BUL	CCLD	CBDL	DDDL	DGDL	EMDL	HODCL	HWDCL	JDL	KML	MDL	MUDL	NDL	NTFGDL	PMDL	PUMDL	PDL	RMBHDL	STFDL	TGDL	UDDL	UJPL
Lending Services	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Reading Room Services	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Reprographic Services	✓	X	✓	X	X	✓	✓	✓	X	✓	X	X	X	X	✓	✓	✓	✓	X	✓	X	✓	✓	✓	X	✓
Reference Services	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Referral Services	X	✓	X	✓	X	X	✓	X	X	X	✓	X	X	X	✓	✓	X	✓	X	✓	✓	X	X	X	X	✓
Bibliographic Services	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Current Awareness Services (CAS)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
SDI Services	X	X	X	X	X	X	X	X	X	X	X	X	✓	X	X	X	✓	X	X	X	X	X	X	X	X	X

Services/ Facilities available in the DL	ADLS	BADL	BIDL	BUDL	BUL	CCLD	CBDL	DDDL	DGDL	EMDL	HODCL	HWDCL	JDL	KML	MDL	MUDL	NDL	NTFGDL	PMDL	PUMDL	PDL	RMBHDL	STFDL	TGDL	UDDL	UJPL
Abstracting Services	X	X	X	✓	X	X	✓	X	X	✓	–	X	✓	X	✓	X	X	✓	X	X	X	X	X	X	X	✓
Indexing Services	X	✓	X	✓	X	X	✓	X	X	X	✓	✓	✓	X	✓	X	X	✓	X	✓	X	X	X	X	X	✓
User Orientation	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Document Delivery services	✓	✓	✓	✓	X	X	✓	✓	X	✓	X	X	✓	✓	✓	✓	X	✓	✓	✓	✓	X	X	✓	✓	✓
Translation Services	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Inter-Library Loan services	X	X	X	X	X	X	✓	X	X	X	X	X	X	X	X	X	X	✓	X	✓	X	X	X	✓	X	✓
Consultation service	X	X	X	X	X	X	✓	X	X	X	X	X	X	X	✓	X	X	✓	X	X	✓	X	X	✓	X	✓
Literature search service	✓	✓	X	✓	✓	X	✓	X	✓	✓	X	X	✓	X	X	X	X	✓	✓	✓	✓	X	✓	✓	X	✓
Children's services	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Community Information Services	✓	✓	X	X	✓	✓	✓	✓	✓	✓	X	✓	✓	X	X	✓	X	✓	✓	✓	✓	✓	✓	✓	X	✓
Library extension services	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Resource Sharing	✓	X	✓	✓	✓	✓	✓	X	✓	✓	X	✓	✓	✓	✓	✓	X	X	✓	✓	X	✓	✓	✓	✓	✓
ICT facilities	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Total		14	12	15	12	12	19	12	12	15	11	12	16	11	16	14	11	18	13	16	14	12	13	16	11	19

Table 3 shows that different services available in the district libraries. Uttarpara Joykrishna Public Library and Cooch Behar District Library have reached the apex position, and provided 19 library services, followed by North 24 Parganas Govt. District Library which are providing 18 services. Jalpaiguri District Library, Malda District Library and Taki Government District Library have provided 16 services respectively.

Table 4: Distribution of various community level e- government services available in the district libraries in West Bengal

Different e-government information	ADLS	BADL	BIDL	BUDL	BUL	CCLD	CBDL	DDDL	DGDL	EMDL	HODCL	HWDCL	JDL	KML	MDL	MUDL	NDL	NTFGDL	PMDL	PUMDL	PDL	RMBHDL	STFDL	TGDL	UDDL	UJPL
Searching court proceedings and other judiciary activities	X	↘	X	↘	↘	↘	↘	X	↘	↘	X	↘	X	↘	↘	X	X	↘	↘	↘	↘	↘	↘	X	↘	↘
Searching property databases	X	X	X	↘	↘	↘	↘	↘	X	X	↘	↘	↘	X	↘	↘	X	↘	X	↘	↘	X	↘	↘	↘	↘
Helping students for taking admission to School and Colleges	↘	↘	↘	↘	↘	↘	↘	↘	↘	↘	↘	↘	↘	↘	↘	↘	↘	↘	↘	↘	↘	↘	↘	↘	↘	↘
Developing and maintaining local government Webs sites	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Applying for granting permission of various public services	↘	↘	X	↘	↘	X	X	↘	X	↘	X	↘	X	X	↘	X	↘	X	↘	↘	↘	↘	↘	↘	X	↘
Training programme for using e-government services	X	↘	X	↘	X	X	↘	X	X	↘	X	X	↘	X	↘	X	X	↘	X	↘	X	X	X	↘	X	↘
Paying fees and Taxes	X	X	X	↘	X	X	X	↘	X	↘	X	X	↘	X	X	X	X	↘	X	X	X	X	X	↘	X	↘
Completion of various government services in online mode	X	X	X	X	X	X	↘	X	X	X	↘	X	↘	↘	X	X	X	X	X	X	X	↘	X	X	X	↘
Total	2	4	1	6	4	3	5	4	2	5	3	4	5	3	5	2	2	5	3	5	4	4	4	5	3	7

