EBLT – 2024

EVIDENCE BASED LIBRARY TRANSFORMATIONS

QUALITY SERVICES FOR NEXTGEN USERS

EDITORS

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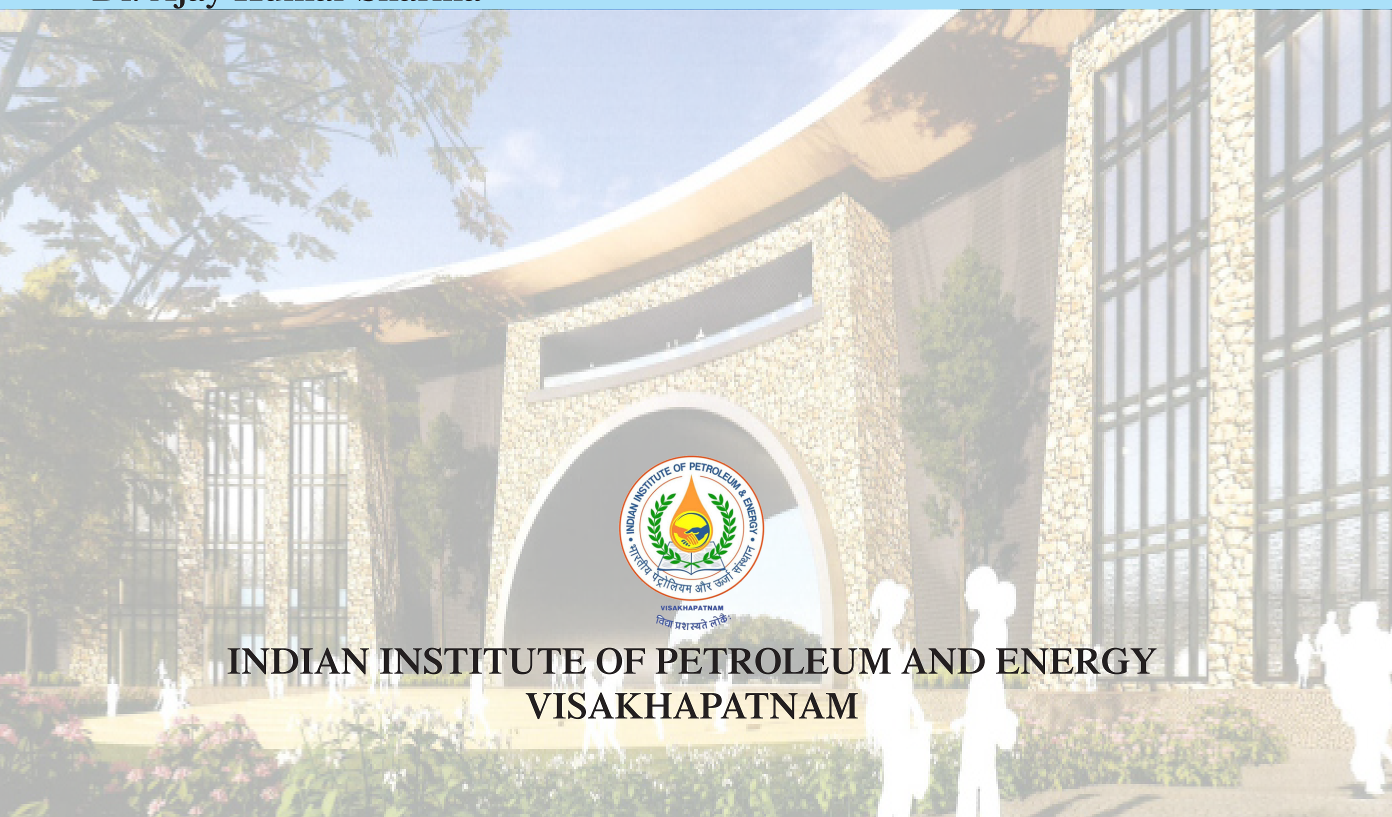

INDIAN INSTITUTE OF PETROLEUM AND ENERGY
VISAKHAPATNAM

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MESSAGE

Dear Esteemed Participants and Visionaries,

It is with great pleasure and a deep sense of pride that I extend my warmest welcome to all of you at the Evidence Based Library Transformations (EBLT-2024) Quality Services for NextGen Users Conference organized by the Indian Institute of Petroleum and Energy. This gathering serves as a testament to our shared commitment to pioneering advancements in library services, ensuring they cater effectively to the needs of our dynamic and forward-thinking NextGen users.

Libraries stand as bastions of knowledge, evolving alongside the needs and expectations of their users. In this era of rapid change, our challenge lies not just in adapting to technological shifts but also in embracing evidence-based practices that elevate the quality of services we offer. This conference serves as a nexus for exploring and promoting these transformations.

The theme, "Evidence Based Library Transformations: Quality Services for NextGen Users," encapsulates our collective aspirations. It underscores the importance of not only leveraging cutting-edge technologies but also employing evidence-driven methodologies to enhance the services we provide to our diverse and evolving user base.

This conference is an opportunity for us to exchange experiences, share best practices, and envision the future of libraries. Our discussions and collaborations during this event will pave the way for the evolution of libraries that are responsive, innovative, and tailored to meet the distinct needs of the NextGen users.

I encourage each one of you to actively engage, challenge existing paradigms, and contribute your expertise to the dialogue. Let us collectively explore avenues that will shape the landscape of library services, making them more accessible, relevant, and indispensable in the lives of our users.

I extend my deepest gratitude to the organizers, speakers, sponsors, and participants whose dedication has made this conference a reality. Your passion and commitment to transforming library services for the NextGen users inspire us all.

May this conference serve as a springboard for actionable insights, impactful collaborations, and the ushering in of a new era in library services that truly meets the needs of the NextGen users.

Warm regards,

Prof. Shalivahan
Director
IIPE Visakhapatnam

MESSAGE

It gives me immense pleasure to write this message for the conference volume of the *National Conference on Evidence-Based Library Transformations: Quality Services for NextGen Users - EBLT – 2024.* on 24^{th}-25^{th} January 2024, being conducted by the Institute Library. This conference is a platform for information professionals, students and others. The organising committee has selected well-known personalities from the reputed Institutions and Universities who will share their expertise, views, and best practices being followed in the libraries. The themes of the conference are very well chosen. The conference's sub-themes are very well selected, covering almost all the important aspects of the libraries.

Library Technologies, Policies, and Innovations. Library Resources, Copyrights, and Licensing. Library Buildings and Infrastructure. Innovative Library Services in Academic and Research Libraries; and Open Science and Open Library.

Libraries need to adopt new tools and technologies to provide better services to their users. To adopt these tools and technologies, libraries need certain policies adopted by the respective institutes. Library resources and issues related to subscription, access, etc., need to be addressed in the digital age, where there is always a chance of being plagiarised or violating copyright. Library building and infrastructure are crucial in providing a good ambience for the users. New-age users are very used to new tools and technologies, and libraries need to embrace them to attract them. To attract NextGen users' libraries need to introduce innovative services. Increasing the price of the resources and budget constraints to the libraries give the opportunity to promote open source. Open source is the demand of the time. Libraries, researchers and the user community should encourage it so scholarly communication can reach the last user.

The IIPE library is adopting new tools and technologies to serve its users efficiently and promptly. At this conference, library professionals' faculties, researchers and students from different parts of the country will share their research and experience with the participants. Participants can interact with speakers; experts can benefit from them.

I encourage all the participants to utilise these two days, benefit from this conference, and carry back new ideas to their respective institutes. Have a pleasant and fruitful stay at Visakhapatnam.

Best Wishes!

Ram Phal Dwivedi

Registrar

IIPE Visakhapatnam

FOREWORD

It's my privilege to welcome all the distinguished speakers, invitees and participants to the *National Conference on Evidence Based Library Transformations: Quality Services for NextGen Users* - EBLT – 2024 on 24th-25th January 2024, being conducted by the Dr. S. R. Ranganathan Library, Indian Institute of Petroleum and Energy (IIPE), Visakhapatnam, India. The academic stature of any Educational Institute is gauged by the status of its Library. Libraries are guardians of research ethics and the academic integrity of all the stakeholders. Libraries play a significant role not only in the progress of Academic Institutes but also in catering to the scholastic thirst for knowledge-seeking visitors or simply providing an enthralling experience to a casual onlooker. By acting as knowledge repositories, libraries help scholars realize their true research potential. Globally, the role of libraries as centers of knowledge resources are rapidly changing in the realm of Augmented & Virtual Realities, the Internet of Things (IoT) and AI-based technologies. Catering to the needs of a mobile user is another challenge which provides an exciting opportunity for re-positioning the Libraries. The transformation is imminent; however, all the transformations have to be evidence-based. The present conference is timely to deliberate on the necessary library transformations and the cautions we need to adopt during this transition phase.

The selected Themes *(Theme 1: Library Technologies, Policies and Innovations; Theme 2: Library Resources, Copyrights and Licensing; Theme 3: Library Buildings and Infrastructure; Theme 4: Innovative Library Services in Academic and Research Libraries and Theme 5: Open Science and Open Library)* abundantly cover the relevant topics and provide robust platform to formulate future strategies for a smooth, secured and illuminating Library experience. It is awe-inspiring to have academic luminaries in their respective fields as keynote speakers at the conference. I am sure their expert lectures will have a long-lasting impact on the young participants and motivate them to be the torchbearers of this important academic domain.

The present conference, with its coverage of a wide spectrum of topics, will foster a transformative change in the function of Libraries in India. We wish you all the dignitaries a pleasant stay and an enlightening academic experience in the picturesque city of Visakhapatnam.

Prof. K. Vijaya Kumar
Dean R&D
IIPE Visakhapatnam

PREFACE

Libraries play a key role in any department, whether academic, research, public or special library, in achieving teaching and research excellence. Generally, libraries are known for preserving and disseminating knowledge, but they actually play more than this. Libraries have had their importance since the beginning when they came into their existence. Perhaps the oldest known library is Al-Qarawiyyin Library in Fez, Morocco, opened in 1359 C.E., at the University of Al-Qarawiyyin (also the world's oldest, built in 859 C.E.). In India, libraries have a rich history; they were patronised by the rulers. The greatest example is the Nalanda Vihar Library. Nalanda was an ancient centre of higher learning in Bihar, India, from 427 to 1197. It was a mammoth library with more than Nine Million books at that time.

During these times, libraries have changed themselves to adopt the futuristic requirements of the users. Clienteles' information requirements are changing with the advent of information and communication technologies. Simultaneously, in this internet and A.I. environment, providing the right content to the users is very challenging. Librarians need to keep themselves updated with the new tools and technologies. The teaching and research community rely on the libraries and believes it will provide the right information within the time frame.

Embracing new tools and technologies in their daily services has become inevitable and challenging. The libraries are adopting these changes successfully. Today, librarians talked about A.I. tools, IoT in libraries, ICT-enabled services, and state-of-the-art technologies in the library's day-to-day activities. A.I. Tools and Acceptance of ChatGPT in Academia and Research. They have also started advocating and adopting OPEN Access Software, Open Access Publications, One Nation One Subscription, and Uniform Subscriptions irrespective of their size and specialisations such as university, Institute, Institute of National Importance or Institute of Eminence.

This conference is a step towards exploring the new tools and technologies, different services, and best practices being followed in various libraries. It is a platform for the LIS faculty, professionals, researchers, students, and ICT professionals, among others, who are interested and keen to know new things and adopt best practices for smooth and better services. The conference aims to provide a platform where different library professionals can share their ideas, research, state-of-the-art technologies adopted or adopted and best practices they are following. A.I. Tools and Acceptance of ChatGPT in Academia and Research. In the age of A.I. and ChatGPT, librarians' responsibilities are increasing, and they have challenges in providing the right information and content.

The libraries need better infrastructure and equipment to serve the users, and this conference provides a platform to exchange ideas and experiences among the heterogeneous community. The conference has incorporated contemporary topics in its theme and emphasises evidence services to adopt for its NextGen users.

This proceeding is the outcome of the contributors and editors of this episode. The paper selected for publication went through a deep review by the reviewers. The library has received over 50 manuscripts, of which only 29 were selected and published. It shows the intense review process for the most authentic and widely usable articles. LIS students have shown great enthusiasm towards writing. Some selected papers by the students have been included in the proceedings.

I deeply extend my sincere thanks to the Indian Institute of Petroleum and Energy (IIPE) authorities for their extraordinary support to all extents to organise this national conference and materialise the plan to execute.

I have a deep sense of gratitude to the Indian Council of Social Science Research (ICSSR) for providing monetary support in organising this conference. I acknowledge the financial support received from ICSSR) and other sponsors who showed their interest in sponsoring the conference. Their financial assistance helped us to organise it in a well-organised manner.

The LIS fraternity of Visakhapatnam and surrounding areas and neighbouring states have shown great enthusiasm in contributing their manuscripts to publication in the proceedings.

The conference will provide a platform to identify the strengths and fill the gaps to provide a better Research Ecosystem, Library-Faculty Collaborations, and User-centric Services. It will explore the future avenues of the libraries.

I wish all the speakers, invitees and participants a pleasant stay in the "City of Destiny".

Best Wishes!

Dr. Jitendra Kumar
Chief Editor

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RESEARCH VISIBILITY AND PRODUCTIVITY OF STATE AND PRIVATE INSTITUTIONS OF KARNATAKA: WITH SPECIAL REFERENCE TO IRINS

A. Muthuraj[1] and Dr. T. Ramachandra Naidu[2]

ABSTRACT

This study examines and analyses the faculty profiles of Indian Research Information Network System (IRINS) instances with special reference to Karnataka institutions. The article explores IRINS implemented in Karnataka institutions, institute-wise faculty members, institute-wise citations from Scopus and Crossref, various types of resources, top faculty of individual institutions, top faculty Google scholar citations, h-index, and i10 index. The data were collected from the website of the Indian Research Information Network System (IRINS) https://irins.org/irins/. The present study is confined to 92 institutions in Karnataka, most of them technical institutes. The data were analysed using simple calculations. The finding shows that "Christ University- Deemed University" has the highest number of 763 faculty members and "Indian Institute of Science, Bangalore," has the highest number of 40935 research papers, produced 891 patents, received 797832 citations from the Scopus database, and received 734626 citations from Crossref and Prof. C N R Rao (Professor, Jawaharlal Nehru Centre for Advanced Scientific Research) has published 1576 articles and has received the highest number of 90538 citations from Scopus and 79908 citations from Crossref.

Keywords: *Research Information System, Indian Research Information Network System (IRINS), Karnataka Institutions, Faculty Profiles, Citation and Publications.*

1. INTRODUCTION

Research Information Management Systems (RIMS) is a developing new service in academic and research libraries. RIMS helps universities and libraries in managing their institute, faculty, and researcher information through a single interface. They also allow the researcher to deposit and share their research with the public and enable the reuse of that research.[1] According to the OCLC, "Research information management is the aggregation, curation, and utilisation of information about research".[2] These tools require a subscription: Symplectic Elements, Converis- Thomson Routers, and PURE-Elsevier.

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There are several open-source tools, including VIVO, Profiles Research Networking Software, and DSpace-CRIS. The Indian Research Information Network System is a web-based Research Information Management (RIM) service developed by the Information and Library Network (INFLIBNET) Centre. The portal enables academic, research & development organisations and faculty members to collect, curate, and showcase scholarly communication activities and establish a scholarly network. The IRINS is available as a free software-as-service to academic and R&D organisations in India. [3]

2. REVIEW OF LITERATURE

Annigeri and Shivaraja (2022)[4] analysed the Indian Research Information Network System (IRINS) instances with particular reference to Colleges in Karnataka. The study explored the resource impact from scholarly resources, the contributions of the top individual Colleges, the h-index, the top faculty of respective Colleges, and the h-index. The study is confined to 21 Colleges in India. Jeyapragash and Muthuraj (2020)[5] focused on faculty members' research productivity in State Universities of Tamil Nadu. The faculty member's details were collected from 8 State Universities such as Alagappa University, Annamalai University, Bharathiar University, Bharathidasan University, Madurai Kamaraj University, Manonmaniam Sundaranar University, Periyar University and University of Madras. Naik (2020)[6] analysed the status of the IRINS, its collections, use, and awareness. The main aim of the project is a graphical representation of research and metrics reflecting research impact at both department and individual levels. In this article, the author finds 157 institutions with 25343 scholars from different disciplines and more focus on 208 Library and Information Science scholars from 25 states of India. Singh (2019)[7] described the PU@RIMNS implementation process at Panjab University, Chandigarh. This case study highlights the needs and objectives of the PU@RIMNS project, functional use, features and functionalities, benefits realised, etc.

3. METHODOLOGY

The present study data were collected from the Indian Research Information Network System (IRINS) website (https://irins.org/irins/index.php) on 23rd September 2023. It has been discovered that 92 Karnataka institutes have implemented IRINS. The 35 Technical Institutes (TI), 11 State Universities (SU), 10 Research and Development (RD), 9 Private Universities (PU), 5 Institutes of National Importance (INI), 6 Deemed Universities (DU), 14 Colleges (Col), 1 Central University (CU), and 1 Other Institute (OI) are implemented IRINS instances. The author visited 92 institutes' IRINS instances and collected the institute faculty member's details, publications, citations, and h-index. The data was downloaded into an MS Excel sheet for analysis. Citations were examined in October 2023. The current study also examines IRINS-implemented Karnataka institutes, institute-specific faculty members, publications, patents, resource impacts from various databases, top faculty publications and citations of individual institutions, and leading faculty Google Scholar citations. The data were analysed using simple calculations.

4. OBJECTIVES

The following are the major objectives of the study.

4.1 To identify the Indian Research Information Network System (IRINS) implemented institutions in Karnataka.

4.2 To find out the faculty members' profiles of Karnataka Institutes.

4.3 To analyse the faculty members, Publications and patents.

4.4 To find out the Resource Impact from various databases.

4.5 To identify the contributions of top faculty of individual institutions and its h-index.

4.6 To find out the top faculty of individual institution and their Google citations and h-index.

5. RESULTS AND DISCUSSION

5.1 Research Presence of Karnataka Institutions

Table 1: Research Presence of Karnataka Institutions

S. No	Type	Ins.	No. of Profiles	Pub.	Patents	Citations	
						Scopus	Crossref
1	Central University (CU)	1	75	609	2	3645	1435
2	College (Col)	14	916	2151	28	4895	4895
3	Deemed University (DU)	6	1788	19922	230	231460	214555
4	Institute of National Importance (INI)	5	1014	51332	912	888973	809731
5	Other Institute (OI)	1	23	58		64	52
6	Private University (PU)	9	2510	15379	177	41965	37066
7	Research and Development (RD)	10	444	6625	21	80945	71784
8	State University (SU)	11	1882	33377	110	188619	126062
9	Technical Institute (TI)	35	5908	31361	594	100874	89609
	Total	**92**	**14560**	**160814**	**2074**	**1541440**	**1355189**

CU= Central University; Col= College; DU= Deemed University; INI= Institute of National Importance; OI= Other Institute; PU= Private University; RD= Research and Development; SU= State University; TI= Technical Institute

Table 1 indicates the research presence of Karnataka institutions. In Karnataka, only 92 institutes have implemented the Indian Research Information Network System (IRINS) in their institutes. The institutes cover Central University (1), College (14), Deemed University

(6), Institute of National Importance (5), Other Institute (1), Private University (9), Research and Development (10), State University (11), and Technical Institute (35). It is found that 14560 Research experts have published 160814 research papers, produced 2074 patents, and received 1541440 citations from the Scopus database and 1355189 citations from Crossref. It is further found that 35 Technical Institutes (TI) have 5908 faculty profiles, and the faculty members have published 31361 research papers, produced 594 patents, and received 100874 citations from Scopus and 89609 citations from Crossref further found that the Institute of National Importance (INI) has presently working 1014 faculty members and published 19922 research papers and published 230 patents and received 888973 citations from Scopus and 809731 citations from Crossref.

5.2 Institute-wise Faculty Members

Table 2: Institute-wise Faculty Members

S. No.	Institute	Institute Type	No. of Faculty Members	Rank
1	Adichunchanagiri University	PU	236	19
2	Alliance University	PU	205	22
3	ARG College of Arts and Commerce	Col	25	84
4	Atria Institute of Technology	TI	134	45
5	Bangalore University	SU	177	28
6	Bapuji Institute of Engineering and Technology	TI	146	42
7	Basaveshwar Engineering College (Autonomous)	TI	184	26
8	BLDE Deemed to be University	DU	226	20
9	BLDEA S B Arts and K C P Science College	Col	83	63
10	BLDEA Shri Sanganabasava Mahaswamiji College of Pharmacy and Research Centre	Col	33	77
11	BLDEA's AVS Ayurveda Mahavidyalaya	Col	29	81
12	BLDEA's Commerce BHS Arts and TGP Science College	Col	53	72
13	BLDEAs A S Patil College of Commerce	Col	43	74
14	BLDEAs Shri B M Patil Institute of Nursing Sciences	Col	30	80
15	BLDEAs V P Dr PG Halakatti College of Engineering and Technology	TI	172	31
16	BMS College of Architecture	Col	38	76
17	BMS College of Engineering	TI	298	11

S. No.	Institute	Institute Type	No. of Faculty Members	Rank
18	BMS Institute of Technology and Management	TI	190	25
19	BNM Institute of Technology	TI	153	36
20	Cambridge Institute of Technology	TI	154	35
21	Central University of Karnataka	CU	75	65
22	Channabasaveshwara Institute of Technology	TI	112	53
23	Christ University	DU	763	1
24	CMR Institute of Technology	TI	256	18
25	CSIR-Central Food Technological Research Institute	R & D	135	44
26	CSIR-Fourth Paradigm Institute	R & D	24	86
27	Davangere University	SU	133	46
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29	Dayananda Sagar University	PU	122	49
30	Don Bosco Institute of Technology	TI	149	40
31	Dr Ambedkar Institute of Technology	TI	133	46
32	DST-Centre for Nano and Soft Matter Sciences	R & D	14	92
33	Global Academy of Technology	TI	162	34
34	GM Institute of Technology	TI	114	52
35	Gulbarga University	SU	77	64
36	ICAR-Directorate of Cashew Research	R & D	16	91
37	ICAR-Indian Institute of Horticultural Research	R & D	121	50
38	ICAR-National Bureau of Agricultural Insect Resources	R & D	31	79
39	ICAR-National Institute of Animal Nutrition and Physiology	R & D	40	75
40	ICAR-National Institute of Veterinary Epidemiology and Disease Informatics	R & D	19	89
41	ICSSR-Institute for Social and Economic Change	R & D	25	84
42	Indian Institute of Information Technology, Dharwad	INI	29	81
43	Indian Institute of Management, Bangalore	INI	101	57
44	Indian Institute of Science, Bangalore	INI	565	3
45	Indian Institute of Technology Dharwad	INI	54	71

S. No.	Institute	Institute Type	No. of Faculty Members	Rank
46	Institute of Public Health, Bengaluru	R & D	19	89
47	International Institute of Information Technology Bangalore	DU	44	73
48	Jawaharlal Nehru Centre for Advanced Scientific Research	DU	58	70
49	Jawaharlal Nehru National College of Engineering	TI	173	30
50	JSS Academy of Technical Education, Bengaluru	TI	152	37
51	K S School of Engineering and Management	TI	73	68
52	Karnatak University, Dharwad	SU	141	43
53	KLE College of Pharmacy, Hubli	Col	28	83
54	KLE Technological University	PU	378	6
55	KLS Gogte Institute of Technology	TI	260	16
56	KLS Vishwanathrao Deshpande Institute of Technology	TI	87	60
57	Kuvempu University	SU	111	54
58	M S Ramaiah Institute of Technology	TI	360	7
59	M S Ramaiah University of Applied Sciences	PU	648	2
60	Maharani Lakshmi Ammanni College for Women	Col	106	55
61	Malnad College of Engineering	TI	192	24
62	Mangalore University	SU	115	51
63	National Institute of Technology, Karnataka	INI	265	14
64	NITTE Meenakshi Institute of Technology	TI	285	13
65	PES College of Engineering	TI	88	59
66	PES University	PU	339	9
67	Presidency University	PU	67	69
68	RajaRajeswari College of Engineering	Col	86	61
69	RNS Institute of Technology	TI	179	27
70	RV College of Engineering	TI	174	29
71	RV Institute of Technology and Management	TI	33	77
72	Sapthagiri College of Engineering	TI	151	38
73	SDM Institute for Management Development	Col	22	88

S. No.	Institute	Institute Type	No. of Faculty Members	Rank
74	Shri Dharmasthala Manjunatheshwara College of Engineering and Technology	TI	127	48
75	Shri Dharmasthala Manjunatheshwara University	PU	352	8
76	Siddaganga Institute of Technology	TI	258	17
77	SJB Institute of Technology	TI	212	21
78	Sri Devaraj Urs Academy of Higher Education and Research	DU	167	32
79	Sri Venkateshwara College of Engineering	TI	86	61
80	Srinivas University	PU	163	33
81	St Agnes College (Autonomous), Mangalore	Col	75	65
82	St Aloysius College (Autonomous), Mangaluru	Col	265	14
83	St Joseph Engineering College	TI	148	41
84	St Josephs Institute of Management, Bangalore	OI	23	87
85	The National Institute of Engineering, Mysuru	TI	106	55
86	Tontadarya College of Engineering	TI	75	65
87	University of Agricultural Sciences Bangalore	SU	391	5
88	University of Agricultural Sciences Raichur	SU	202	23
89	University of Mysore	SU	293	12
90	Vijayanagara Sri Krishnadevaraya University	SU	92	58
91	Visvesvaraya Technological University	SU	150	39
92	Yenepoya University	DU	530	4
	Total		**14560**	

Table 2 shows the institute-wise faculty members. It is found that "Christ University-Deemed University" has the highest of the 763 faculty members working presently and got the first rank, followed by "M S Ramaiah University of Applied Sciences – Private University," which has 648 faculty members working and got the second rank. The "Davangere University- State University" and "Dr. Ambedkar Institute of Technology-Technical Institute" have 133 faculty members working presently and placed forty-sixth rank. Further, it was found that "DST-Centre for Nano and Soft Matter Sciences – Research and Development" has the least number of 14 faculty members working and placed ninety-two ranks.

5.3 Institute-wise Faculty Publications, Patents and Citations

Table 3: Institute-wise Publications, Patents and Citations

S. No.	Institute	Publications	R	Patents	R	Citation			
						Scopus	R	Crossref	R
1	Adichunchanagiri University	1176	38	35	12	2949	39	3260	32
2	Alliance University	1806	23	61	4	990	64	1287	53
3	ARG College of Arts and Commerce	12	90	-		3	88	1	89
4	Atria Institute of Technology	289	65	18	21	530	74	376	73
5	Bangalore University	1640	28	3	56	13596	13	10492	15
6	Bapuji Institute of Engineering and Technology	716	44	26	14	1093	59	781	64
7	Basaveshwar Engineering College (Autonomous)	1312	36	13	27	2827	40	2137	43
8	BLDE Deemed to be University	1773	25	7	44	6531	25	5830	22
9	BLDEA S B Arts and K C P Science College	117	81	-		475	75	366	74
10	BLDEA Shri Sanganabasava Mahaswamiji College of Pharmacy and Research Centre	396	59	18	21	1078	60	1009	58
11	BLDEA's AVS Ayurveda Mahavidyalaya	59	85	-		-	90	-	90
12	BLDEA's Commerce BHS Arts and TGP Science College	12	90	-		57	85	38	84
13	BLDEAs A S Patil College of Commerce	134	77	-		-	90	-	90
14	BLDEAs Shri B M Patil Institute of Nursing Sciences	35	89	-		5	87	28	85
15	BLDEAs V P Dr PG Halakatti College of Engineering and Technology	608	49	4	51	1433	50	1421	48
16	BMS College of Architecture	79	83			3	88	3	88
17	BMS College of Engineering	2598	14	46	8	8946	18	7463	19
18	BMS Institute of Technology and Management	1899	21	56	6	7241	24	5555	24
19	BNM Institute of Technology	581	53	25	15	1032	61	1256	54

S. No.	Institute	Publications	R	Patents	R	Citation			
						Scopus	R	Crossref	R
20	Cambridge Institute of Technology	192	73	6	47	225	80	167	78
21	Central University of Karnataka	609	49	2	59	3645	33	1435	47
22	Channabasaveshwara Institute of Technology	122	77	1	61	242	78	184	77
23	Christ University	6444	3	133	2	13302	14	10850	14
24	CMR Institute of Technology	494	56	18	21	1122	58	1225	55
25	CSIR-Central Food Technological Research Institute	1864	22	21	20	43019	5	42045	4
26	CSIR-Fourth Paradigm Institute	228	70	-		3470	34	2690	39
27	Davangere University	717	44	9	34	7270	23	3786	29
28	Dayananda Sagar College of Engineering	1486	32	25	15	5625	26	3500	30
29	Dayananda Sagar University	223	70	-		1179	56	810	63
30	Don Bosco Institute of Technology	599	51	30	13	312	77	239	76
31	Dr Ambedkar Institute of Technology	490	57	16	24	1278	53	1152	56
32	DST-Centre for Nano and Soft Matter Sciences	670	46	-		9461	17	8137	17
33	Global Academy of Technology	312	63	8	38	362	76	250	75
34	GM Institute of Technology	633	48	45	9	1319	52	948	59
35	Gulbarga University	2351	17	3	56	22056	10	18354	8
36	ICAR-Directorate of Cashew Research	123	77	-	-	894	67	722	66
37	ICAR-Indian Institute of Horticultural Research	1534	31	-	-	7311	22	5786	23
38	ICAR-National Bureau of Agricultural Insect Resources	476	57	-	-	3064	38	2521	40
39	ICAR-National Institute of Animal Nutrition and Physiology	969	42	-	-	8945	19	6537	21

S. No.	Institute	Publications	R	Patents	R	Citation			
						Scopus	R	Crossref	R
40	ICAR-National Institute of Veterinary Epidemiology and Disease Informatics	283	65	-	-	2041	46	1898	44
41	ICSSR-Institute for Social and Economic Change	337	61	-	-	1896	48	1381	49
42	Indian Institute of Information Technology, Dharwad	43	88	-	-	805	70	612	69
43	Indian Institute of Management, Bangalore	1615	29	-	-	26498	8	12897	11
44	Indian Institute of Science, Bangalore	40935	1	891	1	797832	1	734626	1
45	Indian Institute of Technology Dharwad	300	63	8	38	1236	54	1113	57
46	Institute of Public Health, Bengaluru	141	76	-	-	844	69	67	81
47	International Institute of Information Technology Bangalore	1086	41	25	15	3452	35	3274	31
48	Jawaharlal Nehru Centre for Advanced Scientific Research	5401	5	8	38	193400	2	183019	2
49	Jawaharlal Nehru National College of Engineering	842	43	1	61	2723	41	2877	35
50	JSS Academy of Technical Education, Bengaluru	1457	34	15	25	1387	51	1308	51
51	K S School of Engineering and Management	231	70	-	-	157	81	104	80
52	Karnatak University, Dharwad	4827	6	3	56	29374	7	10935	13
53	KLE College of Pharmacy, Hubli	129	77	1	61	90	83	40	83
54	KLE Technological University	2615	12	36	11	15913	12	14182	10
55	KLS Gogte Institute of Technology	1170	38	7	44	3908	31	3234	33
56	KLS Vishwanathrao Deshpande Institute of Technology	182	74	10	32	604	72	563	71
57	Kuvempu University	5412	4	-	-	30682	6	24854	6
58	M S Ramaiah Institute of Technology	3224	11	40	10	17473	11	16514	9

S. No.	Institute	Publications	R	Patents	R	Citation			
						Scopus	R	Crossref	R
59	M S Ramaiah University of Applied Sciences	1678	27	7	44	5569	27	5098	25
60	Maharani Lakshmi Ammanni College for Women	343	61	1	61	892	68	687	67
61	Malnad College of Engineering	572	53	5	49	4934	28	4633	26
62	Mangalore University	3503	9	1	61	25642	9	19324	7
63	National Institute of Technology, Karnataka	8439	2	13	27	62602	3	60483	3
64	NITTE Meenakshi Institute of Technology	1752	26	15	25	3715	32	4471	27
65	PES College of Engineering	1167	38	12	29	930	65	834	62
66	PES University	2612	14	9	34	8882	20	7559	18
67	Presidency University	256	69	5	49	727	71	736	65
68	RajaRajeswari College of Engineering	119	81	4	51	227	79	16	86
69	RNS Institute of Technology	356	60	6	47	1150	57	884	61
70	RV College of Engineering	1474	32	8	38	4304	30	3944	28
71	RV Institute of Technology and Management	87	83	8	38	102	82	140	79
72	Sapthagiri College of Engineering	293	65	9	34	2721	42	1862	45
73	SDM Institute for Management Development	65	85	-	-	26	86	15	87
74	Shri Dharmasthala Manjunatheshwara College of Engineering and Technology	1240	37	10	32	2699	44	2351	42
75	Shri Dharmasthala Manjunatheshwara University	2617	12	1	61	4569	29	2828	36
76	Siddaganga Institute of Technology	2001	20	22	19	11959	16	12076	12
77	SJB Institute of Technology	1347	35	74	3	1017	62	909	60
78	Sri Devaraj Urs Academy of Higher Education and Research	1800	23	2	59	1828	49	1374	50
79	Sri Venkateshwara College of Engineering	288	65	-	-	1007	63	649	68
80	Srinivas University	2396	16	23	18	1187	55	1306	52

S. No.	Institute	Publications	R	Patents	R	Citation			
						Scopus	R	Crossref	R
81	St Agnes College (Autonomous), Mangalore	9	92	-	-	-	90	-	90
82	St Aloysius College (Autonomous), Mangaluru	642	47	4	51	2039	47	2692	38
83	St Joseph Engineering College	603	51	4	51	2712	43	2400	41
84	St Josephs Institute of Management, Bangalore	58	85	-	-	64	84	52	82
85	The National Institute of Engineering, Mysuru	572	53	11	30	3190	37	2701	37
86	Tontadarya College of Engineering	172	74	-	-	595	73	501	72
87	University of Agricultural Sciences Bangalore	4170	8	9	34	8167	21	7412	20
88	University of Agricultural Sciences Raichur	1551	30	8	38	902	66	582	70
89	University of Mysore	4831	6	4	51	45273	4	25563	5
90	Vijayanagara Sri Krishnadevaraya University	2120	19	11	30	2344	45	1728	46
91	Visvesvaraya Technological University	2255	18	59	5	3313	36	3032	34
92	Yenepoya University	3418	10	55	7	12947	15	10208	16
	Total	**160814**		**2074**		**1541440**		**1355189**	

Table 3 shows institute-wise faculty publications, patents, and citations. It is found that the "Indian Institute of Science, Bangalore" has the highest number of 40935 research papers and produced 891 patents and received 797832 citations from the Scopus database and received 734626 citations from Crossref and placed first rank. It is followed by the "National Institute of Technology, Karnataka" which has published 8439 research papers, and "Christ University" has produced 133 patents and "Jawaharlal Nehru Centre for Advanced Scientific Research" has received 193400 citations from Scopus and received 183019 citations from Crossref and placed the second rank. It is further found that "St Agnes College (Autonomous), Mangalore" has published least number of 9 research papers and received no citations and further found that ARG College of Arts and Commerce, BLDEA S B Arts and K C P Science College, BLDEA's AVS Ayurveda Mahavidyalaya, BLDEA's Commerce BHS Arts and TGP Science College, BLDEAs A S Patil College of Commerce, BLDEAs Shri B M Patil Institute of Nursing Sciences, CSIR-Fourth Paradigm Institute, Dayananda Sagar University, DST-Centre for Nano and Soft Matter Sciences, ICAR-Directorate of Cashew Research, ICAR-Indian Institute of Horticultural Research, ICAR-National Bureau of Agricultural Insect Resources, ICAR-National Institute of Animal Nutrition and Physiology, ICAR-National Institute of Veterinary Epidemiology and Disease Informatics, ICSSR-Institute for Social and Economic Change, Indian Institute of Information Technology, Dharwad, Indian Institute of Management, Bangalore, Institute of Public Health, Bengaluru, Kuvempu University, SDM Institute for Management Development, Sri Venkateshwara College of Engineering, St Agnes College (Autonomous), Mangalore, St Josephs Institute of Management, Bangalore and Tontadarya College of Engineering has produced no patents.

5.4 Various Types of Resources

Table 4: Various Types of Resources

S. No.	Institute	Journal Articles	Conference / In Proceeding	Books / Chapters	Others	Total
1	Adichunchanagiri University	794	55	13	314	1176
2	Alliance University	887	461	208	250	1806
3	ARG College of Arts and Commerce	9	1	2		12
4	Atria Institute of Technology	142	107	24	16	289
5	Bangalore University	1310	237	18	75	1640
6	Bapuji Institute of Engineering and Technology	457	181	37	41	716
7	Basaveshwar Engineering College (Autonomous)	611	596	62	43	1312
8	BLDE Deemed to be University	1541	81	48	103	1773
9	BLDEA S B Arts and K C P Science College	82	23	10	2	117
10	BLDEA Shri Sanganabasava Mahaswamiji College of Pharmacy and Research Centre	298	69	16	13	396
11	BLDEA's AVS Ayurveda Mahavidyalaya	56	-	1	2	59
12	BLDEA's Commerce BHS Arts and TGP Science College	10	2	-	-	12
13	BLDEAs A S Patil College of Commerce	56	41	33	4	134
14	BLDEAs Shri B M Patil Institute of Nursing Sciences	30	3	-	2	35

S. No.	Institute	Journal Articles	Conference / In Proceeding	Books / Chapters	Others	Total
15	BLDEAs V P Dr PG Halakatti College of Engineering and Technology	283	241	36	48	608
16	BMS College of Architecture	31	38	1	9	79
17	BMS College of Engineering	1325	1025	100	148	2598
18	BMS Institute of Technology and Management	1098	625	65	111	1899
19	BNM Institute of Technology	338	126	23	94	581
20	Cambridge Institute of Technology	98	78	9	7	192
21	Central University of Karnataka	432	70	32	75	609
22	Channabasaveshwara Institute of Technology	55	51	1	15	122
23	Christ University	4560	903	406	575	6444
24	CMR Institute of Technology	237	217	17	23	494
25	CSIR-Central Food Technological Research Institute	1618	24	83	139	1864
26	CSIR-Fourth Paradigm Institute	194	25	4	5	228
27	Davangere University	588	48	36	45	717
28	Dayananda Sagar College of Engineering	665	628	80	113	1486
29	Dayananda Sagar University	157	32	19	15	223
30	Don Bosco Institute of Technology	380	160	35	24	599
31	Dr Ambedkar Institute of Technology	319	139	18	14	490
32	DST-Centre for Nano and Soft Matter Sciences	622	28	8	12	670
33	Global Academy of Technology	173	108	12	19	312
34	GM Institute of Technology	372	131	36	94	633
35	Gulbarga University	1756	233	35	327	2351
36	ICAR-Directorate of Cashew Research	104	-	2	17	123
37	ICAR-Indian Institute of Horticultural Research	1264	29	126	115	1534

S. No.	Institute	Journal Articles	Conference / In Proceeding	Books / Chapters	Others	Total
38	ICAR-National Bureau of Agricultural Insect Resources	424	6	15	31	476
39	ICAR-National Institute of Animal Nutrition and Physiology	843	3	62	61	969
40	ICAR-National Institute of Veterinary Epidemiology and Disease Informatics	266	-	3	14	283
41	ICSSR-Institute for Social and Economic Change	184	27	94	32	337
42	Indian Institute of Information Technology, Dharwad	65	63	7	8	143
43	Indian Institute of Management, Bangalore	1293	191	88	113	1685
44	Indian Institute of Science, Bangalore	29350	8594	678	2313	40935
45	Indian Institute of Technology Dharwad	161	128	1	10	300
46	Institute of Public Health, Bengaluru	55	1	4	81	141
47	International Institute of Information Technology Bangalore	265	712	76	33	1086
48	Jawaharlal Nehru Centre for Advanced Scientific Research	4629	215	128	432	5404
49	Jawaharlal Nehru National College of Engineering	491	288	15	48	842
50	JSS Academy of Technical Education, Bengaluru	963	381	32	81	1457
51	K S School of Engineering and Management	137	75	10	9	231
52	Karnataka University, Dharwad	3621	643	260	303	4827
53	KLE College of Pharmacy, Hubli	107	3	-	19	129
54	KLE Technological University	1161	1042	190	222	2615
55	KLS Gogte Institute of Technology	809	270	30	61	1170
56	KLS Vishwanathrao Deshpande Institute of Technology	113	55	7	7	182

S. No.	Institute	Journal Articles	Conference / In Proceeding	Books / Chapters	Others	Total
57	Kuvempu University	3703	1118	249	342	5412
58	M S Ramaiah Institute of Technology	1699	1240	130	155	3224
59	M S Ramaiah University of Applied Sciences	1064	404	54	156	1678
60	Maharani Lakshmi Ammanni College for Women	194	47	66	36	343
61	Malnad College of Engineering	315	208	18	31	572
62	Mangalore University	2714	602	42	145	3503
63	National Institute of Technology, Karnataka	5096	2711	264	368	8439
64	NITTE Meenakshi Institute of Technology	1051	533	65	103	1752
65	PES College of Engineering	647	476	14	30	1167
66	PES University	927	1390	55	240	2612
67	Presidency University	154	84	13	8	259
68	Raja Rajeswari College of Engineering	96	20	2	1	119
69	RNS Institute of Technology	194	123	17	22	356
70	RV College of Engineering	644	697	69	64	1474
71	RV Institute of Technology and Management	41	40	6	-	87
72	Sapthagiri College of Engineering	175	86	4	28	293
73	SDM Institute for Management Development	37	7	13	8	65
74	Shri Dharmasthala Manjunatheshwara College of Engineering and Technology	741	335	63	101	1240
75	Shri Dharmasthala Manjunatheshwara University	1607	5	16	989	2617
76	Siddaganga Institute of Technology	1020	849	93	39	2001
77	SJB Institute of Technology	771	420	66	90	1347
78	Sri Devaraj Urs Academy of Higher Education and Research	1689	27	10	74	1800

S. No.	Institute	Journal Articles	Conference / In Proceeding	Books / Chapters	Others	Total
79	Sri Venkateshwara College of Engineering	127	157	1	3	288
80	Srinivas University	1725	290	29	352	2396
81	St Agnes College (Autonomous), Mangalore	8	-	-	1	9
82	St Aloysius College (Autonomous), Mangaluru	420	84	62	76	642
83	St Joseph Engineering College	335	194	17	57	603
84	St. Joseph's Institute of Management, Bangalore	23	3	3	29	58
85	The National Institute of Engineering, Mysuru	274	249	14	35	572
86	Tontadarya College of Engineering	79	43	5	45	172
87	University of Agricultural Sciences Bangalore	928	43	33	3112	4116
88	University of Agricultural Sciences Raichur	820	247	8	476	1551
89	University of Mysore	3998	453	70	310	4831
90	Vijayanagara Sri Krishnadevaraya University	1606	293	188	33	2120
91	Visvesvaraya Technological University	1613	481	95	66	2255
92	Yenepoya University	2983	61	86	288	3418
	Total	**107407**	**33533**	**5296**	**14700**	**160936**

Table 4 indicates various types of resources. In Karnataka, 92 institutions published 107407 research papers, 33533 conference proceedings, 5296 book chapters, and 14700 other items. It is found that the Indian Institute of Science (IISc), Bangalore, has published 40935 scholarly resources, including journal articles, Conference Proceedings, Book Chapters, and others; such placed first and followed by the National Institute of Technology, Karnataka, having 8439 resources. It is further found that ARG College of Arts and Commerce and BLDEA's Commerce BHS Arts and TGP Science College have 12 resources, and St Agnes College (Autonomous), Mangalore has nine resources like Journal articles, Conference Proceedings, Books/Chapters in books, and others have placed respectively.

5.5 Top Faculty of Individual Institution's and Publications and Citations

Table 5: Top Faculty of Individual Institution's and Publications and Citations

S. No.	Faculty Name	Designation	Institute	Citations		
				Publication	Scopus	Crossref
1	Dr K Prashantha	Dean	Adichunchanagiri University	77	2372	2091
2	Dr Jyotishkumar Parameswaranpillai	Associate Professor	Alliance University	184	3634	3887
3	Dr Chaman Sab M	Librarian	ARG College of Arts and Commerce	55	22	6
4	Dr A Vijaya Bhaskar Reddy	Associate Professor	Atria Institute of Technology	56	900	408
5	Dr Suresh Babu V.V.	Professor	Bangalore University	224	2242	1530
6	Dr B M Prasanna	Associate Professor	Bapuji Institute of Engineering and Technology	46	272	281
7	Dr Suresh Jangamshetti	Professor	Basaveshwar Engineering College (Autonomous)	6	440	337
8	Prof Krishnacharya Akamanchi	Adjunct Professor	BLDE Deemed to be University	110	2395	1638
9	Dr Parutagouda Patil	Assistant Professor	BLDEA S B Arts and K C P Science College	179	2435	1967
10	Dr Raghavendra Kulkarni	Vice Principal	BLDEA Shri Sanganabasava Mahaswamiji College of Pharmacy and Research Centre	144	1488	1356
11	Dr Pramod Baragi	Professor	BLDEA's AVS Ayurveda Mahavidyalaya	24	-	3
12	Dr Jayant Gowda	Assistant Professor	BLDEA's Commerce BHS Arts and TGP Science College	28	78	59
13	Dr Muragesh Pattanshetti	Associate Professor	BLDEAs A S Patil College of Commerce	11	24	-
14	Prof Shalmon Chopade	Principal	BLDEAs Shri B M Patil Institute of Nursing Sciences	1	5	4

S. No.	Faculty Name	Designation	Institute	Citations		
				Publication	Scopus	Crossref
15	Dr Ramesh S. Malladi	Assistant Professor	BLDEAs V P Dr PG Halakatti College of Engineering and Technology	18	451	433
16	Mrs Namratha Bharadwaj	Assistant Professor	BMS College of Architecture	4	1	2
17	Dr Latha Kumari	Assistant Professor	BMS College of Engineering	45	1664	2101
18	Dr Daruka Prasad B	Assistant Professor	BMS Institute of Technology and Management	102	3194	2483
19	Dr Prashanth M K	Assistant Professor	BNM Institute of Technology	61	364	585
20	Dr Shankar B S	Professor	Cambridge Institute of Technology	10	101	80
21	Dr N Sandeep	Assistant Professor	Central University of Karnataka	207	6466	2970
22	Dr Umesh Laddi	Professor	Channabasaveshwara Institute of Technology	19	163	6
23	Dr Nainesh Patel	Associate Professor	Christ University	157	4960	2244
24	Prof Phani Kumar Pullela	Professor	CMR Institute of Technology	24	979	881
25	Dr Navin Kumar Rastogi	Chief Scientist	CSIR-Central Food Technological Research Institute	156	6621	6012
26	Dr Sridevi Jade	Chief Scientist	CSIR-Fourth Paradigm Institute	35	1406	1002
27	Prof B.C Prasannakumara	Professor	Davangere University	154	3553	2329
28	Dr Blessy Baby Mathew	Assistant Professor	Dayananda Sagar College of Engineering	35	2061	1259
29	Dr Rohidas B Arote	Professor	Dayananda Sagar University	51	2088	1729
30	Dr Ranjini P S	Professor	Don Bosco Institute of Technology	43	87	63
31	Dr C E Nanjundappa	Professor	Dr Ambedkar Institute of Technology	40	537	399

S. No.	Faculty Name	Designation	Institute	Citations		
				Publication	Scopus	Crossref
32	Prof Giridhar U. Kulkarni	Professor	DST-Centre for Nano and Soft Matter Sciences	275	8687	7546
33	Dr Roshan Joy	Associate Professor	Global Academy of Technology	43	2777	435
34	Dr Srinivasa C V	Professor	GM Institute of Technology	39	582	284
35	Dr A Venkatraman	Professor	Gulbarga University	73	2760	2653
36	Dr Shamsudheen M	Senior Scientist	ICAR-Directorate of Cashew Research	25	359	278
37	Dr Selvakumar G	Principal Scientist	ICAR-Indian Institute of Horticultural Research	49	1246	1248
38	Dr T Venkatesan	Principal Scientist	ICAR-National Bureau of Agricultural Insect Resources	84	784	597
39	Dr V Sejian	Principal Scientist	ICAR-National Institute of Animal Nutrition and Physiology	167	2240	1872
40	Dr V. Balamurugan	Principal Scientist	ICAR-National Institute of Veterinary Epidemiology and Disease Informatics	148	2298	1848
41	Dr Sunil Nautiyal	Professor	ICSSR-Institute for Social and Economic Change	76	1345	881
42	Dr Sunil Saumya	Assistant Professor	Indian Institute of Information Technology, Dharwad	4	243	176
43	Prof S Ramesh Kumar	Professor	Indian Institute of Management, Bangalore	457	10877	3400
44	Dr Jyothsna Rani Komaragiri	Assistant Professor	Indian Institute of Science, Bangalore	1087	74110	47778
45	Prof S R Mahadeva Prasanna	Professor	Indian Institute of Technology Dharwad	144	1493	1174
46	Dr Prashanth N Srinivas	Assistant Director	Institute of Public Health, Bengaluru	70	525	35
47	Dr Sachit Rao	Assistant Professor	International Institute of Information Technology Bangalore	16	800	722

S. No.	Faculty Name	Designation	Institute	Citations		
				Publication	Scopus	Crossref
48	Prof. C N R Rao	Professor	Jawaharlal Nehru Centre for Advanced Scientific Research	1576	90538	79908
49	Dr K.SABEEL AHMED	Professor	Jawaharlal Nehru National College of Engineering	15	731	673
50	Dr Anandkumar R Annigeri	Professor	JSS Academy of Technical Education, Bengaluru	14	209	197
51	Dr Girish V Attimarad	Professor	K S School of Engineering and Management	21	31	8
52	Dr Seetharamappa J	Professor	Karnatak University, Dharwad	151	3661	121
53	Mr Ravindra Karadi	Associate Professor	KLE College of Pharmacy, Hubli	28	63	24
54	Dr Tejraj Aminabhavi	Directorate of Research	KLE Technological University	792	39220	35631
55	Dr Raviraj Kulkarni	Professor	KLS Gogte Institute of Technology	116	1411	1357
56	Dr Vinod Naik	Associate Professor	KLS Vishwanathrao Deshpande Institute of Technology	9	405	359
57	Dr Gireesha. B J	Associate Professor	Kuvempu University	274	6381	4994
58	Dr B M NAGABHUSHANA	Professor	M S Ramaiah Institute of Technology	187	5471	5316
59	Dr Tapasi Ghosh	Assistant Professor	M S Ramaiah University of Applied Sciences	107	12982	10484
60	Dr Sushil Kumar Middha	Associate Professor	Maharani Lakshmi Ammanni College for Women	69	639	451
61	Dr Madhu P	Assistant Professor	Malnad College of Engineering	60	1368	1189
62	Prof Badiadka Narayana	Professor	Mangalore University	783	5804	3976
63	Prof Arun Mohan Isloor	Professor	National Institute of Technology, Karnataka	260	4876	4667

S. No.	Faculty Name	Designation	Institute	Citations		
				Publication	Scopus	Crossref
64	Dr Sandeep Kumar	Professor	NITTE Meenakshi Institute of Technology	599	8793	9189
65	Dr Gopiya Naik S	Professor	PES College of Engineering	25	347	214
66	Dr Lata Pasupulety	Professor	PES University	19	1723	1592
67	Dr Gopal Shyam	Associate Professor	Presidency University	12	480	437
68	Dr Jobish Johns	Associate Professor	RajaRajeswari College of Engineering	65	461	13
69	Dr Jeevananda T	Associate Professor	RNS Institute of Technology	28	756	631
70	Ms Vidya Niranjan	Professor	RV College of Engineering	36	1460	1045
71	Dr Srinatha N	Assistant Professor	RV Institute of Technology and Management	18	377	371
72	Dr Roopa K P	Assistant Professor	Sapthagiri College of Engineering	19	369	376
73	Dr Sriram M	Associate Professor	SDM Institute for Management Development	5	8	6
74	Dr A A Kittur	Professor	Shri Dharmasthala Manjunatheshwara College of Engineering and Technology	63	1628	1498
75	Dr Ashith B Acharya	Professor	Shri Dharmasthala Manjunatheshwara University	44	896	518
76	Dr Nagaraju Ganganagappa	Assistant Professor	Siddaganga Institute of Technology	206	3597	3994
77	Dr Jnaneshwara D M	Associate Professor	SJB Institute of Technology	18	306	287
78	Dr Kalyani Raju	Professor	Sri Devaraj Urs Academy of Higher Education and Research	155	171	322
79	Mr Sunil Kumar K N	Assistant Professor	Sri Venkateshwara College of Engineering	3	101	33

S. No.	Faculty Name	Designation	Institute	Citations		
				Publication	Scopus	Crossref
80	Dr U Sandhya Shenoy	Inspire Faculty	Srinivas University	65	1661	1782
81	Mrs Dolan Champa Banerjee	Assistant Professor	St Agnes College (Autonomous), Mangalore	2	-	-
82	Dr Richard A Gonsalves	Director	St Aloysius College (Autonomous), Mangaluru	30	631	817
83	Dr Vincent Crasta	Professor	St Joseph Engineering College	14	540	504
84	Dr Oswald Mascarenhas	Professor	St Josephs Institute of Management, Bangalore	31	507	416
85	Dr Suresha Bheemappa	Professor	The National Institute of Engineering, Mysuru	89	1953	1755
86	Dr Veeresh Magalad	Professor	Tontadarya College of Engineering	10	302	289
87	Prof Sheshshayee Sreeman	Professor	University of Agricultural Sciences Bangalore	207	1872	1780
88	Dr Saroja Narsing Rao	Assistant Professor	University of Agricultural Sciences Raichur	14	380	297
89	Prof Kanchugarakoppal S Rangappa`	Professor	University of Mysore	465	8026	5285
90	Prof K V Prasad	Professor	Vijayanagara Sri Krishnadevaraya University	173	2105	1485
91	Prof Dinesh Rangappag	Professor	Visvesvaraya Technological University	161	2142	2047
92	Dr T S Keshav Prasad	Professor	Yenepoya University	305	9609	8374

Table 5 shows the top faculty of individual institutions and publications and citations. This study is analysed based on its citations. Prof. C N R Rao (Professor, Jawaharlal Nehru Centre for Advanced Scientific Research) has published 1576 articles and has received the highest number of 90538 citations from Scopus and 79908 citations from Crossref and placed the first position, followed by Dr. Jyothsna Rani Komaragiri (Assistant Professor, Indian Institute of Science, Bangalore) has published 1087 articles and received 74110 citations from Scopus and 47778 citations from Crossref takes the second position. It is further found that Dr. Pramod Baragi (Professor, BLDEA's AVS Ayurveda Mahavidyalaya) has published 24 articles and received only three citations from Crossref and Mrs. Dolan Champa Banerjee (Assistant Professor, St Agnes College (Autonomous), Mangalore) has published least number of articles and have received no citations from databases so placed in the last position.

5.6 Top Faculty of Individual Institution's and Google Scholar Citations & h-index

Table 6: Top Faculty of Individual Institution's Google Scholar Citations & h-index

S. No.	Faculty Name	Institute	Google Scholar Citation	h-index	i10- index
1	Dr K Prashantha	Adichunchanagiri University	3549	29	49
2	Dr Jyotishkumar Parameswaranpillai	Alliance University	5077	36	93
3	Dr Chaman Sab M	ARG College of Arts and Commerce	152	7	5
4	Dr A Vijaya Bhaskar Reddy	Atria Institute of Technology	1286	21	32
5	Dr Suresh Babu V.V.	Bangalore University	1058	16	26
6	Dr B M Prasanna	Bapuji Institute of Engineering and Technology	-	-	-
7	Dr Suresh Jangamshetti	Basaveshwar Engineering College (Autonomous)	990	12	14
8	Prof Krishnacharya Akamanchi	BLDE Deemed to be University	2582	31	68
9	Dr Parutagouda Patil	BLDEA S B Arts and K C P Science College	2981	28	80
10	Dr Raghavendra Kulkarni	BLDEA Shri Sanganabasava Mahaswamiji College of Pharmacy and Research Centre	2497	28	55
11	Dr Pramod Baragi	BLDEA's AVS Ayurveda Mahavidyalaya	-	-	-
12	Dr Jayant Gowda	BLDEA's Commerce BHS Arts and TGP Science College	458	11	13
13	Dr Muragesh Pattanshetti	BLDEAs A S Patil College of Commerce	-	-	-

S. No.	Faculty Name	Institute	Google Scholar Citation	h-index	i10- index
14	Prof Shalmon Chopade	BLDEAs Shri B M Patil Institute of Nursing Sciences	14	1	1
15	Dr Ramesh S. Malladi	BLDEAs V P Dr PG Halakatti College of Engineering and Technology	501	11	11
16	Mrs Namratha Bharadwaj	BMS College of Architecture	7	2	0
17	Dr Latha Kumari	BMS College of Engineering	2310	22	29
18	Dr Daruka Prasad B	BMS Institute of Technology and Management	3560	39	82
19	Dr Prashanth M K	BNM Institute of Technology	739	15	32
20	Dr Shankar B S	Cambridge Institute of Technology	-	-	-
21	Dr N Sandeep	Central University of Karnataka	9316	57	193
22	Dr Umesh Laddi	Channabasaveshwara Institute of Technology	267	10	10
23	Dr Nainesh Patel	Christ University	6372	41	78
24	Prof Phani Kumar Pullela	CMR Institute of Technology	1587	13	15
25	Dr Navin Kumar Rastogi	CSIR-Central Food Technological Research Institute	10913	58	133
26	Dr Sridevi Jade	CSIR-Fourth Paradigm Institute	-	-	-
27	Prof B.C Prasannakumara	Davangere University	4927	40	132
28	Dr Blessy Baby Mathew	Dayananda Sagar College of Engineering	5379	19	23
29	Dr Rohidas B Arote	Dayananda Sagar University	3030	28	40
30	Dr Ranjini P S	Don Bosco Institute of Technology	-	-	-
31	Dr C E Nanjundappa	Dr Ambedkar Institute of Technology	-	-	-
32	Prof Giridhar U. Kulkarni	DST-Centre for Nano and Soft Matter Sciences	11526	55	216
33	Dr Roshan Joy	Global Academy of Technology	-	-	-
34	Dr Srinivasa C V	GM Institute of Technology	1263	21	31
35	Dr A Venkatraman	Gulbarga University	4522	31	60

S. No.	Faculty Name	Institute	Google Scholar Citation	h-index	i10- index
36	Dr Shamsudheen M	ICAR-Directorate of Cashew Research	-	-	-
37	Dr Selvakumar G	ICAR-Indian Institute of Horticultural Research	-	-	-
38	Dr T Venkatesan	ICAR-National Bureau of Agricultural Insect Resources	-	-	-
39	Dr V Sejian	ICAR-National Institute of Animal Nutrition and Physiology	5547	42	113
40	Dr V. Balamurugan	ICAR-National Institute of Veterinary Epidemiology and Disease Informatics	-	-	-
41	Dr Sunil Nautiyal	ICSSR-Institute for Social and Economic Change	3629	33	67
42	Dr Sunil Saumya	Indian Institute of Information Technology, Dharwad	755	11	14
43	Prof S Ramesh Kumar	Indian Institute of Management, Bangalore	-	-	-
44	Dr Jyothsna Rani Komaragiri	Indian Institute of Science, Bangalore	215189	197	887
45	Prof S R Mahadeva Prasanna	Indian Institute of Technology Dharwad	-	-	-
46	Dr Prashanth N Srinivas	Institute of Public Health, Bengaluru	1297	18	28
47	Dr Sachit Rao	International Institute of Information Technology Bangalore	-	-	-
48	Prof. C N R Rao	Jawaharlal Nehru Centre for Advanced Scientific Research	108029	152	1159
49	Dr K.SABEEL AHMED	Jawaharlal Nehru National College of Engineering	1928	21	32
50	Dr Anandkumar R Annigeri	JSS Academy of Technical Education, Bengaluru	284	5	4
51	Dr Girish V Attimarad	K S School of Engineering and Management	-	-	-
52	Dr Seetharamappa J	Karnatak University, Dharwad	4936	36	96
53	Mr Ravindra Karadi	KLE College of Pharmacy, Hubli	-	-	-

S. No.	Faculty Name	Institute	Google Scholar Citation	h-index	i10- index
54	Dr Tejraj Aminabhavi	KLE Technological University	50312	109	600
55	Dr Raviraj Kulkarni	KLS Gogte Institute of Technology	1825	25	46
56	Dr Vinod Naik	KLS Vishwanathrao Deshpande Institute of Technology	520	10	10
57	Dr Gireesha. B J	Kuvempu University	9149	54	215
58	Dr B M NAGABHUSHANA	M S Ramaiah Institute of Technology	7244	49	152
59	Dr Tapasi Ghosh	M S Ramaiah University of Applied Sciences	-	-	-
60	Dr Sushil Kumar Middha	Maharani Lakshmi Ammanni College for Women	1211	21	34
61	Dr Madhu P	Malnad College of Engineering	2346	20	24
62	Prof Badiadka Narayana	Mangalore University	8059	37	214
63	Prof Arun Mohan Isloor	National Institute of Technology, Karnataka	-	-	-
64	Dr Sandeep Kumar	NITTE Meenakshi Institute of Technology	-	-	-
65	Dr Gopiya Naik S	PES College of Engineering	-	-	-
66	Dr Lata Pasupulety	PES University	2128	16	17
67	Dr Gopal Shyam	Presidency University	1025	8	7
68	Dr Jobish Johns	RajaRajeswari College of Engineering	651	14	16
69	Dr Jeevananda T	RNS Institute of Technology	1061	17	22
70	Ms Vidya Niranjan	RV College of Engineering	2427	12	12
71	Dr Srinatha N	RV Institute of Technology and Management	565	13	14
72	Dr Roopa K P	Sapthagiri College of Engineering	95	7	3
73	Dr Sriram M	SDM Institute for Management Development	59	5	1
74	Dr A A Kittur	Shri Dharmasthala Manjunatheshwara College of Engineering and Technology	2283	25	29

S. No.	Faculty Name	Institute	Google Scholar Citation	h-index	i10- index
75	Dr Ashith B Acharya	Shri Dharmasthala Manjunatheshwara University	2273	25	33
76	Dr Nagaraju Ganganagappa	Siddaganga Institute of Technology	5519	38	120
77	Dr Jnaneshwara D M	SJB Institute of Technology	438	11	11
78	Dr Kalyani Raju	Sri Devaraj Urs Academy of Higher Education and Research	910	17	33
79	Mr Sunil Kumar K N	Sri Venkateshwara College of Engineering	381	10	10
80	Dr U Sandhya Shenoy	Srinivas University	2367	29	53
81	Mrs Dolan Champa Banerjee	St Agnes College (Autonomous), Mangalore	-		
82	Dr Richard A Gonsalves	St Aloysius College (Autonomous), Mangaluru	770	11	13
83	Dr Vincent Crasta	St Joseph Engineering College	842	12	14
84	Dr Oswald Mascarenhas	St. Joseph's Institute of Management, Bangalore	-		
85	Dr Suresha Bheemappa	The National Institute of Engineering, Mysuru	3510	32	80
86	Dr Veeresh Magalad	Tontadarya College of Engineering	-		
87	Prof Sheshshayee Sreeman	University of Agricultural Sciences Bangalore	3577	35	71
88	Dr Saroja Narsing Rao	University of Agricultural Sciences Raichur	-		
89	Prof Kanchugarakoppal S Rangappa`	University of Mysore	10776	54	262
90	Prof K V Prasad	Vijayanagara Sri Krishnadevaraya University	4012	33	95
91	Prof Dinesh Rangappag	Visvesvaraya Technological University	3482	26	63
92	Dr T S Keshav Prasad	Yenepoya University	15016	47	149

Table 6 indicates the Top faculty of individual institutions and Google Scholar publications and citations. It is found that Dr. Jyothsna Rani Komaragiri (Indian Institute of Science, Bangalore) has received the highest number of 215189 citations with 197 h-index and 887 i10-index from Google Scholar, followed by Prof. C N R Rao (Jawaharlal Nehru Centre for Advanced Scientific Research) has received 108029 citations with 152 h-index and 1159 i10-index. It was found that Mrs. Namratha Bharadwaj (BMS College of Architecture) has received the least number of citations and h-index. It is further found that Dr B M Prasanna (Bapuji Institute of Engineering and Technology), Dr Pramod Baragi (BLDEA's AVS Ayurveda Mahavidyalaya), Dr Muragesh Pattanshetti (BLDEAs A S Patil College of Commerce), Dr Shankar B S (Cambridge Institute of Technology), Dr Sridevi Jade (CSIR-Fourth Paradigm Institute), Dr Ranjini P S (Don Bosco Institute of Technology), Dr C E Nanjundappa (Dr Ambedkar Institute of Technology), Dr Roshan Joy (Global Academy of Technology), Dr Shamsudheen M (ICAR-Directorate of Cashew Research), Dr Selvakumar G (ICAR-Indian Institute of Horticultural Research), Dr T Venkatesan (ICAR-National Bureau of Agricultural Insect Resources), Dr V. Balamurugan (ICAR-National Institute of Veterinary Epidemiology and Disease Informatics), Prof S Ramesh Kumar (Indian Institute of Management, Bangalore), Prof S R Mahadeva Prasanna (Indian Institute of Technology Dharwad), Dr Sachit Rao (International Institute of Information Technology Bangalore), Dr Girish V Attimarad (K S School of Engineering and Management), Mr Ravindra Karadi (KLE College of Pharmacy, Hubli), Dr Tapasi Ghosh (M S Ramaiah University of Applied Sciences), Prof Arun Mohan Isloor (National Institute of Technology, Karnataka), Dr Sandeep Kumar (NITTE Meenakshi Institute of Technology), Dr Gopiya Naik S (PES College of Engineering), Mrs Dolan Champa Banerjee (St Agnes College (Autonomous), Mangalore), Dr Oswald Mascarenhas (St Josephs Institute of Management, Bangalore), Dr Veeresh Magalad (Tontadarya College of Engineering) and Dr Saroja Narsing Rao (University of Agricultural Sciences Raichur) has no Google scholar data available in their IRINS profile.

6. CONCLUSION

Indian Research Information Network System (IRINS) plays the most crucial role in higher learning educational institutions to know their research productivity, citations, h-index, collaborations, awards, etc. In recent scenarios, many academic institutions are facing the problem of collecting research productivity reports and faculty profiles for ranking and accreditation purposes. The IRINS helps to solve this problem and gives more information, which is required by the ranking and accreditation organisations at the national and international levels. IRINS helps to update the research and faculty details in a simple manner by themselves. Hence, this will help the institutions to know about their faculty member's personal information, publications, awards, honours, educational background, identity and such up-to-date. In Karnataka, only ninety-two institutes are implementing IRINS. This study recommends that all academic institutions update their academic and research activities in IRINS to have better visibility by the outside world.

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REVOLUTIONIZING LIBRARIES THE POWER OF AI IN AUTOMATING INFORMATION MANAGEMENT

Dr. A. Ravi*

ABSTRACT

This paper explores the impact of AI on library operations, focusing on information management. AI streamlines cataloguing, enhances search functionalities, and optimizes resource allocation. The abstract highlights AI's role in user experiences, enabling data-driven decision-making and addressing information overload challenges. The case studies show that AI is revolutionizing libraries, shaping a more efficient, accessible, and responsive information ecosystem.

Keywords: *Artificial Intelligence, Automation, Libraries, Information Management*

INTRODUCTION

In the internet era, libraries face challenges in managing vast amounts of information, ensuring seamless access for users. To meet these needs, libraries are being automated using the latest technologies. Artificial intelligence (AI) is one of the transformative forces that can revolutionize library operations and user experiences. The integration of AI in library automation spans various services. Like collection management, it refines cataloguing and introduces AI-driven recommendation systems, enriching user engagement. AI adopts presents challenges, from technical complexities to ethical considerations.

The Role of Artificial Intelligence in Library Automation. Examines the applications of AI, user perspectives, and ethical implications. It aims to offer insights into how AI can elevate library services while addressing potential challenges. Libraries can use AI to make informed decisions, enhancing their capacity to serve users effectively in the digital age. AI integration in library automation promises to elevate libraries as knowledge hubs, empowering users with seamless access to information.

Objectives

- To conduct an in-depth analysis of library automation, assessing the problems in traditional library systems and effectively managing the data and services in the digital era.

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- To investigate and evaluate the applications of artificial intelligence in library automation, collection management, cataloguing, user services, and data analytics, make necessary recommendations, and understand their potentiality, impact, and efficiency.
- To know the advantages and disadvantages of the integration of AI into library operations, with a focus on operational efficiency, user-centric experiences, cost-benefit analysis, and sustainability of long-term implementation.
- To know the experiences of librarians, library staff, and users in adopting AI in libraries through a combination of surveys and interviews.
- To identify and analyze successful case studies and best practices from libraries that have successfully implemented AI-driven automation and effectively utilize these technologies.
- To explore the ethical and privacy implications of AI in libraries, developing comprehensive guidelines and necessary recommendations for deployment of AI to address potential issues such as data privacy, algorithmic bias, and the role of human librarians.

To contribute substantively to the existing body of knowledge on leveraging cutting-edge technology, particularly AI, to augment library services and bolster information institutions, thereby facilitating their effective functioning in the contemporary technological landscape

Challenges

Libraries have historically served as repositories for extensive knowledge, catering to individuals seeking information, research materials, and entertainment. However, with the world becoming increasingly digitized and interconnected, traditional library systems need help managing and providing seamless access to the vast information available. To tackle these hurdles, libraries have begun adopting automation and information technologies, with Artificial Intelligence (AI) emerging as a transformative solution for these hurdles.

The core challenge lies in comprehending the role of Artificial Intelligence in library automation and its impact on enhancing library services. Despite AI's potential benefits, integrating AI solutions into library operations poses several complexities and uncertainties:

1. **Integration Challenges:** Implementing AI systems in library automation demands seamless integration with existing infrastructure and workflows. Questions arise regarding the compatibility of AI technologies with legacy systems and the resources required for successful implementation.
2. **User Experience:** AI-driven automation has the potential to enrich user experiences through personalized services and recommendations. However, ensuring user privacy

while employing AI algorithms and comprehending user preferences pose ethical concerns that demand attention.

3. **Expertise and Training:** Successful AI integration in libraries necessitates staff proficiency in AI technologies. Providing adequate training and opportunities for upskilling library staff is imperative for effectively harnessing AI's potential.
4. **Cost and Sustainability:** Smaller and underfunded libraries might face financial constraints in adopting AI technologies. Evaluating AI implementations' cost-effectiveness and long-term sustainability is crucial to ensure equitable access to AI benefits.
5. **Ethical Considerations:** The utilization of AI in libraries brings ethical inquiries related to data privacy, algorithmic bias, and its impact on human librarians' roles and job security.

Addressing these challenges and uncertainties is pivotal to unlocking AI's true potential in library automation. Thus, this research aims to explore, analyze, and provide insights into the role of Artificial Intelligence in library automation and its implications for library services. By doing so, this study will furnish valuable knowledge to guide libraries in making informed decisions about AI integration, thereby enhancing their ability to serve users effectively in the digital era.

Applications of AI in Libraries

- **Cataloguing and Metadata Enhancement:** AI can streamline the process of cataloguing and organizing library resources by automatically tagging, classifying, and enhancing metadata. This enables efficient search and retrieval of information for users.
- **Recommendation Systems:** AI-powered recommendation engines can suggest relevant books, articles, or resources based on user preferences, borrowing history, and behaviour, enhancing user experience and engagement.
- **Natural Language Processing (NLP) for Queries:** NLP algorithms enable libraries to understand and respond to natural language queries. AI-driven Chatbots or virtual assistants can help users navigate the library, find resources, and receive personalized recommendations.
- **Predictive Analytics for Collection Development:** AI algorithms can analyze usage patterns, trends, and demand to predict future resource needs. This assists libraries in optimizing their collections by acquiring materials that are likely in demand.
- **Enhanced Accessibility Services:** AI technologies can facilitate accessibility by converting texts into various formats (audio, braille, etc.) and assisting users with disabilities in accessing and navigating library resources effectively.
- **Preservation and Conservation:** AI can aid in digitizing and preserving fragile or rare materials through technologies like image recognition and restoration, ensuring long-term access to valuable resources.

- **Workflow Optimization:** AI-driven systems can automate routine tasks such as inventory management, scheduling, and resource allocation, freeing up human resources for more complex and personalized services.
- **Content Curation and Filtering:** AI can assist in content curation by filtering out irrelevant or low-quality resources, ensuring that the library collection maintains high standards of information quality.
- **Cybersecurity and Data Protection:** AI tools can strengthen cybersecurity measures within libraries by identifying and mitigating potential threats and safeguarding sensitive user data and library resources.
- **Learning and Training Support:** AI-powered educational tools can support patrons and staff by offering personalized learning paths, tutorials, and training materials tailored to individual needs and learning styles.

These applications demonstrate the diverse ways AI can revolutionize information management within libraries, ultimately enhancing user experiences and optimizing library services.

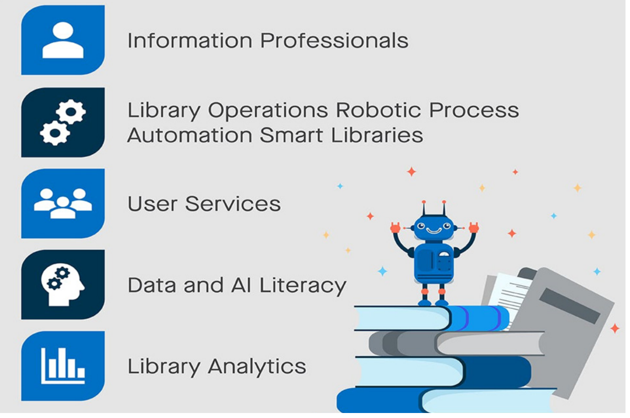

Fig. 1: The above figure shows the impact of AI in Libraries

Impact of AI in Libraries

- **Information Professionals**:

  The information professionals are the first to be affected. It helps improve the accuracy and efficiency of information and retrieval so that the users can access relevant resources.
- **Library operations robotic process automation smart libraries**:

  The library operations are being integrated with robotic processes, automation and smart technologies to manage the resources effectively
- **User Services:**

  AI has revolutionized user service in accessing information, interacting with library resources, and assisting. Some key impacts are improving search, available 24/7 user behaviour, suggestions from the user, access to resources, data analysis, etc.

- **Data and AI literacy**:

  The institutions evolve to implement necessary technology in libraries. The staff must know how to use the AL. They guide the users in accessing and evolving data, creating resources, technical support and assistance, ethical users, and research.

- **Library Analytics**:

  Systematic analysis of data gathered from various sources makes them make decisions and improves library services. There are five significant aspects of using age metrics: user behaviour analysis, collection development, decision support, assessment and improvement of libraries.

Case Studies

1. **Singapore National Library Board (NLB):** NLB adopted AI-powered Chatbots to enhance user experience and assist patrons in finding resources, navigating the library catalogue, and providing real-time assistance with inquiries.
2. **University of Oklahoma Libraries:** This institution integrated AI algorithms to enhance cataloguing processes, improving the accuracy of metadata and information retrieval for their extensive academic resources.
3. **New York Public Library (NYPL):** NYPL employed machine learning algorithms to analyze borrowing patterns and user preferences, offering personalized recommendations to patrons for books, events, and resources.
4. **Bibliothèque nationale de France (BnF):** BnF utilized AI for digitization efforts, employing Optical Character Recognition (OCR) and Natural Language Processing (NLP) to digitize and process vast amounts of historical texts and manuscripts.
5. **Library of Congress:** The Library of Congress implemented AI systems to automate metadata tagging and classification, streamlining the categorization and retrieval of diverse media types within its extensive collection.
6. **Calgary Public Library, Canada:** This library integrated AI-powered systems to manage inventory and optimize resource allocation, allowing for efficient tracking of borrowed materials and predicting demand for specific resources.
7. **Oodi Library, Helsinki:** Oodi Library implemented AI-driven systems for space management, analyzing foot traffic patterns to optimize the layout and resource placement for improved user accessibility.

These case studies demonstrate diverse applications of AI in libraries, showcasing how AI technologies have been employed to streamline information management, enhance user experiences, and optimize resource allocation in various library settings.

Limitations of AI in Library Automation

- **Resource Accessibility:** While AI can significantly streamline information management, not all libraries may have the resources or infrastructure to implement sophisticated AI systems. Smaller or underfunded libraries face limitations in acquiring and maintaining AI technologies.

- **Data Quality and Quantity:** AI heavily relies on data quality and quantity for effective automation. Libraries with incomplete or inadequate datasets may need help in harnessing the full potential of AI for information management.
- **Integration Complexity:** Integrating AI into library systems can be complex and time-consuming. Legacy systems or outdated infrastructure might pose compatibility issues, limiting the seamless integration of AI technology.
- **Ethical and Privacy Concerns:** AI algorithms may inadvertently perpetuate biases present in the data, leading to skewed recommendations or categorizations. Ensuring the ethical use of AI while maintaining user privacy can be challenging and might limit the scope of AI implementation.
- **Staff Expertise and Training:** Libraries require skilled personnel to operate and manage AI systems effectively. Limited expertise or training opportunities in AI technologies for library staff could hinder AI's successful implementation and utilization in information management.
- **Cost and Sustainability:** The initial investment and ongoing maintenance costs associated with AI systems might be prohibitive for some libraries. Long-term financial sustainability and budget constraints could limit how AI can be integrated.
- **Adaptation to Diverse Needs:** AI solutions might only cater equally well to some user demographics or needs within a library setting. Customizing AI systems to serve diverse users and information requirements might pose challenges.

These limitations highlight various hurdles libraries might encounter while leveraging AI for automating information management.

CONCLUSION

Incorporating Artificial Intelligence (AI) into library systems offers a promising avenue for advancing information management. AI's potential to streamline operations, personalize user experiences, and redefine library services is undeniable. However, successful integration necessitates addressing challenges such as ethical considerations, resource constraints, and staff expertise. Collaboration between stakeholders is crucial to maximize AI's benefits while upholding ethical standards and core library values. Striking a balance between innovation and preserving inclusivity will empower libraries to thrive in the digital era, reshaping their role as indispensable knowledge hubs.

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DEVELOPMENT OF DIGITAL LIBRARY USING DSPACE-CRIS: THE OPEN-SOURCE, FREE CURRENT RESEARCH INFORMATION SYSTEM

Bommali Vinod Kumar,[1] Vangapandu Prasad,[2] and Sanku Sankar Rao[3]

ABSTRACT

This study discusses the importance of DSpace-CRIS open-source software that supports numerous digital libraries and repositories worldwide. An expanded version of DSpace software, the most widely used repository platform worldwide, is called DSpace-CRIS. It features an effective and adaptable data model that can characterise all the entities that make up the research environment and their significant relationships, not only publications. It offers your institution a sustainable and efficient way to handle research information, including researcher profiles, department pages, project funding and awards, research outputs, metrics, reports, and statistics. It additionally happens to be open-sourced, free to use, and consistent with open standards. This article briefly overviews the key features, capabilities, hardware, and software requirements of DSpace-CRIS. Specifically, we highlight the ORCID Integrations feature, which allows DSpace-CRIS to integrate with research information management systems and enhance data quality by facilitating connections between researchers. To guarantee correct evaluation of your research effect and constant and dependable crediting of your work, your ORCID sets you apart from all other researchers in the present-day digital research environment.

Keywords: *Digital Signal Processing and Control Engineering (DSpace), Open Researcher and Contributor ID (ORCID), Current Research Information System (CRIS).*

INTRODUCTION

The first DSpace extension for research data and information management that is available for free is called DSpace-CRIS. In contrast to existing CRIS/RIMS (commercial) systems, DSpace-CRIS is centred around an institutional repository, which gives all of the gathered data and objects prominent web visibility. While staying consistent with its code base, DSpace-CRIS extends DSpace's capabilities and data model.

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DSpace-CRIS consists of a set of instruments for managing data and a data model characterising items of interest to the Research community. Unlike Standard DSpace, which only handles documents and records, all entities within the research field are handled by DSpace-CRIS. These entities include the researchers, Projects, organisation Units, and the second thing, Level Dynamic Objects (single objects specialised by a profile, like Journals, Awards, Activities, etc.; each profile can define its own set of characteristics and embedded objects).

Three DSpace Committers, Andrea Bollini, Luigi Andrea Pascarelli, and Giuseppe Digilio, are actively working on the creation and maintenance of DSpace-CRIS, which was first developed at Cilea as a project abetted by Hong Kong University. Beyond their dedication, DSpace-CRIS is becoming the centre of a burgeoning community around which the research domain is represented (see DSpace-CRIS Users).

OBJECTIVES

The main objective is to determine why, features, function, ORCID Integrations and applications in the development of digital library using DSpace-CRIS

1. To study the DSpace-CRIS software.
2. To know about the Features of DSpace-CRIS.
3. To Develop a digital library by using DSpace-CRIS Software
4. To know about the uses, application, Hardware and Software requirements of DSpace-CRIS
5. To study ORCID Integrations in DSpace-CRIS

DSpace

Open-access educational and/or published digital work repositories are frequently created using DSpace, a free, open-source repository software package. The DSpace repository software meets a particular requirement as a digital archives system focused on the long-term storage, access, and preservation of digital content. While certain aspects of DSpace are similar to those of content management systems and document management systems, it is more than just that. There are around three thousand worldwide repositories in the optional DSpace registry.

D Space is a software dais that enables organisations to:

- Use various automated intake options or a submission process module to catalogue and annotate digital content.
- Distribute digital assets for a company online using an apparatus for finding and obtaining.
- Maintain resources online for a lengthy period.

In July 2000, the HP-MIT partnership began work on the DSpace project. The DSpace Foundation, a non-profit organisation, was founded in 2007 to support the growing community of DSpace-using institutions. The foundation aims to promote the cooperative creation of open-source software to provide perpetual access to digital works.

Features of DSpace: The following are some of DSpace's most significant features.

- No-cost open-source software
- fully scalable to accommodate the user's demands
- Organise and protect all digital content formats (PDF, Word, JPEG, MPEG, TIFF files)
- Look for complete text and metadata using Apache SOLR.
- UTF-8 Compatibility
- The interface supports twenty-two distinct languages.
- Granular access control is based on groups and permits to be set down to individual files.
- Designed to be indexed by Google Scholar
- Granular group-based access control allows permissions to be set down to individual files.

DSpace-CRIS: Why?

- Investing in a commercial platform (a CRIS or RIMS) to handle research data is expensive and commits your organisation to a closed system.
- It is a cost-free and open-source tool that complies with criteria for managing research information such as research outputs, metrics, reports, statistics, department websites, project funding and awards, and researcher biographies at your institution.
- It broadens the use of DSpace to circumstances requiring more sophisticated item management inside a particular field.
- It is especially beneficial to organisations that have previously built a CRIS using a business product since it allows them to make some of the CRIS data publicly available and use DSpace-CRIS's powerful distribution capabilities to gain exposure.

Main Features of DSpace-CRIS

1. Management of CRIS entities
    - Entities that have already been configured
    - Entity customisation
    - Customisation of relationships between two or more objects

2. Worldwide finding and indexing
    - worldwide check over the whole website
    - Highlighting the terms you looked for
    - Multiple Search Faces
    - Active components that have been given context
    - Customizable Browse indexes in the same way as you would for DSpace objects.
    - The detail page for any entity is arranged using boxes and tabs.
3. Evaluation, documentation, and statistical analysis
    - Every level of the structure, including the whole repository, has metrics available.
    - Perspectives and downloads of global and top-ranked items
    - Statistics for each entity
        - The item page's cited-by-count
        - Views and downloads of items by regions
    - Figures gathered from connected items
    - Periodical automatic alarms
4. Management and promotion of one's profile
    - Curriculum Vitae for Researchers
        - Ability to individually display/hide chosen things
        - Previously inputted things can be claimed/disclaimed.
    - Notification of duplication
    - Network for collaboration
5. Taking care of financial prospects
    - Lookup using contributor
    - Connecting contributors with tasks
    - New opportunity screening that is automated
    - Notification of New Opportunity
6. Connectivity to databases and other systems
    - Scripts are regularly provided to search bibliographic databases, including PubMed, Scopus, and Web of Science.
    - Using deduplications, records found in many sources or previously entered data may be combined.
    - Read-Only access to CRIS data using SOAP Webservices
    - Export CRIS entities using CERIF XML 1.6
    - Use the CERIF 1.6 XML to import CRIS entities.
    - CERIF compliance test / REST API

- When combined with sources of bibliometric data
- Open and member APIs with ORCID integration

7. Connectivity with Extras
   - CKAN Integration - Research Data Management
     - Examine the data source
     - Display the information
     - Establish factors.

DSpace CRIS Architecture

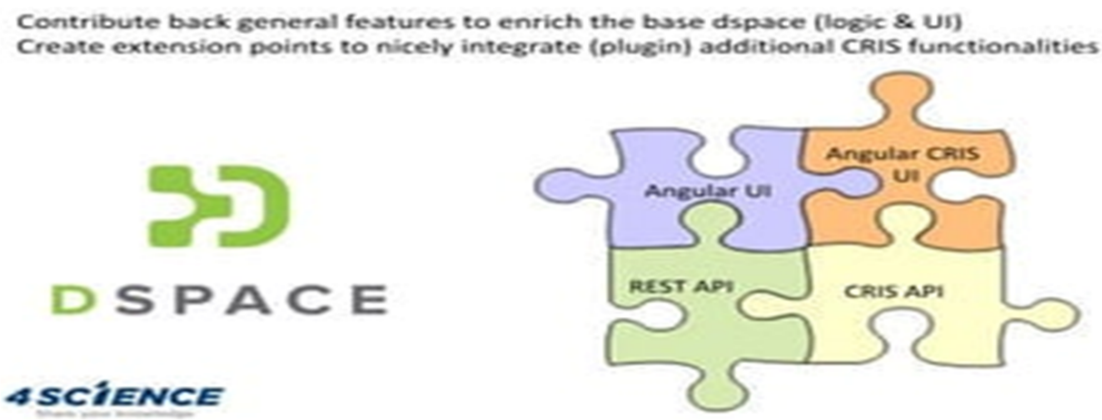

Fig. 1: DSpace CRIS Architecture

Hardware & Software Requirements of DSpace-CRIS 7

This minimum would consist of approximately

- 2GB of RAM for Node.js and the Front-end (UI). Sites with high activity will require more.
- 1GB of memory for the Backend (REST API) / JVM / Tomcat. Highly active sites will need more.
- 512 MB is the PostgreSQL database's memory. Sites with high traffic volumes will need more
- 512MB of memory for Solr. Sites with high activity could require more.
- Extra memory may be required for command line scripts (which get kicked off in a separate JVM)

1. **Installing the Backend (Server API**
   - Backend Requirements
     - An OS similar to Linux or Microsoft Windows

- Java JDK 11 or 17 (OpenJDK or Oracle JDK)
- Apache Maven 3.5.4 or above (Java build tool)
- Apache Solr 8.x (full-text index/search service)
- Servlet Engine (Apache Tomcat 9, Jetty, Caucho Resin or equivalent)
- IP to City Database (Optional) for Location-Based Statistics
- Relational Database (PostgreSQL)
  - PostgreSQL 12.x, 13.x, 14.x or 15.x (with pgcrypto installed)
  - Oracle (UNSUPPORTED AS OF 7.6)
- Backend Configuration

2. **Setting up the User Interface (Front-end)**
   - Front-end specifications
     - Microsoft Windows or an OS similar to UNIX
     - Node.js (version 16.x or 18.x)
     - Yarn (v1.x)
     - PM2 (or another Process Manager for Node.js apps) (optional but recommended for Production)
     - DSpace 7.x Backend (see above)
   - Installation of Front-end

Advantages of DSpace-CRIS

1. **Viewer of Documents**

   Explore, access and work on full documents.
2. **Make it Beautiful**
   - Modern technologies for your user interface
   - flexible and receptive
   - Icons for a natural exploring approach
   - Widgets showing the most referenced, most watched, etc.
3. **IIIF Image Viewer**

   Enjoy and work with image collection using the finest international standards.
4. **DSpace-CRIS use cases**

   Research Data, an object, a researcher, metrics, publications, networks, and statistics
5. **OCR Module**

   Find the information you want quickly from digitised documents.
6. **Video/Audio Streaming**

Make it easier to access and repurpose audiovisual material.

7. **Analytics and Reporting**

   Strong suite of tools for reporting, data analysis, and data visualisation.

8. **UX Plus**

   A contemporary and user-friendly interface for interacting with and accessing digital material will improve the user experience.

9. **Content & Usage Statistics**

   Track user behaviour within the repository and generate content-representation charts.

10. **Data Quality and Security**

    Make a duplication-free repository, manage duplicates, and test them.

11. **Network Lab**

    Build dynamic graphs to identify previously unidentified connections between individuals, papers, projects, occasions, venues, organisations, etc.

12. **Open AIRE Guidelines**

    It is for CRIS Managers V1.1.1's data archives and literature repository managers V4.

13. **Modular Data Structure**

    lets you collect and arrange study data and information.

14. **Set Up Various Data Models and Schemas for Information**

    It brings fresh, imaginative DSpace users to the community.

Full ORCID Integrations

Identifying and linking researchers to their research work is challenging since the researchers can be very active and frequently move between organisations. A complex process in and of itself, updating the information on them is necessary since they often utilise different forms of their name in their work.

The implementation of CRIS systems offers the use of persistent IDs for uniquely identifying researchers. It serves as a solution for gathering, administering, archiving, analysing, and exhibiting the research output of universities. These identifiers that are being used are the ORCID IDs, which a researcher can use throughout his career.

When a researcher uses the platform to generate an ORCID, information about them, including name, ORCID ID, authorisation token, and ORCID creation date, is recorded in a log file on the system server. The library can then use this log file for different reasons.

DSpace provides a bidirectional integration with ORCID based on the ORCID API v3.0. Both the Public ORCID API and the Membership API are supported.

Features Types of ORCID Integrations in DSpace-CRIS

1. **ORCID Login**

   When enabled, the user is given the option to log in using ORCID in addition to the other authentication methods set up inside the system. The user cannot reset his password via DSpace using the ORCID authentication.

2. **Import publications from ORCID**

3. **ORCiD Registry Lookup**

   The procedure ends with creating a local profile.

4. **ORCID Authority**

   - Searching the ORCID Registry and local researcher profiles is possible with an ORCID Authority plug-in.
   - The data from both registries are concatenated to provide identical results when the local or ORCID entries are used at the end.

5. **Pull information from ORCID**

   In order to build CRIS objects as part of an item submission that extends beyond the straightforward ORCID use case, the consumer supplies a generic infrastructure. ORCID Import Filleris responsible for PULL biography data from ORCID when a new Researcher Profile is created

6. **Link current profiles to ORCID**

   Through the designated "tab" in ORCID preferences, a researcher can verify and link their local profile to ORCID**.**

7. **ORCID Synchronisation preferences**

   The user can manually synchronise one or more modifications to ORCID, such as preferences for projects, publications, biographies, etc., or the system can automatically synchronise changes from DSpace-CRIS to ORCID (batch mode).

8. **ORCID Mapping**

   By configuring the biography preference settings, mapping between the Researcher Page attributes and the ORCID profile is implicitly managed.

9. **ORCID Access tokens**

   The access token is stored in the eperson.orcid.access token of the logged-in EPersonand copied is RP properties: system-orcid-token-authenticate, system-orcid-token-orcid-profile-read-limited, etc.

10. **Get a researcher profile**

    If a researcher's profile is not linked to a DSpace Eperson, there are two potential ways to claim the profile. If the profile has an email, you can guess the email address to get an email with a forgot password link. After that, a new account will be made and connected to the researcher's profile using that email address. If the profile has an ORCID, all you have to do to establish your ownership of the profile is to log in using ORCID.

11. **Configuration of the ORCID API-Key**
12. **Environment configuration**

Table 1: The supported functionalities are shown below, broken down by the kind of ORCID API setup.

Feature	No credentials	Public API	Member API
Authentication		Yes	Yes
Connect local profile to ORCID (authenticated ID)		Yes	Yes
ORCID Registry Lookup - import Person records	Yes	Yes	Yes
ORCID Registry Lookup - as an authority	Yes	Yes	Yes
Import the ORCID publication.	Yes	Yes	Yes
Push biographic data to ORCID.			Yes
Submit articles to ORCID (works)			Yes
Send funding requests for projects to ORCID.			Yes

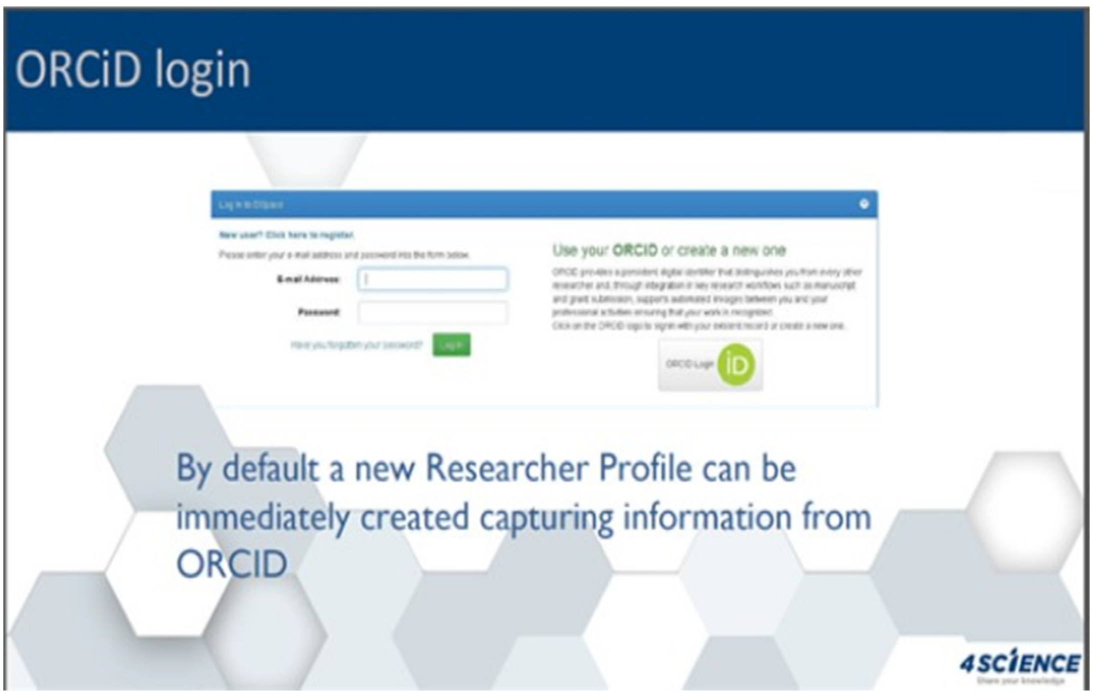

Fig. 2: ORCID Login in DSpace -CRI

SUGGESTIONS AND CONCLUSION

The world's most widely utilised repository platform, DSpace, has a new version called DSpace- Current Research Information System. The primary feature of DSpace-CRIS is its adaptable data architecture, which enables you to construct entities and traits along with the reciprocal linkages between them, as well as collect and organise research data and information typical of a CRIS system. It collects and handles research data and information about your associations and researchers, departments and structural units, labs and facilities, agreements and meetings, publications and inventions, awards, and so on.

It provides IRs and the DSpace community with several benefits, including the ability for CRIS objects to exercise authorised control over an item›s metadata values, the potential for DSpace Items to be connected to and shown on the detail page of any CRIS entity, the possibility of creating and showcasing specific publications in the researcher profiles; evaluation of CRIS entity data; email and RSS notifications, PubMed article level metrics and total citations for the researcher.

Purchasing a commercial platform (a CRIS or RIMS) to handle research information is costly and locks your organisation into a proprietary system, as recommended. Open-source software and a potent and adaptable data model is DSpace-CRIS.

Compared to DSpace software, the DSpace-CRIS has more features supported by Research Information Management System software and is the most useful and flexible for researchers. Extra functionality was added to the DSpace version, making it easier to manage the repository and handle complex data. It also offers the ability to apply and support extremely granular security up to the single metadata value for a single record. It has unique features like the ability to push professional, educational, and eligibility details that are frequently imported into DSpace-CRIS from legacy applications that cannot be implemented in DSpace.

This Paper discussed one of the features of DSpace-CRIS, the Integrations of ORCID. Researchers can use the internationally unique ID that ORCID offers them for the duration of their academic career. Integrating ORCID with DSpace-CRIS is incredibly effective because it uses ORCID's potential to enhance data quality by establishing a connection between researchers and their study while significantly improving the quality of their output. In today's digital research environment, your ORCID sets you apart from all other researchers to guarantee precise evaluation of your research impact and constant, dependable attribution of your work.

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MAPPING THE RESEARCHGATE (RG) PROFILES OF HORTICULTURE RESEARCHERS OF ASSAM AGRICULTURAL UNIVERSITY THROUGH ALTMETRIC APPROACH

Dibanjyoti Buragohain[1] and Amit Kumar[2]

ABSTRACT

A new approach or new metrics have been adopted for the purpose of the study, where Horticulture Researchers of Assam Agricultural University have been taken into account. The study is the first of its kind to analyse the ResearchGate profiles of the researchers by adopting Altmetrics analysis. The results show that the researchers of the Horticulture Department need to upgrade their potential and skills in using academic and social networking sites such as Google Scholar, ResearchGate, Academia, and so on. The researchers still need to upload any forms of documents, though they might have been published in various forms. The study possesses future potentiality and scope for the researchers to understand the utility of ResearchGate and Altmetrics in their horticulture discipline.