Table 4 shows that Uttarpara Joykrishna Library provides 7 e-government information services, followed by Burdwan District Library, which provides 6 services. Seven libraries, i.e., Cooch Behar District Library, Edward VII Memorial District Library, Jalpaiguri District Library, Malda District Library , North 24 Parganas Govt. District Library , Purba Medinipur District Library, and Taki Govt. District Library, have provided 5 services.

Table 5: Distribution of summaries data taken from the above tables

	ADLS	BADL	BIDL	BUDL	BUL	CCLD	CBDL	DDDL	DGDL	EMDL	HODCL	HWDCL	JDL	KML	MDL	MUDL	NDL	NTFGDL	PMDL	PUMDL	PDL	RMBHDL	STFDL	TGDL	UDDL	UJPL	Total
Sections	7	9	7	10	7	8	9	7	8	7	8	7	7	7	8	7	7	8	7	8	7	8	9	8	7	8	200
Types of Resources	11	13	15	16	13	12	17	14	12	11	11	13	17	16	12	14	14	13	11	09	13	15	10	10	09	16	337
Services/Facilities	14	14	12	15	12	12	19	12	12	15	11	12	16	11	16	14	11	18	13	16	14	12	13	16	11	19	360
e-government information	2	4	1	6	4	3	5	4	2	5	3	4	5	3	5	2	2	5	3	5	4	4	4	5	3	7	100
Total	34	40	35	47	36	35	50	37	34	38	33	36	45	37	41	37	34	44	34	38	38	39	36	39	30	50	997

7. Findings

Based on the above tables, researchers calculated all the data for the findings of Mean value. At first, it gathered all values in one table for calculating the sum.

$$\bar{x} = \frac{1}{n} \sum_{i=1}^{n} x_n$$

Where $\bar{x}$ = Mean, n = Number of items in the sample, Xn = Sum of all Values.

$\bar{x}$ = 1/26* 997=38.35

Then Mean is 38.35

Here 38.35 is the Mean or Average value of all twenty six libraries. Only eight libraries (BADL, BUDL, CBDL, HWDCL, MDL, PDL, TGDL and UJPL) have qualified above the mean in respect of library sections, services, collections, as well as government services. Those scores 40, 47, 50, 45, 41, 39, 39, and 50 have already crossed the Mean value of 37.66 and the rest of the other eighteen libraries have also obtained good scores, but they are not qualified. Because they did not touch the Mean value as well as cross the value.

8. Conclusion

The public libraries are intimately connected with the people as they try to provide the best services from their end. Increase in information access have historically been tied to increase in the inclusiveness of the democratic process. E-government is a new manifestation of the public library's contributions to the health of the democratic process. E-governance has brought about a new way of government functioning. This paper covered twenty six district libraries with their collection, services, sections, and e-government information. The results reveal that all libraries have valuable collections and can promote good services. The above findings have represented that more or less all the libraries successfully implemented their better quality of services based on their collections. Moreover, all libraries have working on their database. Twenty six district libraries have installed and used library management software as Koha. They try their level best to change their present plan of work for the elevation of service and stride to the modern age from the traditional era for the fulfillment of human optimism in the digital world. In order to adopt it effectively, the government must redesign its delivery process and reengineer its structure and functioning, viz., more internet facilities, ICT enabled computer terminal, formal and informal e-governance training facilities etc.

Essentially, the mode of public governance has to become more responsive, transparent and accountable to the citizens who are the key stakeholders in the development process.

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* DEDICATED SERVICE IS A MUST FOR ALL LIBRARIANS

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