Keywords: *Altmetrics, ResearchGate, Research Scholar, Correlation and Metrics.*

1. INTRODUCTION

In the world of research and innovation, citations are playing an important role in monitoring and evaluating the research impacts on society since the 1960s. Nevertheless, it was observed that the citations alone cannot capture the full picture of the research impact (Barbic, Tubman, Lam, & Barbic,2016). The reason which abstains citations are the only tool for measurement of the research article is that the articles are frequently being used by academicians, medical practitioners, undergraduates, and postgraduate students, which marks that research can go beyond the traditional boundaries where the enhancement of knowledge can be identified in environmental, economic, cultural and social factors (Dutta, 2016). The traditional citation-based metrics report only a few years of publications. The introduction of altmetrics has brought a new scenario in the process of scholarly communication among researchers globally (Shi, Tang,& Lu, 2021).

The process of scholarly communication is defined as the steps involved in the creation, publication, dissemination, and discovery of scholarly research (Sreenivasulu & Nandwana,

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2001). The increasing use of information and communication technology has made a rapid transformation in the dissemination of information in a more broad and rapid manner where new opportunities are opened up for new researchers to increase access to scholarship of the new contents in different new areas of research (Sutton, Miles, & Konkiel, 2018), as per the analysis of the previous studies it has been found that there are three types of web presences. They include social, institutional and personal (Dulle et al., 2001). There are some web presences which open the door for researchers to provide the research paper/articles to upload either manually or automatically (Houghton et al., 2009).

A citation can be defined as a reference that was published or unpublished. In a simple sense, citation analysis can be explained as the examination of the frequency, patterns, and graphs of citations in any form of publication (Kolahi et al., 2020). In the 1970s, Eugene Garfield, the founder of the Institute for Scientific Information (ISI) first applied this analysis to the journal, which was scientific in nature (Chisita, 2011). Due to the advancement of technology, the automated citation pattern has obtained considerable attention among researchers and government officials for analysis of large-scale patterns, knowledge discovery, and evaluation of the performance of individual researchers, research groups, various government departments, and universities (Prathap & Gupta, 2011). The traditional method of evaluating scientific publications is being criticised as it is not field-dependent.

In the contemporary world, social media has acquired considerable attention among the general public due to its various advantages and features posses by it (Bar-Ilan et al. 2012). One of the factors for the rapid growth of social media is the fastest way of transferring knowledge capacity. A new era of metrics, popularly known as Altmetrics, was introduced to the scientific community in 2010 (Shrivastava & Mahajan, 2017). Altmetric has developed keeping in mind the traditional citation impact metrics to elaborate not just based on the citations but also included articles' views, downloads, or mentions in social media or any other news media. Parameters such as Facebook, Twitter, Wikipedia, Mendeley, and other networking platforms together constituted the Altmetric Score (Sutton,2014). It is to be noted that a higher Altmetric score means the articles had received considerable sharing on various social networking platforms (Bonnet & Méndez-Brady, 2017).

2. REVIEW OF RELATED LITERATURE

A relevant piece of pieces of literature is always important to draw a sketch or framework of any research work (Matusiak et al., 2017).). Some of the important works of literature that have been consulted for the study include Kolahi et al.'s (2019) paper, which discusses the altmetrics attention of knowledge structure of scientific articles published in the endodontology field. The main motivation was to discover hot topics, active researchers, and the journal involved in the development of the endodontology perspective. The result revealed that only 192 articles had altmetrics scores>5. It was found that the Journal of Endodontics had the highest rank of altmetrics attention. The most popular altmetrics data is Twitter, which is followed by patents and Facebook. In their paper, Htoo and Na (2016) highlight the understanding of altmetrics in the field of social science among its different disciplines. The main objective of the study is to investigate the budding potential of altmetrics in the different disciplines of social sciences. The study suggests that there is a steady growth in the achievement of altmetrics attention among the articles published in a different discipline. Ali and Richardson (2017), in their paper, discuss the performance of Pakistani research scholars in the field of Library and Information Science by adopting altmetrics approaches in the respective research gate profiles. The study indicates that there are positive correlations between publications, reads, and citations for at least one publication published by the scholars, and it was also found that the majority of scholars do not have publications in the high-impact journals in the Library and Information Science Journals. It was suggested that Academic Networking site profiles have the potential to boost collaboration, build connections, and exchange information. Zohreh, Costas, and Wouters (2013), in their articles, analysed the possibilities and presence of Altmetrics, where 20000 publications were collected using the web-based tool impact story from the Web of Science. The results indicate that Mendeley is the greatest source of Altmetrics that provides metrics, and a moderate correlation was found in terms of relation with citations. Barbic et al. (2015) have moderate emphasis on analysing the 50 most cited articles abstracted in the journals of Emergency Medicine (EM), wherein the comparison is made between traditional metrics and altmetrics. The result reveals that EM articles that have received the highest altmetrics score were 25.0. Resuscitation has received the highest mean articles Altmetric Score among the EM journals. The clinical areas in most of the EM articles were trauma and cardiac arrest. The result also demonstrated a mild correlation between citation counts and the Altmetric Score for the top papers in EM. Mohammadi et al. (2013) in their paper highlight the detailed information in the context of the readership of research articles and which articles are being used to read. The study explores the different types of users from different fields, such as Clinical Medicine, Engineering and Technology, Social Science, Physics, and Chemistry, where data were gathered from members who are registered in Mendeley. The study reveals that the majority of the readers are post-graduate, Ph.D., and postdoctoral candidates. Jain and Goria (2001) in their articles discuss the status of Agricultural Libraries in India. The study focused on the professionals, users, collections, and many more. The study has also attempted a comparative analysis between State Agricultural University libraries and ICAR Institute libraries while considering the factors which affect the development of agriculture. Dulle et al. (2001) tend to underline the factors of Agriculture University Libraries which were responsible for meeting the information needs of agriculture researchers. It also intends to study the means by which the researchers are meeting their scientific information needs. It also provides suggestions and recommendations for the professionals working in agriculture university libraries in Tanzania. Nidheesh (2009), in their paper, examines the knowledge and perceptions of the tribal among adults in Kerala state. The study was conducted on the basis of certain parameters such as natural resources, food, and agriculture. It was found that the people who reside in rural areas have more knowledge about agriculture as compared to those who live in urban areas. The educated ones have more agricultural knowledge as compared to the less educated ones. Gupta (2011), in his article, analyses the research productivity in the area of agricultural sciences by Indian Institutions where the parameters are based on various quantitative indicators. The study concludes that the ranking based on composite indicators yields much better results as compared to other indicators because it combines both quality and quantity factors in consideration.

3. OBJECTIVE AND METHODOLOGY OF THE STUDY

The study examines the metrics provided by ResearchGate and includes a systematic observation of the metrics as per ResearchGate, such as publications, reads, citations, networking that includes followers and following information, h-index, RGScore, etc. (Jain & Gorla, 2001). The RGScore is provided to the researchers on the basis of the quality of their research, but the calculation technique is not disclosed to its users by ResearchGate. The metrics/variables studied in the study, in brief, can be understood with the following figure:

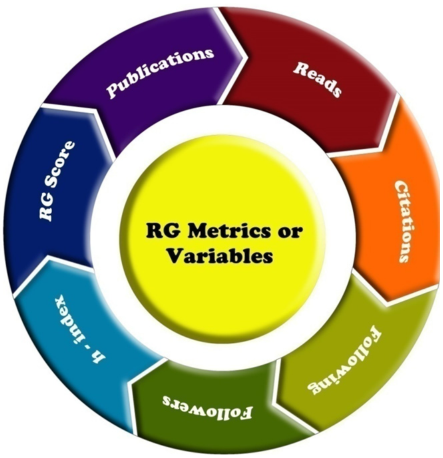

Fig. 1: Metrics/Variables of the Study

The methodology adopted for the purpose of the study was the observation method wherein the list of researchers was prepared from the profile page of the Department of Horticulture found in the Research Gate Platform. The data were collected manually from the RG profile of the concerned researcher, who had the RG account from August 2022 to November 2022. The Department of Horticulture of Assam Agricultural University is considered as it has the maximum number of profiles compared to other departments of the university. The researcher has found a total of 101 researchgate profiles in the Horticulture Department. The data were collected by the authors for publications, profile views, citations, RGScore, impact points, reads, followers, and following from the profile page of researchers in the community profile of Horticulture. In a nutshell, the entire methodology followed during this study can be understood by the following figure:

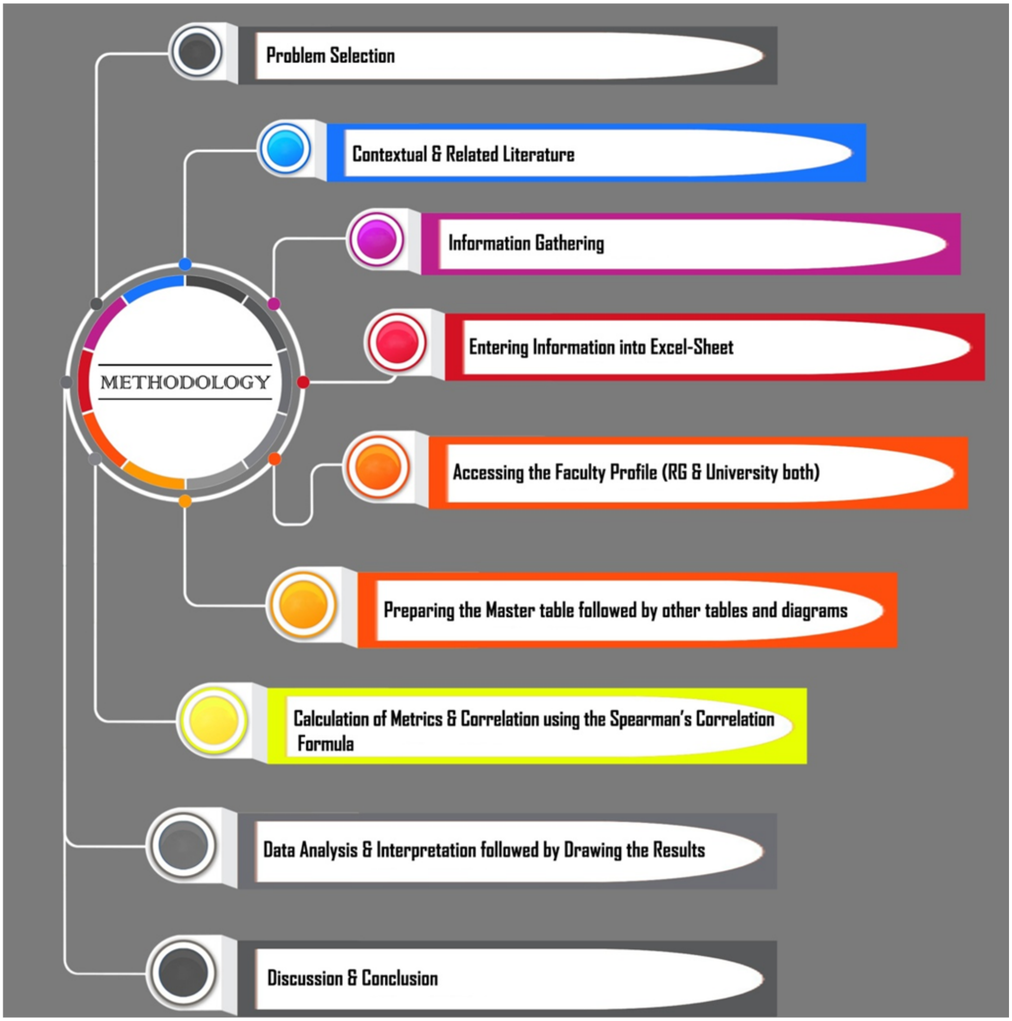

Fig. 2: Methodology

Citations play an important role in measuring scholarly communications in metrics studies (Liu, 2013). There are many sources of retrieving citation-based metrics, such as Google Scholar, Web of Science, and Scopus, but ResearchGate citation-based metrics have been taken into consideration due to several parameters. Though there are other sources for citation-based metrics, Spearman's rank correlation coefficient was found to be more appropriate. Further, the correlation was also measured to seek the nature of the relationship among the different ResearchGate metrics (Shrivastava & Mahajan, 2017). The following Spearman's rank correlation coefficient formula was used for the calculation of the nature of the relationship among ResearchGate metrics.

$$\rho = 1 - \frac{6\sum d^2}{n(n^2 - 1)}$$

4. AN OVERVIEW OF ASSAM AGRICULTURAL UNIVERSITY

The university is considered one of its first kind in the whole of North-East India, where agricultural education is imparted from a different perspective of agriculture. One of the major objectives of the institution is to educate and produce competitive human resources where individuals can excel both in traditional and frontier areas of research activities. The establishment seed of the university was shown on 1st April 1969 under The Assam Agricultural University Act, 1968, with the motto to disseminate farm education and research in agriculture and allied disciplines. The university academic system is divided into the following faculties:

- Faculty of Agriculture
- Faculty of Veterinary Science
- Faculty of Community Science
- Faculty of Fisheries Science
- Faculty of Horticulture
- Faculty of Sericulture

Again, the university is further divided into different divisions based on the different locations within Assam. The functioning colleges under the Assam Agricultural University include College of Agriculture, Jorhat; College of Community Science, Jorhat; College of Veterinary Science, Khanapara; College of Fishery Science, Raha; Biswanath College of Agriculture, Biswanath Chariali; Sarat Chandra Sinha College of Agriculture, Rangamati, Dhubri; Lakhimpur College of Veterinary Science, North Lakhimpur; College of Horticulture, Nalbari (Currently functioning at Assam Agricultural University›s Jorhat campus) and College of Sericulture, Titabor (Currently functioning at Assam Agricultural University›s Jorhat campus). The university also has six Regional Agricultural Research Stations such as Titabar - Upper Brahmaputra Valley Zone; North Lakhimpur - North Bank Plain Zone; Shillongoni - Central Brahmaputra Valley Zone; Diphu - Hill Zone; Gossaigaon - Lower Brahmaputra Valley Zone and Karimganj - Barak Valley Zone. In addition, the University also has four Commodity Research Stations wherein mentioned to be made of Citrus Research Station, Tinsukia; Sugarcane Research Station, Buralikson; Horticulture Research Station, Kahikuchi; and Goat Research Station, Burnihut.

4.1 Department of Horticulture

Since the inception of the Assam Agricultural College in 1948, the Department of Horticulture has existed with the motive of imparting horticulture value education with four years B.Sc degree Programme. In 1972, the department started to offer an M.Sc Degree Programme and subsequently a Ph.D. program in 1986 with the establishment of Assam Agricultural University, where the prime focus was on teaching, research, and extension activities in horticulture. Meanwhile, the department started implementing M.Sc in Food Science and

Technology in 2014. The department has been recognised for All India Coordinated Projects (AICRP) by the Indian Council for Agricultural Research (ICAR) for fruits, vegetables, and tuber crops rather than potatoes. The boost for research in the horticulture department has emerged with the "Horticulture Mission for North Eastern and Himalayas", which was under Technology Mission, MM-1 operated from 2001 to 2014. Numerous projects are earned by the faculties from statutory bodies such as BARC (Bhabha Atomic Research Centre), DBT (Department of Biotechnology, Govt. of India), and Oil India Limited. The department has put its efforts into training and implementing horticulture issues and problems in the state and North-East India as a whole. For the benefit of the farmers, several joint venture projects were launched between the state government and the Department of Horticulture. There are existing 23 Krishi Vigyan Kendras in various localities wherein the scientists are imparting technological innovation to be implemented for the farmers of the state.

5. DATA ANALYSIS AND INTERPRETATION

It is found from the analysis that 101 horticulture researchers of Assam Agricultural University had their research gate profiles. The Department of Horticulture was chosen for the study as it obtains the highest number of RG profiles among the other departments of the university. The following methodologies were adopted as follows:

5.1 Publication Pattern

Table 1

S.No	Publications	Members	Members (%)
1.	0	61	60.39
2.	1-10	32	31.68
3.	11-20	5	4.95
4.	21-30	1	.99
5.	31-40	2	1.98
6.	41-50	0	0
7.	>50	0	0
	Total	101	100

Table 1 shows the number of publications pattern of the researchers of Assam Agricultural University. 60.39% (61) of the researchers had no publication to their accounts. 32 (31.68%) of the researchers have at least one or more publications to their account. There are five researchers (4.95%) who had published in the range of 11-20. O.99 % of the Horticulture Researcher, which implies one researcher has the publication in the range of 21-30. In the category of 31-40, there are two researchers who had their research publications. None of the researchers in the categories of 41-50 and >50 have their publications.

5.2 Full-Text

Table 2

S.No.	Full-Text	Members	Members (%)
1.	0	75	74.25
2.	1-10	20	19.80
3.	11-20	6	5.94
4.	21-30	0	0
5.	31-40	0	0
6.	41-50	0	0
7.	>50	0	0
8.	Total	101	100

Table 2 shows the full-text added by the researchers to their RG profiles. Only 19.80% (20) of the researchers had their full texts in the account in the range of 1-10. 75 (74.25%) researchers of the Horticulture department have not a single full-text upload to their accounts. 5.94% of the researchers of horticulture have their publication in the category of 11-20. In the range of 21-30, 31-40, 41-50 and >50 haven't added any publications in this range.

5.3 Reads

Table 3

S.No.	Reads	Members	Members (%)
1.	0	58	57.42
2.	1-200	17	16.83
3.	201-400	4	3.96
4.	401-600	5	4.95
5.	601-800	1	.99
6.	801-1000	0	0
7.	>1000	16	15.84
8.	Total	101	100

It is shown in Table 3 that the majority of the researchers (57.42%) don't have a single read in the account in ResearchGate Profiles. Around 17 (16.83%) of Horticulture Researchers have reading members in the range of 1-200. Four Researchers (3.96%) have obtained their reads in the category of 201-400. 4.95% (5) of the researchers have their reads in the category of 401-600. There is only one researcher (.99%) of the Horticulture Department who has reads in the range of 601-800. In the category of 801-1000, none of the researchers obtained a read number. 15.84% (16) of the researchers have read in the range greater than 1000.

5.4 Citations

Table 4

S.No.	Citations	Members	Members (%)
1.	0	72	71.28
2.	1-100	27	26.73
3.	101-200	0	0
4.	201-300	1	.99
5.	301-400	0	0
6.	401-500	0	0
7.	>500	1	.99
8.	Total	101	100

Citations play an important role in measuring the impact of scholarly communication on academic society. Table 4 shows the number of citations obtained by the Horticulture researchers in their respective RG profiles. 71.28% (72 members) of the researchers have no citation to their account. It is also seen that 26.73% of the researchers have their citations in the range of 1-100. In the range of 201-300 and >500, there is one researcher (0.99%) who has been cited from their respective publications in different fields. There is not a single researcher who has been cited in the categories 101-200, 301-400, and 401-500. The horticulture community needs to create awareness about the usability and validity of academic social networking sites such as ResearchGate, Google Scholar, Academia and others.

5.5 h-Index

Table 5

S.No.	h-index	Members	Members (%)
1.	0	77	76.23
2.	1-5	23	22.77
3.	6-10	0	0
4.	11-15	0	0
5.	16-20	1	.99
6.	>20	0	0
7.	Total	101	100

Of the 101 scholars surveyed in the horticulture discipline, 77 scholars have no H-Index in their RG profile. Only one of the scholars (.99%) had an h-Index in the range of 16-20. 22.77% of the Scholars have their H-Index in the range of 1-5. The table also shows that there are no scholars in the ranges of 6-10, 11-15 and > 20. These marks that there is a need for diligence among the researchers of the Horticulture Department of Assam Agricultural University to develop the zeal and enthusiasm to work on scholarly communications.

5.6 No. of Followers

Table 6

S.No.	Followers (No.)	Members	Members (%)
1.	0	30	29.70
2.	1-10	32	31.68
3.	11-20	11	10.89
4.	21-30	6	5.94
5.	31-40	8	7.92
6.	41-50	6	5.94
7.	51-100	7	6.93
8.	100-150	1	.99
9.	>150	0	0
10.	Total	101	100

In a similar pattern to Twitter and Instagram, ResearchGate also provides metrics data about the followers and followers of the profiles. Table 6 shows that 30 scholars of the Horticulture Department have no single followers on their RG profiles. 31.68% of the surveyed scholars have their followers in the range of 1-10. In the range of 21-30 and 41-50, there are 6 (5.94%) followers in their respective ranges. There are 11 researchers (10.89%) who have followers in the range of 11-20. 7.92% of the Horticulture Researchers have their followers in the range of 31-40, and on the other hand, 6.93% of the total researchers have their followers' members in the range of 51-100. Only a single horticulture researcher has the highest number of researchers in the range of 100-150. There is no researcher in the range of greater than 150.

5.7 No. of followings

Table 7

S.No.	Followings (No.)	Members	Members (%)
1.	0	29	28.71
2.	1-10	26	25.74
3.	11-20	10	9.91

S.No.	Followings (No.)	Members	Members (%)
4.	21-30	16	15.84
5.	31-40	7	6.93
6.	41-50	6	5.94
7.	51-100	7	6.93
8.	>100	0	0
9.	Total	101	100

In a similar manner to the number of followers, the number of followers also follows the same pattern for the metrics analysis of the data of researchers in the RG profiles. 28.71% (29 members) of the Horticulture researchers have no single followings in their accounts. 26(25.74%) scholars have their followings in the range of 1-10. There are ten scholars (9.91%) who have followings in the category of 11-20, and 15.84% of the scholars have obtained a 21-30 range of followings among the Horticulture Researchers. In the category of 31-40 and 51-100, 6.93% of the members have their followings in this range. 5.94% of the researchers have occupied the range of 41-50 followers; on the other end, no researchers have secured a position in the range > 50.

5.8 Total Research Interest

Table 8

S.No..	Research Interest	Members	Members (%)
1.	0	62	61.38
2.	1-20	25	24.75
3.	21-40	4	3.96
4.	41-60	1	.99
5.	61-80	3	2.97
6.	81-100	2	1.98
7.	101-150	2	1.98
8.	>150	2	1.98
9.	Total	101	100

Table 8 shows that the total research interest in the Department of Horticulture, Assam Agricultural University, has been portrayed. 61.38% of the researchers have no research interest to their credit. There are around 25 researchers (24.75%) who have Research Interests in the range of 1-20. The categories such as 81-100, 101-150 and >150 have two researchers (1.98%) to the account. Just one researcher (.99) is accounted to have a range of 41-60.

5.9 RG Score

Table 9

S.No.	RG Score	Members	Members (%)
1.	0	73	72.27
2.	1-10	26	25.74
3.	11-20	1	.99
4.	21-30	1	.99
5.	31-40	0	0
6.	>40	0	0
7.	Total	101	100

The majority of the researchers accounted for 72.27%, which has been allocated in the range of zero. There is only a single horticulture researcher (.99%) in each category of 11-20 and 21-30. None of the researchers has been able to secure the range of 31-40 and >40. 25.74% (26) of researchers in the horticulture department have their RG score in the category of 1-10.

5.10 No. of Articles

Table 10

S.No.	Articles	Members	Members (%)
1.	0	67	66.33
2.	1-10	28	27.72
3.	11-20	4	3.96
4.	21-30	1	.99
5.	31-40	1	.99
6.	41-50	0	0
7.	>50	0	0
8.	Total	101	100

Out of 101 researchers in the discipline of Horticulture, 66.33% of the researchers haven't added any publication to their RG profiles. Twenty-eight researchers (27.72%) have been allotted in the range of 1-10. There is a single researcher who has added their publication in the range of 21-30 and 31-40. There is no researcher who has added more than 40 publications to their account. 3.96% of the researchers have their publications in the range of 11-20.

5.11 No. of Books

Table 11

S.No.	Books (No.)	Members	Members (%)
1.	0	100	99.1
2.	1	1	.99
3.	2	0	0
4.	3	0	0
5.	4	0	0
6.	>5	0	0
7.	Total	101	100

It is seen from table 11 that 99.1% (100) of the researchers have no book published to their credit. There is only one member who has added the book to its collection in the Researchgate profiles.

5.12 No. of Chapters

Table 12

S.No.	Chapters (No.)	Members	Members (%)
1.	0	93	92.07
2.	1	6	5.94
3.	2	1	.99
4.	3	0	0
5.	4	1	.99
6.	>5	0	0
7.	Total	101	100

A book chapter can be defined as the reviewed information which was collected and redefined from the published literature or other related materials. The book chapter is generally based on the theme, where each chapter is co-related with the others. Table 12 shows that 92.07% of the horticulture researchers have no chapters to their credit. 5.94% (6) of the researchers have a single chapter to their credibility. It is also noticed that. 99% of the researchers in the Horticulture Department have single-book chapter publications in their RG profiles.

5.13 No. of Conference Paper

Table 13

S.No.	Conference Paper (No.)	Members	Members (%)
1.	0	95	94.05
2.	1	5	4.95
3.	2	1	.99
4.	3	0	0
5.	>4	0	0
6.	Total	101	100

It is seen from table 13 that 94.05% of the researchers have not a single publication to their account. 4.95% of the Horticulture Researchers have a single conference paper to their credit. There is only one researcher who has two conference papers added to its RG profiles.

5.14 No. of Pre-Prints

Table 14

S.No.	Pre-Print (No.)	Members	Members (%)
1.	0	95	94.05
2.	1	1	.99
3.	2	4	3.96
4.	3	0	0
5.	>4	1	.99
6.	Total	101	100

Pre-prints is generally defined as some pieces of writing which are either printed in advance or issued prior to the general publication of the piece of work. 94.05% of the Horticulture researchers still need pre-prints to their RG accounts. The minority of the researchers have their pre-prints in the category of one and greater than four with. 99%. In the category of two pre-prints, there are four horticulture researchers who have their pre-prints publications. There are no researchers in the category of three ranges.

6. CORRELATION BETWEEN RGSCORE AND OTHER RESEARCH METRICS

Correlation between RGScore and Publications

Spearman's Rank correlation coefficient (ρ) was calculated between RGScore and publications and was found to be -0.76. This indicates that their publications are given less priority, which the researchers need to be concerned about. It is to be noted that there are many of the researchers who may, due to some circumstances, have failed to upload their earlier publications or some pre-prints. There seems to be more creation awareness about the importance of uploading documents in social media academic networking such as Researchgate, Google Scholars, etc.

Correlation between RGScore and Full-Text

The calculation of RGScore and Full-Text was made using Spearman's Rank correlation coefficient (ρ), and it was found to be -0.25. The negative correlation shows that the horticulture researchers are declining their interest in uploading their published documents. The researchers need prior interest to make more work of their respective RG accounts, wherein fellow researchers will access those publications where the RG metrics in today's contemporary world play an important role in measuring scholarly communications.

Correlation between RGScore and Reads

By using the formula of Spearman's Rank correlation coefficient (ρ), it was found that there is a negative correlation between RGScore and the reads of the Horticulture Researchers. The result signifies that there are fewer interesting topics which were covered in their area of study. It also indicates that the researchers are not able to produce burning issues in their respective disciplines.

Correlation between RGScore and Citations

Spearman's Rank correlation coefficient (ρ) formula indicates that -0.12 points in the correlation between RGScore and citations. The negative correlation highlights that the negative growth poses a major setback for the researchers of the discipline. The researchers of the horticulture discipline need to take some serious measures in light of the improvement of the discipline.

Correlation between RGScore and H-Index

The correlation of RGScore and H-Index was calculated using Spearman's Rank correlation coefficient (ρ) formula and found that there is a negative correlation between the two. H-index is a metric for evaluating the cumulative impact of an author's scholarly output and performance. The negative correlation indicates the quality and quantity aspects of their research performance.

Correlation between RGScore and No. of Followers

The coefficient and correlation of RGScore and the Number of followers are determined using Spearman's Rank correlation coefficient (ρ) formula and found to have a negative correlation between the two variables. -0.51 is the core value where the declination remarks of their research work, though only a few of the researchers are carrying out some of the excellent work in the discipline of Horticulture.

Correlation between RGScore and No. of Followings

The relation of these two variables, i.e. RGScore and the Number of followings, are again indications of negative growth with -0.62 of the variables taken into consideration. The same explanation is applied to the previous explanation of the number of followers, as both complement each other.

Correlation between RGScore and Research Interest

The negative correlation between RGScore and Research Interest is calculated using Spearman's Rank correlation coefficient (ρ) formula. It was found that the negative correlation (-0.33) has a direct impact on the status of the Horticulture Researchers as it indicates that the researchers are not following some standard guidelines to carry out their products in some standardised platform.

Correlation between RGScore and Publications (Articles, Books, Chapters, Conference Papers, Pre-prints)

Publications are further divided into several types of items, such as articles, books, chapters, conference papers, and pre-prints. The correlation between RGScore and Publications is calculated between these variables, and a negative correlation was found between them except in terms of no. the books with 1 point in aggregate. The negative correlation is a marked decrease in interest in the area of publication. Awareness about the publication of the research item in electronic format is another element that was taken into consideration.

7. DISCUSSION AND CONCLUSION

The present study was an attempt to examine the Horticulture Researchers of Assam Agricultural University, Assam, who were the members of ResearchGate profiles. The study applied an altmetrics approach to analyse the Horticulture researchers, and Spearman's correlation coefficient was calculated to understand the correlations.

In terms of publication, the researchers lack their skills and knowledge, which needs serious improvement. Only a few researchers are able to publish their research work in a more quantitative manner than other researchers. Though 101 Researchers have their accounts in the ResearchGate profiles, they failed to publish a larger number of publications. Further, it was also found that the research has several publications on their account, but they failed to upload their research work to the RG profiles. It was also observed that the senior researchers have good publications to their account, but they are either unaware or extremely technically unsound about the latest technological advancement in their field.

Earlier, citations are considered an important tool for measuring the scholarly communications of the researchers and the impact of the journal. The majority of the researchers have fewer citations, which remarks negatively on the growth of horticulture researchers. The researchers need more time to understand the usability and validity of these contemporary academic social networking sites.

Another key metric for the measurement of scholarly communication is the number of followers and followings. The study indicates that there are no fewer researchers who have a majority of the researchers. Research interests have also shown that there is a minority of researchers who have had some fellow research mates showing interest or reading their projects' works.

The study also tried to analyse the correlation of RGScore with other research metrics by using Spearman's correlation coefficient formula (Nidheesh, 2010). The analysis has examined that there is a negative correlation between RGScore and other research metrics. The study has shown that the researchers of the Horticulture Department need to give priority to all those research ideas which have relevance to the present course of study. Though some traditional/ conventional topics are of utmost importance for the overall development of the subject matter, new or emerging areas need to be focused on wherein the readers or followers will be able to understand the methods and formulate their applicability as per their needs and convenience of their study matter. The present study also emphasises lots of future prospects for horticulture researchers where competition and prioritise to understand the significance of academic social networking sites such as ResearchGate, Academia, Google Scholars and others, which provide the platform for the upliftment of their Researcher's status and all development of their carrier profiles.

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AWARENESS, KNOWLEDGE AND USE OF OPEN-SOURCE LAW DATABASES IN NATIONAL LAW UNIVERSITY LIBRARIES IN INDIA: A STUDY

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ABSTRACT

The main purpose of this paper is to describe the awareness, knowledge and use of open-source law databases in selected National Law University Libraries. The present study covers two National Law University Library Users of the State of Karnataka and the State of Telangana in India. In the era of globalization, economic crises are a major issue for all nations. Since many libraries are unable to subscribe to electronic resources due to the high cost of subscription-based databases at this time, the idea of open access was created. There are no restrictions on the usage of e-resources, limited use requirements, or pricing in an open-access environment. Present day, the open-source electronic environment prevails in all sectors and plays a major role, including the information sector and especially in academic institutions.

Keywords: *Legal Education, Open-Source Law databases or Online Resources, National Law Universities, Digital Environment.*

1. INTRODUCTION

The availability of information sources and their use in Libraries is an important item to meet the information needs of the libraries attached to institutions. In contemporary libraries, the collection of information resources comprises books, cartographic materials, electronic resources, etc. Out of all these resources, electronic resources are significantly available in academic libraries, particularly law libraries. This situation made the libraries turn to electronic resources in their collections. The beginnings of electronic resources can be traced from magnetic tapes to resources available through intranet, internet, physical media, etc. The growth of electronic resources in any library largely depends upon library policies and the level of users of electronic resources. These resources are very expensive and unaffordable to Law Professionals, so there are a lot of chances to move to open resources.

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2. DEFINITION OF OPEN ACCESS

An open-source database is any database application with a codebase that is free to view, download, modify, distribute, and reuse. Open-source licenses give developers the freedom to build new applications using existing database technologies.

3. OPEN ACCESS USAGE OF ELECTRONIC RESOURCES IN LAW LIBRARIES

Open access resources have been provided through the library websites so that e-resources and references can be accessed from anywhere at any time. The link to the open-access resources is often provided on the University homepage, from where the database can be accessed by clicking on a link provided on the homepage. The open access to the e-resources is often Internet Protocol (IP) Address, which can be accessed only by connecting to the internet provided by the University by means of Wi-Fi. This facilitates and encourages the use of e-resources by the students and professors as the e-resources can be accessed within the campus, and there is no necessity to visit the library. Many independent organizations and websites provide open-access resources to the general public without any membership or subscription fee to access information and e-resources. For example, Advocate Khoj is a web portal that provides free legal information to the public and contains over 6000 legal forms, agreements, judgments, bare acts, rules, etc. American Doctoral Dissertations is also a free database that provides access to over 153,000 theses and dissertations. The Indian Law Institute also provides free access to ILI publications, the Annual Survey of India Law (ASIL), the Journal of Indian Law Institute and Commission and Committee Reports.

4. REVIEW OF LITERATURE

1. Bhatt (2018) discussed the future of digital books in Indian Law schools. A detailed discussion is made on Law libraries and electronic resources. The open-access e-book platforms and the prominent open-access platforms, such as Project Gutenberg, internet archives, the online book page open access publishing in European networks, Directory of open-access books, later e-book acquisition modules are discussed: Patrons driven acquisition and demand-driven acquisition and demand-driven acquisition in Indian Law school libraries e-books are playing a crucial role. Most of the users depend on e-books to fulfil their pursuits. The procurement of e-books of law by PDA or DDA suggested creating more facilities to enhance the use of Law books.
2. Musa & others (2015) conducted a study on the use of electronic databases by the academics of the faculty of sciences at a Nigerian University. The concept of electronic resources is stated in the profile of Umaro Musa Yaradua University, which briefly gathered

information from 100 respondents and analyzed the use of electronic databases, level of use of electronic databases, purpose of using electronic databases, satisfaction with the use of electronic databases and challenges on the use of electronic databases. They reported that open-access journal databases are thoroughly used; electronic databases are used for writing theses, teaching, etc. Suggested improvement of internet connectivity and uninterrupted power supply.

3. Ayoku and Okafor (2015) discussed the acquisition of ICT skills and competencies of librarians in Nigerian university libraries. This study was undertaken to understand the reasons why librarians need to acquire ICT skills. A good majority of respondents can create email and use it, about 50% of the respondents reported knowledge and world process, and a good majority reported knowledge and internet searching techniques. It was found that the majority of users need help with library databases, particularly open-access databases. The familiarity with database management web design was very low. The knowledge of search engines and directories was not promising. It recommended that librarians have adequate skills in e-mail and word processing, sufficient knowledge of search engines and directories, reasonable skills in database management, etc.

5. PROFILES OF THE NATIONAL LAW UNIVERSITIES

5.1 National Law School of India University (NLSIU)

The National Law School of India University (NLSIU) is situated in the city of Bangalore. It is a school of excellence in the field of law that imparts legal education to undergraduate as well as graduate students. In 1988, the State of Karnataka's Legislative Assembly passed a bill designating NLSIU Bangalore as the first National Law School of its kind in the country to provide undergraduates with a five-year integrated law degree. To meet the demands of a society that is always changing, the institution is also actively involved in the field of socioeconomic research. The best law library in the nation is the Shri Narayan Rao Melgiri National Law Library at NLSIU.

5.2 National Academy of Legal Studies and Research (NALSAR)

The National Academy of Legal Studies and Research, often known as NALSAR University of Law, was established in the state of Andhra Pradesh using the same principles as NLSIU Bangalore. This was the second law university in India to be established in 1998, following NLSIU Bangalore, thanks to an Act that the Andhra Pradesh State Legislative Assembly (Act 34 of 1998) enacted. The institution aims to ensure students' holistic development while offering top-notch legal education and producing professionally competent, socially conscious attorneys. The Institute has been regarded as one of the top two law schools in India for the past 20 years and is known as the law school of excellence.

6. OBJECTIVES OF THE STUDY

- To study the Awareness of Open access electronic resources in Law university libraries.
- To study the knowledge of users on Open-access electronic resources in Law University Libraries.
- To study the Use of Open-access electronic resources in Law university libraries.

7. METHODOLOGY

To elicit the needful information from the respondents in the present study, it is decided to apply one of the popular research methods- the survey method. In view of the objectives of the present study, it is meaningful to collect the needed information from the Library users of selected Law Universities in India.

8. SAMPLE COVERAGE

The total number of respondents covered for the study is 355, of whom 186 are from NALSAR University, and 169 are from NLSIU. Questionnaires were used for the collection of primary data from the faculty members, Research Scholars, LLM and B.A.LLB students of Law Universities were identified for the survey.

9. DATA ANALYSIS

9.1 USE OF LAW ELECTRONIC DATABASES

The main interest of the present study is to bring out the difference in awareness, knowledge and use of different electronic databases in the subject of law by the respondents from the two universities. Accordingly, information was gathered on the respondents' levels of awareness, knowledge and use of different open source databases, frequency of use of the databases, method of accessing, understanding of different e-databases and which database is most popularly used. Responses relating to these aspects are analyzed and presented here separately for each aspect of the study.

9.1.1 Awareness, Knowledge and Use of Open Source Databases in LAW

The level of awareness, knowledge and Use of Open-Source databases in law by the respondents is shown in Table 1 (Fig. 1).

Faculty Group

Awareness & Knowledge of Open Source Databases

In the faculty group, all three members from NLSI U reported awareness and knowledge of open databases law khoj, advocate khoj and Indian Kanoon, and two have reported awareness and knowledge of the world e-book library. Although all three are aware of the legal sutra, knowledge of it is reported by only two of the three.

Table 1: Level of Awareness, Knowledge and Use of Different Open Source Databases in Law

E_Resource Type	Faculty		X2	LLB Students		X2	LLM Students		X2
	N	NISU	(d.f.=1)	N	NISU	(d.f.=1)	N	NISU	(d.f.=1)
	n=21	n=3		n=143	n=133		n=22	n=33	
AWARENESS									
Law Khoj	81.0	100.0	0.686	87.4	92.5	1.942	90.9	93.9	0.180
Advocate Khoj	95.2	100.0	0.149	82.5	94.7	10.038*	95.5	90.9	0.404
Legal Sutra	57.1	100.0	2.057	47.6	70.7	15.199*	72.7	57.6	1.310
World e-book Library	38.1	66.7	0.882	45.5	63.9	9.460*	68.2	42.4	3.513
Indian Kanoon	100.0	100.0	--	96.5	95.5	0.185	100.0	100.0	--
KNOWLEDGE									
Law Khoj	66.7	100.0	1.412	81.8	87.2	1.528	72.7	84.8	1.212
Advocate Khoj	81.0	100.0	0.686	79.0	89.5	5.618*	86.4	81.8	0.199
Legal Sutra	42.9	66.7	0.599	34.3	56.4	13.634*	54.5	48.5	0.194
World e-book Library	28.6	66.7	1.714	32.9	50.4	8.713*	45.5	36.4	0.455
Indian Kanoon	90.5	100.0	0.312	95.8	94.7	0.175	100.0	100.0	--
U S E									
Law Khoj	61.9	100.0	1.714	78.3	82.7	0.842	68.2	81.8	1.360
Advocate Khoj	66.7	100.0	1.412	72.7	80.5	2.283	81.8	81.8	0.000
Legal Sutra	38.1	66.7	0.882	27.3	45.9	10.309*	27.3	45.5	1.849
World e-book Library	14.3	66.7	4.367*	24.5	40.6	8.202*	27.3	30.3	0.059
Indian Kanoon	90.5	100.0	0.312	93.7	91.0	0.730	95.5	93.7	0.059
* Value Significant @ 5% level									

In NALSAR U, all are aware of Indian kanoon, and 91 per cent reported knowledge of the same. About 95 percent are aware of advocate khoj and the percentage reporting knowledge of the same is 81. Awareness about law khoj is reported by 81 per cent and knowledge by 67 per cent. The level of awareness and knowledge about legal sutra is 57 and 43 per cent, respectively. Awareness about the world of e-book libraries is reported by only 38 per cent and knowledge by 29 per cent.

Use of Open Source Databases

All three members from NLSI U have reported the use of the databases –law khoj, advocate khoj and Indian kanoon. Two of the three have reported the use of legal sutra and world e-book library. In NALSAR U, 91% have reported the use of Indian kanoon, 67% reported the use of advocate khoj, 62% use of law khoj, 38% reported the use of legal sutra, and 14% reported the use of world e-book library.

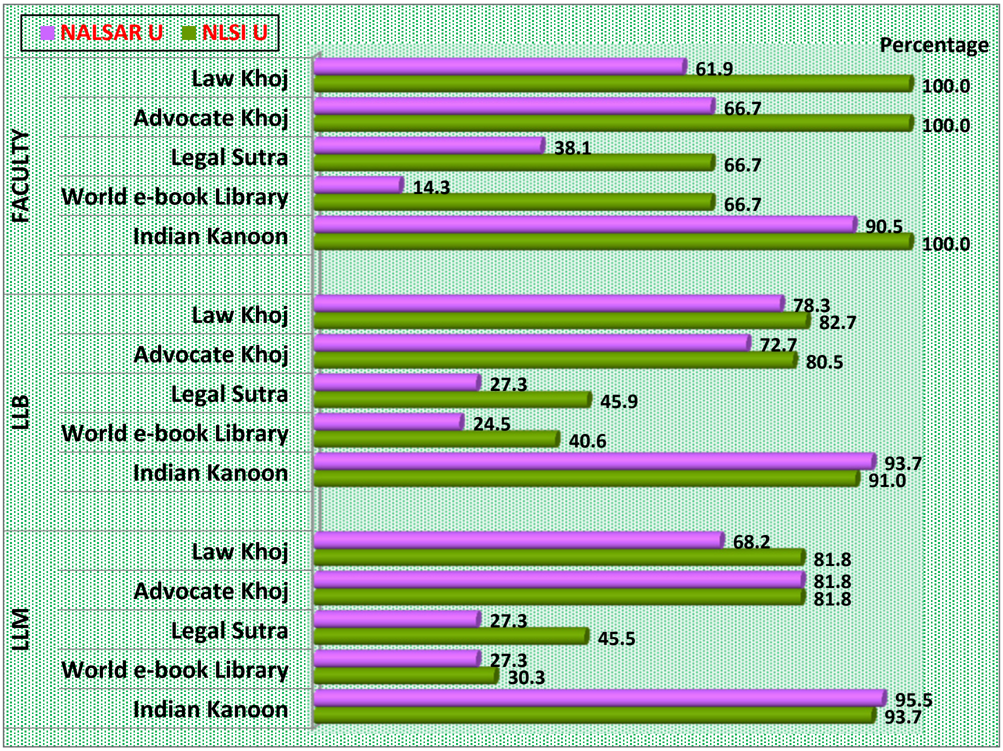

Fig. 1: Use of Open Source Databases in Law

LLB Students Group

Awareness & Knowledge of Open Source Databases

The levels of awareness and knowledge about the open databases appear to be higher in NLSI U compared to NALSAR U. The differences in awareness and knowledge of three databases between the two universities are found statistically significant with regard to advocate khoj, legal sutra and world e-book library.

From NALSAR U, awareness of the database Law Khoj is reported by 87%, and knowledge of the same is reported by 82%, while 93% from NLSI U reported awareness and 87% reported knowledge of Law Khoj. Awareness and knowledge of advocate khoj are reported by 83 and 79 per cent, respectively, from NALSAR U and 95 and 90 per cent, respectively from NLSI U. Awareness, and knowledge of legal sutra is reported by 48 and 34 per cent, respectively, from NALSAR U and from NLSI U by 71 and 56 per cent respectively. In the same way, 46 per cent of NALSAR U and 64 per cent from NLSI U reported awareness of the world e-book library, while knowledge of the same was reported by 33 and 50 per cent, respectively, from the two universities. Awareness and knowledge of Indian Kanoon are reported by 97 and 96 per cent, respectively, from NALSAR U and from NLSI U 96 and 95 per cent, respectively.

Use of Open Source Databases

Use of almost all the listed open databases appears to be more in NLSI U compared to NALSAR U, and the differences in use between the two universities are found statistically significant with regard to the use of two databases – legal Sutra and World e-book library.

With regard to the use of open databases in the LLB students group, use of database Law Khoj is reported by 83% of NLSI U and 78% of NALSAR U. Use of advocate Khoj is 73% from NALSAR and 81% of NLSI U. Use of the legal sutra is 27% in NALSAR U and 46% in NLSI U. World e-book library are used by 41 per cent from NLSIU and 25 per cent from NALSAR U. About 94 per cent from NALSAR U and 91 per cent from NLSI U reported use of the database Indian Kanoon.

LLM Students Group

Awareness & Knowledge of Open Source Databases

The levels of awareness and knowledge about the open databases appear to be slightly higher in NALSAR U compared to NLSI U among the LLM students. The differences in awareness and knowledge between the two universities are not found to be statistically significant with regard to any of the listed databases among the LLM students.

From NALSAR U, awareness of the database Law Khoj is reported by 91% and knowledge of the same by 73%, while 94% from NLSI U reported awareness and 85% reported knowledge of Law Khoj. Awareness and knowledge of advocate khoj are reported by 96 and 86 per cent, respectively, from NALSAR U and 91, and 82 per cent, respectively from NLSI U. Awareness and knowledge of legal sutra are reported by 73 and 55 per cent, respectively, from NALSAR U and from NLSI U by 58 and 49 per cent respectively. In the same way, 68% of NALSAR U and 42% of NLSI U reported awareness of the world e-book library, while knowledge of the same is reported by 46% and 36%, respectively, from the two universities. Awareness and knowledge of Indian Kanoon are reported by all the respondents (100%) from the two universities.

Use of Open Source Databases

Use of almost all the listed open databases appears to be more in NLSI U compared to NALSAR U, and there are no statistically significant differences in the use of the listed databases between the two universities among the LLM students.

With regard to the use of open databases in the LLM students group, the use of database Law Khoj is reported by 82% of NLSI U and 68% of NALSAR U. Use of advocate Khoj is 82% from both universities. Use of legal sutra is 27 per cent in NALSAR U and 46 per cent of NLSI U. World e-book libraries are used by 30 per cent of NLSIU and 27 per cent of NALSAR U. About 96 per cent of NALSAR U and 94 per cent of NLSI U reported use of the database Indian Kanoon.

SUGGESTIONS AND CONCLUSION

The use of e-resources in law libraries has grown exponentially in the past decade. Thus, it can be inferred that a major portion of the generation is not aware of the intricacies surrounding access to online information. Computer education still needs to be part of the curriculum in most schools, and thus, students need to be made aware of the technical aspect of access to information. The elderly generation of academicians and research scholars is put in a disadvantageous position due to the lack of awareness of technical intricacies surrounding the use of these resources. The condition is further degenerated in the rural and backward areas that have not yet been electrified, do not use computers, and still rely on traditional libraries and resources for information.

Law libraries across the country should undertake a systematic and collusive effort to create awareness of the use of e-resources to access information. To this effect, user orientation programs, seminars, conferences and workshops should be organized by the law school libraries to train, equip, educate, enlighten and encourage the library staff, academicians, research scholars and other clientele with the knowledge of using e-resources using computers and mobile devices.

The library staff should be provided specialized training and knowledge in the operation of the internet and the management of e-resources. Every library should strive to develop and make available a manual on how to access and use e-resources on its premises to the users.

The libraries should invest in e-infrastructure such as computers and Wi-Fi to create an environment that facilitates the use and access of e-resources amongst the users. The library staff should make all the online legal or other databases available on the University website and should update them at regular intervals. The libraries should also provide Internet Protocol (IP) address-based remote access facilities to their users so that the information can be accessed campus-wide and even outside the campus. Trained IT staff should also be appointed to this position to handle any technical issues that might arise in the course of the use and access of e-resources.

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GLOBAL RESEARCH TRENDS ON OPEN EDUCATIONAL RESOURCES: A BIBLIOMETRIC ANALYSIS

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ABSTRACT

Open Educational Resources (OER) has emerged in the last two decades with the swift growth of technology and its interventions in education. The Open Educational Resources (OER) have become popular among the educators. The primary objective of this study is to analyse global research trends on open educational resources. This analysis aims to understand the research landscape better, identify significant trends, and support informed decision-making. For this study, the data was derived from the Scopus scientometric database covering the period of 2013 to 2022. A total of 669 publications with 8332 citations were found during the search. Most publications published on the subjects are in social science (54%), followed by computer science (18%) and engineering (6%). Burgos, Hilton, and Wiley were the most prolific and impactful authors. It was found that for effective and impactful collaboration in two and three authors, 3.23 is the highest collaborative index, 0.90 is the collaborative degree, and 0.60 is the collaborative coefficient in 2022. The highly cited paper, "Ocean Basin Evolution and Global-Scale Plate Reorganization Events since Pangea Breakup by RD Muller, " was published in 2016 and received 689 citations. The journal "International Review of Research in Open and Distance Learning" was the most preferred source. Also, highly productive institutes with Open Educational Resources, funding agencies and countries were observed.

Keywords: *Open Educational Resources, Bibliometrics Analysis, Open Access, MOOC, Learning Object*

1. INTRODUCTION

The concept of Open Educational Resources (OERs) has emerged steadily in the last two decades. With the rapid growth of technology and its intervention in education, the OERs

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have become popular in the education sector. Also, learners need to engage in a self-paced and independent lifelong learning experience. The OERs have created opportunities for alternative learning methods and the dissemination of online learning resources (Patel et al., 2021). OECD's paper on the Expert Meeting on Open Educational Resources reported the history of OER. This paper mentioned that the term "learning object", coined by Wayne Hodging in 1994, has become widely used by educators. In 1998, David Wiley targeted the educational community and coined the word "open content". Subsequently, the Creative Commons was founded by Lary Lessings and others in 2001 and set the Open Publication License. MIT launched Open Course Ware to distribute university courses freely for unrestricted access and non-commercial use. UNESCO held a Forum in 2002 that "wish[ed] to develop together a universal educational resource available for the whole of humanity." They chose the term "open educational resource" (Organisation for Economic Cooperation and Development, n.d.).

UNESCO defines "Open Educational Resources (OERs) are teaching, learning or research materials that are in the public domain or released with intellectual property licences that facilitate the free use, adaptation and distribution of resources" (UNESCO, 2017). David Wiley defined the terms "open content" and "open educational resources" as any copyrightable work (traditionally excluding software, which is described by other terms like "open source") that is either (1) in the public domain or (2) licensed in a manner that provides users with free and perpetual permission to engage in the 5R activities, such as Retain, Reuse, Revise, Remix and Redistribute (Wiley, n.d.).

Mishra et al. (2022) opine Open Education Resources (OER) can enhance access, teaching quality, and costs in developing nations, making them essential worldwide. The knowledge economy and local resources drive global competitiveness. Therefore, well-educated people must be productive and creative. The OER movement promotes open information, digital teaching, learning, and research materials.

Open educational resources (OER) refer to digital content that is freely accessible online, without copyright or licensing limitations, and can be used for lifelong learning without expense.

2. REVIEW OF LITERATURE

A study on bibliometric mapping on Open Educational Resources was done by Zancanaro et al. (2015) for mapping publications to related OER dating from 2002 to 2013. They have retrieved data from Scopus, Web of Science and OER Knowledge Cloud open repository and used the bibliometrics analysis method to explore scientific production in OER, with parameters such as (a) number of publications per year, (b) most cited publications, (d) most productive authors, institutions, and countries, and (e) most referenced bibliography by the authors. In this study, 544 (n) papers were analysed. The study revealed that OER is a promising field for researchers as *Open Movement* spreads and catches up.

Wang, Liu, Li & Gao (2017) examined Open Educational Resources (OER) research using the lens of bibliometrics spanning from 2002 to 2017. The data of publications n=910 was extracted from the Web of Science. The study's key findings indicate that Spain, the United States, England, Romania, and China are the top countries producing research on Open Educational Resources (OER). These countries play an important role in the development of collaborations among researchers. Also, the *"International Review of Research in Open and Distance Learning"* was identified as the most influential journal in the field. The UK Open University was the most productive institute. This study presented a complete overview of Open Educational Resources (OER) research, including its historical development and possible implications for future research.

Papić (2022) conducted a scientometric study on Open Educational Resources (OERs) and data considered for the study from 2018 to 2022. Significantly, OER research increased suddenly in 2020 during the COVID-19 pandemic. In this paper, the key findings were that the top author was Daniel Burgos, the top institute was The Open University, the USA was the top country contributor, and the *"International Review of Research in Open and Distance Learning"* was the top journal. Also, the study acknowledged collaborative trends among authors from China and Spain, Turkey and the USA, and South Africa and the USA.

Mishra et al. (2022) conducted a study to examine the significant influence of open educational resources (OER) on the educational environment, concentrating on its evolution driven by a mission-oriented approach. They have done a bibliometric study to examine the recent developments in Open Educational Resources (OER), using Scopus data and focused on five prominent subthemes. They analysed the data in their study and examined research trends, the distribution of subjects, top journals, institutions, countries, and prominent authors. This paper analysed the development of Open Educational Resources (OER) from 2002 to 2020. They highlighted the scholarly contributions in the domain of OER, with particular emphasis on identifying significant obstacles.

The literature reviewed and found that Wang, Liu, Li & Gao (2017) conducted the study in 2017, and this study provides direction for further research. The Papic (2022) study covered five years of data, and the Mishra et al. (2022) study analysed the data up to 2020. Therefore, the current development in this field has not been reported. They have yet to report funding agencies which are supporting and promoting OERs.

3. OBJECTIVES OF THE STUDY

With a period of study from 2013 to 2022 and using the Scopus database, the following are the objectives of the present study:

3.1 To study the growth of the scholarly output on Open Educational Resources

3.2 To identify the Top authors whose contribution is at the maximum level and highly impacted authors

3.3 To determine authorship pattern and collaborative index
3.4 To identify the Top cited papers on Open Educational Resources
3.5 To identify the source titles of the literature
3.6 To identify the Affiliations of the top institutions in the production of literature, i.e., Open Educational Resources
3.7 To determine the funding agencies for the production of open educational resources
3.8 To assess the country-wise productivity of the literature

4. METHODOLOGY

The study aims to identify the growth of scholarly output, productivity, and its impact on Open Educational Resources from 2013 to 2022. Quantitative research methodology has been used to perform the bibliometric analysis.

4.1 Data Collection

The authors used the search string mentioned below to retrieve data from the Scopus database on 28th September 2023 and initially searched with the primary keyword "Open Educational Resources". After retrieving the data, it was found that there were variations in the primary keywords, which appear in the below search string as exact keywords. Including this variation and filtering the data using the time period, the 1506 (n) records were retrieved. Going further, three more filters were applied as appearing in the search string, i.e., "Exact keywords (variation of OERs)", "exclude articles in press" and "limit to Article and Review papers", the 669 records were retrieved to analyse.

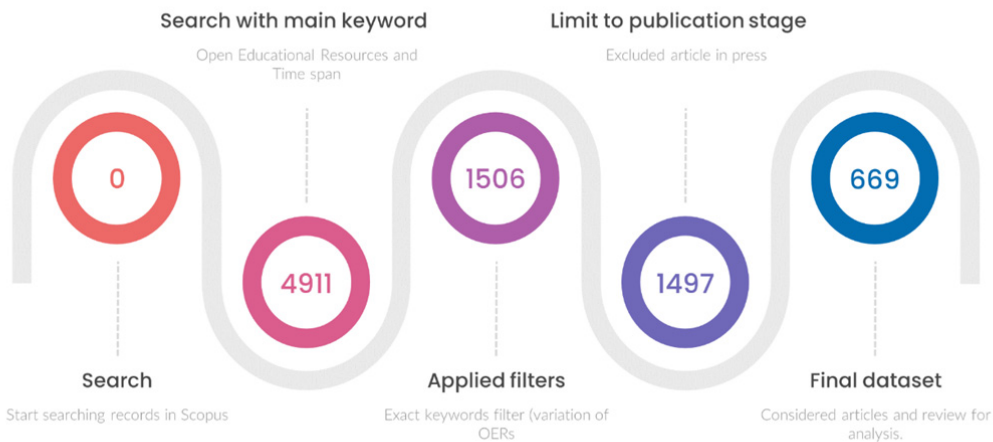

Fig. 1: Search process of the data from Scopus

Final Search String:

TITLE-ABS-KEY (open AND educational AND resources) AND PUBYEAR > 2012 AND PUBYEAR < 2023 AND (LIMIT-TO (EXACTKEYWORD, "Open Educational

Resources") OR LIMIT-TO (EXACTKEYWORD, "Open Educational Resources (OER)") OR LIMIT-TO (EXACTKEYWORD, "Open Education Resources") OR LIMIT-TO (EXACTKEYWORD, "Open Educational Resource") OR LIMIT-TO (EXACTKEYWORD, "Open Educational Resources (OERs)")) AND (LIMIT-TO (PUBSTAGE, "final")) AND (LIMIT-TO (DOCTYPE, "ar") OR LIMIT-TO (DOCTYPE, "re")) (Scopus, n.d.)

4.2 Data Analysis

The data has been analysed using a set of scientometric indicators to understand in a comprehensive manner and quantify the intricate dynamics of the collaborative nature of research in the domain of open educational resources. Yadav et al. (2019) have used the following metrics in their study on authorship and collaboration patterns in the SRELS Journal of Information Management, and Kuri et al. (2023)each with seven papers and 139 and 121 citations, respectively. China leads the list of contributing countries, with 108 papers and 731 citations, followed by the United States (51 also used these metrics in their study on mapping and visualisation of global research output of Military Stealth Technology. Similarly, in the present study, these metrics were used in authorship patterns in Tables 3 and 4 to calculate and understand the collaboration of authors.

Collaboration Index

The collaboration Index (CI) is determined using the formula proposed by Lawani (1980) as follows:

$$CI = \frac{\sum_{j=1}^{A} jfj}{N}$$

Where,

A = the total number of authors per article

j = the number of authors in an article

fj = the number of j-authored articles, and

N = the total number of articles published in a year

Degree of Collaboration

The degree of collaboration (DC) is quantified using a formula proposed by Subramanyam (1983), as shown below:

$$DC = 1 - \frac{f1}{N}$$

Where,

f1 = the number of single-authored articles

N = the total number of articles published in a year

Collaboration Coefficient

The collaboration coefficient (CC) has been calculated using the formula proposed by Ajiferuke et al. (1988), as stated below:

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

Where,

j = the number of authors per article

fj = the number of j-authored articles

N = the total number of articles published in a year, and

A = the total number of authors per article

4.3 Software Used for Data Analysis and Visualisation

Data was derived from the Scopus database in CSV format and was analysed using R Studio, Version 2023.06.0 Build 421, BiblioShiny, and VOSViewer. The data is represented in the following tables, graphs, and charts.

5. RESULTS & DISCUSSION

The data has been analysed to be interpreted, and the summary of analysed data as below:

Table 1: Basic Information of Data

MAIN INFORMATION ABOUT DATA	
Timespan	2013-2022
Sources (Journals, Books, etc)	282
Documents	669
Annual Growth Rate %	7.04
Document Average Age	4.71
Average citations per doc	12.45
References	21399
DOCUMENT TYPES	
Article	644
Review	25

5.1 Annual Growth and Impact of Scientific Output

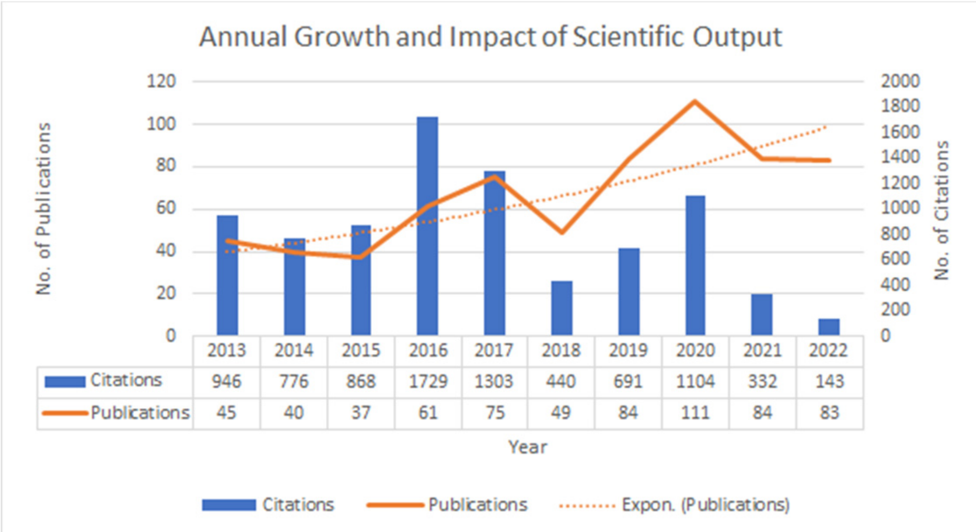

Fig. 2: Annual Growth and Impact of Scientific Output of Open Educational Resources

The above figures show the positive annual growth of scientific output and its impact. The highest publications (n=111) were made in 2020, and the highest citations (n=1729) were received in 2016. The data analysis shows an exponential growth in publications.

Table 2: Annual Performance of Scientific Output on Open Educational Resources

Year	TC	% of TC	TP	% of TP	ACPP	ACPY	Citable Years
2013	946	11.35	45	7	21.02	1.91	11
2014	776	9.31	40	6	19.4	1.94	10
2015	868	10.42	37	6	23.46	2.61	9
2016	1729	20.75	61	9	28.34	3.54	8
2017	1303	15.64	75	11	17.37	2.48	7
2018	440	5.28	49	7	8.98	1.50	6
2019	691	8.29	84	13	8.23	1.65	5
2020	1104	13.25	111	17	9.95	2.49	4
2021	332	3.98	84	13	3.95	1.32	3
2022	143	1.72	83	12	1.72	0.86	2
Total	**8332**	**100.00**	**669**	**100**			

TC=Total Citations, TP=Total Publications, ACPP=Average Citations per Paper, ACPY= Average Citations per Year

The data shown in Table 2 demonstrates the study of research output on Open Educational Resources (OER), indicating a steady increase in Total Citations (TC) over time. The highest number of citations 1729, was recorded in the year 2016. Nevertheless, there has been a decrease in research activity for the years 2021 and 2022, indicating a change in the areas of study being prioritised. The impact distribution, shown as a % of TC and Total Publications (TP), reached its highest point in 2016, suggesting a very significant year. The metric of Total Citations (TC) per article reached its highest point in 2016. However, in the following years, there has been a decline, suggesting a possible dilution of impact. Although the total number of TCs per year may vary, the average citation rate per publication remains consistent. The declining pattern in Citable Years indicates that newer OER papers are being cited faster, highlighting their increasing relevance over time. This approach facilitates researchers' understanding of OER research's dynamic expansion and influence, providing guidance for strategic planning in future investigations.

5.2 Subject Areas Contributed

Several documents in various subject areas were published as Open Educational Resources. Figure 3 shows that significant documents were published in the area of Social Sciences, i.e. 54%. Second to it is Computer Science, where 18% of documents were published, followed by 6% of documents in Engineering. The subject of Social Sciences was the main contributor to the scholarly output of Open Educational Resources.

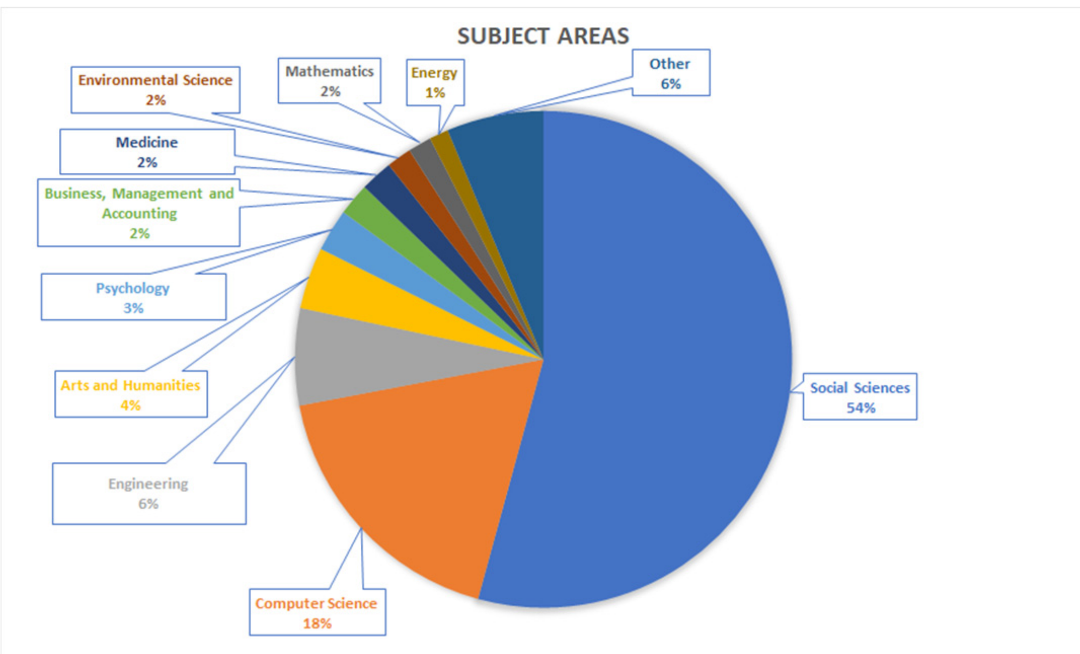

Fig. 3: Research Output by Subjects Area-wise

5.3 Most Prolific Authors

Table 3: Most Prolific Authors

S.No.	Author	Author's Affiliation	TP	TC	ACPP	AF
1	Burgos D.	UNIR Research, Universidad Internacional de La Rioja (UNIR), Madrid, Spain	13	338	26.00	3.94
2	Hilton J.	Brigham Young University, United States	11	635	57.73	3.06
3	Wiley D.	Brigham Young University, United States	11	449	40.82	2.18
4	Tlili A.	Smart Learning Institute of Beijing Normal University, Beijing, China	10	280	28.00	1.75
5	Huang R.	Smart Learning Institute of Beijing Normal University, Beijing, China	8	276	34.50	1.28
6	Nascimbeni F.	UNIR Research, Universidad Internacional de La Rioja (UNIR), Madrid, Spain	8	304	38.00	2.13
7	Jung I.	International Christian University (ICU), Tokyo, Japan	6	89	14.83	1.51
8	Otto D.	University of Duisburg-Essen, Essen, German	6	50	8.33	3.17
9	Tang H.	Department of Educational Studies at the University of South Carolina, United States	6	87	14.50	3.67
10	Veletsianos G.	Royal Roads University, Canada	6	57	9.50	1.76

TP= Total Publication, TC= Total Citations, ACPP= Average Citations per Paper, AF=Articles Fractionalized

Table 3 demonstrates the presence of a heterogeneous cohort of highly productive authors within the realm of open educational resources. One noteworthy observation is that Hilton J. from Brigham Young University has achieved the highest overall number of citations (635) with an ACPP of 57.73, followed by Wiley D (449) with 40.82 ACPP. Burgos D. is the most prolific author with 13 publications and the highest Article Fractionalized score of 3.94 for collaboration. Researchers from many international universities make substantial contributions, underscoring the extensive influence of open educational resource research. Collaboration is a prevalent phenomenon, as indicated by the substantial prevalence of fractionalised values in scholarly articles. The study highlights the significance of international and joint efforts in making influential contributions to this field.

5.4 Highly Impacted Author

Figure 4 shows authors who have substantially impacted the scholarly literature, as determined by their h-index, highlighting the prominent positions held by Burgos D. and Wiley D. These authors have achieved an h-index of 8, signifying a noteworthy influence on the academic community. Hilton J., Huang R., and Tlili A. exhibit h-indices of 7, indicating moderate scholarly impact and productivity in their respective fields. Nasimbeni F., Tang H., Fischer L., Anderson T., and Chang T-W have significantly contributed to their respective fields, as evidenced by their h-indices ranging from 4 to 6. The h-index places significant emphasis on the enduring impact and influence exhibited by these authors within the academic community.

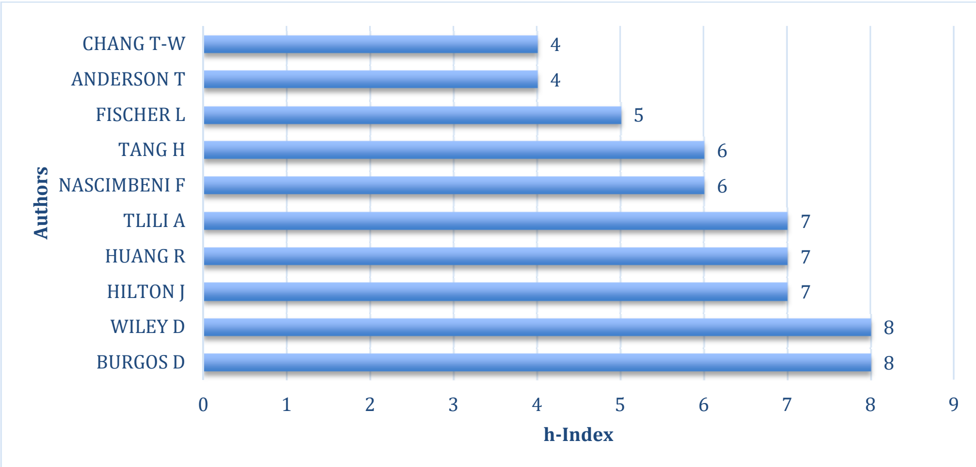

Fig. 4: Highly Impacted Author by h Index.

5.5 Authorship Pattern

Table 4: Authorship Pattern

Author Pattern	No. of Publications	No. of Citations	ACPP
1	133	1652	12.42
2	208	2047	9.84
3	142	1400	9.86
4	87	1186	13.63
5	42	531	12.64
6	28	360	12.86
7	11	180	16.36
8	4	52	13
9	3	6	2
10	2	2	1
12	4	872	218
14	2	6	3
26	1	29	29
93	2	9	4.5
Total	**669**	**8332**	**358.11**

[ACPP= Average Citations Per Paper]

Table 4 shows that the data exhibits a broad range of research author patterns, indicating varying degrees of academic output. Specific authors have accumulated many publications and citations, demonstrating their prolific contributions to their respective academic disciplines. Author 7 and 26 exhibit exceptional performance in terms of the highest ACPP, which suggests that their scholarly contributions consistently get a significant number of citations in each publication, hence showing a noteworthy level of scholarly impact. On the other hand, Authors 9 and 10 exhibit the lowest CPP, indicating a somewhat restricted influence in terms of citations. Author 12 exhibits an outlier status due to a remarkably high CPP, which can reasonably be qualified for a few highly impactful articles. The dataset emphasises the importance of citations as a primary measure of research effect, as evidenced by the diverse CPP values ranging from 1 to 218. This variation in research influence among these authors is notable. Publications authored by individuals with higher citation per publication (CPP) values tend to have a more significant impact within their respective academic disciplines, thus highlighting the significance of research that generates substantial influence.

Table 5: Authorship Pattern with Collaborative Measure

Year	Single Author	Two Authors	Three Authors	Four Authors	Five Authors	Six and More Authors	TP	TC	CI	DC	CC
2013	18	11	7	4	3	2	45	946	2.31	0.60	0.38
2014	7	15	6	6	4	2	40	776	2.78	0.83	0.52
2015	7	8	8	7	4	3	37	868	3.05	0.81	0.55
2016	9	22	16	9	1	4	61	1729	2.72	0.85	0.53
2017	16	25	18	11	5	0	75	1303	2.52	0.79	0.49
2018	12	20	10	4	1	2	49	440	2.35	0.76	0.45
2019	22	28	15	9	5	5	84	691	2.55	0.74	0.46
2020	20	29	25	15	9	13	111	1104	3.03	0.82	0.54
2021	14	23	20	10	3	14	84	332	3.08	0.83	0.55
2022	8	27	17	12	7	12	83	143	3.23	0.90	0.60
Total	**133**	**208**	**142**	**87**	**42**	**57**	**669**	**8332**	**2.76***	**0.79***	**0.51***

*[TP=Total Papers, TC=Total Citations, CI=Collaboration Index, DC=Degree of Collaboration, CC=Collaboration Coefficient] * Average of CI, DC and CC.*

The authorship patterns in Table 5 above reveal a notable transition towards collaborative research, marked by a diminishing number of single-author papers and a prevalence of two- and three-author collaborations. The total number of OER papers has steadily increased, peaking at 111 in 2020, indicating an increasing interest and output in the field. Collaborative metrics, such as the Collaborative Index and Collaborative Coefficient, demonstrate a growing trend, highlighting a collaborative pattern within the OER research community. The total collaborative metrics emphasise a healthy collaboration with an average Collaborative Index of 2.76, strengthening the significance of collaborative practices in advancing OER knowledge. Particularly, 2022 has the highest Collaborative Coefficient of 0.60, and a Degree of Collaboration of 0.90 indicates substantial collaboration among authors.

5.6 Highly Cited Papers

Table 6: Highly Cited Papers

S.No.	Paper	Title	DOI	TC	ACPY	Normalised TC
1.	MÜLLER RD, 2016, ANN REV EARTH PLANET SCI	Ocean Basin Evolution and Global-Scale Plate Reorganization Events since Pangea Breakup	10.1146/annurev-earth- 060115-012211	689	86.13	24.31
2.	HILTON J, 2016, EDUC TECHNOL RES DEV	Open educational resources and college textbook choices: a review of research on efficacy and perceptions	10.1007/s11423-016-9434-9	215	26.88	7.59
3.	HUANG R, 2020, SMART LEARN ENVIRON	Disrupted classes, undisrupted learning during COVID-19 outbreak in China: application of open educational practices and resources	10.1186/s40561-020-00125-8	149	37.25	14.98
4.	CRONIN C, 2017, INT REV RES OPEN DISTANCE LEARN	Openness and praxis: Exploring the use of open educational practices in higher education	10.19173/irrodl.v18i5.3096	146	20.86	8.40
5.	TOLKS D, 2016, GMS Z MED AUSBILD	An introduction to the inverted/flipped classroom model in education and advanced training in medicine and in the healthcare professions	10.3205/zma001045	142	17.75	5.01
6.	FISCHER L, 2015, J COMPUT HIGH EDUC	A multi-institutional study of the impact of open textbook adoption on the learning outcomes of post-secondary students	10.1007/s12528-015-9101-x	127	14.11	5.41
7	PURDY E, 2015, CAN J EMERG MED	The use of free online educational resources by canadian emergency medicine residents and program directors	10.1017/cem.2014.73	97	10.78	4.13

S.No.	Paper	Title	DOI	TC	ACPY	Normalised TC
8	MCKERLICH R, 2013, INT REV RES OPEN DISTANCE LEARN	Measuring use and creation of open educational resources in higher education	10.19173/irrodl.v14i4.1573	88	8.00	4.19
9	DIETZE S, 2013, PROGRAM	Interlinking educational resources and the web of data: A survey of challenges and approaches	10.1108/00330331211296312	82	7.45	3.90
10	DE MEDIO C, 2020, COMPUT HUM BEHAV	MoodleREC: A recommendation system for creating courses using the moodle e-learning platform	10.1016/j.chb.2019.106168	78	19.50	7.84

ACPY=Average Citations per Year

The above table shows highly cited papers in the field of Open Educational Resources. The paper titled *"Ocean Basin Evolution and Global-Scale Plate Reorganisation Events since Pangea Breakup"*, published in 2016, has received 689 citations and ACPY is 86.13. Hilton's paper "Open Educational Resources and College Textbook Choices" has garnered considerable attention within the academic community, with a total citation of 215 and TC per year being 26.88. Huang's paper "Disrupted classes, undisrupted learning during COVID-19 outbreak in China: application of open educational practices and resources" has received a total citation of 149, and ACPY is 37.25. These works have significantly impacted the research on Open Educational Resources.

5.7 Most Preferred Journals for Publishing Articles on OER

Table 7: Top Sources on OER

S.No.	Sources	TP	TC	ACPP	Rank
1	International Review of Research in Open and Distance Learning	85	1829	21.52	1
2	Educational Technology Research and Development	13	339	26.08	2
3	International Journal of Emerging Technologies in Learning	13	75	5.77	2
4	Journal of Interactive Media in Education	12	171	14.25	3
5	Library Philosophy and Practice	12	80	6.67	3
6	Sustainability (Switzerland)	12	16	1.33	3
7	Distance Education	11	205	18.64	4

S.No.	Sources	TP	TC	ACPP	Rank
8	Open Learning	10	185	18.50	5
9	British Journal of Educational Technology	9	199	22.11	6
10	Education and Information Technologies	9	78	8.67	6

[TP= Total Papers, TC=Total Citations, ACPP=Average Citation Per Paper]

Table 7 shows the top 10 most preferred journals for publishing scholarly output on Open Educational Resources from 282 journals. The *"International Review of Research in Open and Distance Learning"* emerges as a significant source with 85 total papers (TP) and a substantial total citation count (TC) of 1829, reflecting a high average citations per paper (ACPP) of 21.52. "Educational Technology Research and Development" follows closely, with 13 publications and commendable citations of 339, resulting in an ACPP of 26.08. While the *"International Journal of Emerging Technologies in Learning"* has modest citations, the ACPP is relatively low at 5.77, indicating room for increased citation impact. *"Distance Education"* and *"Open Learning"* stand out for their considerable citations and above-average ACPP, showcasing their impact in the field. *"Sustainability (Switzerland)",* though contributing 12 publications, has notably low citations and ACPP, suggesting potential for increased visibility. Overall, this analysis aids researchers in identifying key sources, understanding citation impact, and recognising potential areas for collaboration and improvement in research dissemination.

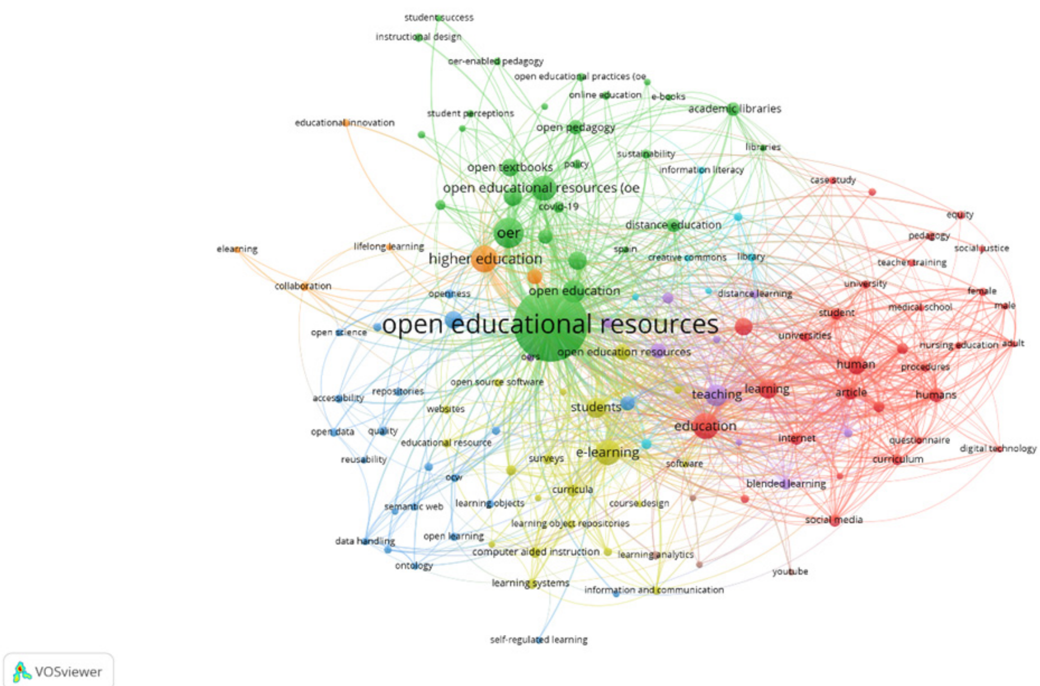

Fig. 5: Co-occurrence in Keywords

The above figure shows co-occurrence in keywords analysed by using VOSViewer software. There were seven clusters generated: Cluster 1 has 31 keywords, cluster 2 has 28 keywords, cluster 3 has 22 keywords, cluster 4 has 20 keywords, cluster 5 has 14 keywords, and Cluster 6 has 6 keywords. A total of 127 keywords were found with a minimum threshold of five times the keywords occurred. The keyword *"Open Educational Resources"* belongs to cluster two with 543 occurrences, link 125 and a total link strength of 1334, followed by the "OER" and "Higher Education" occurred.

5.8 Most Productive Affiliated Institutions of Corresponding Authors

Table 8: Most Productive Affiliated Institutions

S.No.	Affiliation	TP
1	Smart Learning Institute of Beijing Normal University	22
2	The Open University	19
3	Universitat Oberta De Catalunya	18
4	Universidad Internacional De La Rioja (Unir)	16
5	Open University	15
6	Beijing Normal University	14
7	University of Florida	14
8	University of Duisburg-Essen	13
9	Brigham Young University	12
10	University of Cambridge	12

Table 8 provides insights into the institutions that have demonstrated high productivity levels in terms of scholarly output on Open Educational Resources (OER). These findings shed light on discernible patterns and trends within this domain. The Smart Learning Institute of Beijing Normal University has demonstrated a commendable commitment to Open Educational Resources (OER) research, as evidenced by its impressive total of 22 publications and also determined that The Open University and Universitat Oberta de Catalunya remarkable involvement in the field, as evidenced by their respective TP of 19 and 18. This study highlights significant insights for researchers, as it efficiently recognises top institutions that contributed to the Open Educational Resources (OER) field.

5.9 Top Funding Agencies

Table 9: Top Funding Agencies

S.No.	Name of Funding Agency	TP
1	European Commission	62
2	William and Flora Hewlett Foundation	39

S.No.	Name of Funding Agency	TP
3	National Science Foundation	24
4	Seventh Framework Programme	18
5	Horizon 2020 Framework Programme	16
6	Bundesministerium für Bildung und Forschung	15
7	Coordenação de Aperfeiçoamento de Pessoal de Nível Superior	15
8	Conselho Nacional de Desenvolvimento Científico e Tecnológico	11
9	Fundação de Amparo à Pesquisa do Estado de São Paulo	11
10	Erasmus+	8

Table 9 shows the top funding agencies that support the research on Open Educational Resources, where the primary funding organisations in Open Educational Resources (OER) research underscores the European Commission as a prominent advocate with 62 publications, demonstrating a substantial dedication. The William and Flora Hewlett Foundation has a strong presence with 39 publications, demonstrating significant global impact. The National Science Foundation, Seventh Framework Programme, and Horizon 2020 Framework Programme have significant contributions in terms of publications, with 24, 18, and 16, respectively. The German funding agency, Bundesministerium für Bildung und Forschung, and the Brazilian funding agencies, Coordenação de Aperfeiçoamento de Pessoal de Nível Superior and Conselho Nacional de Desenvolvimento Científico e Tecnológico, exhibit international diversity by providing support and funding for 15, 15, and 11 publications, respectively. The Fundação de Amparo à Pesquisa do Estado de São Paulo and Erasmus+ each contribute 11 and 8 publications, respectively, completing the list. This analysis facilitates academics' comprehension of significant factors influencing the OER environment, providing valuable insights for collaboration and strategic involvement.

5.10 Most Productive Countries (of Corresponding Authors)

Table 10: Top Most Productive Countries in OER Papers

S.No.	Country	TP	TC	Freq	SCP	MCP	MCP_Ratio
1	USA	129	1255	0.30	124	5	0.04
2	United Kingdom	32	429	0.08	28	4	0.13
3	Spain	24	282	0.06	17	7	0.29
4	China	23	462	0.05	7	16	0.70

S.No.	Country	TP	TC	Freq	SCP	MCP	MCP_Ratio
5	Germany	23	361	0.05	16	7	0.30
6	India	17	111	0.04	16	1	0.06
7	Brazil	12	44	0.03	11	1	0.08
8	Canada	11	153	0.03	10	1	0.09
9	Netherlands	10	115	0.02	5	5	0.50
10	Australia	9	130	0.02	7	2	0.22

[SCP= Single Country Publications, MCP= Multiple Country Publications]

Table 10 demonstrates the most productive countries of scholarly output on open educational resources (OER); the USA is the most productive country, leading with 129 total papers (TP) and a significant total citation count (TC) of 1255. The frequency (Freq), representing the average number of papers per researcher, is relatively high at 0.30, suggesting a prolific research community. The USA's emphasis on Single Country Publications (SCP) is evident, with a high SCP count of 124, underscoring a robust national focus. While the Multiple Country Publication (MCP) count is lower, the MCP ratio is minimal (0.04), indicating a preference for national collaborations. In contrast, China stands out for its balanced approach, with a higher MCP ratio (0.70), showcasing extensive international collaborations. This analysis supports investigators in understanding the global scenario of OER research, highlighting the USA's dominance, its collaborative patterns, and the potential for diverse worldwide partnerships in evolving OERs.

6. CONCLUSION

The bibliometric study analysed data collected from Scopus between 2013 to 2022. It demonstrated publication growth in Open Educational Resources, top highly impacted authors, authorship patterns and collaborative index, worldwide contributions, cited publications, and sources. In 2020, it showed that the maximum number of scholarly publications was out. Most publications covered the Social Science subject area, followed by Computer Science and Engineering. Burgos, Hilton and Wiley were the most prolific and highly impactful authors. A single author did 133 publications, and two and three authors collaborated on most publications. Collaboration is a prevailing phenomenon, shown in the growing number of works with several authors. Countries, institutions and funding agencies play a vital role and contribute to developing open educational resources research.

There is always further scope of research to explore more on Open Educational Resources. Further, emerging patterns, technological intervention in OERs, the impact of OER on higher education, and OER promotional strategies can be investigated. It will be essential to examine the impact of OER in attempting issues such as digital discrepancy, educational diversity, and inclusivity. Examining cutting-edge technology, like artificial intelligence and blockchain, into OER systems shows the possibility for success. In summary, it is crucial to constantly monitor OER developments and adjust to the changing educational environment to pursue future research in this area effectively.

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AN EVALUATIVE STUDY OF INDIAN CONTRIBUTIONS TO OPEN ACCESS SCHOLARLY COMMUNICATION IN SCIENCE

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ABSTRACT

The study examines Indian publications that are open-access scholarly communication in science. The data retrieved from the Web of Science database with the science citation index expanded to measure the contribution to science. 142091 open-access publications in India and 4644591 open-access publications worldwide were retrieved from the WoS database. A year-wise comparison of data, rankings of the countries, and the significant role of Indian contribution measured through data evaluation. India has secured 13th place in gold open access with 3.2%, 23rd place at gold-hybrid open access with 1.9% and 14th place in green OA publication with 3.3% of the total. The highest articles of the Indian institutions are the Indian Institute of Technology system and the NIT system, contributing 21087 (14.8 %) and 6875 (4.8 %) open-access articles, respectively. This paper will help us find out the growth of open-access publications and the current publication scenario, and we can get a clear perspective on Indian open-access scholarly communication.

Keywords: *Open Access, Scholarly Communication, Green open access, Gold open access, Hybrid open access*

1. INTRODUCTION

Open-Access (OA) is a generic word for information resources that are freely available in the public domain for use and consumption by scholars and the general public, with no subscription fees or access charges (Sahu & Arya, 2013). Open access is a new phenomenon in scientific publishing. To understand the OA philosophy, we have three open-access declarations, known as 'BBB' declarations. OA formally began with the Budapest open access declaration. *The* Budapest Open Access Initiative (2002) stated that to accelerate the research and remove the access barrier of literature; by this step, We may share the rich's information with the poor and the poor's learning with the rich, and thereby benefit the entire research community

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(Suber, 2011). The Berlin Declaration (2003) believes in and promotes the internet as a useful tool for a global perspective. The primary goal of this proclamation is knowledge dissemination and reflection within the scientific community. Bethesda Declaration (2003) stated that scientific research relates to the interdisciplinary process whereby each scientific result will immediately be informed to other related scientific communities. Here, the specialist will place the content online with a license granting the right to reuse (Kanjilal & Das, 2015). Open-access (OA) journals are scholarly journals available online to the reader "without financial, legal or technical barriers other than those inseparable from gaining access to the internet itself." They remove price barriers like subscription, licensing fees, pay-per-view fees and most permission barriers like copyright or licensing limitations (Beall, 2014). While open-access journals are freely available to the reader, there are still costs associated with publishing and producing such journals. "Some open access journals are financed by an academic institution, learning society or a government information centre.» Few journals demand the article processing charges (APC) by submitting the author to publish their articles immediately; both methods of article publishing refer to the Gold Open Access model. The Green Open Access model involves making research publications freely accessible to read via a repository. The journals are available to read online, often with fewer copyright and licensing restrictions (Misra & Agarwal, 2019).

1.1 Open Access Scholarly Communication

The term scholarly communication is based on the creation, publication, dissemination and discovery of academic knowledge published in peer-reviewed journals and books. In the 1660s, the first scientific association was founded, and scientific publications were first published. Scholarly journal publishing evolved into a subscription-based model controlled primarily by commercial publishers and scientific institutions after the formal system of disseminating scientific research discoveries began with the publication of the Philosophical Transactions of the Royal Society in 1965. However, the domination of a few in journal publishing caused access to scientific knowledge to become increasingly unaffordable and restricted, which alarmed scientific and academic communities. The open access (OA) publishing movement was created around the end of the twentieth century in reaction to these advances, which challenged the traditional subscription-based approach ("Scholarly Communication," 2022).

1.2 Review of Literature

Arunachalam (2006) explained that the open-access initiative in India, which has less than 3% of articles and poor citation rates compared to the global average, reflects India's inadequate contribution to new scientific knowledge. Indian research has low exposure and influence because it frequently goes overlooked by scientists in other labs. By obtaining Access to knowledge created globally and ensuring that its study is easily accessible to experts worldwide, India can improve its performance in the science field. Indian research may be better disseminated by opening journals and creating distributed and central archives. Open Access (OA) campaigning and creating institutional and national policies must address disagreement and misunderstanding among institutions, scientists, librarians and policymakers. **Keisham & Sophiarani (2008)** identify the OA movement as a pioneering movement that advocates for free online retrieval of scholarly publications, eliminates financial and legal restrictions, and ensures the most extensive possible dissemination of knowledge. Open Access means digital content access is immediate, accessible, and unrestricted. The main issues facing Indian researchers are their limited Access to international publications and the low exposure of their research papers. OA is a way to address this issue. During this time, several workshops and training sessions were held in India, where a few thousand librarians and IT professionals got training in using open-source software to create open-access repositories. The current study aims to introduce the idea of open Access while highlighting some of India's open-access journal initiatives. OA to knowledge and information helps close social gaps while enabling the digital addition of regular people, especially underprivileged populations. **Sahu et al.'s (2013)** study helps us understand India's open-access publishing practices. Scholars and the scientific community are involved in accessing the research outcomes from the internet free of cost. This study aims to measure the awareness of open-access publishing among the scholar community and evaluate the development of open-access among the researchers of IIT and IIMs. The growth of OA was analysed through collected data and secondary sources from websites, DOAJ, ROAR AND Open DOAR. The findings demonstrated that India's contribution has grown in recent years. It was discovered that the research community is becoming more and more aware of these open-access information sources and activities. **Nazim et al. (2023)** examined India›s open-access publishing trends and policy perspectives. Multiple data sources were used to compile the information needed to analyse OA trends, including the DOAJ, OpenDOAR, SCImago, and Web of Science (WoS) databases. The data from open-access journals and digital repositories were extracted using DOAJ and OpenDOAR. To determine the portion of OA in the research literature, data on Indian publications were obtained from the SCImago Journal, Country Ranking Portal, and WoS database. Despite requirements that research be deposited in open-access repositories, funding organisations in India do not offer scholars financial support to pay article processing charges. India does not yet have a national open access policy, but it intends to do so by implementing the "one nation, one subscription" approach. **Nazim & Zia (2019)** investigated the extent to which open access (OA) is being used by researchers at Indian Institutes of Technology (IITs), identified predictors of OA status (OA vs non-OA) and investigated the availability of OA versions of the publications as well as the platforms that the researchers used to store their papers. To know the design/methodology/approach, the WoS Core Collection database's advanced search aptitude was applied to search articles that IIT researchers had submitted. According to the findings, 68.70% of the 1,013 publications analysed had open-access versions. 10.26% of the total OA articles were available through the gold OA route, 58.44% were available through the green OA route, and the remaining

6.21 % were accessible over gold and green OA pathways. Research Gate and institutional repositories are the most popular options among IIT researchers, even if they use a variety of platforms for self-archiving their works. As more than 85% of self-archived publications were discovered as final PDF files, which are often not permitted by publishers, researchers in IITs need to be made aware of the self-archiving limitations of publishers.

1.3 Web of Science (Science Citation Index Expanded)

WoS offers subscription-based access to a variety of databases in many academic areas. The Institute for Scientific Information (ISI) established it, and it is presently handled by Clarivate Analytics (previously Thomson Reuters' Intellectual Property and Science business). The Web of Science indexing coverage has been expanded from 1900 to the present. Web of science's transdisciplinary coverage included 12,000 high-impact publications and 160,000 conference papers as of February 24, 2017. Eugene Garfield created the Science Citation Index (SCI) for the Institute for Scientific Information (ISI). Clarivate Analytics currently controls the company created in 1964 (formerly Thomson Reuters' Intellectual Property and Science business). More than 8,500 prominent journals from 150 categories are included in the Science Citation Index Expanded. From 1900 to the present, the bigger edition (Science Citation Index Expanded) includes almost 9,200 famous and notable publications in 178 categories.

2. OBJECTIVES OF THE STUDY

The study goal is to discover the outline of publication in the last five years. This study investigated the growth of open-access and Indian authors' contributions towards open-access scholarly communication in the last five years, from 2018 to 2022. The following objectives of the study are mentioned below. To measure the year-wise growth of the Indian contribution to open-access scholarly science equated to the world.

I. To compare the publication across five years.
II. To find out the rank of Indian scholarly communication in subscription-based journals and open-access journals.
III. To know the rank of Indian shares as per open access type.
IV. To find out the contribution of the top productive institutions in open-access publications.
V. To know the highly productive journals and discipline-wise open access publications.

3. METHODOLOGY

The study will concentrate on quantitative databases. As a result, quantifiable data from the WoS database was retrieved to determine the entire Indian research output in science. In Web of Science advanced search, a country field tag (CU=India) was employed" on

December 10 2023. SCI EXPANDED citation index was selected. All other indexes, such as Social Science Citation Index and Arts and Humanities Citation Index, were excluded. The search was restricted to English language and journal articles from 2018 to 2022. After applying this method, a total of 453379 articles were retrieved. Select the open-access filter refined using the "Open-access" option on the left-hand side of the result page to identify the Indian research output published in open-access journals. A total of 142091 articles were retrieved to analyse and identify the patterns. For the interpretation of data, the MS Excel tables were used. Moreover, the discussion is based on the tables. All the results and figures were prepared with the help of Microsoft Excel.

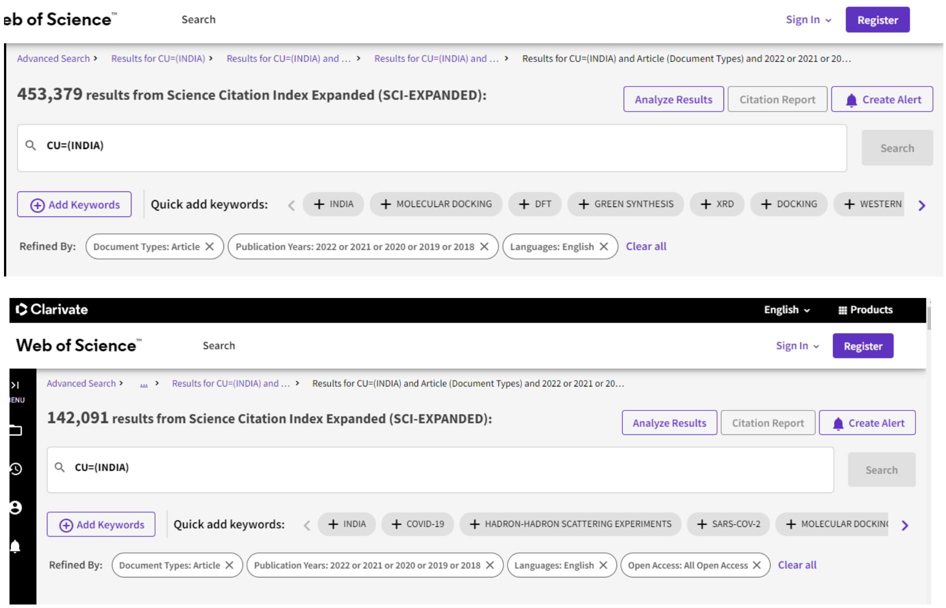

Fig. 1: Web of Science Search Result

4. DATA ANALYSIS

4.1 Year-wise Growth of Publications

Table 1 and Figure 2 illustrate the year-by-year publishing production and contribution in open access journals in science in India versus the rest of the globe from 2018 to 2022. There were 88,14,924 research publications published worldwide, with 46,44,591 (52.7%) being open-access articles. During the same time period, i.e. 2018-2022, a total of 4,53,379 research articles were published from India, with a contribution in open access journals of 1,42,091 (31.3%), accounting for nearly half of the world's open access contribution.

The graph depicts the annual publication output of Indian scholars and research articles published in open-access journals. It can be shown that India's overall research output has gradually increased over the study period, rising from 13.8% of research articles in 2018 to 26.8% of research articles in 2022. This indicates an increase in the number of articles contributed by Indian authors between 2018 and 2022. Figure 3 depicts an increasing trend of Indian authors publishing research articles in open-access journals.

Table 1: Yearly Publication Production in Terms of Global and Indian Contribution

Year	World			India		
	Total No. of Articles	OA Articles	OA Articles (%)	Total No. of Articles	OA Articles	OA Articles (%)
2018	14,77,889	7,12,365	15.3	70,370	19,648	13.8
2019	16,45,577	8,18,133	17.6	80,347	23,150	16.3
2020	17,90,112	9,39,716	20.2	90,922	27,323	19.2
2021	19,41,027	10,78,373	23.2	1,03,387	33,856	23.8
2022	19,60,319	10,96,004	23.6	1,08,353	38,114	26.8
	88,14,924	46,44,591	52.7	4,53,379	1,42,091	31.3

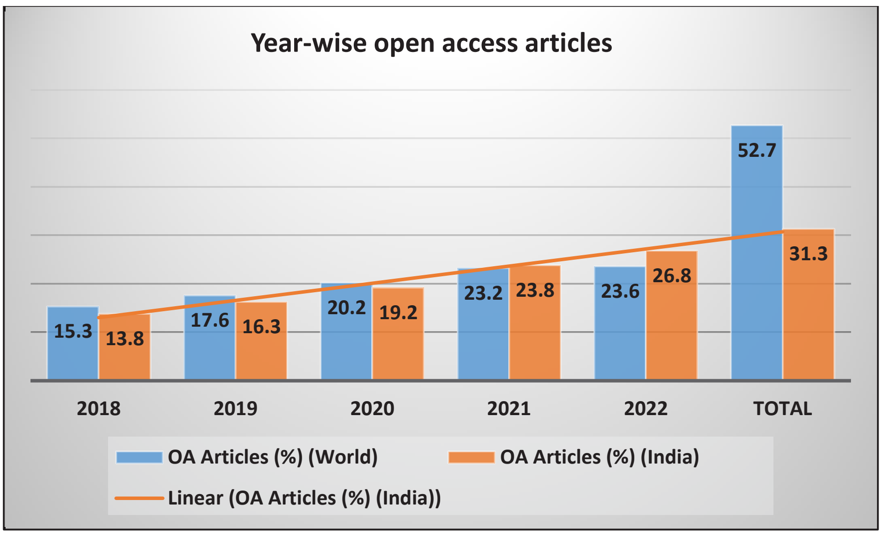

Fig. 2: Year-wise open access articles

Table 2 shows the increase in global contributions to Open Access and subscription-based articles. The increase in the percentage of publications reflected growth in subsequent years. A, B, and C represent the total number of open-access and subscription-based papers. C was calculated for subscription-based publications by subtracting the figures for open-access papers from the total number of articles. Figure 3 depicts a data comparison between open-access and subscription-based papers. The line graph is used to determine the patterns in publication. Percentage change is a statistical term that is frequently used in data analysis and comparison over time. There were very few changes in the change percentage of OA articles, which was 0.01% from 2019 to 2020.

Table 2: World Publication Output in Terms of Open Access (OA) Articles and Subscription-based Publications by Year

Year	World				
	Total No. of Articles	OA Articles	Subscription-based Articles	Change (%) of Publications in Succeeding Years	
	A	B	(A – B = C)	B	C
2018	14,77,889	7,12,365	7,65,524	0.00	0.00
2019	16,45,577	8,18,133	8,27,444	6.91	3.89
2020	17,90,112	9,39,716	8,50,396	6.92	1.37
2021	19,41,027	10,78,373	8,62,654	6.87	0.72
2022	19,60,319	10,96,004	8,64,315	0.81	0.10

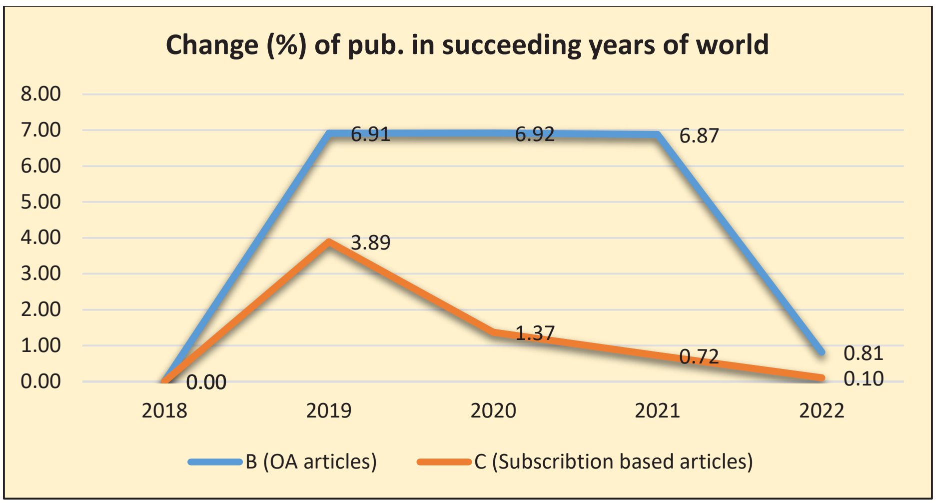

Fig. 3: World publications output by year

Table 3 shows the increase in Indian contributions to Open Access and subscription-based articles. The increase in the percentage of publications reflected growth in subsequent years. A represents the total number of articles, and B shows open-access articles. C has been determined for subscription-based publications by subtracting the figures for open-access papers from the total number of articles. Figure 4 compares data from open-access and subscription-based articles. The line graph is used to determine the patterns in publication. Percentage change is frequently used in data analysis and comparison over time. The most significant shift of 10.68% was reported in open-access publications in 2021 and 6.00% in subscription-based papers in 2019.

Table 3: Indian Publication Output in Terms of Open Access (OA) Articles and Subscription-based Publications by Year

Year	India				
	Total No. of Articles	OA Articles	Subscription-based Articles	Change (%) of Publications in Succeeding Years	
	A	B	(A – B = C)	B	C
2018	70,370	19,648	50,722	0.00	0.00
2019	80,347	23,150	57,197	8.18	6.00
2020	90,922	27,323	63,599	8.27	5.30
2021	1,03,387	33,856	69,531	10.68	4.46
2022	1,08,353	38,114	70,239	5.92	0.51

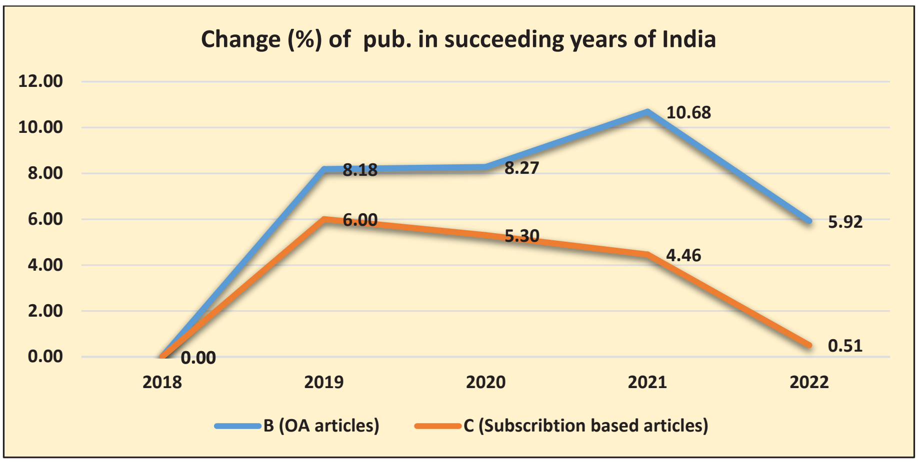

Fig. 4: Indian publications output by year

4.2 Top Publishing Countries, as well as Global Research Output and Open-access Publication Participation

In recent years, the total contribution of India's research output in science and the number of open-access articles have increased. The total research production and open-access contribution of the 20 most productive publishing countries are shown in Table 4. Regarding total research output and contribution to open-access journals, the People's Republic of China (PRC) and the United States (US) are the most productive publishing countries. The total number of research publications published by the PRC and the USA is 2631172 (29.84%) and 1874362 (21.26%), respectively. Regarding contribution to open-access journals, the PRC and the US have the most significant proportion, with 1100159 (23.70%) and 1202735 (25.90%) open-access articles, respectively.

Table 4: Top 20 Publishing Countries and Their Percentage of Open-access Publications

Country	Total Publications	(%) share of global research output	Open-access Publications	Open Access Publication (%)
Peoples R China	2631172	29.84	1100159	23.70
USA	1874362	21.26	1202735	25.90
Germany	540819	6.13	374628	8.07
England	503477	5.71	415504	8.95
India	**453480**	**5.14**	**142091**	**3.06**
Japan	426591	4.84	239900	5.17
Italy	374307	4.25	246140	5.30
France	361350	4.10	268547	5.78
Canada	343723	3.90	190911	4.11
South Korea	334934	3.80	172160	3.71
Australia	321996	3.65	185529	4.00
Spain	309399	3.51	220113	4.74
Brazil	261276	2.96	134033	2.89
Iran	217930	2.47	63,416	1.37
Russia	205521	2.33	75602	1.63
Netherlands	196644	2.23	166404	3.58
Turkey	182499	2.07	71303	1.54
Poland	162192	1.84	112768	2.43
Switzerland	161544	1.83	126929	2.73
Sweden	144846	1.64	113223	2.44

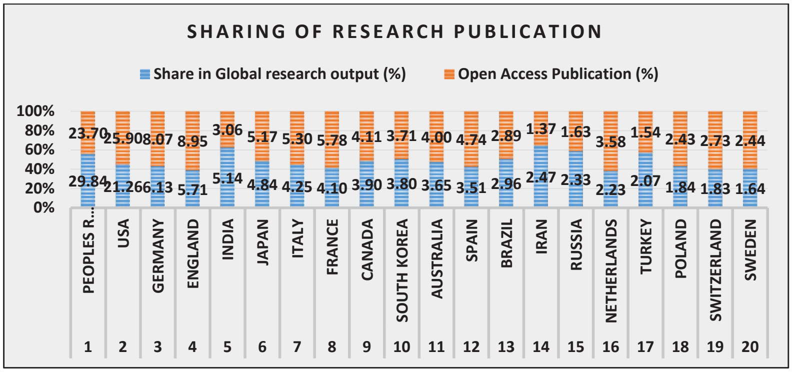

Fig. 5: sharing of research publication

4.3 Ranking of India as per Research Output

India ranks fifth in terms of an overall number of articles (453480, 5.14%) out of total publications (8817052) but thirteenth (142091, 18.63%) out of 4642962 publications in terms of contribution in open access journals. The People's Republic of China leads in total research output, whereas the United States leads in open-access research output. Sweden is ranked 20th in total research share with 144846 (1.64% of total) and 16th in open access research share with 113223 (2.44%) in the top twenty list.

Table 5: Top Publishing Countries by Total Research Production and Open Access Research Output

Rank	Total Research Output	Open Access Research Output
1	China	USA
2	USA	China
3	England	England
4	Germany	Germany
5	**India**	France
6	Italy	Italy
7	Japan	Japan
8	France	Spain
9	Canada	Canada
10	Australia	Australia
11	Spain	South Korea
12	South Korea	Netherlands
13	Brazil	**India**

Rank	Total Research Output	Open Access Research Output
14	Netherlands	Brazil
15	Iran	Switzerland
16	Russia	Sweden
17	Switzerland	Poland
18	Turkey	Belgium
19	Poland	Taiwan
20	Sweden	Saudi Arabia

4.4 Rank of Indian Research Output According to Open-access Publication Types

Regarding open-access publication types, China and the United States top 29.4% and 17.5%, respectively. The top contributing countries in gold-hybrid open access are the United States and England, with 33.4% and 13.7%, respectively. Again, the United States and China are the top contributors of green open-access articles, with 30.9% and 17.3%, respectively. India ranks 13th in gold open access with 3.2%, 23rd in gold-hybrid open access with 1.9%, and 14th in green OA publication with 3.3% of total publications.

Table 6: Rank of Indian Research Output as per Open Access Publication Types

Rank	Country	Publication in Gold Open Access (%)	Country	Publication in Gold-Hybrid Open Access (%)	Country	Publication in Green Open Access (%)
1	China	29.4	USA	33.4	USA	30.9
2	USA	17.5	England	13.7	China	17.3
3	Germany	6.0	China	13.4	England	13.7
4	England	5.7	Germany	13.4	France	11.4
5	Italy	5.3	France	8.7	Germany	11.2
6	Japan	5.0	Netherlands	7.3	Italy	7.5
7	South Korea	4.7	Italy	5.7	Spain	6.2
8	Spain	4.3	Japan	5.7	Japan	5.6
9	France	3.5	Sweden	5.2	Australia	5.0
10	Canada	3.5	Spain	5.2	Canada	4.9
11	Australia	3.3	Canada	4.6	Netherlands	4.0

12	Brazil	3.3	Switzerland	4.4	Switzerland	3.8
13	**India**	**3.2**	Australia	4.1	Brazil	3.3
14	Poland	2.9	Austria	2.9	**India**	**3.3**
15	Netherlands	2.2	Poland	2.9	South Korea	3.1
16	Saudi Arabia	2.1	Norway	2.4	Sweden	2.8
17	Taiwan	2.1	Scotland	2.3	Russia	2.6
18	Switzerland	2.0	Denmark	2.2	Denmark	2.3
19	Sweden	1.7	Finland	2.1	Poland	2.3
20	Turkey	1.6	Brazil	2.1	Belgium	2.2
21	Iran	1.5	South Korea	2.1	Scotland	2.1
22	Russia	1.5	Belgium	2.1	Austria	1.8
23	Pakistan	1.5	**India**	**1.9**	Israel	1.5
24	Egypt	1.4	Russia	1.4	Portugal	1.4
25	Belgium	1.2	Ireland	1.1	Finland	1.4

4.5 Top Institution in Terms of Open-access Research Output

The output of the institutions was evaluated from highest to lowest based on the writers' association with the institutions. In open-access journals, 61,942 institutions contributed 1,42,091 papers. Table 7 shows the contribution of India's 15 most productive institutions. The Indian Institute of Technology system, which includes publications from IIT Madras & IIT Bombay, which are ranked 9th and 10th respectively, and the National Institute of Technology system (NIT system), which includes publications from each NITs, contributed the most open-access articles i.e., 21087 (14.8%) and 6875 (4.8%) open-access articles, respectively. Institutions under the Council of Scientific & Industrial Research and the Indian Council of Agricultural Research have published 5984 (4.2%) and 5379 (3.8%) open-access articles, ranked 3rd and 4th, respectively.

Table 7: Top Institution in Terms of Open Access Publications

Rank	Institutions' Name	OA articles	OA articles (%)
1	Indian Institute of Technology System	21087	14.8
2	National Institute of Technology System	6875	4.8
3	Council of Scientific Industrial Research CSIR India	5984	4.2
4	Indian Council of Agricultural Research ICAR	5379	3.8

Rank	Institutions' Name	OA articles	OA articles (%)
5	Indian Institute of Science IISc Bangalore	4972	3.5
6	Department of Science Technology India	4626	3.3
7	Homi Bhabha National Institute	4016	2.8
8	Tata Institute of Fundamental Research TIFR	3996	2.8
9	IIT Madras	3321	2.3
10	IIT Bombay	3133	2.2
11	Department of Biotechnology India	2824	2.0
12	University of Delhi	2709	1.9
13	Vellore Institute of Technology VIT	2519	1.8
14	AIIMS New Delhi	2502	1.8
15	Indian Council of Medical Research ICMR	2414	1.7

4.6 Top 20 Open-access Journals with the Greatest Number of Indian Publications between 2018 and 2022

Core journals publish the most significant amount of papers in any subject area. Similarly, researchers may be interested in discovering renowned open-access publications to which authors contribute their work regularly. Twenty-six thousand eight hundred seventy-four open access papers (18.91%) were published in 20 core journals, while the remainder, 115217 (81.09%) were spread throughout 6689 OA journals. Table 9 displays the 20 most active open-access journals and their publishing country, to which Indian scientists contributed 18.91% of their research output. Scientific Reports has been highlighted as one of the leading open-access journals, with 4018 articles published by Indian authors. Scientific Reports is followed by ACS Omega and IEEE Access, which each have 2228 and 2150 articles.

Table 8: Top 20 Open-access Journals with the Highest Number of Indian Publications

Rank	Research Areas	Open-access publications	Percentage of total OA Publications
1	Scientific Reports	4018	2.8
2	ACS Omega	2228	1.6
3	IEEE Access	2150	1.5
4	PLOS One	1841	1.3
5	Physical Review D	1741	1.2
6	Indian Journal Of Ophthalmology	1733	1.2

Rank	Research Areas	Open-access publications	Percentage of total OA Publications
7	RSC Advances	1535	1.1
8	Monthly Notices Of The Royal Astronomical Society	1450	1.0
9	Current Science	1427	1.0
10	Sustainability	1042	0.7
11	Physical Review B	1035	0.7
12	Journal Of High Energy Physics	962	0.7
13	3 Biotech	922	0.6
14	Heliyon	853	0.6
15	Astrophysical Journal	801	0.6
16	European Physical Journal C	646	0.5
17	Energies	644	0.5
18	Molecules	631	0.4
19	Journal Of Food Science And Technology Mysore	616	0.4
20	Indian Journal Of Animal Research	599	0.4

4.7 Distribution of Open-access Publications by Discipline

When we examine the open-access research output of Indian scholars across disciplines, we discover a significant variance in the proportion of articles published in open-access journals (Table 8). Out of the 135 disciplines, only the best 20 were chosen. Physics has the most significant number of open-access journal articles (13%), followed by engineering (12.5%) and science technology other topics (11.9%). While Energy Fuels (2.4%) and Immunology give a proportion of 1.9, Neurosciences Neurology (1.7%) have the fewest articles in open-access journals.

Table 9: Distribution of Open-access Publications by Discipline

Rank	Research Areas	No. of open-access publications	Percentage of total OA Publications
1	Physics	18478	13.0
2	Engineering	17710	12.5
3	Science Technology Other Topics	16850	11.9
4	Chemistry	14910	10.5
5	Materials Science	11685	8.2

Rank	Research Areas	No. of open-access publications	Percentage of total OA Publications
6	Computer Science	10485	7.4
7	Mathematics	7795	5.5
8	Environmental Sciences Ecology	7269	5.1
9	Astronomy Astrophysics	6955	4.9
10	Biochemistry Molecular Biology	5920	4.2
11	Pharmacology Pharmacy	4217	3.0
12	Telecommunications	3996	2.8
13	Biotechnology Applied Microbiology	3380	2.4
14	Public Environmental Occupational Health	3241	2.3
15	Agriculture	3194	2.2
16	Plant Sciences	3086	2.2
17	Microbiology	3033	2.1
18	Energy Fuels	2729	1.9
19	Immunology	2661	1.9
20	Neurosciences Neurology	2404	1.7

5. DISCUSSION

1. Table 1 is suitable for identifying the expansion of open access (OA) and non-open access scholarly communication. The total publication globally in the previous five years (2018-2022) was 8814924; in OA, it was 211252, 52.7% of overall publications. At the Indian level, the total number of articles was 453379, and OA articles were 142091, which was 31.3% in relation to the whole publication. Indian open-access articles contribution is greater than half the overall contribution.
2. Table 2 shows the percentage change in the publications over the period. The yearly growth of the world's open-access and subscription-based articles is represented in percentages.
3. Table 3 shows the percentage change in the publications over the period. The yearly growth of Indian open-access and subscription-based articles is represented in percentage.
4. Table 4 reveals global research output share in open-access and subscription-based articles. India's global share in subscription-based publications is 453480 (5.14%),

and open-access publications are 142091 (3.06%). Table 5 shows India ranked fifth in total output, and according to OA share, the rank is thirteenth.

5. Table 6 shows the OA type-wise ranks of the countries. In these rankings, India has secured 13th, 23rd, and 14th place in gold open access, gold-hybrid open access, and green open access, respectively.
6. Table 7 shows the contribution of India's 15 most productive institutions. The Indian Institute of Technology system, which includes publications from IIT Madras & IIT Bombay, which are ranked 9th and 10th respectively, and the National Institute of Technology system (NIT system), which includes publications from each NITs, contributed the most open-access articles i.e., 21087 (14.8%) and 6875 (4.8%) open-access articles, respectively. Institutions under the Council of Scientific & Industrial Research and the Indian Council of Agricultural Research have published 5,984 (4.2%) and 5,379 (3.8%) open-access articles, which ranked 3rd and 4th, respectively.
7. Table 8 lists the 20 most active open-access journals and their publishing countries, to which Indian scientists and engineers contributed 18.91 per cent of their research output. Scientific Reports has been recognised as one of the leading open-access journals, with 4018 articles published by Indian authors. With 2228 and 2150 publications, respectively, Scientific Reports is followed by ACS Omega and IEEE Access.
8. The discipline-specific list is shown in Table 9. Physics has the biggest amount of open-access journal articles (13%), followed by Engineering (12.5%) and Science and Technology Other Topics (11.9%). While Energy Fuels (2.4%) and Immunology give a proportion of 1.9, Neurosciences Neurology (1.7%) have the fewest articles in open-access journals.

6. CONCLUSION

The study aimed to determine India's position in open-access scholarly communication. Following the discovery and discussion, it was determined that India's growth and contribution to OA scholarly communication are acceptable. India's global ranking of fifth overall and thirteenth in OA publication demonstrates that Indian contribution is essential. The IIT system and the NIT system contributed 21087 (14.8%) and 6875 (4.8%) open-access articles, respectively, and played a significant play role in the development of open-access publications. Physics has the most articles published in open-access journals (13%), followed by engineering (12.5%) and science and technology (11.9%).

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RESEARCH EMPHASIS OF IITs ON CLIMATE CHANGE: A SCIENTOMETRIC ASSESSMENT

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ABSTRACT

The main objectives of the paper are to examine the research priorities of Indian Institutes of Technology (IITs) concerning climate change from 2000 to 2023. It is commonly known that the ongoing worldwide problems of climate change and global warming substantially influence many aspects of the environment. This study examines research scholars' research, influence, scholarly publication patterns, etc., among sixteen IITs. During 24 24-year period, the study analyses 7,923 research publications from the Scopus database using scientometric indicators. The success of IITs in researching climate change, patterns in scholarly publication behaviour (including citations and average citations per paper), most preferable sources and cooperative efforts with other nations. Some of these results include a large number of citations, a preference for open-access papers (22.52% of the total), and a steady yearly increase in research publications. The results provide valuable insights into the ever-changing research landscape on Climate Change at IITs, highlighting their diverse contributions in addressing important environmental challenges. The study emphasised the crucial contribution of IITs in enhancing Climate Change research in India. Furthermore, they have also formed collaborative partnerships amongst several countries, as seen by their research publications. The publication outputs require greater emphasis on other areas, and the study could be beneficial to policymakers in determining the distribution of resources for a group of IITs to enhance the quality of research.

Keywords: *Indian Institutes of Technology (IITs), Climate Change, Scientometrics, Research Emphasis, India.*

1. INTRODUCTION

According to the United Nations Environmental Programme (UNEP, 2017), climate change and water problems are projected to be the most enduring and significant global challenges in the coming decades. The correlation between climate change and water utilisation practices

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has emerged as a pivotal and evolving subject of investigation within the realm of earth sciences. Climate change has a widespread impact that encompasses various aspects. It is evident through the rise in temperature and the occurrence of extreme weather events. It also significantly affects local hydrological cycles and the management of water resources by human populations. Water resource availability, quality, streamflow, and mobility exhibit a high degree of sensitivity to variations in temperature and precipitation (Abbass et al., 2022). A prior investigation demonstrated that the presence of snow caps and the subsequent melting of snow significantly influence the production of snowmelt-driven runoff. This, in turn, has the potential to impact the accessibility and regulation of water resources in high-altitude regions, leading to noteworthy economic implications. Implementing sustainable water management practices plays a pivotal role in enhancing the resilience of both communities and ecosystems while concurrently mitigating carbon emissions. (Urata et al., 2023), Universities play a significant role in disseminating high-quality education and advancing research and development. The attainment of a high-quality education is directly correlated with the production of high-quality research outcomes. It is imperative to comprehensively examine the research output produced by different universities to identify critical aspects contributing to effective research communication, hence benefiting policymakers and academicians. Examining the publishing of an institution offers a comprehensive understanding of its research productivity(Mondal, 2022). A range of methodologies and instruments exist that can be employed to assess the level of research output quality. One such tool is scientometric evaluation, which is a contemporary approach used to analyse the quantitative aspects of literature production((Morton, 2015).

With the primary aim of integrating high-quality research with undergraduate teaching, seven (07) IITs were initially established as autonomous institutions under the Ministry of Education, i.e., the erstwhile Ministry of Human Resource Development (MHRD) as first-generation IITs. Subsequently, eight (08) second-generation IITs were founded between 2006 and 2008, and two (02) upgrades from old institutions, i.e., IT-BHU and ISM-Dhanbad, were added to the second generation. After that, six (06) more IITs were set up as third-generation IITs, now making a total of 23 IITs spread all over the country ('Indian Institutes of Technology', 2023). Within a short span of time, the institutes achieved significant milestones and recognition. Therefore, the present study focuses on the research trend and impact of IITs in the field of *Climate Change*.

2. REVIEW OF THE RELATED LITERATURE

The literature evaluation is crucial for finding unexplored areas and potential new research directions. Assessment of the research productivity of universities and other institutions of importance is a significant research area among scholars of various disciplines. Over the years, several researchers have attempted to create a road map of an institute's research outputs, particularly in India's tertiary education system. Some notable studies are reviewed as underfitting the current study.

Scientometrics is a part of the bibliometric study; David J. Hess had defined "the quantitative study of science, communication in science, and science policy" in his book Science Study, published in 1997 (Milojevic et al., 2014). Wolfram and Dietmar (2019), there is no universally accepted definition of scholarly communication. However, they provide a comprehensive viewpoint from the Association for College and Research Libraries (ACRL) on the subject. The statement emphasises the significance of scholarly communication across all fields. It underscores the necessity for research on the communication practises of scholars, particularly in relation to social and technological issues. Sahoo, Sahu, and Mohanty (2021) utilised Scopus to examine the trends in basic science research in IISERs, employing both qualitative and quantitative methods. The research outcomes of the five older IISERs were evaluated. Significant research outcomes, including a high number of citations, a preference for open-access (OA) publications, an annual increase in the number of research publications, a robust author network, a high degree of collaboration, and a high impact as measured by other scientometric indicators, are attributable to these institutions, according to the findings. Mondal et al. (2019) studied scientometrics. From 2008 to 2017, the Indian Association for the Cultivation of Science (IACS) published 4,304 research articles with an average of 17.08 citations. Domestic partnerships (77.42%) affect citations less than international partnerships (22.58%). Global cooperation is declining, emphasising the need for stronger alliances. Despite the fact that most international collaborators are domestic, future research requires relationships with reputable foreign institutions, particularly those in the US, Japan, Germany, and England. Choi et al. (2019) examined North Korean researchers' intellectual framework and scientific collaboration. They analysed co-words using 1976-2018 Web of Science data. Despite the lack of global dissemination, 55 ultimate keywords and 56 ultimate author names show an intricate network with 17 and 15 sub-clusters across four domains for keywords and author names, respectively. Researchers can identify collaborators and collaborate internationally by understanding North Korea's changing research patterns and community organisation. This study is essential to understanding North Korea's research network. Das and Ramesh (2019) investigated academic communication patterns in pharmaceutical research in the United States, China, and India from SCOPUS from 1998 to 2017. These three nations account for 40.54% of the worldwide research publications in the pharmaceutical sciences field, amounting to 1,395,221. The study encompasses various qualitative and quantitative dimensions, such as publication productivity, citation influence, research intensity, prevalent publication sources, and research collaboration. Czerniewicz (2017) examined how digital affordances could undermine Northern knowledge supremacy in climate change research and question knowledge creation and dissemination. The internet presence of a climate change group at a prominent African university and searches for 'climate change/South Africa' are examined to determine the discoverability and visibility of local climate change research. Moed et al. (2021) used a methodological-infometric approach to study international collaboration, citation impact, and national orientation in scientific journals. This study uses journals with an initial national orientation percentage (INO-P) of over 50% to confirm the previous paper's findings. In 26% of Scopus-listed national journals, publishing author populations decreased between 1997 and 2010. 37% of these journals also saw a drop in citing authors. The above percentages exceed international periodicals' INOs below 50%. Publishing authors' median Impact Normalised Output (INO) dropped from 86% to 63%, while citing authors' dropped from 80% to 42%. This suggests that these journals' national publishing and citing author populations have declined over time. Dua et al. (2023) studied India's international scientific collaboration between 2001 and 2020. The findings showed a 12.27% compound annual growth rate. The US, Germany, England, and China were major collaborators, while South Korea and Saudi Arabia increased their cooperation. About 50% of international collaboration papers had Indian lead authors. This shows that a productive indigenous scholarly ecosystem depends on international collaborations for impact and visibility. Among the climate change-related studies, Sangam and Savitha (2019) conducted scientometric research on global warming and changes in climate from 2001 to 2016 using the Web of Science database. The study concluded with a growth trend in scientific literature, a prevalent single authorship pattern amongst all authorships, and a strong degree of collaboration amongst authors. From 2008 to 2017, Das and Sahu (2020) investigated bibliometric analysis of research papers from five prestigious Indian Institutes of Technology (IITs). The scholarly output of IIT-Bombay, IIT-Kanpur, IIT-Kharagpur, IIT-Delhi, and IIT-Madras was assessed using bibliometrics, as demonstrated by the SCOPUS-based study. Logic analysis and network visualisation utilising R-bibliometrics and VOSviewer. All research objectives include annual Contributions, productive authors, document formats, institutional productivity, and collaboration. Raza et al. (2021) explored the global research trend in buildings' carbon footprints from 1971 to 2021 and found a growth in research after 2002. The published scientific literature is related to other interdisciplinary aspects like engineering, materials sciences, earth and planetary sciences, chemical engineering, energy, and environmental sciences. In 2013, Narsimlu et al. evaluated changes in climate and their effects on the River Basin's water supplies of Upper Sind. With the help of a technique for assessing soil water, they discovered that the correlation coefficient, d-factor, p-factor, and Nash-Sutcliffe coefficients for the stream flows and simulated flows matched fairly well. In order to provide a deeper understanding of research, the authors here used the scientometric approach to analyse the development and influence of the field of climate change in Indian IITs from 2000 to 2023.

3. OBJECTIVES OF THE STUDY

The primary objective of this study is to ascertain the current status of research on climate change by researchers affiliated with the Indian Institutes of Technology (IITs). This study primarily investigates several aspects, such as research profile, the progression of publications over time, citations, scholarly influence, areas of research interest, the pattern of scholarly communication, collaborating institutions, and collaborating countries. The study aims to address the following inquiries:

1. What has been the performance of the Indian Institutes of Technology (IITs) in conducting climate change research from 2000 to 2023?
2. What is the scholarly communication behaviour exhibited by researchers of Indian Institutes of Technology (IITs) in different document types?
3. What is the citation pattern of open-access vs. Non-open-access publications?
4. What are the sources of publication where researchers prefer to publish?
5. What are the top countries and top institutions departments involved in research collaboration?
6. What are the most preferred keywords used in *climate change* research in IITs?

4. METHODOLOGY AND DATA SOURCE

Several studies have tried to assess the research performance of Indian institutions, both individual institutions and institutional systems (Banshal et al., 2017). This study investigates the scholarly output of researchers from a specific set of Indian Institutes of Technology (IITs) in the field of Climate Change from 2000 to 2023, spanning 24 years. The authors utilised a particular string of searches mentioned below to retrieve data from the Scopus Database, covering 16 IITs in this study. The study employed the following search string:

(TITLE-ABS-KEY ("climate change") OR TITLE-ABS-KEY ("sustainable development") OR TITLE-ABS-KEY ("climate action") OR TITLE-ABS-KEY ("climate change effect") OR TITLE-ABS-KEY ("climate variations") OR TITLE-ABS-KEY ("climatic changes") OR TITLE-ABS-KEY ("climatic fluctuations") OR TITLE-ABS-KEY ("climatic trend") OR TITLE-ABS-KEY ("global climate change") OR TITLE-ABS-KEY ("global warming") OR TITLE-ABS-KEY ("humidity") OR TITLE-ABS-KEY ("atmospheric conditions") OR TITLE-ABS-KEY ("meteorologic conditions")) AND PUBYEAR > 1999 AND PUBYEAR < 2024 AND (LIMIT-TO (AFFILCOUNTRY, "India")) AND (LIMIT-TO (AF-ID, "Indian Institute of Technology Kharagpur" 60004750) OR LIMIT-TO (AF-ID, "Indian Institute of Technology Indian School of Mines, Dhanbad" 60008898) OR LIMIT-TO (AF-ID, "Indian Institute of Technology Guwahati" 60010126) OR LIMIT-TO (AF-ID, "Indian Institute of Technology Bombay" 60014153) OR LIMIT-TO (AF-ID, "Indian Institute of Technology BHU Varanasi" 60019106) OR LIMIT-TO (AF-ID, "Indian Institute of Technology Kanpur" 60021988) OR LIMIT-TO (AF-ID, "Indian Institute of Technology Madras" 60025757) OR LIMIT-TO (AF-ID, "Indian Institute of Technology Roorkee" 60031818) OR LIMIT-TO (AF-ID, "Indian Institute of Technology Delhi" 60032730) OR LIMIT-TO (AF-ID, "Indian Institute of Technology Hyderabad" 60103917) OR LIMIT-TO (AF-ID, "Indian Institute of Technology Ropar" 60103918) OR LIMIT-TO (AF-ID, "Indian Institute of Technology Bhubaneswar" 60104339) OR LIMIT-TO (AF-ID, "Indian Institute of Technology Mandi" 60104340) OR LIMIT-TO (AF-ID, "Indian Institute of Technology Gandhinagar" 60104341) OR LIMIT-TO (AF-ID, "Indian Institute of Technology Jodhpur" 60104343) OR LIMIT-TO (AF-ID, "Indian Institute of Technology Indore" 60104350)). A total of 7923 research documents (publications) were retrieved from the Scopus database. The required data was individually downloaded from the Scopus database on 18th December 2023 for each IIT. The search results were analysed using Excel, R-bibliometrics Packages, and VOSviewer software for visualisation.

5. DATA ANALYSIS

5.1 Year-wise Research Output and Growth Trends from 2000 to 2023

Table 1: No of Pubs, Citation and Average Growth Rate

YEAR	NP	NC	AGR
2000	16	267	-
2001	29	1477	81.25
2002	21	1064	-27.59
2003	32	2110	52.38
2004	54	3334	68.75
2005	54	2406	0.00
2006	74	3630	37.04
2007	75	2543	1.35
2008	92	3937	22.67
2009	101	6987	9.78
2010	103	3543	1.98
2011	195	8563	89.32
2012	203	7566	4.10
2013	209	11105	2.96
2014	233	7523	11.48
2015	268	8571	15.02
2016	391	14611	45.90
2017	393	15977	0.51
2018	548	18758	39.44
2019	636	18727	16.06
2020	786	17909	23.58
2021	992	16102	26.21
2022	1157	10236	16.63
2023	1261	2220	8.99

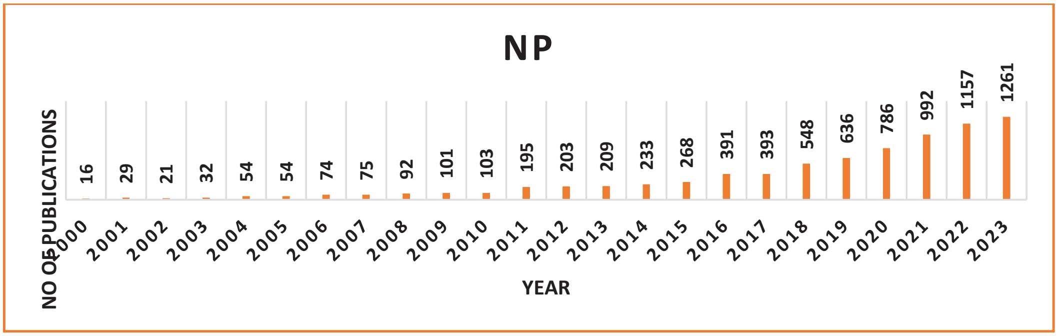

Fig. 1(a): No of Publications

Table 1 and **Figure 1(a) and (b)** show the year-wise distribution of publications, citations, and average annual growth rate of publications from 2000 to 2023.

In 2000, there were a total of 16 articles that received 267 citations. The growth rates in the subsequent years varied. 2001, 2011, 2016, and 2018 experienced significant growth peaks, with respective average annual growth rates (AGR) of 81.25%, 89.32%, 45.90%, and 39.44%. Conversely, specific years, such as 2017 (with an annual growth rate of 0.51%) and 2002 (with an annual growth rate of -27.59%), exhibit minimal or negative growth. The overall trend exhibits a dynamic trajectory characterised by yearly fluctuations in growth rates. The number of citations rises in parallel with the increase in publications, indicating a growing level of influence. The data demonstrates a noteworthy surge in research productivity and impact, occasionally interrupted by sporadic periods of slower growth or decreases. Further investigation is required to ascertain the underlying factors driving these patterns.

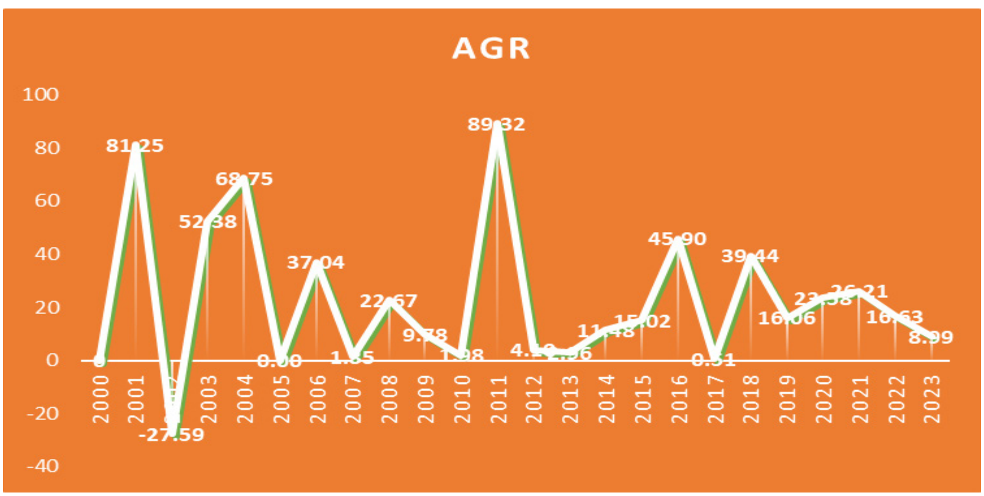

Fig. 1(b): Year-wise Average Growth Rate of Publications

5.2 Document Type of Research Publications

Figure 2 displays the distribution of research contributions throughout the study period in various document types. Out of 7923 publications, the greatest contribution category is "Articles," with 5184, accounting for 65.43% of the total. This is followed by "Conference Paper" with 1344 (16.96%), "Review" with 688 (8.68%), and "Book Chapter" with 575 (7.26%). The remaining 1.67 per cent of all publications are attributed to the other types of short communication, which are considerably fewer in quantity. When considering research papers, it is observed that IIT Kharagpur (16.18%), IIT Delhi (15.02%), and IIT Bombay (12.92%) have a stronger position.

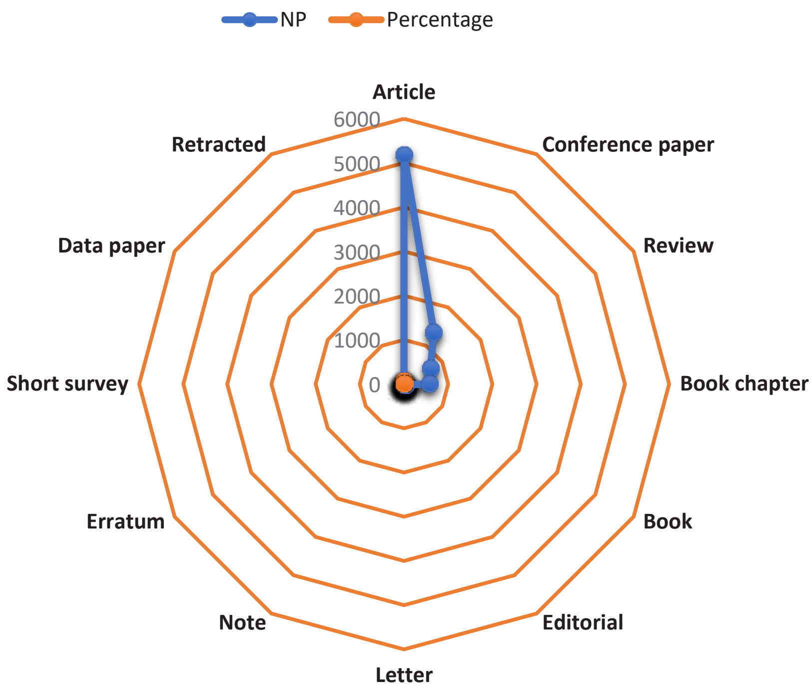

Fig. 2: Document type of research publications

5.3 Publication Pattern and Citations of IITs

Figure 3 and Table 2 provide a detailed and comprehensive overview of the average citation per paper (ACPP), citations, and research productivity of various Indian Institutes of Technology (IITs) from 2000 to 2023. IIT Kharagpur is a highly influential institution in research, with a remarkable number of publications (1,282) and citations (32,860). The research output of this institution is abundant and noteworthy, as evidenced by its remarkably high Average Citations Per Paper (ACPP) of 1144.16. IIT Delhi has generated a total of 1,190 scholarly articles, received 38,530 citations, and achieved an Average

Citations per Paper (ACPP) score of 1022.69. These figures demonstrate a well-rounded research performance, positioning IIT Delhi in second place. IIT Roorkee has a research profile and is ranked third, with 1,036 publications, 21,985 citations, and an impressive ACPP of 779.75. IIT Bombay has a significant number of publications (1024) in this field, with a total of 25,812 citations. The average citations per publication (ACPP) is 930.91. The research contributions of the remaining IITs in the field of Climate Change and their Annual Climate Change Performance Plans (ACPPs) have shown a gradual increase, as indicated by Table 2. The data illustrates the distinct contributions that various IITs make to research, with certain institutions such as Kanpur, Madras, and Guwahati displaying unique strengths and significant impacts across multiple academic disciplines. This comprehensive analysis emphasises the significant contribution that these leading institutions have made in advancing knowledge across various disciplines and provides valuable insights into the evolution of their climate change research over time. Based on an analysis of publications and citation patterns in IITs, it has been determined that a total of 189,166 citations were received from 7,923 publications over a span of 24 years. The mean citation range per paper is 37.91. It denotes that IITs' publications in the field of climate change are of high impact. Similarly, there is a noticeable decrease in the number of citations in 2010 and current years, as older articles have more time to gather additional citations.

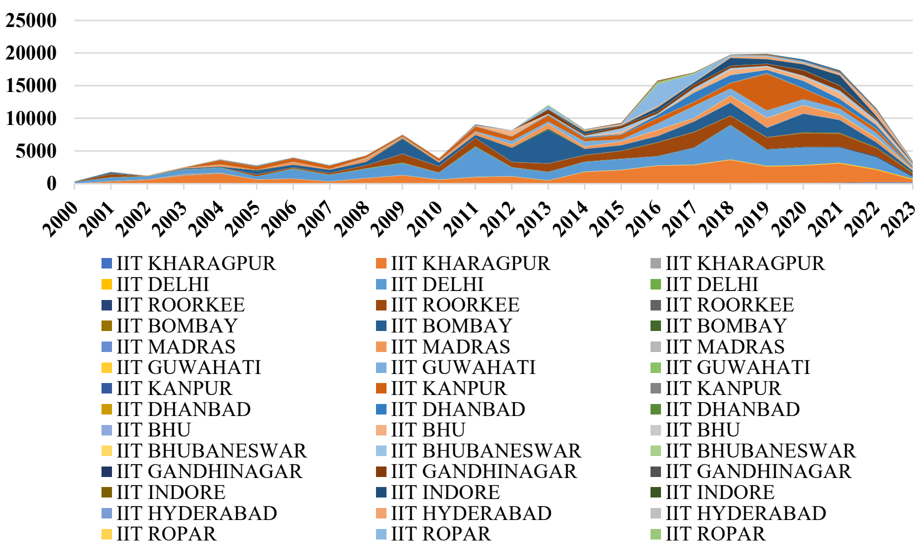

Fig. 3: Publication pattern and citations received by IITs

Table 2: Publication Pattern and Citations Received by IITs

II 1 s		2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	Total
IIT Kharagpur	NP	2	4	7	5	12	10	22	12	19	25	16	28	30	16	37	45	69	53	93	114	113	140	211	199	1282
	NC	6	301	543	1202	1502	572	695	275	767	1217	543	926	1031	418	1722	1979	2639	2742	3499	2476	2608	2920	1876	401	32860
	ACPP	3.00	75.25	77.57	240.40	125.17	57.20	31.59	22.92	40.37	48.68	33.94	33.07	34.37	26.13	46.54	43.98	38.25	51.74	37.62	21.72	23.08	20.86	8.89	2.02	1144.33
IIT Delhi	NP	8	12	9	13	21	14	18	25	22	18	31	43	34	36	43	45	47	78	74	96	101	123	131	148	1190
	NC	224	524	450	647	755	429	1463	984	1414	1789	1031	4529	1336	1238	1451	1623	1355	2532	5187	2474	2679	2310	1819	287	38530
	ACPP	28.00	43.67	50.00	49.77	35.95	30.64	81.28	39.36	64.27	99.39	33.26	105.33	39.29	34.39	33.74	36.07	28.83	32.46	70.09	25.77	26.52	18.78	13.89	1.94	1022.69
IIT Roorkee	NP	2	4	1	5	1	5	5	10	10	11	15	55	15	43	30	34	56	64	61	71	86	109	159	184	1036
	NC	15	459	0	17	1	250	133	219	429	1274	889	1251	738	1234	962	1161	2022	2300	1325	1744	2070	1964	1211	317	21985
	ACPP	7.50	114.75	0.00	3.40	1.00	50.00	26.60	21.90	42.90	115.82	59.27	22.75	49.20	28.70	32.07	34.15	36.11	35.94	21.72	24.56	24.07	18.02	7.62	1.72	779.75
IIT Bombay	NP	1	4	1	4	5	6	9	13	16	18	15	17	30	25	42	33	54	49	78	65	115	142	131	151	1024
	NC	0	154	0	118	115	547	379	467	484	2183	540	408	2099	5088	891	810	910	1538	1919	1399	2830	1934	722	277	25812
	ACPP	0.00	38.50	0.00	29.50	23.00	91.17	42.11	35.92	30.25	121.28	36.00	24.00	69.97	203.52	21.21	24.55	16.85	31.39	24.60	21.52	24.61	13.62	5.51	1.83	930.91
IIT Madras	NP	1	1	3	2	5	3	9	4	10	7	13	14	19	30	16	23	29	22	43	67	71	65	73	71	601
	NC	0	3	71	34	275	20	386	80	468	138	141	388	432	726	317	535	888	467	1010	1388	1191	691	595	74	10318
	ACPP	0.00	3.00	23.67	17.00	55.00	6.67	42.89	20.00	46.80	19.71	10.85	27.71	22.74	24.20	19.81	23.26	30.62	21.23	23.49	20.72	16.77	10.63	8.15	1.04	495.96
IIT Guwahati	NP	0	0	0	0	0	1	0	0	3	5	4	14	18	11	21	20	36	33	44	56	49	78	86	87	566
	NC	0	0	0	0	0	2	0	0	56	70	37	110	499	264	743	258	915	1769	1012	1093	874	884	715	108	9409
	ACPP	0.00	0.00	0.00	0.00	0.00	2.00	0.00	0.00	18.67	14.00	9.25	7.86	27.72	24.00	35.38	12.90	25.42	53.61	23.00	19.52	17.84	11.33	8.31	1.24	312.04
IIT Kanpur	NP	1	1	0	2	6	10	7	8	9	8	7	13	24	21	10	22	23	18	22	29	47	51	56	52	447
	NC	14	7	0	44	601	497	535	473	316	225	342	729	638	924	466	688	784	594	777	5534	1571	565	486	76	16886
	ACPP	14.00	7.00	0.00	22.00	100.17	49.70	76.43	59.13	35.11	28.13	48.86	56.08	26.58	44.00	46.60	31.27	34.09	33.00	35.32	190.83	33.43	11.08	8.68	1.46	992.92
IT Dhanbad	NP	1	3	0	0	2	4	3	3	2	3	0	2	22	5	9	8	22	26	40	29	45	56	68	64	417
	NC	8	29	0	0	14	87	21	45	0	28	0	1	41	71	136	80	454	1341	1167	435	1086	807	554	151	6556
	ACPP	8.00	9.67	0.00	0.00	7.00	21.75	7.00	15.00	0.00	9.33	0.00	0.50	1.86	14.20	15.11	10.00	20.64	51.58	29.18	15.00	24.13	14.41	8.15	2.36	284.86
	NP	0	0	0	1	2	1	1	0	1	6	1	6	6	6	2	7	6	9	13	23	30	46	42	62	271

II 1 s		2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	Total
IIT Bhu	NC	0	0	0	48	71	2	18	0	3	63	17	115	744	38	22	295	15	304	776	445	581	797	363	137	4854
	ACPP	0.00	0.00	0.00	48.00	35.50	2.00	18.00	0.00	3.00	10.50	17.00	19.17	124.00	6.33	11.00	42.14	2.50	33.78	59.69	19.35	19.37	17.33	8.64	2.21	499.51
IIT Bhubaneswar	NP	0	0	0	0	0	0	0	0	0	0	1	0	0	3	4	10	10	8	9	9	16	39	34	40	183
	NC	0	0	0	0	0	0	0	0	0	0	3	0	0	62	130	465	130	308	194	112	140	367	289	105	2305
	ACPP	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.00	0.00	0.00	20.67	32.50	46.50	13.00	38.50	21.56	12.44	8.75	9.41	8.50	2.63	217.45
IIT Gandhinagar	NP	0	0	0	0	0	0	0	0	0	0	0	0	0	5	2	5	6	11	9	13	21	25	30	24	151
	NC	0	0	0	0	0	0	0	0	0	0	0	0	0	592	155	353	318	438	303	266	779	707	185	39	4135
	ACPP	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	118.40	77.50	70.60	53.00	39.82	33.67	20.46	37.10	28.28	6.17	1.63	486.61
IIT Indore	NP	0	0	0	0	0	0	0	0	0	0	0	2	0	0	2	2	10	8	32	32	44	60	54	70	316
	NC	0	0	0	0	0	0	0	0	0	0	0	106	0	0	278	12	522	320	1160	676	856	1494	344	74	5842
	ACPP	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	139.00	6.00	52.20	40.00	36.25	21.13	19.45	24.90	6.37	1.06	346.36
IIT Hyderabad	NP	0	0	0	0	0	0	0	0	0	0	0	0	3	1	9	2	7	3	7	13	12	20	24	32	133
	NC	0	0	0	0	0	0	0	0	0	0	0	0	3	31	164	107	163	43	163	332	164	211	660	86	2127
	ACPP	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	31.00	18.22	53.50	23.29	14.33	23.29	25.54	13.67	10.55	27.50	2.69	244.57
IIT Ropar	NP	0	0	0	0	0	0	0	0	0	0	0	1	0	3	3	5	9	8	11	11	11	19	23	28	132
	NC	0	0	0	0	0	0	0	0	0	0	0	0	0	415	51	61	3321	1211	212	179	183	119	153	51	5956
	ACPP	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	138.33	17.00	12.20	369.00	151.38	19.27	16.27	16.64	6.26	6.65	1.82	754.83
IIT Mandi	NP	0	0	0	0	0	0	0	0	0	0	0	0	1	4	2	7	6	2	9	7	11	15	21	27	112
	NC	0	0	0	0	0	0	0	0	0	0	0	0	3	4	13	144	154	69	42	129	48	156	142	10	914
	ACPP	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.00	1.00	6.50	20.57	25.67	34.50	4.67	18.43	4.36	10.40	6.76	0.37	136.23
IIT JODHPUR	NP	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	1	1	3	1	14	4	14	22	62
	NC	0	0	0	0	0	0	0	0	0	0	0	0	2	0	22	0	21	1	8	45	249	176	122	27	673
	ACPP	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.00	0.00	22.00	0.00	21.00	1.00	2.67	45.00	17.79	44.00	8.71	1.23	165.39

5.4 Citation Pattern of Open-access vs. Non-open-access Publications

Open Access (OA) publishing facilitates global research and scholarship communication, thereby speeding up discovery and innovation. Open access allows the reader to access content without any cost, thereby redistributing the expenses associated with publishing. This paper investigates open-access climate change publications using the IITs dataset. The open-access articles are freely accessible to the global research community. OA publications have a higher number of citations compared to non-open-access (NOA) publications. India is actively participating in the worldwide Open Access movement. **Table 3 and Figure 4** thoroughly compare citation patterns between papers published by different Indian Institutes of Technology (IITs) that are open-access (OA) and those that are not. With 22.29% (1,766 publications) of OA publications receiving 58,859 citations, the grand total shows that 31% of citations are on open-access.

Conversely, 77.71% of publications received 1,30,307 citations; the grand total shows 31% of citations for non-open-access (NOA). With 281 open-access papers receiving 8368 out of 32,860 citations, IIT Kharagpur has the most balanced citation proportion (21.92%). IIT Delhi and IIT Bombay also show strong OA contributions, with 246 and 261 publications, respectively. With OA papers obtaining a sizable portion of all citations, the data highlights the importance of open access and the role that accessibility plays in the diffusion of knowledge. A comprehensive insight into each IIT's publishing policies and the visibility of their research results in both the open-access and non-open-access domains can be gained from the full breakdown provided.

Table 3: Citation Pattern of Open-access vs. Non-open-access Publications by IITs.

IITs	OA	P	COA	P	NOA	P	CNOA	P	TP	CTP
IIT BHU	59	21.77	1153	24	212	78.23	3701	76	271	4854
IIT Bhubaneswar	56	30.60	846	37	127	69.40	1459	63	183	2305
IIT Bombay	261	25.49	11539	45	763	74.51	14273	55	1024	25812
IIT Delhi	246	20.67	8972	23	944	79.33	29558	77	1190	38530
IIT Gandhinagar	66	43.71	2517	61	85	56.29	1618	39	151	4135
IIT Guwahati	91	16.08	1081	11	475	83.92	8328	89	566	9409
IIT Hyderabad	42	31.58	924	43	91	68.42	1207	57	133	2131
IIT Jodhpur	15	24.19	151	22	47	75.81	522	78	62	673
IIT Kanpur	109	24.38	8971	53	338	75.62	7915	47	447	16886
IIT Kharagpur	281	21.92	8368	25	1001	78.08	24492	75	1282	32860
IIT Madras	106	17.64	2107	20	495	82.36	8211	80	601	10318

IIT Mandi	22	19.64	293	32	90	80.36	621	68	112	914
IIT Roorkee	217	20.95	5016	23	819	79.05	16969	77	1036	21985
IIT Ropar	32	24.24	3522	59	100	75.76	2434	41	132	5956
IIT Indore	82	25.95	1796	31	234	74.05	4046	69	316	5842
IIT-ISM Dhanbad	81	19.42	1603	24	336	80.58	4953	76	417	6556
Grand Total	**1766**	**22.29**	**58859**	**31**	**6157**	**77.71**	**130307**	**69**	**7923**	**189166**

OA= Open Access Publication; P= Percentage; COA= Citations Received Open Access Publications; PCOA=Percentage of Citations Received Open Access; NOA=Non-Open Access Publication; CNOA=Citations Received Non-Open Access Publication; PCNOA=Percentage of Citations Received Non-Open Access Publication; TP=Total Publications; CTP=Citations received in Total publications.

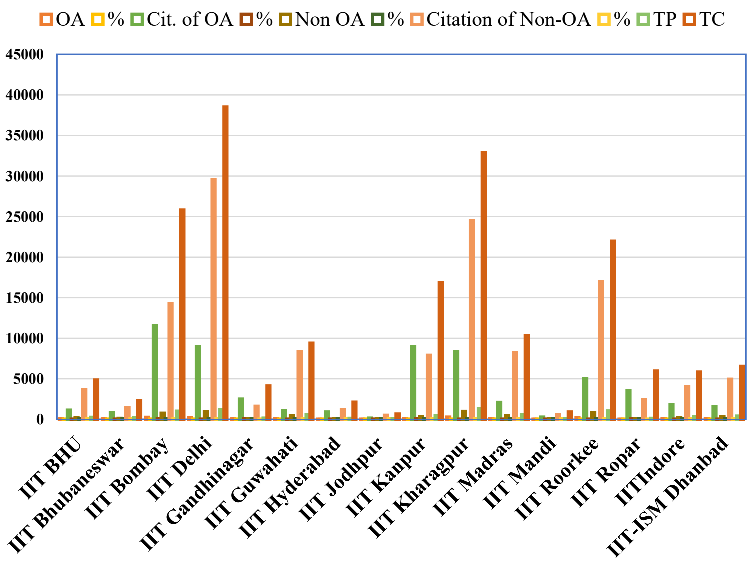

Fig. 4: Citation pattern of open-access publications vs. non-open-access publications

5.5 Sources of Top-ranked Preferable Publications

Table 4 shows the list of top-ranked publications and sources and their access type pertaining to climate change research. With 172 publications or 2.23% of the total, the "*Journal of Cleaner Production*" is the most prominent source. Elsevier publishes this open-access (OA) journal, which has a high Cite Score of 18.5; its SCImago Journal Ranking (SJR) is 1.981; and its Source Normalisation of Impact Factor (SNIP) is 2.379. With 110 non-open-access (NOA) papers from Elsevier, "*Science of the Total Environment*" finishes in second place with an impressive Cite Score of 16.8, SJR of 1.946, and SNIP of 2.026. "*Lecture Notes in Civil Engineering*," an NOA journal published by Springer Nature, is the third-ranked source, emphasising its special importance using different metrics. Renowned journals that have made substantial contributions to the literature on climate change include "*Theoretical and Applied Climatology*," "*Journal of Hydrology*," and "*Renewable and Sustainable Energy Reviews*." Researchers can find influential channels for their work by using these rankings, which provide insights into the accessibility and influence of various sites.

Table 4: Top-Ranked Publication Sources

Rank	Source	No of Pubs.	%	Acc. Type	Publisher	Cite Score	SJR	SNIP
1	Journal of Cleaner Production	172	2.23	OA	Elsevier	18.5	1.981	2.379
2	Science of the Total Environment	110	1.43	NOA	Elsevier	16.8	1.946	2.026
3	Lecture Notes in Civil Engineering	95	1.27	NOA	Springer Nature	0.7	0.147	0.196
4	Journal of Hydrology	89	1.11	NOA	Elsevier	10.4	1.67	1.731
5	Environmental Monitoring and Assessment	72	0.93	NOA	Springer Nature	5.2	0.626	0.906
6	Renewable and Sustainable Energy Reviews	66	0.88	NOA	Elsevier	26.3	3.232	3.631
7	Theoretical and Applied Climatology	64	0.76	NOA	Springer Nature	6.5	0.826	1.094
8	Journal of Environmental Management	52	0.65	NOA	Elsevier	13.4	1.678	1.849
9	Current Science	50	0.67	NOA	Indian Academy of Sciences	1.7	0.246	0.559
10	Environmental science and pollution research journal	49	0.62	NOA	Springer Nature	7.9	0.944	1.214

SJR: Simango Journal Ranking, SNIP: Source Normalisation of Impact Factor

5.6 Top Ten Collaboration of Countries and Institution's Departments

Table 5: Top Ten Collaboration of Countries

S.No.	Country	NP	NC	TLS
1	United State	662	38608	1596
2	United Kingdom	345	25028	1143
3	China	244	15445	881
4	Australia	211	14146	768
5	Germany	191	16970	726
6	Canada	179	10251	655
7	Japan	120	7519	374

S.No.	Country	NP	NC	TLS
8	South Korea	97	4278	310
9	France	82	12958	450
10	Sweden	78	10814	359

NP= Number of Publications, **NC**= Number of Citations, **TLS**= Total Link Strength

Table 5 and **Figure 5** display data from the Indian Institutes of Technology (IITs), which have a strong research focus on climate change, specifically analysing publication and citation metrics across multiple countries. Researchers can collaborate at various levels, such as individuals, departments, institutions, industries, and nations. This collaboration is supported by 7,923 publications, 1,89,166 citations, and a total link strength of 3785. International collaboration entails the cooperative efforts of scholars and research institutions from many countries, who join forces to offer reciprocal assistance and contribute to the execution of research. International collaboration is typically acknowledged when a research publication has co-authors from two or more separate nations. The analysis of the study indicates that the United States has the largest quantity of joint publications, accounting for a total of 662 pubs. Subsequently, the United Kingdom ranks second with 345 publications, followed by China with 244 publications, Australia with 211 publications, Germany with 191 publications, Canada with 179 publications, South Korea with 97 publications, France with 82 publications, Sweden with 78 publications, and various other countries. The IITs have collectively produced all publications in collaboration with 152 nations. This highlights the vital role that Indian institutions play in the worldwide cooperation on climate change. The USA, UK, and China are renowned for their significant contributions to climate change research, accordingly. The global influence and interconnectivity of IITs' research are highlighted by the comprehensive link strength indicator, which emphasises the collaborative and interdisciplinary approach to tackling climate change worldwide.

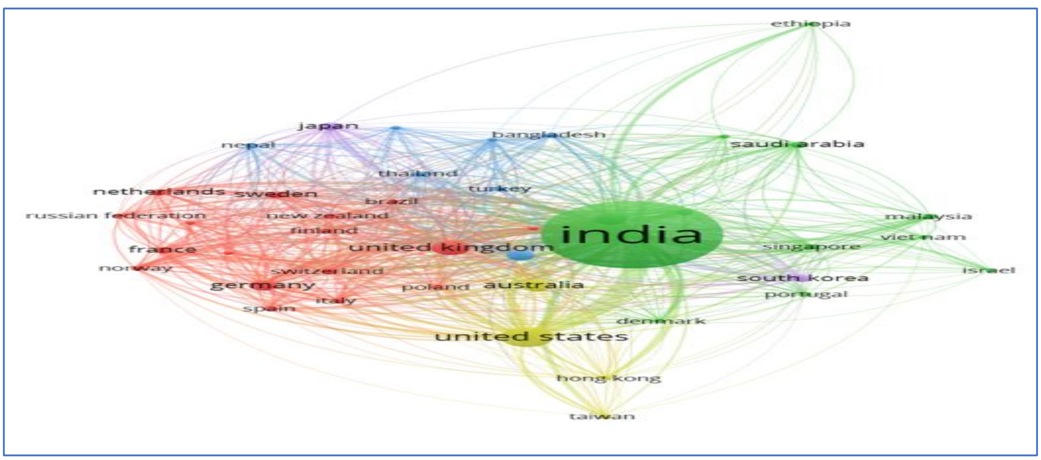

Fig. 5: Top Collaboration Countries

Table 6 and **Figure 6** illustrate the climate change research output of various departments and organisations within the Indian Institutes of Technology (IITs) in India. The "Department of Civil Engineering, IIT Bombay" is a prominent contributor in the realm of climate change, having published 125 articles, received 2666 citations and had a total link strength (TLS) of 62. This demonstrates their strong and significant research effort in this field. The Department of Management Studies at IIT Delhi is a second significant contributor to climate change research, with 30 publications, 618 citations, and a total link strength (TLS) of 2. The Department of Geology and Geophysics at IIT Kharagpur is the third contributor, with 30 publications, 808 citations, and a total link strength (TLS) of 1. The table showcases the scientific contributions made by various departments at IITs, emphasising their collaborative efforts in addressing the challenges of climate change using the VOSviewer software.

Table-6: Collaborations of Organisations and Their Total Link Strength

S.No.	Organisations	No. of Pubs.	No. of Citations	TLS
1	Depart. of Civil Engineering, IIT Bombay	125	2666	62
2	Depart. of Management Studies, IIT Delhi	30	618	2
3	Depart. of Geology and Geophysics, IIT Kharagpur	30	808	1
4	Centre for Atmospheric Sciences, IIT Delhi	26	600	4
5	Centre for Rural Development and Technology, IIT Delhi	26	372	4
6	Coral, IIT Kharagpur	24	189	3
7	Centre for Energy Studies, IIT Delhi	24	324	3
8	Depart. of Hydro and Renewable Energy, IIT Roorkee	23	268	6
9	Depart. of Mechanical Engineering, IIT Madras	23	438	1
10	Depart. of Civil Engineering, IIT Madras	40	552	20
11	Depart. of Civil Engineering, IIT Kanpur	20	867	4
12	Depart. of Civil Engineering, IIT Kharagpur	19	191	1
TLS= Total Link Strength				

Fig. 6: Collaborations of Organisations

5.7 Most Preferred Keywords and Their Occurrence

Table 7: Top Ten Keywords and Their Occurrence

S.No	Keywords	Frequency
1	Climate change	2246
2	Sustainable development	2168
3	India	1775
4	Global warming	682
5	Carbon dioxide	591
6	Article	577
7	Biomass	347
8	Rain	332
9	Decision making	327
10	Climate models	317

Table 7 and **Figure** 7 illustrate the most preferred keywords in the corpus. "Climate change" emerges as the most prevalent term, appearing 2,246 times (13%), reflecting a significant focus on this critical environmental issue. "Sustainable development" closely follows with 2,168 (12%) mentions, emphasising the intertwined nature of environmental and developmental concerns. "India" is a prominent term, occurring 1,775 times (10%) indicative of a geographical or regional emphasis. Other notable words include "global warming" (682, 4%), "carbon dioxide" (591, 3%), and "biomass" (347, 2%). The frequency of terms like "article" (569, 3%) suggests a general focus on scholarly content. Additionally, specific topics such as "rain" (2%), "decision-making" (2%), "climate models" (2%), and so on highlight diverse aspects of climate change research covered in the corpus.

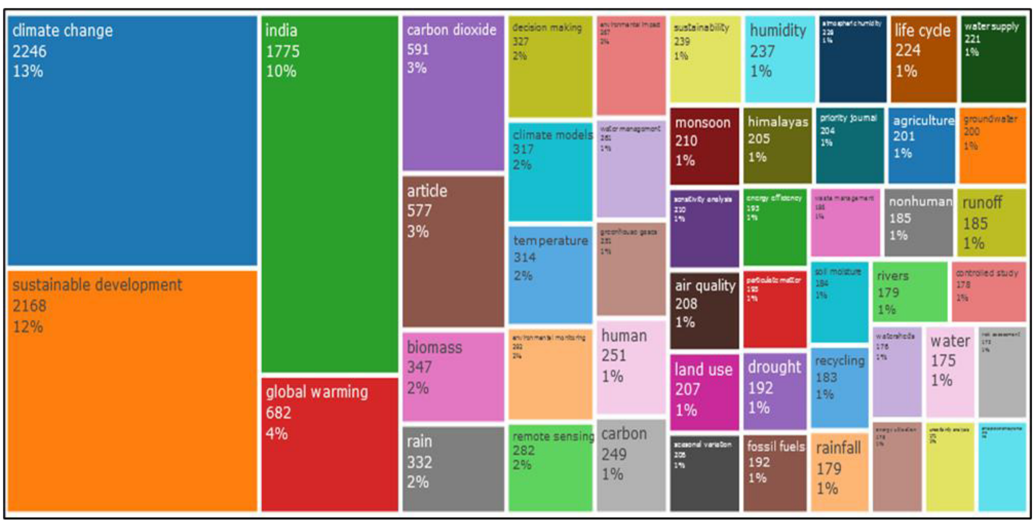

Fig. 7: Most Preferred Keyword Occurrence

6. CONCLUSION

A total of 7,923 research contributions on climate change have been identified from the Scopus database from 2000 to 2023. Based on the analysis of the provided tables and figures, it can be observed that the publication trends, citation patterns, and average rate of growth in climate change research output vary across different Indian Institutes of Technology (IITs) as per the search string. According to Table 1, there is a consistent upward trajectory in research emphasis. This is evident from the notable peaks and annual growth rates in 2001(81.25%), 2004(68.75%), 2011(89.32%), and 2016(45.90%), respectively. However, the negative growth rate in the year 2002 (-27.59%), no growth in the year 2005 (0.00%), and the minimum growth year in 2017 (0.51%) etc. were seen during the investigation. Various forms of research contribution, i.e. 65.43% of the total publications identified as articles, while the remaining 34.57% were publications published by all 16 IITs. Among all the IITs, IIT Kharagpur has made the highest number of contributions in terms of publications(16.18%) in this particular field. Among the publication pattern, citation count, and average citation per paper on climate change research conducted by IITs. IIT Kharagpur has the highest number of publications, with 1242 citations, with 32,860. It is followed by IIT-Delhi, which has 1190 publications and 38,530 citations. In other ways, IIT Jodhpur has the lowest number of publications (62) and received a total citations of 673. The focus was on Open Access (OA) publications among IITs. The average citations per paper (ACPP) is found to be 37.91, and the un-cited ratio is significantly less in the case of climate change research. It is observed that open-access publications have received a much greater number of citations.

The publication sources that have the highest ranking in climate change research. 2.17% of publications were published in the Journal of Cleaner Production, followed by Science, Total Environment (1.39%) and Lecture Notes Civil Engineering (1.20%), respectively of total publications. The authors found that countries' collaboration and India, driven by the Indian Institutes of Technology, led the way in global climate change research with 7,422 articles, 1,75,347 citations, and a significant link strength 3785. The international network is demonstrated by collaborative efforts with the United States (662 publications, 38,608 citations, link strength of 1,596), the UK (345 articles), China (244 articles), and Australia (211 articles). The substantial contributions from Germany, Canada, France, Japan, and the Netherlands highlight the cooperative and multidisciplinary endeavours that characterise the worldwide response to climate change. For the topmost keyword occurrence, it is observed that the keywords most frequently utilised are associated with significant subjects like climate change, sustainable development, and global warming. The collective analyses offer a comprehensive insight into the evolving landscape of climate change research at leading educational institutions in India. These institutions are known for their diverse research interests and significant contributions to tackling environmental challenges. According to Ivancheva (2008), scientometrics is considered a promising area of research in the broader study of science. It offers valuable tools for analysing and evaluating scientific activities, which can contribute to economic growth and social development. The study's insight will be helpful for authorities/ policymakers in identifying where the group of IITs stand in Climate Change research in comparison between them and also valuable for further study by future researchers.

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EXPLORING INFORMATION SOURCES AND SERVICES AT MANGALORE UNIVERSITY LIBRARY AS SCIENCE RESEARCH SCHOLARS' PERSPECTIVE: A COMPREHENSIVE EVALUATION

Dr. Dayanandappa Kori*

ABSTRACT

Library and information centres are vital for accessing information, promoting knowledge, and supporting academic happenings. Library and information centres work with other organizations to offer specialized services like job search assistance and information literacy programs. The study explored the information sources and benefits from a science research scholars' perspective: a comprehensive evaluation at Mangalore University Library, Karnataka, India. The investigation uses a questionnaire to collect the data from the respondents. Fifty-eight research scholars participated in this survey. The research findings highlight the strengths and weaknesses of the library's resources and services and provide valuable suggestions for improvement. The satisfaction with library sources services varied among respondents, with some areas receiving positive ratings and others needing improvement. By implementing study suggestions, Mangalore University Library can further enhance its role in supporting the research endeavours of scholars and contributing to the advancement of knowledge.

Keywords: *Research Scholars, Mangalore University, Information sources and services*

INTRODUCTION

Library and information centers are vital for accessing information, promoting knowledge, and supporting academic happenings. Libraries are a significant source for research scholars. It needs to create a more favourable and welcoming environment. Libraries work together with other organizations to provide specialized services. Understanding user satisfaction is essential for optimizing library and information services. The present research explored the information sources and benefits from a science research scholars' perspective: a comprehensive evaluation at Mangalore University Library, Karnataka, India.

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REVIEW OF LITERATURE

Sinha, P. A. S. & Sinha, M.K. (2023) research offers a valuable overview of the research data management services provided by South and Southeast Asian academic libraries and information centres. The researchers identify the challenges library and information science professionals face in providing these services and suggest ways to improve the quality of RDM support. In their research, Frati, F., Oja, L. A., Kleinberg, J., & Chla-Absc Standards Task Force (2021). The Canada Health Libraries Association Standards are valuable for Canadian health and social services libraries. They provide a framework for ensuring libraries offer the essential services their users need. In their study Zhang, S., Wang, J. N., Chiu, Y. L., & Hsu, Y. T. (2020) found that Patients' choice of information sources for selecting doctors varies depending on the complexity of the medical decision, the provider's hospital level, and the patient's location. Government and healthcare industry efforts can benefit from understanding these preferences. Peggy Johnson's (1997) study investigates the service quality of the Aga Khan University library in Kenya using the SERVQUAL tool. The findings show that users' expectations of library services are higher than their perceptions.

OBJECTIVES

- To assess research scholars' awareness and utilization of information sources and services.
- To identify the strengths and weaknesses of information sources and services at Mangalore University.
- To gather suggestions from research scholars for enhancing the effectiveness of Mangalore University information sources and services.

RESEARCH DESIGN AND METHODOLOGY

This research utilized a well-designed structured questionnaire to gather data in this research. The questionnaire consisted of carefully designed questions to collect information about the present study. A survey was conducted among 58 science research scholars at Mangalore University, Mangalore, Karnataka, India.

SCOPE AND LIMITATIONS

In this research, confinement at Mangalore University is examined. The study collected 58 responses from science research scholars. It is significant to note that the research only pertains to this educational institution.

DATA ANALYSIS AND INTERPRETATION

Table 1: Reliability Statistics

S.No.	Reliability Statistics	
1.	Cronbach's Alpha	No of Items
	0.836	35

The Cronbach's alpha value of 0.836 suggests a relatively high level of internal consistency for the scale or test, suggesting that the items are measuring a single construct effectively.

Table 2: Gender of The Participants

S.No.	Gender	Frequency	Percentage
1.	Male	35	60.34
2.	Female	23	39.66
Total		**58**	**100.0**

Table 2 shows the gender of the participants; the majority of the participants (60.34%) were male, followed by females with 39.66% of the participants.

Table 3: Library Visit of Respondents

S.No.	Library Visit	Frequency	Percentage
1.	Yes	57	98.28
2.	No	1	1.72
Total		**58**	**100.0**

Table 3 shows the library visits of respondents; the vast majority (98.28%) reported visiting the library. Only a tiny percentage (1.72%) of respondents reported not visiting the library.

Table 4: Frequency of Library Visit

S.No.	Frequency of Library Visits	Frequency	Percentage
1.	Daily	15	25.9
2.	Twice a week	14	24.1
3.	Weekly	4	6.9
4.	Fortnightly	22	37.9
5.	Once a month	3	5.2

Table 4 shows the frequency of library visits; the most common frequency is fortnightly, with 37.9% of respondents reporting visiting the library every two weeks. This is followed by daily visits (25.9%) and twice-weekly visits (24.1%). A smaller percentage of respondents reported visiting the library weekly (6.9%) or once a month (5.2%).

Table 5: Level of Importance of Library Use

S.No.	Importance	Frequency	Percentage
1.	Very important	21	36.2
2.	Important	30	51.7
3.	Not important	7	12.1

Table 5 shows the level of importance of library use; the majority of respondents (87.9%) found library use to be either significant (36.2%) or significant (51.7%). Only a small percentage (12.1%) of respondents found library use unimportant.

Table 6: Evaluation of Library and Information Services

S.No.	Library and Information Services	N	Minimum	Maximum	Mean	Std. Deviation	Rank	Decision
1.	Circulation service	58	1.00	4.00	3.2	0.75028	1	High Perception
2.	Reference service	58	1.00	4.00	3.2	0.72067	4	High Perception
3.	Current Awareness Service	58	1.00	4.00	2.7	0.80681	18	Low Perception
4.	Photocopy Service	58	1.00	4.00	2.8	0.95069	15	Low Perception
5.	Book Lending Service (Number of Books to Borrow)	58	1.00	4.00	2.8	0.90722	14	Low Perception
6.	Hours of operation	58	1.00	4.00	3.0	0.82699	10	High Perception
7.	Reservation of Books	58	1.00	4.00	3.2	0.71222	3	High Perception
8.	Newspaper clipping	58	1.00	4.00	3.2	0.65005	1	High Perception
9.	OPAC	58	1.00	4.00	3.0	0.89834	8	High Perception
10.	Library website	58	1.00	4.00	2.8	1.02833	12	Low Perception

S.No.	Library and Information Services	N	Minimum	Maximum	Mean	Std. Deviation	Rank	Decision
1.	Internet service	58	1.00	4.00	3.0	0.85840	8	High Perception
2.	Facilities (Seating, Lighting, Cleanliness)	58	1.00	4.00	2.9	0.75108	11	Low Perception
3.	Library Display/ Exhibition	58	1.00	4.00	3.1	0.82552	7	High Perception
4.	Organization/ Arrangement of Library Services	58	1.00	4.00	2.8	0.79776	12	Low Perception
5.	Library Orientation Programme	58	1.00	4.00	2.7	0.83336	17	Low Perception
6.	Digital Library Services	58	1.00	4.00	2.8	0.77331	16	Low Perception
7.	Seats, Reading Carrels, and space	58	1.00	4.00	3.1	0.70796	6	High Perception
8.	Support from library staff	58	1.00	4.00	3.1	0.66727	5	High Perception

(N=58 5=Excellent 4=Good 3=Fair 2=Poor 1=Don't know Decision - weighted average 53.3/18 =3.0)

Table 6 shows the evaluation of library and information services; the overall perception of library and information services is fair to good. The average mean score for all 18 services is 3.0. The highest-rated services are circulation service, reference service, reservation of books, newspaper clipping, OPAC, and support from library staff, with a mean score of 3.2. The lowest rated services are current awareness service, photocopy service, book lending service (number of books to borrow), library website, facilities (seating, lighting, cleanliness), organization/arrangement of library services, library orientation program, and digital library services, with a mean score of 2.8. *Strengths* The library provides various services generally perceived as fair to sound quality. The library staff is helpful and knowledgeable. The library has a variety of electronic resources available. *Weaknesses:* Some of the library's services, such as the current awareness service, photocopy service, book lending service, library website, facilities, organization/arrangement of library services, library orientation program, and digital library services, are not as highly rated as others. The library could improve its organization and arrangement of materials to make them easier to find. The library could create a more conducive and friendly environment for reading and learning. Recommendations The library should focus on improving the following services: Current awareness service, Photocopy service, Book lending service (number of books to borrow), Library website Facilities (seating, lighting, cleanliness), Organization/arrangement of library services, Library orientation program Digital library services The library should improve the organization and arrangement of its materials to make them easier to find.

Table 7: Evaluation of Library and Information Products

S.No.	Library and Information Products	N	Minimum	Maximum	Mean	Std. Deviation	Rank	Decision
1.	Books	58	2.00	4.00	3.2	0.58516	1	High Perception
2.	Journals	58	1.00	4.00	3.0	0.67538	4	Low Perception
3.	Newspapers	58	2.00	4.00	3.2	0.64233	1	High Perception
4.	Magazines	58	1.00	4.00	3.1	0.76525	3	Low Perception
5.	Reports	58	1.00	4.00	2.8	0.69481	7	Low Perception
6.	Databases	58	1.00	4.00	2.9	0.79167	6	Low Perception
7.	E-Resources	58	1.00	4.00	3.0	0.83699	4	Low Perception
8.	Reference materials	58	1.00	4.00	2.0	0.85769	8	Low Perception
9.	Thesis and projects	58	1.00	4.00	2.0	0.83699	8	Low Perception

(N=58 5=Excellent 4=Good 3=Fair 2=Poor 1=Don't know Decision - weighted average 28.5/9 =3.2)

Table 7 shows the evaluation of library and information products, which are perceived to have fair to sound quality. The highest-rated products are books and newspapers. The lowest-rated products are reference materials, Thesis and projects, reports, databases, e-resources, magazines, and journals. The library should improve the following products: Reference materials, Thesis and project reports, Databases, E-resources, Magazines, and Journals.

Table 8: Overall Perception of the Library

S.No.	Perception	Frequency	Percentage
1.	Excellent	11	19.0
2.	Good	45	77.6
3.	Fair	2	3.4
Total		**58**	**100.0**

Table no 8 shows that the overall perception about the library, the overall perception of the library is positive. Most respondents (77.6%) rated the library as good, while 19.0% rated it as excellent. Only 3.4% of respondents rated the library as fair.

Table 9: Problems Affecting Effective Use of The Library Sources and Services

S.No.	Problems	Frequency	Percentage
1.	Little/No assistance from the library staff	1	1.7
2.	Poor organization of the materials on the shelves	3	5.2
3.	Collections are inadequate	8	13.8
4.	Collections are not relevant	3	5.2
5.	The library has little or no resources in my course of study	3	5.2
6.	The library environment is not conducive/friendly for reading and learning.	3	5.2
7.	Others	37	63.8
Total		**58**	**100.0**

Table 9 shows the problems affecting the effective use of the library sources and services; the most common problem reported by respondents is "Others" (63.8%), which suggests that there are various reasons why students cannot effectively use the library sources and services. The other most common problems reported are "Collections are inadequate" (13.8%), "Poor organization of the materials on the shelves" (5.2%), "Collections are not relevant" (5.2%), "The library has little or no resources in my course of study" (5.2%), and "The library environment is not conducive/friendly for reading and learning." (5.2%).

FINDINGS

The study identified several strengths and weaknesses of Mangalore University's information sources, services, and products. The perception of library and information services is fair to good. The highest-rated services are circulation service, reference service, reservation of books, newspaper clipping, OPAC, and support from library staff. The lowest rated services are current awareness service, photocopy service, book lending service (number of books to borrow), library website, facilities (seating, lighting, cleanliness), organization/arrangement of library services, library orientation program, and digital library services. The library and information products are perceived as fair to sound quality. The highest-rated products are books and newspapers. The lowest-rated products are reference materials, Thesis and projects, reports, databases, e-resources, magazines, and journals.

RECOMMENDATIONS

The library intends to allocate supplementary resources towards the procurement and upkeep of an extensive assortment of electronic resources, with a particular focus on specialized research domains, to augment its assistance to scholars engaged in research. Its objective is to share resources and expertise through collaboration with other academic institutions and research organizations. Consistent surveys and focus groups will be administered by the library to ascertain the information requirements of researchers and assess their contentment with the existing resources and services. There are plans to establish a comprehensive training programme to instruct academics on the optimal utilization of electronic journals, online databases, and other digital resources. A specialized group of librarians will be assembled to aid in identifying and retrieving pertinent information.

CONCLUSION

This investigation is necessary for managing the library. The outcomes will help identify strengths and weaknesses in the library's current services and resources. The results will help library management make informed decisions, implement changes, and allocate resources effectively. Ultimately, the study aims to contribute to the overall improvement in library services, leading to higher user satisfaction and engagement with the Mangalore University Library. The Mangalore University Library can establish a more enhanced, effective, and gratifying user experience by perpetually soliciting user feedback and implementing the suggested enhancements. Consequently, this will contribute to the library's status as a vital repository of information and a beneficial resource for the community at large.

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IDENTIFYING THE FACTORS IMPEDING RESEARCH PROGRESS FROM THE RESEARCH SCHOLARS' PERSPECTIVE: A COMPREHENSIVE ANALYSIS AT MANGALORE UNIVERSITY, MANGALORE, KARNATAKA, INDIA

Dr. Dayanandappa Kori*

ABSTRACT

Research scholars are crucial in expanding our understanding and developing new tools and ideas. However, various things often stand in the way of research progress. From the viewpoint of research scholars at Mangalore University, Mangalore, Karnataka, India, this research attempted to find and examine the things that hinder research from moving forward. A questionnaire was used to collect data for this investigation. This study was conducted with 100 research scholars. The outcome showed that various reasons impede research progress, such as familial obligations, limited time availability, the necessity to work for financial support, the geographical location of the significant study site, and challenges in accessing pertinent research resources within one's profession. The results suggested augmenting research funding, enhancing research infrastructure, alleviating teaching responsibilities, reinforcing mentorship initiatives, and offering workshops on research publication. This research indicates that Mangalore University can create a better environment for research and new ideas by following the advice it contains.

Keywords: Research scholars, Research progress, Mangalore University, India

INTRODUCTION

Researchers are significant for helping us learn more and develop new tools and ideas. However, many things get in the way of their research success. Things at Mangalore University slowing down scientific progress are many and hard to understand. From the viewpoint of research scholars at Mangalore University, Mangalore, Karnataka, India, this research attempted to find and examine the things that hinder research from moving forward. A questionnaire was used to collect data for this investigation.

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REVIEW OF LITERATURE

A study by Sahranavard, Esmaeili, Salehiniya, and Behdani (2019) found that behavioural therapy can effectively reduce anxiety levels and increase students' self-efficacy. A survey by Ardi, Rangka, Ifdil, Suranata, Azhar, and Alizamar (2019) found that students with higher research self-efficacy had less anxiety about mathematics and fewer difficulties learning mathematics. A study by Gencoglu, Sahin, and Topkaya (2018) found that self-forgiveness and situational forgiveness were negatively associated with anxiety and stress symptoms. Razavi, Shahrabi, and Siamian (2017) studied the relationship between research anxiety and self-efficacy among research scientists in Iran. A study by Maharajan, Rajian, Tam, Chaw, Ang, and Yong (2017) examined the relationship between research self-efficacy and anxiety among postgraduate pharmacy students in Malaysia.

OBJECTIVES

- To recognise the factors that hinder research progress.
- To examine the relative importance of these factors.
- To know the need for training for research scholars
- To recommend measures to address these factors and improve research progress.

RESEARCH METHODOLOGY

The study assessed the factors impeding research progress from the perspective of research scholars at Mangalore University, Mangalore, Karnataka, India. This research used a structured questionnaire to gather data. The study was conducted among 100 research scholars at Mangalore University, Mangalore, Karnataka, India.

SCOPE AND LIMITATIONS

The paper collected 100 responses from research scholars to gain insight into their perspectives on factors impeding research progress. It is important to note that the research only pertains to Mangalore University.

DATA ANALYSIS AND INTERPRETATION

Table 1: Reliability Statistics

S.No.	Reliability Statistics	
1.	Cronbach's Alpha	N of Items
Score	0.852	45

Table no 1 shows Cronbach's alpha value; the result 0.852 suggests a relatively high level of internal consistency for the scale or test, suggesting that the items are measuring a single construct effectively.

Table 2: Gender of the Participants

S.No.	Gender	Frequency	Percentage
1.	Male	61	61.0
2.	Female	39	39.0
Total		**100**	**100.0**

The above table shows the gender of respondents. 61 (61%) of the participants are male, while 39 (39%) are female.

Table 3: Factors Constrain the Progress of Research

S.No.	Constraints	N	Minimum	Maximum	Mean	Std. Deviation	Rank	Decision
1.	Pressure of time	100	3.00	5.00	4.2	.73656	1	High Perception
2.	Family pressures	100	1.00	5.00	3.8	1.01225	3	High Perception
3.	Relationship with supervisor	100	1.00	5.00	3.6	1.22479	10	High Perception
4.	Necessity of working to support research	100	1.00	5.00	4.0	.85723	2	High Perception
5.	Location of the main place of research work	100	1.00	5.00	3.8	.98473	4	High Perception
6.	Difficulties in identifying relevant research materials in your field	100	1.00	5.00	3.6	1.08971	9	High Perception
7.	Difficulties in getting hold of relevant research materials	100	1.00	5.00	3.6	1.09779	8	High Perception
8.	Lack of own research and information-seeking skills	100	1.00	5.00	3.3	1.14150	14	Low Perception
9.	Restricted or lack of availability of specific technology requirements	100	1.00	5.00	3.4	1.24117	11	Low Perception
10.	Restricted or lack of adequate internet /network speeds in your prominent place of work	100	1.00	5.00	3.3	1.19949	13	Low Perception

S.No.	Constraints	N	Minimum	Maximum	Mean	Std. Deviation	Rank	Decision
11.	Restrictions imposed by the regulations of research libraries other than your institution	100	1.00	5.00	3.4	1.17426	11	High Perception
12.	Licensing and other restrictions imposed by online e-journal and other information services	100	1.00	5.00	3.7	1.21854	7	High Perception
13.	Finance	100	1.00	5.00	3.8	1.17082	5	High Perception
14.	Field-related data collection	100	1.00	5.00	3.7	1.07586	6	High Perception
15.	Lack of Technological knowledge	100	1.00	5.00	2.6	1.21983	15	Low Perception

(Note: N=100, 5= Very high 4= High 3= Sometimes 2= Low 1= Very low Decision - weighted average 54.0/15 =3.6)

Table 3 shows that the average weighted average of the perception of constraints is 3.6, considered "high" on a scale of 1 to 5, which means that most participants perceive the constraints listed in the table to be at least somewhat constraining to their research progress. The top five factors with the highest perception of constraints are Pressure of time, Family pressures, the necessity of working to support research, the location of the principal place of research work, and Difficulties in identifying relevant research materials in your field. These factors are all perceived as at least "high" constraints to research progress. The bottom two factors with the lowest perception of constraints are lack of technological knowledge and restricted or lack of adequate internet /network speeds in your prominent place of work. These factors are perceived as at least "low" constraints to research progress.

Table 4: Descriptive Statistics

S.No.	Descriptive Statistics		Statistic	Std. Error
1.	Mean		3.5967	.06243
2.	95% Confidence Interval for Mean	Lower Bound	3.4728	
3.		Upper Bound	3.7205	
4.	5% Trimmed Mean		3.5985	
5.	Median		3.4667	
6.	Variance		.390	
7.	Std. Deviation		.62427	
8.	Minimum		2.00	

S.No.	Descriptive Statistics	Statistic	Std. Error
9.	Maximum	4.73	
10.	Range	2.73	
11.	Interquartile Range	.80	
12.	Skewness	.158	.241
13.	Kurtosis	-.458	.478

Table no 4 shows an analysis of the descriptive statistics, and the table reveals that the average researcher's perception of constraints affecting research progress stands at 3.5967 on a scale of 1 to 5, with a standard error of 0.06243. The 95% confidence interval for the mean ranges from 3.4728 to 3.7205. The distribution exhibits a slight negative skew (skewness = 0.158) and a platykurtic shape (kurtosis = -0.458), with a median of 3.4667. Data variability is characterised by a variance of 0.390 and a standard deviation of 0.62427. The minimum and maximum values range is 2.73, while the interquartile content is 0.80. These statistics provide a comprehensive picture of the central tendency, variability, and distribution of factors influencing research constraints.

Table 5: Need of Training on Research Tools

S. No.	Need training in the following tools	Yes		No	
		Respondents	Percentage	Respondents	Percentage
1.	Bibliographic/Citations Indexes and Databases	73	73%	27	27%
2.	Researcher Identification Tools	75	75%	25	25%
3.	Research Metrics Tools	70	70%	30	30%
4.	Statistical and Data Analysis Tools in Research	63	63%	37	37%
5.	Reference Management Software's	62	62%	38	38%
6.	Academic Writing Tools	63	63%	37	37%
7.	Plagiarism Detection Tools	63	63%	37	37%
8.	Social Book Marking/Aggregating Tools (Delicious, FriendFeed)	57	57%	43	43%
9.	Grammar Checkers and Sentence Correction Tools	58	58%	42	42%
10.	Online Surveys Tools	55	55%	45	45%
11.	Scientists' Databases	61	61%	39	39%

S. No.	Need training in the following tools	Yes		No	
		Respondents	Percentage	Respondents	Percentage
12.	News alert Services, e-alerts	65	65%	35	35%
13.	Academic Social Networks	64	64%	36	36%
14.	Research Platforms	60	60%	40	40%
15.	Copyright and Licensing Mechanisms	56	56%	44	44%
16.	Electronic Information Resources	60	60%	40	40%
17.	Scholarly Search Engines	55	55%	45	45%
18.	Online Discussion Forums	59	59%	41	41%
19.	Research Guides, Reference and Citation Style Manuals	54	54%	46	46%
20	Document Creation, Edition and Sharing Tools	57	57%	43	43%
21.	Communication Tools	63	63%	37	37%
22.	Instant Messaging Tools	58	58%	42	42%
23.	Presentations: Creation, Edition and Sharing Tools	68	68%	32	32%
24.	Data visualisation tools	66	66%	34	34%

Table 5 shows a significant need for training among academic researchers in various tools and platforms. The majority of participants (over 60%) indicated a need for training in tools such as Bibliographic/citation indexes and Databases, Researcher Identification Tools, Research Metrics Tools, Statistical and Data Analysis Tools in Research, Reference Management Software, Academic Writing Tools, Plagiarism Detection Tools, and Social Book Marking/ Aggregating Tools. Additionally, a substantial number of participants expressed a desire for training in Grammar Checkers and Sentence Correction Tools, Online survey tools, Scientists' Databases, News alert Services, e-alerts, Academic Social Networks, Research Platforms, Copyright and Licensing Mechanisms, Electronic Information Resources, Scholarly Search Engines, Online Discussion Forums, Research Guides, Reference and Citation Style Manuals, Document Creation, Edition and Sharing Tools, Communication Tools, Instant Messaging Tools, Presentations: Creation, Edition and Sharing Tools, and Data visualisation tools. This data suggests that academic institutions and research organisations consider providing comprehensive training programs to ensure researchers have the necessary skills and knowledge to utilise these tools and platforms effectively. By doing so, institutions can support researchers in conducting high-quality research and advancing their academic endeavours.

FINDINGS

Researchers perceive significant constraints to their research progress. The average weighted average of the perception of constraints is 3.6, considered "high" on a scale of 1 to 5. This means that most participants perceive the constraints listed in the table to be at least somewhat constraining to their research progress. The top five factors with the highest perception of constraints are Pressure of time, Family pressures, the necessity of working to support research, Location of the prominent place of research work, and Difficulties in identifying relevant research materials in your field. The bottom two factors with the lowest perception of constraints are lack of technological knowledge and restricted or lack of adequate internet /network speeds in your prominent place of work. There is a significant need for training in various tools and platforms among academic researchers. The majority of participants (over 60%) indicated a need for training in tools such as Bibliographic/citation indexes and Databases, Researcher Identification Tools, Research Metrics Tools, Statistical and Data Analysis Tools in Research, Reference Management Software, Academic Writing Tools, Plagiarism Detection Tools, and Social Book Marking/Aggregating Tools. A substantial number of participants expressed a desire for training in Grammar Checkers and Sentence Correction Tools, Online survey tools, Scientists' Databases, News alert Services, e-alerts, Academic Social Networks, Research Platforms, Copyright and Licensing Mechanisms, Electronic Information Resources, Scholarly Search Engines, Online Discussion Forums, Research Guides, Reference and Citation Style Manuals, Document Creation, Edition and Sharing Tools, Communication Tools, Instant Messaging Tools, Presentations: Creation, Edition and Sharing Tools, and Data visualisation tools. Academic institutions and research organisations should consider providing comprehensive training programs to ensure researchers have the necessary skills and knowledge to effectively utilise these tools and platforms. By doing so, institutions can support researchers in conducting high-quality research and advancing their academic endeavours.

SUGGESTIONS

This study highlights the various challenges encountered by research scholars about personal, institutional, and societal elements. Primary personal obstacles encompass the necessity for efficient time allocation, equilibrium between work and personal life, and ongoing enhancement of skills. Limited resources, poor funds, and inadequate help are examples of institutional impediments. Being in a very competitive academic setting can make stress levels rise and could lower the quality of research. Misconceptions about studying in the public sphere led to unrealistic expectations and restrictions. To deal with these issues, organisations should provide training in time management, programmes to help people handle work and personal life, chances to improve their skills and mentoring. To make a place that encourages new ideas and knowledge growth, it is crucial to get more money and resources, build a supportive institutional culture, set up fair and open evaluation systems, involve the public, follow ethical rules, and encourage people from different fields to work together.

CONCLUSION

Researchers are significant for helping us learn more and develop new tools and ideas. However, many things get in the way of their research success. Things at Mangalore University slowing down scientific progress are many and hard to understand. Coordinated work between university leaders, faculty members, and study scholars is needed to solve these issues. This research suggests that Mangalore University can create a better environment for research and new ideas by following the advice it contains.

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RESEARCH SCHOLARS' PERCEPTION AND ATTITUDE TOWARDS COPYRIGHT LAW: A CASE STUDY

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ABSTRACT

Copyright issues in the digital environment are very significant, and the knowledge of such issues among academic and research communities in the University setup is essential to deal with legal consequences due to violation of Copyright issues. The present study attempted to assess the research scholars' awareness regarding Copyright Law and its related concepts and found significant results in terms of knowledge and perception among respondents. The study reveals that though the respondents replied that they are aware of copyright law, their perception and attitude showed differences in their opinions/ views regarding copyright issues. Most of the respondents agreed that a lack of knowledge of Copyright law and related issues led them towards copyright infringement.

Keywords: *Copyright, Intellectual Property Rights (IPR), Research Scholars, Research Attitude.*

1. INTRODUCTION

Technology advancements in the present context have brought drastic changes in every sector of the world and have also extended to the education sector. The dynamic changes in technologies have made people access information anywhere and anytime with the assistance of innumerable technologies. The information is acquired through various multidimensional ways such as print, electronic versions, social media, etc. Therefore, misuse of information is increasing rapidly, which is considered a threat to original creative work. This led to the introduction of "Copyright" and "Intellectual Property Rights (IPR) as Copyright is, without any doubt, the most important link connecting creativity and availability of information and knowledge-based items (Bosumprah, 2009). Leading experts across the world gave different definitions from different perspectives. The term Copyright, according to Fishman (1996), is a legislative tool that gives the author of a piece of artwork or literature, or a work that transmits information or ideas, the ability to regulate how the work is used. In general, Copyright is a highly valued intellectual property that grants the creator of an

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artistic activity the exclusive right to reproduce it in any form. The main aim of Copyright is to safeguard the individual's unique work in major intellectual productions. Originators of literary, scenic, lyrical, and creative works and makers of motion films and audiovisual works are granted Copyright under the law (Ahmadi & Sonkar, 2015). In this regard, the present study has made an attempt to assess the knowledge and perception of University research scholars regarding Copyright law and its related issues.

2. OBJECTIVES OF THE STUDY

The present study was designed to collect responses from the research scholars of three state Universities of Karnataka regarding their awareness and perception of copyright law and infringement. To deal with this objective, the researcher asked a few research questions;

- Are the research scholars aware of Copyright law?
- What is their level of awareness related to Copyright issues?
- What are their perception and attitudes regarding Copyright law and infringement?
- How did they infringe the Copyright, and what were the reasons behind this violation?

3. MATERIAL AND METHODS

For the present study, the researcher has adopted a survey method, and the following materials and methodology were used.

3.1 Population

This study consists of regular research scholars of science faculty of three state Universities, namely the University of Mysore, Bangalore University, and Mangalore University of Karnataka.

3.2 Sampling Technique

For the present study, the researcher has used the Cochran sample formula.

3.3 Research Tool

Well-structured questionnaires were designed (using the Likert scale), which consist of the following parts.

a. Part 1: Demographic characteristics of respondents (Name, Gender, Name of the University).
b. Part 2: Awareness of Copyright and related concepts and
c. Part 3: Perception and attitude towards Copyright Infringement. For data collection, the researcher visited each department and distributed dully filled questionnaires from the respondents of the respective Universities.

4. ANALYSIS AND INTERPRETATION OF DATA

The collected data was analyzed using SPSS (Statistical Package for Social Sciences) version 21 and presented in tabular form.

Table 1: Gender-wise Distribution of Respondents

S.No.	Name of the Universities	Male	Female	Total respondents
1.	University of Mysore (UOM)	58 (51.3)	55 (48.6)	113 (32.01)
2.	Bangalore University (BU)	49 (39.8)	74 (60.1)	123 (34.8)
3.	Mangalore University (MU)	62 (52.9)	55 (47.0)	117 (33.14)
Total		169 (47.8)	184 (52.1)	353 (100)

It is found from table 1 that, out of 353 respondents, 169 (47.8) are male, and 184 (52.1) are female category.

Table 2: Awareness of Copyright Law among the Respondents

Awareness	UOM (N-113)	BU (N-123)	MU (N-117)	Total
Yes	94 (83.1)	117 (95.1)	115 (98.2)	326 (92.3)
No	19 (16.8)	6 (4.8)	2 (1.7)	27 (7.6)
Total	113 (100)	123 (100)	117 (100)	353 (100)

This study aimed to know the awareness of copyright law among respondents, and a question was asked to respondents to assess their knowledge of copyright law (table 2). The majority of the respondents, i.e. 326 (92.3), are aware of Copyright Law, whereas a smaller number of respondents, i.e. 27 (7.6), are not aware of same. The data shown in the table clearly indicates that the majority of the research scholars are aware of the concept of Copyright Law.

Table 3: Level of Awareness About Copyright Law among the Respondents

Level of awareness	UOM	BU	MU	Total
Excellent	18(15.9)	17(13.8)	26(22.2)	61 (18.7)
Good	45(39.8)	57(46.3)	44 (37.6)	146 (44.7)
Average	25(22.1)	30(24.3)	34 (29.0)	89 (27.3)
Poor	3 (2.6)	5 (4.0)	6 (5.1)	14 (4.2)
Unaware	3(2.6)	8 (6.5)	5 (4.2)	16 (4.9)
Total	113 (100)	123 (100)	117 (100)	326 (100)

Further, a question was raised to respondents to determine their level of awareness of copyright law, which is depicted in Table 3. It can be seen from the table that most of the respondents, i.e. 146 (44.7), rated their awareness of Copyright Law as 'Good', followed by an average number of respondents, i.e. 89 (27.3) replied as 'average', 61 (18.7) of them said as 'excellent' about Copyright Law. From the table, it can be inferred that the majority of the respondents indicated their level of awareness of copyright law as good.

Table 4: Level of Awareness Among Respondents on Copyright Infringement

Level of awareness	UOM (N-113)	BU (N-123)	MU (N-117)	Total
Excellent	21 (22.3)	21 (17.9)	17 (14.7)	59 (18.0)
Good	48 (51.0)	36 (30.7)	57 (49.5)	141 (43.2)
Average	17 (18.0)	46 (39.3)	27 (23.4)	90 (27.6)
Poor	5 (5.3)	10 (8.5)	4 (3.4)	19 (5.8)
Unaware	3 (3.1)	4 (3.4)	10 (8.6)	17 (5.2)
Total	94 (100)	117 (100)	115 (100)	326 (100)

It is found from Table 4 that a fair number of the respondents, 141 (43.2) indicated their awareness as 'Good' about copyright infringement, followed by 90 (27.6) of the respondents rated as 'Average', and a smaller number the respondents i.e. 59 (18.0) rated as 'Excellent' of the same. It is clear from the results that an average number of respondents are aware of Copyright infringement.

Table 5: Level of Awareness among Respondents on Fair Use

Level of awareness	UOM(N-113)	BU(N-123)	MU (N-117)	Total
Excellent	23 (24.4)	20 (17.0)	14 (12.1)	57 (17.4)
Good	37 (39.3)	42 (35.8)	40 (34.7)	119 (36.5)
Average	26 (27.6)	37 (31.6)	45 (39.1)	108 (33.1)
Poor	3 (3.1)	14 (11.9)	5 (4.3)	22 (6.7)
Unaware	5 (5.3)	4 (3.4)	11(9.5)	20 (6.1)
Total	94 (100)	117 (100)	115 (100)	326 (100)

Table 5 indicates the awareness of the concept of Fair use among respondents. A reasonable number, i.e. 119 (36.5) of the respondents, rated as 'Good' about the concept of fair use, while 108 (33.1) of them replied 'average', and a smaller number of respondents, i.e. 57 (17.4), of them, felt 'Excellent' about Fair use. It could be inferred from the results that a moderate number of respondents are aware of Fair Use.

Table 6: Level of Awareness among Respondents on Digital Right Management

Level of awareness	UOM (N-113)	BU (N-123)	MU (N-117)	Total
Excellent	21(22.3)	14(11.9)	15(13.0)	50 (15.3)
Good	48(51.0)	35(29.9)	53(46.0)	136 (41.7)
Average	17(18.0)	41(35.0)	30(26.0)	88 (26.9)
Poor	5 (5.3)	21(17.9)	6 (5.2)	32 (9.8)
Unaware	3 (3.1)	6 (5.1)	11 (9.5)	20 (6.1)
Total	94 (100)	117(100)	115 (100)	326 (100)

Table 6 reveals the respondents' awareness of digital rights management. It can be observed from the results that a moderate number of respondents, i.e. 136 (41.7), rated their awareness as 'Good' about DRM, while 88 (26.9) of them stated it as 'average'. Followed by 50 (15.3) of them felt 'excellent' for the same. The data indicate that an average number of respondents are aware of Digital Right Management.

Table 7: Level of Awareness among Respondents on Creative Commons

Level of awareness	UOM (N-113)	BU (N-123)	MU (N-117)	Total
Excellent	15 (15.9)	12(8.5)	15(13.0)	42 (12.8)
Good	38 (40.4)	35(29.9)	53(46.0)	126 (38.6)
Average	28 (29.7)	41(35.0)	30(26.0)	99 (30.3)
Poor	5 (5.3)	21(17.9)	6 (5.2)	32 (9.8)
Unaware	8 (8.5)	8 (6.8)	11 (9.5)	27 (8.2)
Total	94 (100)	117(100)	115 (100)	326 (100)

The above table 7 found that an average number, i.e. 126 (38.6) of the respondents, stated their awareness as 'Good', followed by 99 (30.3) of them rated as 'average', and a smaller number of respondents, i.e. 42 (12.8) felt 'Poor' about CC. It is inferred from the results that the moderate number of respondents are aware of CC.

Table 8: Perception of Respondents about Copyright Law

Statements	Universities	Strongly agree	Agree	Uncertain	Disagree	Strongly disagree
Copyright Law is the exclusive right given to the owner of an original work for a specific period.	UOM	57 (60.6)	26 (27.6)	9 (9.5)	1 (1.0)	1 (1.0)
	BU	54 (46.5)	45 (36.5)	13 (10.5)	3 (2.4)	1 (0.8)
	MU	38 (32.4)	56 (47.8)	18 (15.3)	00 (00)	3 (2.5)
	Total	148 (45.3)	127 (38.9)	40 (12.2)	4 (1.2)	5 (1.5)

Statements	Universities	Strongly agree	Agree	Uncertain	Disagree	Strongly disagree
Copyright is given automatically to every individual who has made sufficient effort in making the work original in character.	UOM	29 (25.6)	42 (37.1)	14 (12.3)	7 (6.1)	2 (1.7)
	BU	13 (10.5)	47 (38.2)	39 (31.7)	12 (9.7)	5 (4.0)
	MU	25 (21.3)	48 (41.0)	35 (29.9)	4 (3.4)	3 (2.5)
	Total	67 (20.5)	137 (42.0)	88 (26.9)	23 (7.0)	10 (3.0)
Translated works available online or in print are eligible for copyright protection.	UOM	14 (14.9)	48 (51.1)	25 (26.6)	5 (5.3)	2 (2.1)
	BU	8 (6.9)	48 (41.4)	43 (37.1)	10 (8.6)	7 (6.0)
	MU	11 (9.6)	56(48.7)	37 (32.2)	6 (5.2)	5 (4.3)
	Total	33 (10.1)	152 (46.6)	105 (32.2)	21 (6.4)	14 (4.2)
Copyright owners are given exclusive rights to control the reproduction of the works, such as unauthorized downloading of digital contents.	UOM	37 (39.4)	36 (38.3)	17 (18.1)	2 (2.1)	2 (2.1)
	BU	20 (17.2)	58 (50.0)	26 (22.4)	10 (8.6)	2 (1.7)
	MU	20 (17.4)	46(40.0)	41 (35.7)	4 (3.5)	4 (3.5)
	Total	77 (23.6)	140 (42.9)	84 (25.7)	16 (4.9)	8 (2.4)
Copyright law is infringed if a student/ academic community makes unauthorized copies of copyrighted materials for commercial purpose.	UOM	26 (27.7)	36 (38.3)	19 (20.2)	10 (10.6)	3 (3.2)
	BU	21 (18.1)	59 (50.9)	23 (19.8)	11 (9.5)	2 (1.7)
	MU	16 (13.9)	53 (46.1)	27 (23.5)	11 (9.6)	8 (7.0)
	Total	63 (19.3)	148 (45.3)	69 (21.1)	32 (9.8)	13 (3.9)

Copyright law is a legal right granted for a limited period to a copyright owner who made an effort to create a new literary work. Knowledge of copyright law is essential among academics so that it protects their intellectual creativity and also makes them aware of someone's efforts in terms of IPR. Table 8 shows the respondents' perception towards copyright law, and it was found that the majority of the respondents, i.e. 152 (46.6) agreed that 'Translated works available online or print are eligible for copyright protection', followed by an equal number of respondents i.e. 148 (45.3) 'strongly agreed' and agreed to the statements that "Copyright Law is the exclusive right given to the owner of an original work for a specific period" & "Copyright law is infringed if a student/ academic community makes unauthorized copies of copyrighted materials for commercial purpose" which indicate that the moderate number of respondents are aware of importance of copyright law. It is noticed from the table that a moderate number of respondents perceived the copyright law as exclusive rights to the copyright holders.

Table 9: Respondents' Attitudes Towards Different ways of Copyright Infringement

	Universities	Strongly agree	Agree	Uncertain	Disagree	Strongly disagree
Photocopying of whole textbooks and scanning of whole documents without permission of copy-righted holder	UOM	26 (27.7)	36 (38.3)	19 (20.2)	10 (10.6)	3 (3.2)
	BU	27 (23.1)	46 (39.3)	30 (25.6)	12 (10.3)	2 (1.7)
	MU	29 (25.2)	38 (33.0)	40 (34.8)	3 (2.6)	5 (4.3)
	Total	82 (25.1)	120 (36.8)	89 (27.3)	25 (7.6)	12 (3.6)
Unauthorized Internet downloads lead to copyright infringement	UOM	25 (26.6)	38 (40.4)	25 (26.6)	4 (4.3)	2 (2.1)
	BU	23 (19.7)	49 (41.9)	33 (28.2)	10 (8.5)	2 (1.7)
	MU	26 (22.6)	44 (38.3)	37 (32.2)	7 (6.1)	1 (0.9)
	Total	74 (22.6)	131 (40.1)	95 (29.1)	21 (6.4)	5 (1.5)
Using published articles/copying from the Internet without getting permission from the author leads to copyright infringement.	UOM	31 (33.0)	36 (38.3)	13 (13.8)	7 (7.4)	7 (7.4)
	BU	34 (29.1)	53 (45.3)	20 (17.1)	8 (6.8)	2 (1.7)
	MU	45 (39.4)	42 (36.5)	23 (20.0)	2 (1.7)	3 (2.6)
	Total	110 (33.7)	131 (40.1)	56 (17.1)	17 (5.2)	12 (3.6)
Complete reproduction and reselling of copyrighted items is a violation of copyright act.	UOM	31 (36.9)	38 (45.2)	5 (6.0)	7 (8.3)	3 (3.6)
	BU	41 (35.0)	39 (33.3)	21 (17.9)	8 (6.8)	8 (6.8)
	MU	46 (40.0)	27 (23.5)	35 (30.4)	4 (3.5)	3 (2.6)
	Total	118 (36.1)	104 (31.9)	61 (18.7)	19 (5.8)	14 (4.2)

Table 9 indicates the respondents' level of understanding about copyright infringement. It is found from the table that an equal number of respondents, i.e. 131 (40.1), agreed to the statements that 'Unauthorized Internet downloads lead the copyright infringement & Using published article/copying from the Internet without getting permission from author leads to copyright infringement' leads them to violation of Copyright law. While 120 (36.8) of them agreed that 'Photocopying of whole textbooks and scanning of whole document without permission of copyrighted holder' and 118 (36.1) of them strongly agreed to the statement 'Complete reproduction and reselling of copyrighted items is a violation of copyright act'. It is clear from the results that a moderate number of respondents are aware of how copyright law infringes in different ways, and it needs to be trained on such issues of copyright law.

Table 10: Factors responsible for Copyright Infringement by the Respondents

Major factors	UOM (N-113)	BU (N-123)	MU (N-117)	Total
High Cost of Textbooks/ Journals	69 (61.0)	84 (68.2)	61 (52.1)	214 (65.6)
Lack of understanding of the concepts of Copyright and Plagiarism	77 (68.1)	91 (73.9)	87 (74.3)	255 (78.2)
Options to easily download from websites facilitate violation of Copyright law and Plagiarism	68 (55.2)	81 (65.8)	80 (68.3)	229 (70.2)
Lack of good understanding of using the Internet ethically	71 (62.8)	86 (69.9)	76 (64.9)	233 (71.4)
Lack of citation and reference skills	64 (56.6)	73 (59.3)	85 (72.6)	222 (68.0)
Bad Time Management in Research	60 (53.0)	71 (58.5)	72 (61.5)	203 (62.2)
Scarcity of Library Resources	49 (43.3)	76 (61.7)	53 (45.2)	178 (52.1)
Lack of knowledge about Plagiarism detection tools	53 (46.9)	84 (68.2)	85 (72.6)	222 (68.0)

Table 10 exhibits that the majority of the respondents, i.e. 255 (78.2) opined that lack of 'Lack of understanding of the concepts of Copyright' is the major factor in the involvement of violation of Copyright followed by 233 (71.4) of them said 'Lack of good understanding of using the Internet ethically' and 229 (70.2) of them said 'easy download from websites facilitates violation of Copyright law'. From the table, most of the respondents agreed that a lack of knowledge of related issues compelled them towards copyright infringement.

5. CONCLUSION

Copyright issues are hampering the environment of educational institutions, and such issues have made academic communities face legal consequences. Nowadays, it is most significant to be aware of issues of Copyright law. The present study found significant results in terms of knowledge and perception of copyright law among respondents. The study reveals that a moderate number of respondents are aware of Copyright-related concepts, which emphasizes enhancing the knowledge of respondents through various awareness programs by the concerned authorities. Most of the respondents are not aware of whether the translated works come under copyright law or not. Also, an average number of respondents perceived copyright law granted automatically who made sufficient effort to create new literary or artistic work. The results depicted that a moderate number of respondents opined that unauthorized download from the Internet and copying of published articles from the Internet without permission from the author leads to a violation of Copyright. The study found that most of the respondents opined that lack of knowledge on Copyright and related concepts and other major reasons made them compelled towards copyright violation. Therefore, the present study suggests that there are several measures/ initiatives that need to be taken by the concerned authorities and LIS professionals of respective Universities to enrich the knowledge of academic and research communities regarding Copyright Law and related issues by organizing various user orientation/ awareness programs and Information literacy initiatives.

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INFLIBNET INITIATIVES TO SUPPORT ACADEMIC LIBRARIES & PROMOTE RESEARCH ACTIVITIES IN INDIA

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ABSTRACT

The aim of this article is to discuss the various initiatives that the INFLIBNET Centre has taken to support and promote research activities in the country among the scholarly, academic, and scientific communities. It is well known that India is a country with a high brain power, and it is only a matter of time before India moves up the global intellectual ladder through research. In any country, research plays a crucial role in its economic development. The future competitiveness of an economy is dependent on research and development. An individual engages in research to increase their level of knowledge through systematic, creative work. Scientifically and systematically solving educational problems is what is meant by it in the context of education.

Keywords: *Research support, INFLIBNET, Vidwan, IRINS, Shodh Shuddi, DrillBit, Shodh Ganga & Shodh Gangotri, consortium for Higher Education Electronics.*

ABOUT INFLIBNET

Information and Library Network (INFLIBNET) is an autonomous interuniversity center. After being established under the IUCAA by the UGC in March 1991, it became an independent Inter-University Centre in June 1996. The INFLIBNET project is modernizing university libraries in India through the use of state-of-the-art technologies. A major goal of INFLIBNET is to promote scholarly communication among Indian academicians and researchers.

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Major Programs supporting for Research:

1. VIDWAN

Vidawan (Expert Database and National Researcher Network)

Is the best platform. The excellent database provides data/ profiles of scientists, researchers, and other faculties working at leading academic institutions and other research & development organizations involved in teaching and research in India. It offers crucial details regarding the expert's information, such as contact address, experience, scholarly publications, skills, accomplishments, and researcher identity, among others.. Now, the Vidwan database has 18687 organizations, 222351 subject experts registered members and 2827824 publications.

The Vidwan database has been meticulously crafted to offer swift and convenient access to information regarding experts for peers, potential collaborators, funding agencies, policymakers, and researchers within the nation.

- Identify peer reviewers for research proposals and articles.
- Research collaborations can be discovered by finding prospective collaborators.
- Directly communicate with experts who possess the expertise needed by users.
- Assisting scientists in exchanging scientific information and establishing networking opportunities

Table 1: Present Status of Category-wise Registered Institutions as on December 2023 in Vidwan

S.No.	Category	No of Institutions
1.	Central Universities	11778
2.	Deemed University	23479
3.	State University	28612
4.	R & D Organization	7576
5.	Technical Institute	34311
6.	Institute of National Importance	16801
7.	Other Institutes	86531

Table 2: Present Status on Subject Category-wise Registered Expert Members in Vidwan as of December 2023

S.No.	Category	No of Experts
1.	Agricultural Sciences	12381
2.	Arts & Humanities	19023

S.No.	Category	No of Experts
3.	Biological Sciences	8171
4.	Chemical Sciences	9655
5.	Engineering & Technology	83519
6.	Medical & Health Sciences	23457
7.	Physical Sciences	19930
8.	Social Sciences	37475

2. IRINS (INDIAN RESEARCH INFORMATION NETWORK)

Nowadays, researchers and faculties who are involved in the continued activity of research should have multiple identities like ORCID ID, Google Scholar ID, etc., which help to provide a persistent digital identifier that you own and control and that distinguishes you from every other researcher. And to connect through your iD with your professional information — affiliations, grants, publications, peer review, and more. The IRINS would be able to help incorporate the current study management scheme into an example HR method. The management of courses, provision of management services, storage of institutional resources, initiation and provision of business-related data, and collaboration with academic publishers are some of the key components of this system. It has been designed to incorporate various educational identifiers such as ORCID ID, Scopus ID, study ID, Microsoft Academic ID, and Google Scholar ID to facilitate the ingestion of scholarly publications from different sources..

The IRINS is a free online service that helps academic and study organizations in the Republic of India build connections with each other. This portal makes it easy for these organizations to find each other, share information, and develop relationships. In addition, IRINS helps scientists connect to share their research.

Stastistics: The IRINS portal now has 171769 profiles, 2381682 publications, and 22069442 citations.

Table 3: Current Status of Designation-wise Profiles Registered in the IRINS Portal as of December-2023

S.No.	Designation	No of Experts
1.	Professors	25073
2.	Associate Professors	26328
3.	Assistant Professors	96624
4.	Others	24118

2.1 Benefits of IRINS

To Scholars:

a. The website offers a great resource for finding mentors or advisors for your study in the respective realm.
b. It is useful for professors to be able to locate courses in their subject passions, as well as study areas of interest within the department and the corporation. and
c. It offers scholarly metadata that can be used to investigate the passions of faculty subscribers; the study focuses on the various departments and schools and more.

To Faculty:

a. It supports the faculty members in showing their field of study input to the recognized group.
b. It provides greater exposure to their research findings for the global community and opens up funding options from both domestic and international organizations.
c. Improving the quality of study metadata and reducing the redundant data input for various evaluation systems can be achieved in order to enhance efficiency.

2.2 Key Features

- Key research areas are important for the advancement of students, departments, and faculty.
- An elaborate filter function enabling users to search for professionals and their impact with several different parameters
- During the import process, it is possible to bring in publications from various academic identities, including those linked to platforms such as Microsoft Academic Search ID, Google Scholar ID, Researcher ID, and Scopus ID.
- Integrating ORCID into the ingest site to process the provided profile information and publication data
- Altimetry from social media such as Facebook, Twitter and Mendeley.
- Citation from Scopus, Cross Ref and link to Open Access article through Impact Story.
- Faculty members can connect and collaborate with each other through a co-author network and a map of the science network.
- The productivity of the department and individual faculty members can be effectively depicted through a graphical representation

3. SHODH SHUDDI

Plagiarism checking software helps biography assessment programs, which is beneficial in recognizing unintentional instances of borrowing others' material without proper citation and ensuring the originality of their works. Plagiarism can be detected through online browsing, even for a single term or phrase. However, parts or even the entirety of written pieces can potentially be plagiarized and credited improperly. Efforts need to be taken to identify and prevent such wrongdoings that violate ethical standards in academia.

To control Plagiarism activity in literary works, Based on the recommendation of the Sub-Committee,

National Steering Committee (NSC) of The Ministry of Education (the then MHRD), Government of India has initiated this service, which provides access to Plagiarism Detection Software (PDS) to the universities/institutes in India since September 1, 2019. Under this initiative, Ouriginal (initially Urkund, a Web-Based Plagiarism Detection Software, was provided to universities/intuitions in the country.

On October 1 2023, Ouriginal was replaced with DrillBit-Extreme, a Plagiarism Detection Software.

Table 4: Statistics for the Utilization of Ouriginal Plagiarism Detection Software (PDS) as of December-2023

S.No.	Category	No of Experts
1.	Total Member Institutions	1091
2.	Total Users	149699
3.	Total Documents Submitted	3539671

4. RESEARCH PROJECT DATABASE

INFLIBNET Center also promotes research through its “Research Project Database”. This database contains details of completed and ongoing research projects carried out by faculty members at various universities in India. There are currently over 13600 research projects supported by various funding agencies. The UGC, the ICAR, the ICMR, the DST, and the DBT, etc. Funding agencies and project directors have provided information about the project. Through this facility, Scientists, Faculty members or Researchers get details about ongoing research projects funded by other agencies and propose new areas/problems to do projects under funding agencies.

5. INFLIBNET’S INSTITUTIONAL REPOSITORY

Establishing a repository through IR@INFLIBNET, which utilizes the open-access software DSpace, is significant for researchers. Architecture and access distribution are adequate modules within this system. This digital mouthpiece offers three distinct collections to individuals.

6. SHODHGANGA

The Shodhganga(A Reservoir of Indian Theses)

Offers a program to investigate university scholars to deposit, re-use and disclose their theses and dissertations. Shodhganga is a digital repository created as per the UGC Guidelines (minimum & structure for granting M. Phil. or PhD degree, rule 2009 with amendments in 2016); Shodhganga is a repository for digital submission of theses and dissertations by students and researchers from universities across India. It aims to provide global access to these works through the INFLIBNET Centre, which oversees handling responsibilities for e-thesis and dissertations tied within its purview.

The data in the Shodhganga repository is increasing day by day. Now, ShodhGanga provides 503143 full-text Theses and 13075 Synopsis MRPs/FDS/Fellowship reports from 742 Universities (data as of December 2023). To facilitate this program, academics and university advisors are urged to submit a digital version of their approved synopsis when registering for the PhD program. This minimizes redundant research and serves as a resource for future scholars. Accepted theses for the PhD award are then uploaded onto ShodhGanga as part of the protocol.

Table 5: Current Status of Shodhganga Repository upto December 2023

S.No.	Category	No's
1	Full-Text Theses	503143
2	Synopsis MRP's/FDS/Fellowship reports	13075
3	Universities Contributing	742
4	Universities Signed MOU	861

7. SHODHGANGOTRI (REPOSITORY FOR INDIAN RESEARCH IN PROGRESS) AS ON DECEMBER 2023

Under the initiative called **"ShodhGangotri"** " university research scholars and supervisors are encouraged to submit electronic versions of synopses for registering for the PhD program to universities. The repository serves two purposes: firstly, it encompasses MRPs/PDFs/Emeritus Fellowship, and secondly, it provides insights into the ongoing research trends and directions in Indian universities, thereby preventing research duplication. The summary provided in "ShodhGangotri" is eventually linked to the complete theses available in "ShodhGanga". This means that when a thesis is submitted as a summary, a hyperlink to the complete thesis will be established from ShodhGangotri to "ShodhGanga".

Many research scholars are registering for PhDs every year in various higher educational institutions in the country in a wide variety of subjects, and the number of students registering has shown an increasing trend during the last few years. The ShodhGangotri project of INFLIBNET greatly helps research scholars know about what has already been finished. Work, as well as proposed research work, is submitted to various universities and institutions in the country.

As of now, Shodh Gangotri has more than 13075 Synopses uploaded through registered universities/institutions.

Thus, Shodh Gangotri plays an active role in knowing about research progress in India and helps research scholars to choose the right research projects/theme at the time PhD registration.

8. INFED

In India, the Indian Access Management Federation (INFED) has successfully integrated Shibboleth, an open-source software that empowers authorized users from educational institutions to access e-resources at any given time and location conveniently.

The e-ShodSindhu program, operated by the INFLIBNET Centre in India, grants universities and colleges access to scholarly digital resources. As part of its role as a central organization, INFED liaises with member institutions to facilitate the implementation of user authentication and access controls that conform to common protocols and data descriptors among participating organizations.

OBJECTIVES

- To identify and deploy appropriate access management tools so that e-resources can be utilized more efficiently and ROI can be improved.
- To enhance the accessibility of electronic resources for authorized individuals, irrespective of their location, be it on campus, at home, or even while on the move.
- In order to promote and motivate member institutions, it is highly essential to facilitate the establishment of their own identity management systems for the purpose of authenticating and authorizing users.
- Act as an Identity Provider for organizations lacking technical knowledge and ICT infrastructure to establish their identity providers.
- The identity provider and the service provider, acting as publishers, play a crucial role in the authentication process of authorized users by defining standardized rules and metadata for exchanging standardized attributes between institutions.
- Foster trust relationships between resource providers (publishers), member institutions, and federation operators by establishing and managing them.

9. E-SHODH SINDHU

It is the purpose of E-Shodh Sindu: Consortia for Higher Education E-Resources to provide academic institutions with access to high-quality electronic resources, including full-text, bibliographic, and factual databases at lower subscription rates to Universities, Colleges, and Centrally Funded Technical Institutions in India.

AIMS AND OBJECTIVES OF THE E-SHODH SINDHU

- Provide perpetual access to an impressive collection of e-journals, e-journal archives, and e-books.
- Promoting e-resource usage in member colleges, universities, and technical schools in India through awareness and training.
- To provide subscription-based scholarly information (e-books and e-journals) to all educational institutions.
- Scholarly content can be accessed openly through subject portals and subject gateways, ensuring availability to a wide audience.
- Bridging the digital divide can lead to the creation of information-rich societies.
- Open universities and MHRD-funded institutions can access specific e-resources that are not covered by existing consortiums..
- Collaborative platforms can support the provision of additional activities and services that are currently not offered by existing consortiums.
- Initiating the development of a National Electronic Library through electronic journals and electronic books.

Table 6: Current Statistics about E-Shodh Sindhu Registered Institutions and its Services

S.No.	Category	No's
1	CFTIs	98
2	Universities	217
3	Technical Institutions	134
4	Colleges	4200+
5	e-Journals	10000+
6	e-Books	199500+
7	e-Books through NDL	600000+
8	Resources	21
9	Databases	4

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ONE NATION ONE SUBSCRIPTION AND ONE LIBRARY (ONOSOL)

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ABSTRACT

This paper discusses how the concept of "One Nation One Subscription (ONOSOL) and One Library" has brought radical changes to the Indian educational system with the help of the information revolution. This topic fulfils the objective of S.R.Ranganathan's fourth law of S.R.Ranganathan, "Save the time of the reader." This concept can change the entire Indian educational system because the spirit of One Nation upholds Unity in diversity. One subscription also provides access without any discrimination to acquire good knowledge. One library is transforming the lives of people without prejudice. The library is a powerhouse of intellectual property for the nation. Technology is a boon to libraries to promote cooperation and encourage lifelong learning. ONOSOL and digital libraries have become a divine force behind creating a knowledge-based future and help in a new era of inclusive and high-quality education in India.

***Keywords**: Digital Literacy, E-Learning, Cybersecurity, Global, Collaboration, Quality, Ethics.*

INTRODUCTION

The caption "One Nation One Subscription (ONOSOL) and One Library "is a powerful instrument for reforming the Indian educational system in the digital age. The objective of this concept is to provide free educational access to all people irrespective of caste, colour, race, sex, language and region, which will transform the growth and development of the nation. Moreover, it tries to fill the gap, promoting diversity and advancing the country towards a knowledge-based economy.

EDUCATION WITHOUT DISCRIMINATION

One Nation One Subscription and One Library (ONOSOL) aims to Provide Quality education to everyone throughout the country, irrespective of their caste, colour, creed, race, sex, language and region, by a single click subscription. This concept eradicates the barrier between rich and poor without prejudice and serves students, teachers, scholars, and learners with the support of a digital library. The democratisation of knowledge is essential to build a nation like an intellectual army. Hence, the digital library is an instrument for

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academic and intellectual growth in the country. It can be updated in the following aspects by providing high standards and seamless access to educational materials across the country without geographical limitations.

- Quality without geographical disparities
- Disparities between urban and rural
- Decreasing Inequalities in Education
- Various needs and inclusive learning
- Unrepresented group's accessibility
- Free Access to all

STANDARDISATION OF CURRICULUM AND IMPROVE QUALITY

ONOSOL provides standardisation of educational materials and blends national curricula with academic standards. It not only conforms to the uniformity of the educational content but also increases the comprehensive quality of available resources. Under the umbrella of ONOS, a standardised and curated library empowers readers with rich-quality materials, nourishing a uniform, excellent educational experience throughout the country. This item aims to enhance the quality of learning resources and give access to consistency in educational subjects.

- Structure of National Syllabus
- Guarantee of quality
- Using Advanced Educational Methods
- Multidimensional learning resources
- Standardisation promotes Teacher Empowerment
- Integration with global educational curriculum

DEVELOPMENTS IN TECHNOLOGY AND DIGITAL LITERACY

With the initiation of ONOSOL, advanced technological changes have been taking place in education and encouraging digital literacy at the National level. Students can access resources via a unified digital platform; they exhibit advanced learning tools, Interactive content and modified pedagogical approaches. This item leads the students to meet the demands of the digital age. It moulds the students to gain educational advancements and places the Indians at a higher position in the global scenario. There is a great need to enhance educational access through the transformation of technology and the outcomes impact of leveraging technology via the following items:

- Cutting-edge learning tools Access
- Distance learning with digital resources
- Encouragement of online courses
- Practical and comprehensive educational development

- Programmes for digital literacy
- Collaborative online sites
- Ethics for Digital Education and Cyber Security

MULTIPLE NEEDS AND INCLUSIVE LEARNING

One library under the ONOS project provides diverse learning needs for different subjects, languages, and equivalent educational resources. This is an excellent platform to provide various learning styles and preferences to solve the problems of various regions and communities with unique content and resources that try to uphold the cultural relevance and dignity of the nation.

Revolutionary changes have been brought by this project, which creates an appropriate atmosphere for learning resources to meet the diverse requirements of students throughout the nation. The following items fill the objective of the Multiple Needs and Inclusive Learning.

- Favorable Learning paths
- Resources in Multiple languages and Modes
- Access for disabled students with learning resources
- Perspectives on subject matters with diversity
- Personalised Education
- Diverse interests in particular Materials
- Practices about the inclusive assessment
- Inclusivity regarding Community Engagement

HUB OF RESEARCH AND INNOVATION

ONOSOL provides success stories of world-famous scholars through the unified repository to students, research scholars and learners for the pursuit of knowledge in diverse fields. In this connection, researchers and academicians collaborate to overcome geographical barriers. This focal point dais accelerates research and innovation, guiding updates in science, technology and various academic subjects.

The following items have been initiated for educational resources and for providing dynamic research and innovation activities throughout the country with the utmost care for environmental protection.

- Research Material with a centralised Repository
- Collaboration with Interdisciplinary subjects
- Initiative for Open Access Materials
- Opportunity for Global Research
- Encouraging Innovation and Entrepreneurship
- Access to Research funding
- Use of Emerging technologies

RESOURCE OPTIMISATION AND COST- EFFICIENCY

Uniformisation of educational resources can be possible with a single subscription only. ONOSOL is trying to decrease the cost-efficiency of resources. It leads to success when institutions and individuals club together to get infrastructure facilities and resources at reasonable prices with a proper time schedule. Resource optimisation has increased the educational sector's budget and attracted investments in the academic industry for optimum growth.

The following things are essential for the success of Resource Optimization and Cost-efficiency.

- Economies of scale and shared infrastructure
- Minimising Expenditure on Educational Institutions
- Reformation of Administration
- Best Budget Allocations
- Reducing expenses and Rationalisation of resources
- Bargain for bulk licensing
- Utilisation of resources efficiently in remote areas

PARTNERSHIP BETWEEN PUBLIC AND PRIVATE SECTOR

The success of ONOSOL depends upon the decisions taken by the public and private sector cooperation. There is a great need to combine public and private libraries, educational institutions and IT companies to contribute resources, expertise and infrastructure to sustain this unified platform. This partnership strongly influences ONOSOL, generating powerful public and private stakeholders synergies.

THE PARTNERSHIP BETWEEN THE PUBLIC AND PRIVATE SECTORS LEADS TO GROWTH IN THE FOLLOWING AREAS

- Initiatives for public-private partnership
- Collaborate investment in educational infrastructure
- Private Entities regarding Resource contribution
- Innovation and Integration of Technology
- Collaborative curriculum development
- Access to resources linked with industry
- Skill development initiatives with Alignment
- Stakeholder involvement and community participation
- Regular framework and formulation of policy

LIFELONG LEARNING FOR EMPOWERING

ONOSOL encourages individuals to have a lifelong learning culture with continued access to educational resources. From the beginning childhood days onwards to the professional development of individuals, this platform accompanies them throughout their educational journey. This gives strong power to keep updating individuals with industrial technology and appropriate information regarding the socio-economic growth of the country and contributing extraordinary cooperation to the nation.

Transformation of lives can be possible. Continuous learning about worldly things through educational knowledge will undoubtedly change the country's growth and development. The following items are essential to meeting the above objectives.

- Learning resources access on age-based
- Update skills through professional development
- Individual learning routes for diverse objectives
- Education continuity for returned learners
- Identification of earlier knowledge and experience
- Older learners with digital literacy
- Education programmes for the community
- Individual learning programmes
- Services that support learning for all ages

CONCLUSION

The Mission of ONOSOL One Nation One Subscription One Library is to transform the Indian educational system with a new ideology to be placed at the height of world academic standards. It can break down the barriers to providing access, promoting standardisation, and fostering inclusivity, a prestigious technology. Education is not only a right of people but also a fundamental right of every citizen of India; that's why ONOSOL is coming forward at the right time. Proper access is provided through a single subscription, giving ample information about education, science and technology, cultural advancement, etc. ONOSOL is innovatively connecting people with a rapidly growing world and trying to rebuild the nation. The Mission and vision of ONOSOL is taking prompt initiation to drive the country towards knowledge, progress and prosperity via unlocking. This concept ONOSOL will undoubtedly reach its destiny and keep on-faring with developed nations. This concept welcomes the age of knowledge and welfare-based generations.

One Nation One Subscription One Library is an excellent idea. One library is nothing but a digital library. Digital Library of India provides a mine of information with a single click of subscription to any place in India. The student, teacher, researcher, and learner can only acquire the information from his house. This concept strongly supports the "Save the time of the reader" fourth law of the library and fulfils the dream of Dr S.R. Ranganathan.

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INNOVATIVE LIBRARY SERVICES IN ACADEMIC LIBRARIES

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ABSTRACT

This paper explains an academic library and the various basic and innovative services it provides to its valuable users. It is the responsibility of librarians to provide different services to their users. The library has created a learning space for modern and traditional mode users. Earlier, users rushed to the library, but today, the library reached the students on their devices. The library should add various innovative services for the development of knowledge for library users. Besides traditional practices, the academic library provides other services like ICT-based services, extension services, innovative services, research support, and services to the physically challenged. The library should switch to a hybrid mode after COVID-19 by utilising ICT more extensively for all tasks.

***Keywords**: Academic library, Library services, ICT, Innovative library services, Research support.*

INTRODUCTION

An academic library is an integral component of an academic institution, serving the learning and research needs of the users. Innovative philosophy, policy, strategy, programme, procedure, practice, creating new chances, optimism, and social effect are all best practices in an academic library. The academic library includes all the points mentioned in the different services it renders to its users. A best practice is an organisational concept that attests to a framework, system, process, development, motivating factor, or reward that is more effective than another methodology, procedure, process, etc., at achieving a specific goal. The user of an academic library needs different services to fulfil its academic requirements. Information Communication Technology (ICT) plays an important role in the rendering of different services by the academic library. A library is seen as an experimental playground wherein a librarian tests various services by making them available to patrons. In the present ICT era, information explosion in the library and information resources play an important role as learning agents in an institution. The academic library provides the best services to its users for their academic and personal development based on their available resources. The best services or practices enhance the quality of the academic library services.

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Academic libraries face great challenges in their sustainability because the users and management change their behaviour and attitudes towards the library. Today, each user needs to access all the content on their gadgets. Very few students rush towards the library for reading purposes; if they do, they also spend maximum time with their available devices. Earlier, users rushed to the library, but today, the library reaches the students on their devices. The only way to properly utilise the resources available in any library is to introduce various traditional and modern services to its patrons. Following the COVID-19 pandemic, library professionals have faced significant issues, including how to maintain academic libraries within academic institutions while adapting to changes in user behaviour and how they use materials. The best services introduced by the library for their patrons are highly important, not only for the users but for the academic library, too. The library is doing various technical services behind the curtain.

The term "best practice" refers to an organisational notion that verifies the existence of a structure, procedure, process, development, incentive, or other element that is more effective than other methods in reaching a particular objective.

According to the National Board of Accreditation and Assessment (NAAC), "Best practice may be innovative and be a philosophy, policy, strategy, program, process or practice that solves a problem or creates new opportunities and positively impacts on organisations. Institutional excellence is the aggregate of the best practices followed in different areas of institutional activities".

Oxford English Dictionary describes "Best practices as quality of most excellent or desirable type or most appropriate, advantageous, highly improved, outstanding, par excellence services or the customary or expected procedure or way of doing something that is usual or expected way in a particular organisation or situation, guidelines for good practices. In this process of developing best practices we take action rather than good ideas, and we improve our skills".

OBJECTIVES OF THE STUDY

The main objectives of the academic library's best practices are

- To provide the best services to its users.
- To provide the best access to the library collections in blended mode
- To increase the reading habit among users of academic library
- To disseminate the knowledge among the library users.
- To make the academic library more modern with smart services.

REVIEW OF LITERATURE

Many researchers have been working on this topic for a long time; I have collected a few from them and mentioned them in the review of the literature.

Jotwani mentioned that best practice in an academic library optimises resource allocation and deliver high-quality and various value-added services to its users. A library should prepare the benchmark or standard for its quality services. (D Jotwani, 2008)

Benjamin highlighted various services the academic library provides to the students, focused on providing an outstanding user experience. The library uses open-access tools, which help to connect high-quality science and student outputs with a wide public, enabling this research to be accessed and utilised on a global scale. Libraries should work together across sectors to address the current need for evidence-based information and to provide opportunities for citizens to acquire transferable research skills. (Meunier, Benjamin, 2018).

A modern university library is not just a book repository or a reading room; it is increasingly being seen as a place for learning, networks of collections, networks of facilities, and networks of technologies and as a Service Centre.(Gurdish Sandhu, 2015).

Best practices in the academic library include the following services.

1. **Traditional best practices**

   Traditional library practices refer to the fundamental operations of an academic library, which serve as essentials for keeping a library in order to meet patrons' basic needs. The idea is that with authentic techniques, checks, and testing, a desired outcome can be passed on with fewer issues and surprising burdens. The traditional practice of an academic library includes technical services, reader services and various physical services.

   a. **Technical services**
      - Library cataloguing
      - Library Classifications
      - Binding
      - Documentation
      - Stock verification
      - Weed out
      - Indexing and abstracting
      - User Orientation programme
      - Reprographic, scanning and printing

   b. **Reader Services**
      - Library Reference
      - Circulations
      - Bibliographic
      - Library user awards
      - Information sharing and dissemination
      - Library handbook or Manual

- New Arrivals
- Library Exhibition
- Best Library User award
- Current awareness services (CAS)
- Newspaper Clipping

c. **Physical Services**
- Maintenance of the Library building
- Location map
- Ambience of library
- Sorting and dusting
- Reshelving of books

2. **ICT-Based Library Services**

ICT is crucial to the development of an academic library's user services. All academic libraries are moving towards digital libraries these days, and following COVID-19, the majority of academic libraries have attempted to transform their physical libraries into virtual libraries. These services provide users with access to, retrieval of, and interaction with various digital materials using various digital tools and platforms. The use of ICT in libraries provides a wide range of benefits that enhance the overall user experience. ICT has been altering the world in terms of overall development. Today, academic libraries totally depend on ICT in their day-to-day functions; it makes everyone's life more comfortable and simple. It develops information explosion, retrieval more easily and increased adaptability. It drastically lowers costs while greatly enhancing benefits.

- Library Automation
- Web OPAC
- Digital library
- Multimedia
- Email Alert service
- Library management software
- Library web Page
- Electronics Document services
- Audio and video services
- E-Resources
- Institutional Repository
- Remote access services
- Digital literacy
- Scanning, reprography

- Digitisation of rare books and items
- Mobile Computing

3. **Library Extension Services**

   Academic libraries offer patron services in a variety of additional sectors in addition to the traditional ones. Its services transition from the traditional to the contemporary. It was user-centric in the past, but it is now fully community-centric. It focuses on different user communities. These services include seeking the behaviour of different communities who depend on academic libraries. Besides the basic functions, Academic libraries provide different types of extension services to their users. A library has to create community-appropriate information services. These services should incorporate members of the community's information needs, information-seeking behaviours, and service expectations.

   - External library membership
   - Library membership with other association
   - Document delivery services
   - Interlibrary loan
   - Short loan collection
   - Know the day
   - Book of the week
   - Author of the week
   - Overnight issue
   - Library Internship
   - Learn and earn scheme
   - Suggestion box
   - Visitor books
   - Patron traffic Counter/footfall
   - Crowdsourcing and user-generated content
   - Merit card
   - Gadgets charging point
   - Help desk

4. **Innovative Library Services**

   Academic libraries now provide their patrons with different innovative services that are developing in addition to the various basic, traditional, and extension services. A library professional always considers what innovative services to offer its patrons in order to meet their needs.

- 3D printing
- Maker Space
- Single Sign on
- Garden/Green Library
- Kindle or Laptop circulation
- Cyber Lab
- RFID
- Digital wall
- Online discussion room booking
- Online Library dues collection
- Virtual Reality lab
- Thematic Book display
- Idea Lab
- Engineering Clinic
- Library of Things
- Start Museum at the library
- Multimedia Zone
- Researcher Zone
- Heritage Gallery
- Story Telling
- Coding club
- Laptop Charging point
- Digital Skill
- Library Archive
- Virtual Tour
- IOT
- Cloud Computing
- Block Chain Technology
- Library App
- Library as a third place
- Library books and use of Robot
- QR Code
- Library 2.
- BOYD, BOYC

5. **Research Support Services**

   Today, the key service of an academic library is to support an institution's research. The academic library plays a very crucial role in supporting an institution's integrated research. The library has vast potential in technology, which enhances the academic setting. Academic libraries should work in the area of research data management, subscription of different databases, open access publications, citation and reference management, plagiarism, research ethics, and understanding the use of research tools and technology. It should support institutional research activities. Best practices in research support services must be promoted to encourage other academic libraries in the country to enhance academic research quality. In a digitally advanced academic environment, research support services are the emerging services of an academic library.

   - Subscription of Print and online resources
   - Plagiarism detection software
   - Writing tools
   - Research Tools
   - Reference tools
   - Research Visualisation
   - Search engines
   - AI Tools for Research
   - Information about research proposals
   - Reference generation software
   - Faculty publication
   - Researcher's profile
   - Research Funding agency information
   - Open access publications
   - Research Data management
   - Thesis and synopsis repository
   - Intellectual Property Right
   - Patent information
   - Researcher's Profile management
   - Open content, open education

6. **Services for the Physically Challenged**

   - Audio Books
   - App
   - Software and Hardware

- Membership of different agencies
- Sign languages
- Physical facilities: Ramp, lift, wheelchair, Washrooms

INNOVATIVE LIBRARY SERVICES @ GITAM UNIVERSITY

Gandhi Institute of Technology and Management (GITAM) is a deemed to be university popularly known as GITAM situated at Visakhapatnam. It was established in 1980, and presently, it has four campuses. It offers students UG, PG, and PhD courses as well as multidisciplinary courses. This university's main library is called the Knowledge Resource Centre (KRC). It is a beautiful architectural building with a 2.8 lakh print collection and more than 35 publishers' e-resources. It is a hybrid library that provides print and online resources to its patron. It provides traditional services, ICT-based services, research support, and more innovative services to its patrons.

The key services of this library are union catalogue, web OPAC, digital library, Interlibrary loan, short loan collection, Kindle lending service, Discussion rooms, Read and Publish, Remote access, renewal of book online, New arrival information, Patron traffic counter, Online book recommendation, KRC D-space (Digital Repository), Library of Things, Collection of faculty publications, collect the dues through the Gitam-Pay, single-window search engine (Discovery services), plagiarism checking (Turnitin), Grammarly, Single Sign-on, Divayanga (Daisy India), Crowdsourcing methods, Research Profile (IRINS), Vending Zone, Know the day, Best User award, Subscription of e-resources (e-journals, e-databases, e-books, e-newspapers and e-zines). Library membership (NDLI, DELNET, SugmayaPustakalay(Physically Challenges), Current Science)

LIMITATIONS

1. Budget constraints
2. Conventional wisdom regarding manpower
3. Lack of interest in implementing new technologies
4. Old buildings with new services

CONCLUSION

Libraries exist only to serve the needs of the community. While technology might revolutionise libraries, it can also render them obsolete. Library professionals must take advantage of new technology/ services and establish fresh trends in order to modernise library and information services and maintain the library's relevance. The leaders of the libraries need to make sure that their employees are more aware of the institution's mission and objectives and inspire them to come up with creative solutions for how they can contribute. Finally, the library leaders have the responsibility to make their library a component of the global information ecosystem to increase its visibility and shared resources. Serving the community's needs is the sole reason for the existence of libraries and will be the sole measure of success**.**

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ICT TOOLS FOR SAFEGUARDING LIBRARIES: A COMPREHENSIVE OVERVIEW

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ABSTRACT

In the digital age, libraries aren't just about books and peaceful study rooms. Libraries were created to meet the needs of their users in terms of education, culture, research, recreation and information by processing, arranging, preserving and sharing for the benefit of society. Libraries are dynamic places that offer a multitude of services and resources to their users. Enhancing security is becoming more and more necessary as the use of technology grows in libraries. This is where information and communication technology (ICT)-based library security tools come into play. Information and communication technologies (ICTs) in the form of advanced storage devices, closed circuit television (CCTV), 3M/ radio frequency identification (RFID) libraries, security gates systems, cloud computing technologies, and manual security systems will enhance the security of the library. In this article, we will explore the use of these tools and how they can help libraries protect their assets and ensure a safe environment for their patrons.

Keywords: *Library Security, Information Security, Library Security Tools.*

INTRODUCTION

ICT has changed the way libraries operate in the digital era. ICT components have evolved to meet the changing needs of library users and keep up with the rapid advances in digital technology. From online catalogues and databases to digital lending systems and virtual reference services, IT-enabled library services are revolutionising the way information is organised, disseminated, and accessed in traditional libraries, turning them into dynamic and interactive knowledge centres in the digital age. Integrating I.T. into library systems has enabled libraries to improve their services, streamline operations, and reach a wider audience.

Information security refers to the process of protecting information and information-bearing materials from unauthorised access, exploitation, disclosure, destruction, alteration, retrieval, examination, recording or disposal. The exponential growth of information and

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documents results from the ever-increasing development of knowledge, giving impetus to the need to organise information documents and ensure adequate security for these documents. Security is a critical issue in libraries. Security deficiencies in libraries, combined with attacks or other types of failure, can result in unauthorised access to private information or loss of the integrity of data stored in a library. Information professionals and library managers must design strategies to provide adequate security and protect the resources to prevent unauthorised access to library resources. Information is available in the library.

Nowadays, we live in an electronic age, and this has a significant impact on library management. The electronic safety structures are gadgets used with the help of electrical and digital equipment to enclose library materials. They help libraries control, reduce, or prevent fabric theft and ethical losses. To ensure complete security through telecommunications, can adopt electronic systems such as building alarm systems, access control systems, video surveillance, remote surveillance, etc., in the library.

REVIEW OF LITERATURE

According to Gartner (2016), "The integration of technology in library services can enhance the accessibility of information, the user experience and the ability of library staff to communicate effectively with users."

Chen and Deng (2018) state that information and communication technologies (ICTs) can improve library services by allowing users to access online resources, online collections, and electronic books. The authors also state that information technology can enable better information management and better communication between libraries.

The use of information and communications technology (ICT) to improve library services can also be seen in library digitisation literature. **According to IFLA (2017),** library digitisation can improve the accessibility of collections and resources, the user experience, the preservation and protection of cultural heritage, and more.

According to a report by the **Association of Research Libraries (2020),** the proportion of libraries' total collections budget devoted to electronic resources has increased steadily over the past decade, from 22.5% in 2010 to 45.1% in 2019. This shift to digital resources has allowed users to access information from anywhere and anytime while making library resources more accessible.

According to **Chavan (2012),** this paper, "This Paper on Management of Electronic Security System", "is one of the fastest-evolving and most beneficial innovations being adopted by the scholarly library for increasing efficiency and increasing well-being, safety, profitability, accuracy and accommodation". This paper briefly overviews the developing radio repetition recognisable proof innovation, its importance in the library context, and how it works. It also includes information on the essential segment and the discretionary segment.

In his article, **Harwell, Jonathan H. (2014)** explains that, on a case-by-case basis, library staff have observed false warnings at various libraries. These false warnings have been attributed to multiple sources, such as rental DVDs or course books purchased at grounds book shops.

IMPORTANCE OF ICT-ENABLED LIBRARY SECURITY TOOLS

Libraries are not free from security risks. In fact, due to the resources they contain, they are often the target of thieves and vandals. The libraries are vulnerable to theft, vandalism, and loss of library contents. Information and Communication Technologies (ICT) can also address security threats.

Traditional security measures such as surveillance cameras and alarms are no longer sufficient to protect libraries from these threats. This is where ICT-enabled library security tools come into play. These tools leverage the latest technology to provide libraries with a more comprehensive and efficient security solution.

Threat Detection and Prevention

ICT-enabled library security tools can help protect your library by detecting and preventing threats. They use sophisticated algorithms and AI to analyse your data and identify threats. For instance, they can detect if a patron is attempting to steal a book from a library or if someone is trying to vandalise library property. This means that library staff can take immediate action and stop the threat before it escalates.

Real-Time Monitoring

Another benefit of using library security tools that ICT enables is that they can be monitored in real-time. With traditional security, staff would only be notified of a threat when it happens. But with ICT-enabled security tools, staff can keep an eye on the library 24/7 and act on any potential threats as soon as they arise. Not only does this help prevent security incidents, but it also allows for a faster response in the event of an emergency.

Integration with Library Technology

ICT-enabled library security tools integrate seamlessly with other library technologies, such as library management systems (LMS). This makes the security process smoother and more efficient. For instance, if a customer attempts to access a stolen book, the system will automatically notify library staff. Integrating your library security tools with your LMS will also enable you to analyse and report data more effectively, helping you to identify trends and enhance your security posture.

TYPES OF ICT-ENABLED LIBRARY SECURITY TOOLS

Types of library security tools with ICT enabled. There are many types of library security tools on the market today. Here are some of the most popular types:

RFID (Radio Frequency Identification) Systems

Radio Frequency Identification (RFID) systems rely on radio waves to locate and monitor library materials. Each item is individually identified by an RFID tag containing a unique identifier number. This makes the check-in/check-out process simpler and more efficient. RFID devices can also be utilised for security purposes. For example, an RFID system can detect an item's removal from the library after it has been checked out.

Electronic Article Surveillance (EAS) Systems

Electromagnetic or radio frequency identification (EAS) systems detect when library items are removed from the premises without a check-out. EAS systems are made up of tags attached to library items and sensors placed at the library exit. When a tagged item goes through the sensors, an alarm is triggered.

3M Exit Detection

3M Security Systems are the most comprehensive library security solution. The world's largest library security company, 3M, has led the way in library security for over 30 years. 3M Library Systems protects billions of individual items across thousands of libraries worldwide with a unique combination of 3M Security Strips, cutting-edge detection systems and circulation accessories.

Alarm Systems

Alarm devices or systems of alarm devices provide audible, visual, or other form of alert information about an issue or condition. Most alarm devices are equipped with a siren.

Biometrics

Biometric security is the process of verifying and granting access to a facility or system by automatically and immediately verifying an individual's physical characteristics. Since biometric security verifies an individual's physical features or biological information, it is the most powerful and reliable physical security technique to verify identity.

CCTV Cameras

Closed-circuit T.V., also known as video surveillance, is a type of television that uses video cameras to transmit a video signal to a specific location on a limited number of monitors.

An open circuit gadget is a device aimed at an unlimited number of people, such as a television broadcast. A closed-circuit gadget is a gadget that is specifically designed for surveillance purposes. Two CCTV systems can be used for various purposes, such as Security, Disaster Prevention, Power Saving, Income Advertising and Records Services, Manufacturing Management, Industrial Measurement, Scientific Care, Training and Military.

Electronic Eye Detection

The electric eye is a type of photodetector used to detect obstructions to a light beam. A typical example of a door safety system is the door safety system for garage door openers. The door safety system uses a light transmitter and a light receiver at the bottom of the garage door to prevent the door from closing if there are obstructions in the way that break the light beam.

Electronic Recording

An electronic security system is any electronic device that can carry out protection operations such as surveillance, entry to control, alarm or intrusion management to a facility or an area that uses electricity from the main power supply and a backup power supply such as a battery.

Smart Card

Smart cards offer the tremendous advantage of storing data and value in a portable and secure manner. However, adding smart cards to your system comes with its own set of security challenges, as people can access card data across a wide range of applications.

IMPLEMENTING ICT-ENABLED LIBRARY SECURITY TOOLS

ICT-enabled library security tools require a lot of planning and thought. Here are a few things to keep in mind when implementing these tools into your library:

Identify Your Security Needs

The first thing you'll need to do is determine your library's security requirements. Depending on your library's size, type of resources, and the type of security risks you're facing, you'll need to assess your library's security risks and decide which tools will help you address them.

Choose the Right Tools

Once you've determined your security requirements, it's time to decide which tools are best suited for your library. Think about how much each device will cost, how well it integrates with your current library technology, and how easy it will be to use. It's also important to select tools that can efficiently work together to create a more complete security solution.

Train Library Staff

Library staff must be trained in the use of the new security tools so that they can effectively respond to potential threats. They should also be taught how to interpret the data and reports provided by the security tools, as this can help to identify trends and enhance security measures.

Communicate with Patrons

Communicate with your customers about the new security protocols. This will help avoid misunderstandings and conflicts. Educate your customers on using new security tools, like self-checkout and RFID systems.

CONCLUSION

In conclusion, ICT-enabled library security tools are essential to modern library security measures. They provide a more comprehensive and efficient solution for protecting library resources and ensuring a safe environment for patrons. By identifying your library's security needs, choosing the right tools, and training staff and patrons, you can successfully implement these tools and improve the security of your library.

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BIBLIOMETRIC ANALYSIS OF COLLEGE AND RESEARCH LIBRARIES DURING 2011-2020: A STUDY

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ABSTRACT

To analyse various publishing patterns for articles in College and Research Libraries from 2011 to 2020 and provide the findings for publications using bibliometric analysis. The study presents the bibliometric study of the journal to assess the growth pattern of research production published in the journal. The study looks at trends like year-by-year distribution, article length, authorship pattern, distribution of papers according to pages, institutional affiliation of authors, Credibility-wise, and Citation-wise distribution. According to the analysis, 788 articles were published in the journal between 2011 and 2020.

The most productive year was 2017, with 92 publications published during the research period. In the study, the authorship pattern shows that more articles are published by a single author alone, and the distribution of papers shows that most articles have lengths between one and five pages. It has also been noted that authors from academic institutions play a more significant role in publishing papers than authors from non-academic institutions for the published articles during the study period.

Keywords: *Authorship pattern, Institutional affiliation, Citation analysis, Bibliometric study.*

1. INTRODUCTION

Beginning in December 1939, College and Research Libraries were published quarterly for the first 18 years of its existence and started publishing every two weeks since 1956. To help academic librarians satisfy the needs of collegiate users, it disseminates publications with articles in every subject area that academic and research libraries find valuable and intriguing are published in the publication. Every aspect of academic and research librarianship will be covered in well-written publications. The primary emphasis of the journal is on reports of original research. Manuscripts may also contain intelligent analyses of the challenges faced by librarians, vivid accounts of both successful and futile endeavours, and other pertinent subjects.

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2. REVIEW OF LITERATURE

A bibliometric study of the 4821 cited materials appended to the 295 articles published in DJLIT between 2011 and 2015 is presented by **Vishal Dattatray Bapte (2017).** The distribution of citations, authorship patterns, levels of collaboration, distribution of reference sources, famous authors, and a prioritised list of core journals are some of the criticisms used in the citation analysis. According to the study, single authorship predominates, garnering 1912 (39.65%) of the citations, followed by two writers with 1152 (23.89%), three authors with 456 (9.45%), and more than three authors with 386 (8%) citations. A significant number of institutional publications have also been made available**.**

An overview of the Library and Information Science (LIS) research from 1980 to 2017 was presented by **Wusu, Oluwaseyi H. and Lazarus, Nneka G. (2018)**. We use bibliometric and text mining analyses on a sample of 500 of the most cited publications to investigate the effects of several elements on the number of citations they obtained, including the number of authors, improved institutions, document kinds, and keywords. The contribution of various nations, variances in publication years, and the identification of active research fields and significant journal outlets are all noteworthy trends that we look into in the LIS research literature. Future research on LIS trends can use this study as a guide because it illustrates the qualities of the most frequently referenced publications in the field. According to the results, the most often mentioned articles are from the United States, England, and China. South Africa and Nigeria are two of Africa's top 25 producers of LIS research. The year 2016 was the most productive in terms of publications published, with a total of 51,589 citations.

By conducting a bibliometric analysis of the Journal of Knowledge Management (JKM), **Ali Raza and Basharat Ahmad Malik (2018)** they determined the most popular contribution types, publishing trends, highly referenced papers, and most productive nations and institutions. Citations per publication (CPP), citations through 2016 (TC2016), citations in 2016 (C2016), and the number of articles with single, collaborative, first, and corresponding authors are some additional crucial bibliometric metrics that were used. From 2009 to 2016, 508 papers were published in the journal by a total of 1214 authors from 57 nations and 584 institutions. 126 (24.8%) publications came from the USA and the UK. The top two contributing writers were also from the top two contributing institutions, Lakehead University and McMaster University, both located in Canada.

Nadia Anridho, Ardianto Ardianto (2018), 2015 marked the fifteen-year milestone for the International Journal of Digital Accounting Research. This study analysed 93 articles published between 2001 and 2015 bibliometrically. Content and citation analyses were carried out to study and evaluate published articles. By examining the methods employed, primary accounting topical areas, the contribution of authors and institutions, and the citation analysis of IJDAR publication, this study adds to the body of literature on accounting information systems. The results of this study demonstrate that IJDAR is suited for a broad audience such as academics, audiences students, practitioners and all those interested in digital accounting research.

The many facets of the papers published in the Library Trends Journal between 2013 and 2018 are analysed by **Mamta Ranian Alyzedgati (2019).** There are 195 papers and 308 authors, and the distribution of research articles by year, author productivity, authorship pattern by volume, and level of collaboration were all examined. It is the part of bibliometric analysis that is most commonly employed. The published papers ranged from 30 (15.38%) in 2017–2018 to 47 (24.10%) in 2013–2014. The year 2016–2017 saw the highest author output of 70 (23.41%) and the lowest at 54 (18.06%).

This study seeks to give a bibliometric analysis of the Library Philosophy and Practice journal, **P. Kannan and S. Thanuskodi (2019),** to summarise and characterise the most significant features of the library and information science research activity. The report examines a bibliometric analysis of 1402 papers published in the Journal of Library Philosophy and Practice from 1998 to 2018. The study includes bibliometric studies of article distribution by year, classification of papers by category, distribution of articles by subject, authorship patterns, and distribution of contributions by institutions.

Numerous studies that have been published in recent years have influenced the field of human resources training research. **Danvila-del-Valle et al. (2019)** looked at the foundations upon which this research is based, locating pertinent references, authors, subjects, and publications in the process. To do this, we looked at more than 900 publications published between 1975 and 2016 using bibliometric techniques. We identified three publication cycles that have influenced the development of this field of study. Human resources has been discussed from various angles in the periodicals that have published these pieces. Researchers can conduct additional cross-country and cross-industry studies because most of the attention is on the US and labour-intensive sectors. The resource-based view offers a theoretical basis for the articles that top authors have used to establish a foundational understanding of the subject by considering human capital and performance.

To ascertain the various bibliometric characteristics of the texts published in the Journal of the Association for Information Science and Technology (JASIST) from 2014 to 2019, **Haq and Ikram Ul (2020)** conducted the study. The JASIST data were obtained from the Web of Science - Clarivate Analytics database using a retrospective study method. One thousand one hundred ninety-six (1,196) records were discovered, with 62 countries contributing an average of 199 documents yearly. Eleven thousand nine hundred forty-one (11,941) citations were recorded for these documents, averaging 9.98 citations per document. Six of the top 10 most generously contributing organisations belonged to just one nation, and more than half of the research was contributed by just two countries. The percentage of Asian nations has been noted to be relatively low. Since 1950, JASIST has provided an outstanding forum for exchanging novel concepts in the library and information science field.

Since there has been a significant growth in the amount of intercultural competency (ICC) research over the past twenty years, it is crucial to thoroughly evaluate the various literature and the evolution of the field. **Peng, R.-Z. et al. (2020)** used 663 ICC-related research papers from the Web of Science (WoS) database to conduct a bibliometric analysis for the intercultural competence knowledge domain. CiteSpace visualised knowledge maps of ICC research. The results of the study indicate that there has been an apparent upward trend in the number of articles published in the field of intercultural communication studies since 2007. The top five countries in terms of citations are the United States, China, Australia, Spain, and the United Kingdom. The International Journal of Intercultural Relations (IJIR) has been identified as the journal with the highest citations over the past 20 years. The top five authors in terms of citations are Michael Byram, Darla Deardorff, Claire Kramsch, Mitchell Hammer, and Milton Bennett. These data offer insightful information about diachronic research trends, subjects, journals, authors, and hotspots related to ICC. Researchers and academics can find it helpful to visualise the study of the ICC literature by developing a graphical and explicit approach to follow the progress of ICC research.

To recognise the International Journal of Social Economics' 45 years of publication, **Kumar et al. (2020)** set out to offer a summary of the IJSE through a bibliometric analysis of its articles from 1974 to 2018. The importance of the research is evaluated using information from the Scopus database by looking at its annual publication patterns, citation patterns, top-cited papers in IJSE, top-cited documents in IJSE, most productive authors, institutions, and nations in IJSE, as well as the journal's thematic structure through keyword co-occurrence analysis. The study also provides a visual depiction of the bibliometric data using VOSviewer.

The number of articles produced yearly and the rising citation counts indicate that IJSE has risen in stature and production. Poverty, social economics, sustainable development, developing countries, religion, economic theory, etc., are some of the journal's major themes. The study work published in the journal is summarised in this article, which is the first to do so.

Nadeem Siddique (2021) examined 62 years of library and information science research in Pakistan, from 1957 through 2021. Using the four top databases, a thorough bibliometric analysis was done (Web of Science, Scopus, Library and Information Science Abstracts, and Library, Information Science and Technology Abstracts). The scientists discovered a favourable increasing trend. In Pakistan, library research is increasing. The University of Punjab's Department of Information Management has made the most contributions to the field of library and information science. Two Pakistani journals published 40% of the total number of articles. The University of the Punjab and the University of Karachi, two older and more reputable schools, have led in publishing research. More attention and financing are needed for the provinces of Baluchistan and Khyber Pakhtunkhwa.

Vila-Lopez, N. and Küster-Boluda, I. (2021) conducted a bibliometric analysis to look into how "packaging" performance in various fields has been impacted by "marketing" choices. This analysis spans from the earliest publication on the subject to be published (in 1956) to the most recent papers to be published (in 2019). The Web of Science (WOS) and Scopus databases yielded 1,170 scholarly articles with 14,177 citations, published from 1956 to 2019. The data analysis was done using Scimat software. The findings of this research demonstrate that, from a marketing perspective, packaging studies mainly concentrate on two industries: food and tobacco. Retailers, marketers, customers, and manufacturers are some of the different parties engaged in packaging decisions, and recent trends in studies focus on sustainable and healthy packaging. Therefore, both research areas are potential areas of study. Engineers, marketers-psychologists, and doctors-scientists—three distinct investigative profiles—have examined how packaging should be set up for success. However, there isn't a comprehensive bibliometric analysis of "packing" and "marketing" in any of those three fields of knowledge. This research is crucial for directing future directions to close the knowledge gaps.

3. OBJECTIVES OF THE STUDY

The objectives of the study are to understand and find the bibliometric distinctiveness of the College and Research Libraries. The objectives are listed as follows:

1. To study the year-wise distribution of articles.
2. To identify the length of CRL articles.
3. To examine the range of references in the articles.
4. To determine the institutional affiliation of authors.
5. To study the authorship pattern.
7. To identify the demographic affiliation of the author.
8. To determine the citations received by CRL articles.

4. METHODOLOGY

To accomplish the study's goals, a total of 788 articles from 10 volumes and 55 issues of College and Research Libraries for the years 2011 to 2020 were selected for analysis. Downloads of the pertinent articles were made from the CRL website. In order to compare and contrast the various variables, including year-wise distribution, article length, reference range, institutional affiliation of authors, authorship pattern, and number of citations, the data was entered clearly into the MS Excel sheet. After being gathered, the data was meticulously organised, tabulated, and included in the proper order.

5. DATA ANALYSIS

5.1 Number of Articles and Their Length – College and Research Libraries

To know how many papers were published in 'C&RL' and how many pages they were, citations, analysed by year, article count, and page count. A more detailed explanation of C&RL's features may be found in the table below.

Table 1: Year-wise Distribution of Articles and Their Length – College and Research Libraries

Year-wise Distribution of Papers and Their Lengths - College and Research Libraries				
Years	**No of Articles**	**Per cent %**	**To No. of Pages**	**Average No. of Pages /Articles**
2011	75	9.52	587	7.83
2012	73	9.26	587	8.04
2013	72	9.14	594	8.25
2014	50	6.35	882	17.64
2015	89	11.29	1017	11.43
2016	77	9.77	830	10.78
2017	92	11.68	1013	11.01
2018	83	10.53	999	12.04
2019	87	11.04	1082	12.44
2020	90	11.42	1212	13.47
TOTAL	788	100	8803	11.17

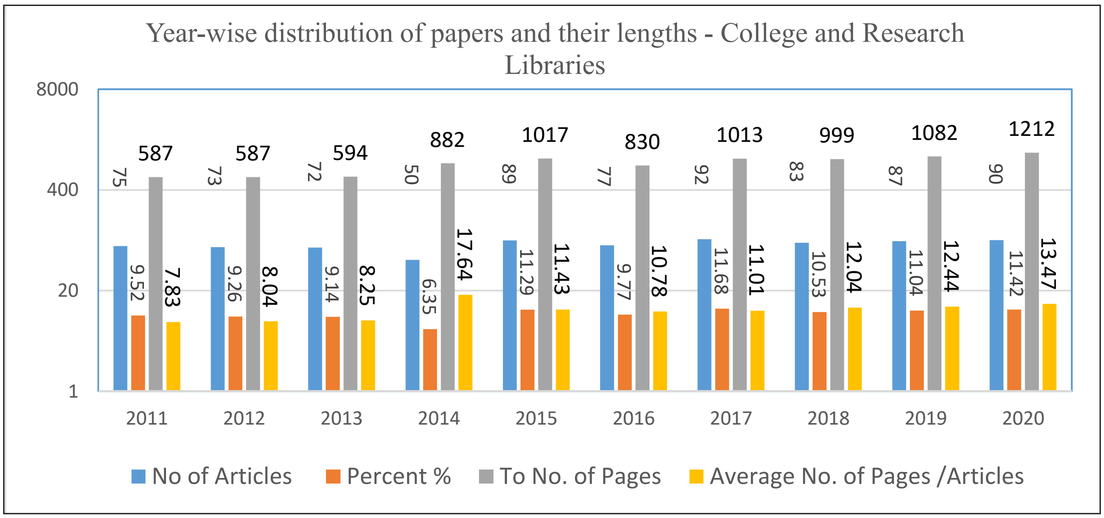

Fig. 1: Year-wise distribution of articles and their length – College and Research Libraries

According to the study of data from year to year, C&RL produces a different number of articles each year. The year with the most significant percentage of papers (11.68%) and the lowest percentage of articles (6.35%) published was 2014. There are variations in article length as well. The articles with the most pages (13) were published in 2020. In 2011, the lowest average number of pages was around 7. The average number of pages per paper was over eleven when looking at all of the articles published in C&RL over the past ten years.

5.2. Authorship Pattern: Articles Distributions of College and Research Libraries

The type of authorship was identified by examining the compositional style of articles. Authorship patterns are one of modern communication patterns' most significant bibliometric indicators. It helps to foster teamwork and productivity among researchers. In order to evaluate authors' research output at the individual, disciplinary, and organisational levels, it is necessary to understand the authorship pattern. More information on these components of College and Research libraries can be found in the table below.

Table 2: Authorship Pattern: Articles Distributions of College and Research Libraries

Authorship Pattern-wise Distribution of Articles– College and Research Libraries											
No of Authors	**2011 (%)**	**2012 (%)**	**2013 (%)**	**2014 (%)**	**2015 (%)**	**2016 (%)**	**2017 (%)**	**2018 (%)**	**2019 (%)**	**2020 (%)**	**Total no. of articles (%)**
ONE	52 (11.23)	54 (11.69)	47 (10.12)	20 (4.33)	52 (11.26)	45 (9.65)	55 (11.90)	47 (10.17)	50 (10.82)	44 (9.52)	466 (100) (59.14)
TWO	15 (9.74)	12 (7.74)	16 (9.80)	14 (9.15)	22 (13.92)	18 (11.25)	15 (9.80)	16 (10.46)	11 (7.19)	21 (13.73)	160 (100) (20.30)
THREE	4 (4.00)	5 (5.00)	4 (4.08)	9 (9.18)	11 (11.00)	10 (10.00)	16 (16.33)	10 (10.00)	19 (19.00)	12 (12.00)	100 (100) (12.69)
FOUR	3 (8.11)	1 (2.70)	2 (5.41)	5 (13.51)	2 (5.41)	2 (5.41)	4 (10.81)	4 (10.81)	5 (13.51)	9 (24.32)	37 (100) (4.70)
> FOUR	1 (4.00)	1 (4.00)	3 (12.00)	2 (8.00)	2 (8.00)	2 (8.00)	2 (8.00)	6 (24.00)	2 (8.00)	4 (16.00)	25 (100) (3.17)
TOTAL	75 (9.52)	73 (9.26)	72 (9.14)	50 (6.35)	89 (11.29)	77 (9.77)	92 (11.87)	83 (10.71)	87 (11.23)	90 (11.42)	788 (100)

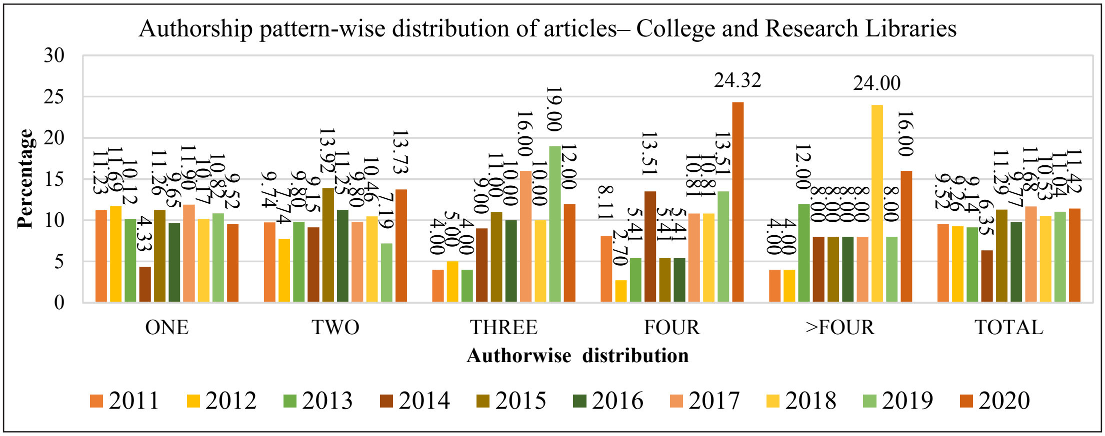

Fig. 2: Authorship pattern-wise distribution of articles– College and Research Libraries

One author contributed to half of the articles produced in College and Research libraries between 2011 and 2020, according to the information in the table's final column (59.14%). Two authors wrote the second-highest percentage of articles (20.30%). Over one-third of the articles in this journal were written by three authors during the research period.

The majority of single-author publications (11.90%) in 2017 and two-author publications (13.92%) were released in 2015, respectively, according to authorship patterns and year analysis. The majority (almost 19%) of publications with three authors were published in 2019.

5.3. Distribution of Pages: College and Research Libraries

Table 3: Distribution of Pages: College and Research Libraries

Distribution of Papers According to Pages-College and Research Libraries											
No. of Pages	2011 (%)	2012 (%)	2013 (%)	2014 (%)	2015 (%)	2016 (%)	2017 (%)	2018 (%)	2019 (%)	2020 (%)	Total no. of articles (%)
01-05	45 (12.93)	43 (12.36)	39 (11.21)	9 (2.63)	34 (9.94)	35 (10.23)	40 (11.70)	33 (9.65)	35 (10.23)	35 (10.23)	348 (100) (44.16)
06-10	3 (10.34)	3 (10.34)	3 (10.34)	0 (0.00)	5 (17.24)	2 (6.90)	4 (13.79)	4 (13.79)	4 (13.79)	1 (3.45)	29 (100) (3.68)
11-15	10 (7.69)	13 (10.00)	16 (12.31)	10 (7.69)	17 (13.08)	15 (11.54)	20 (15.38)	14 (10.77)	6 (4.62)	9 (6.92)	130 (100) (16.50)

Distribution of Papers According to Pages-College and Research Libraries											
No. of Pages	**2011 (%)**	**2012 (%)**	**2013 (%)**	**2014 (%)**	**2015 (%)**	**2016 (%)**	**2017 (%)**	**2018 (%)**	**2019 (%)**	**2020 (%)**	**Total no. of articles (%)**
16 - 20	11 (6.79)	9 (5.56)	11 (6.79)	19 (11.73)	20 (12.35)	15 (9.26)	14 (8.64)	17 (10.49)	24 (14.81)	22 (13.58)	162 (100) (20.56)
> 20	6 (5.04)	5 (4.20)	3 (2.52)	12 (10.08)	13 (10.92)	10 (8.40)	14 (11.76)	15 (12.61)	18 (15.13)	23 (19.33)	119 (100) (15.10)
TOTAL	75 (9.52)	73 (9.26)	72 (9.14)	50 (6.35)	89 (11.29)	77 (9.77)	92 (11.68)	83 (10.53)	87 (11.04)	90 (11.42)	788 (100)

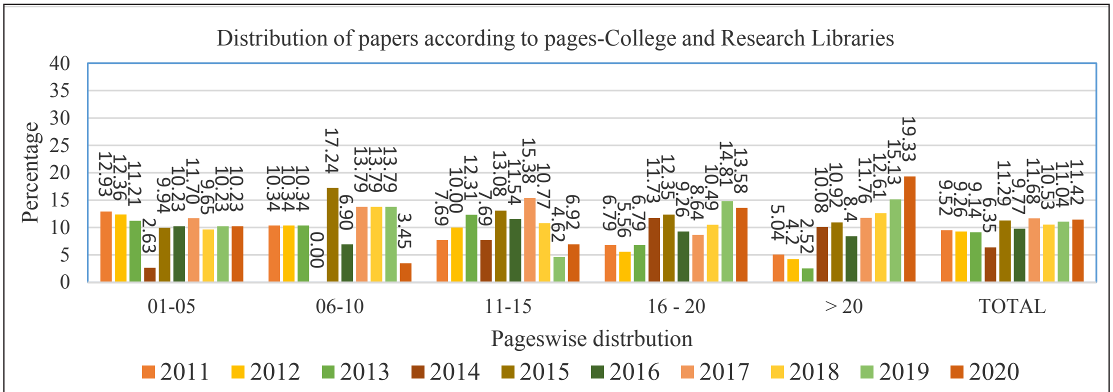

Fig. 3: Distribution of papers according to pages-College and Research Libraries

The bulk of articles (44.16 percent) were published within 1–5 pages, according to an analysis of the pages-by–page and years–by–year distribution of publications in College and Research libraries during the research period. Twenty-page articles made up the second-highest percentage of articles (20.56%). A third of the articles (16.50%) were published between 11 and 15 pages. More than 20 pages were written in articles in the fourth-highest volume (15.10%). 3.68 per cent of stories, the sixth-highest percentage, were published in 6 to 10 pages. It was found that articles with 1 to 5 pages each article performed best in terms of page count.

A row-by-row analysis of the number of pages in each category explains how articles were distributed throughout ten years. The number of papers with 1 to 5 publishing pages published had the highest percentage (12.93%) in 2011. Most articles with 6 to 10 pages were published in 2015 (17.24%), while the majority of articles with 11 to 15 pages (15.38%) were also published in 2015. Between 2011 and 2020, there was no discernible trend in the number of pages per publication in College and Research libraries.

5.4 Institution-Wise Distribution of Articles-College and Research Libraries

Table 4: Institution-wise Distribution of Articles-College and Research Libraries

Institution-wise Distribution of Articles-College and Research Libraries											
Type of Institute	**2011 (%)**	**2012 (%)**	**2013 (%)**	**2014 (%)**	**2015 (%)**	**2016 (%)**	**2017 (%)**	**2018 (%)**	**2019 (%)**	**2020 (%)**	**Total no. of articles (%)**
Academic	75 (9.53)	73 (9.28)	72 (9.15)	50 (6.35)	88 (11.18)	77 (9.78)	92 (11.69)	83 (10.55)	87 (11.05)	90 (11.44)	787 (100) (99.87)
Non-Academic	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	1 (100)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	1 (100) (0.13)
Total	72 (9.3)	72 (9.3)	70 (9.04)	50 (6.46)	87 (11.24)	72 (9.3)	92 (11.89)	82 (10.59)	87 (11.24)	90 (11.63)	788 (100)

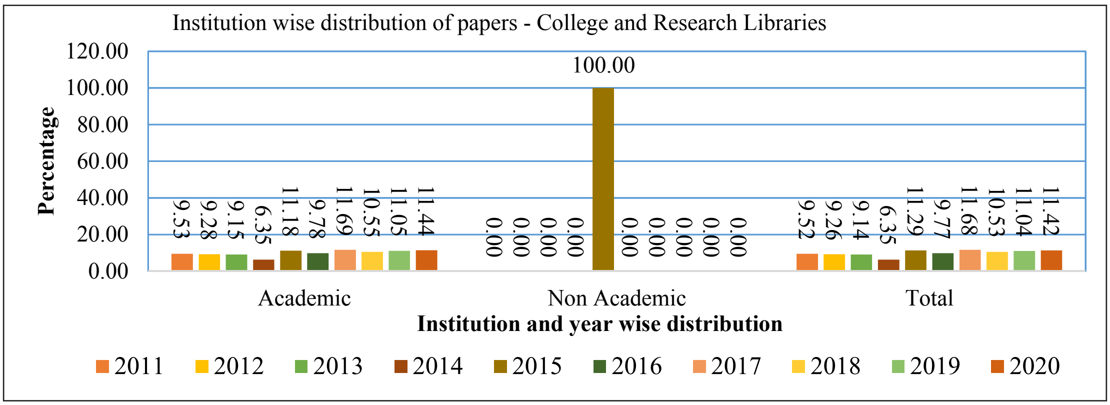

Fig. 4: Institution-wise distribution of articles- College and Research Libraries

According to the author-affiliated institution throughout the study period, the distribution of publications in college and research libraries is shown in the table above. The majority of publications (99.87%) came from the academic sector. The remaining works were written by non-academics (0.13%). In the years 2020 and 2021, the majority of scholarly articles were published. 11.69 percent. In 2015, 100% of the publications were from the non-academic community.

5.5 Credibility-Wise Distribution of Authors-College and Research Libraries

Table 5: Creditability-wise Distribution of Authors-College and Research Libraries

Creditability-wise Distribution of Authors-College and Research Libraries											
Creditability of Authors	**2011 (%)**	**2012 (%)**	**2013 (%)**	**2014 (%)**	**2015 (%)**	**2016 (%)**	**2017 (%)**	**2018 (%)**	**2019 (%)**	**2020 (%)**	**Total no. of articles (%)**
LIS Faculty	53 (10.75)	48 (9.74)	49 (9.94)	26 (5.27)	46 (9.33)	43 (8.72)	60 (12.17)	50 (10.14)	56 (11.36)	62 (12.58)	493 (100) (62.56)
LIS Professional	22 (7.72)	25 (8.77)	23 (8.07)	24 (8.79)	42 (14.74)	34 (11.93)	31 (11.36)	30 (10.53)	28 (9.82)	26 (9.52)	285 (100) (36.17)
Other Depts.	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	1 (10.00)	0 (0.00)	1 (10.00)	3 (30.00)	3 (30.00)	2 (20.00)	10 (100) (1.27)
Total	75 (9.52)	73 (9.26)	72 (9.14)	50 (6.35)	89 (11.29)	77 (9.77)	92 (11.68)	83 (10.53)	87 (11.04)	90 (11.42)	788 (100)

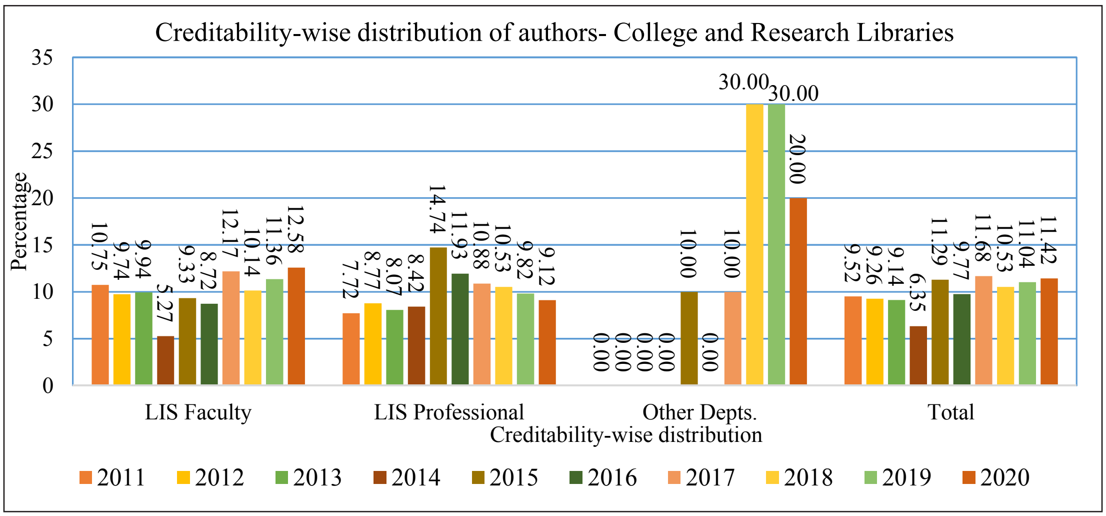

Fig. 5: Creditability-wise distribution of authors- College and Research Libraries

LIS professors contributed the most articles (62.56%) in this category, according to the analysis of the credibility-based distribution of authors in College and Research Libraries, with the majority of articles being contributed in 2020. On the other hand, between 2011 and 2020, LIS professionals were responsible for around 36.17 per cent of the publications found in college and research libraries. The majority of the professional writers' pieces were released in 2015. 1.27 per cent of the articles in this field came from faculty from other departments, and 30 per cent were published in 2018 and 2019.

5.6. Citation-Wise Distribution of Articles

Table 6: Citation-wise distribution of articles- College and Research Libraries

Citation-wise distribution of articles- College and Research Libraries			
Years	**Papers**	**Citations**	**Average**
2011	75	1056	14.08
2012	73	1026	14.05
2013	72	1181	16.40
2014	50	1900	38.00
2015	89	2055	23.09
2016	77	1543	20.04
2017	92	1879	20.42
2018	83	2540	30.60
2019	87	2334	26.83
2020	90	2531	28.12
Total	788	18045	22.90

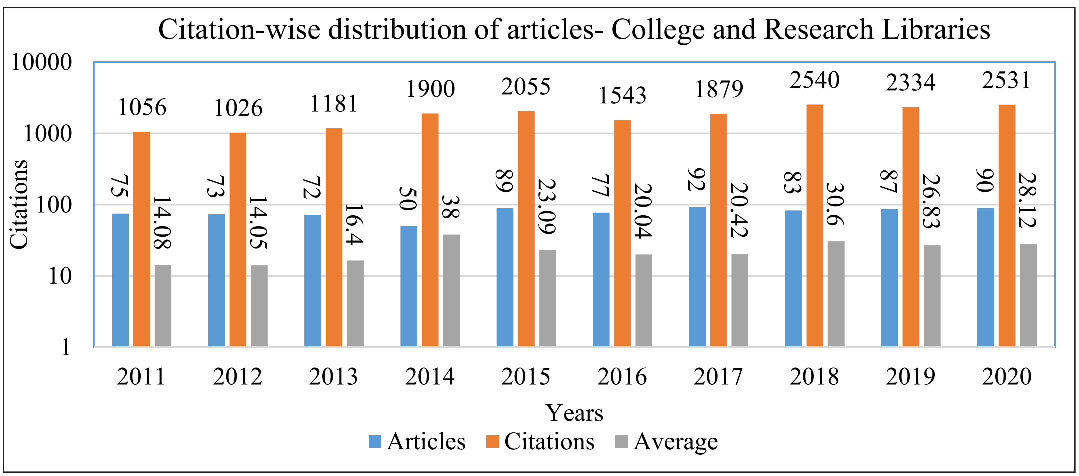

Fig. 6: Citation-wise distribution of articles- College and Research Libraries

The distribution of citations added to works published in college and research libraries is shown in the table above, broken down by year. A total of 788 publications were published in the journal between 2011 and 2020, and an average of 22.90 citations were referred to each paper. The most citations were received on average (38.00) per article in 2014.

6. DISCUSSION

This research conducted a bibliometric analysis of the significant trends in College and Research Libraries for the period from 2011 to 2020. The study listed the significant changes that occurred in the publications' succeeding years.

According to the analysis, there is a discrepancy in the number of articles in the journal that are more than or equal to 11 pages in length regarding the variety in authorship patterns of articles written by a single author.

The findings show that a good number of articles have been published under single authorship in the above-mentioned period. The study also recognised that the majority of the papers published in this journal's page lengths are in the 1–5 range as per the distribution of the papers. It was discovered that academic institutions make up the majority of contributors regarding authors' contributions and institutional affiliation.

According to the authorship pattern, Library and Information Science faculty contributed the most articles in this study period. In 2014, the articles were most cited, 38 percent (50 papers /1900 Citations).

The study unquestionably contributes positively to bibliometric analysis and multiple interpretations of the journal, and the authors work hard to provide the study's conclusions in a way that will advance the field of Bibliometrics.

7. CONCLUSION

The articles published in college and research libraries between 2011 and 2020 were the focus of the current study's bibliometric analysis. The study might be thoroughly carried out by integrating a number of other characteristics and patterns discussed in upcoming journal issues. This kind of effort would be helpful to the entire Library and Information Science professional community.

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SUSTAINABLE BUILDING: A STUDY OF SVNIT SURAT CENTRAL LIBRARY BUILDING

Dr. Ajay Kumar Sharma*

ABSTRACT

The heart of any academic Institution is its library. The library building plays a crucial role in efficiently executing all the activities of a library. A well-designed library building that economically supports all its operations is a vital precondition for appropriately running each library section. The building contributes to operational efficiency by carefully managing resources for its sustainability. A sustainable building utilises natural resources at the optimum level and, due to its architecture and features, can preserve or improve the quality of life in the surrounding atmosphere. To accomplish this, it is critical to attain a high degree of efficiency by decreasing the use of energy, water, and other resources. This paper will discuss the parameters of a sustainable library building with the sustainable features of a central library of the Sardar Vallabhbhai National Institute of Technology (SVNIT), Surat.

Keywords: *Sustainable Library, Planning of New Library Building, Sustainable, Library Building, SVNIT Surat Library Building.*

INTRODUCTION

As science and technology advance, our lifestyles are influencing and changing rapidly. Today, the demand for sustainable resources is fast increasing, and we are capitalising on this capacity to suit our insatiable demands. We have noted that interest in sustainability has expanded in almost every field of our lives, including libraries, in recent years. Libraries, which act as knowledge gateways today, are especially responsible for promoting a sustainable perspective, leading by example and serving as role models.

The role of academic library building is important for more than just keeping books and providing them. It is critical in fostering a lively and enriching educational atmosphere. Libraries provide a range of resources and services to accommodate different learning styles and vivid users.

The design of the library building can have a significant influence on the entire learning experience of the users. Academic libraries are hubs for various educational resources, such as

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books, journals, standards, theses and dissertations, multimedia items, digital databases, etc. The design of the library building has an impact on how easily students, research scholars, and faculty members may access and use these resources to support their academic programs.

A 'Sustainable Library' is a contemporary library that employs environmentally friendly building materials, makes the best use of natural resources, reduces waste, makes the best use of renewable resources, and runs its operations cost-effectively and efficiently.

Sustainability is concerned with design, construction, and operating decisions that will magnify the good and lessen the adverse effects of choices made across a building's entire life cycle.

OBJECTIVES OF THE STUDY

- To discuss the planning of the library building
- To discuss sustainable library building
- To discuss the various rating systems for green and sustainable buildings
- To explore the many features of green and sustainable building parameters used in the construction of SVNIT's new library building

Planning of a New Academic Library Building

Planning a new academic library building requires a comprehensive and systematic approach to ensure that the facility meets the requirements of its users and is consistent with the institution's goals.

Essentially, academic library buildings are diverse spaces that support the educational, research, and cultural needs of the academic community. Its design and functionality are essential in shaping the overall academic experience and contribute to an institution's success and reputation.

Building planning should involve key stakeholders in the planning process, including librarians, administrators, and architects. Also, planning should seek inputs from faculty, students, and other users, as well as collaboration, to ensure diverse perspectives are considered in design. The librarian's role is crucial in designing a new library building. He/she is the suitable person to make decisions regarding the allocation of space for various sections, including reading areas, study rooms, book stacks, digital libraries, special collections, archives, and administrative offices. It is necessary to consider flexible spaces that can adapt to the changing technological and educational needs of the Institute.

The following are the crucial steps to consider in planning a new library building.

- Assessment of necessity for a new library building
- Considerations of the Alternative Options
- Major renovation of the existing building

- Need for building a new library building
- The formation of a building committee
- Get insight from the other libraries' building
- Assessment of the current and projected services
- Projected population growth in the next ten years
- Describe the future needs of the library and plan outline for the project
- Examine the financial situation
- Timeline and project management

Sustainable Library Building

A sustainable building incorporates sustainable design practices to minimise environmental impact and promotes eco-friendly construction materials compared to a traditional structure; it utilises less water, maximises energy efficiency, conserves natural resources, produces less waste, and gives inhabitants healthier places. A sustainable building uses biodegradable and natural building materials, conserves energy, water, and paper, and disposes of waste in an environmentally friendly manner while maximising the quality of the inside environment.

The main feature of sustainable library building:

- Building Construction
- Use of Renewable/Sustainable Materials
- Energy Efficient
    - Energy-Efficient Design
    - Renewable Energy Sources
    - Energy-Efficient Lighting
- Water Conservation
- Waste Reduction and Recycling
- Green Certification

Light and lighting are crucial in library buildings since they affect the atmosphere, user experience, and operation in many ways. The availability of natural light and cooling is an important factor for sustainable building.

Two primary sources decide the right amount of comfortable lighting throughout the working hours in the library building.

- Natural daylight enters the library building.
- Artificial lighting

The environmental effect and operating expenses of lighting systems can be decreased by designing with energy efficiency in mind. Energy-efficient light sources, sensors, and controls may be included to reduce energy use and maintain ideal lighting levels.

Making the most of natural sunshine can improve the lighting plan as a whole. In addition to lowering the need for artificial lighting throughout the day, large windows, skylights, and light wells help create a more liveable and livelier atmosphere.

Rating Systems for Green and Sustainable Buildings

Sustainable building is also known as green building or eco-friendly building. Sustainable building structures are environmentally responsible, resource-efficient, and energy-efficient throughout their life cycle. Predefined criteria or benchmarks are needed to evaluate a green building's efficiency. The Green Building Rating Standards (GBRS) contain these criteria. The Green Building Standards (GBRS) are having series of precise standard parameters for assessing the resource efficiency and environmental responsibility that are integrated into the construction of buildings at every stage of their life cycle, from planning to design and construction to operation, maintenance, renovation, and demolition.

Following are the few popular Green Building Rating Standards (GBRS):

Table 1: Green Building Rating Standards of Different Countries

Green Building Rating Standards	Year	Country	Developed By
Building Research Establishment Environmental Assessment Method (BREEAM)	1990	UK	The Building Research Establishment (BRE)
Leadership in Energy and Environmental Design (LEED)	2000		The United States Green Building Council (USGBC)
Green Globes	2000	Canada	ECD ENERGY and Environment Canada Ltd
Comprehensive Assessment System for Building Environmental Efficiency (CASBEE)	2001	Japan	Japanese Ministry of Land, Infrastructure, and Transport
Green Star	2003	Australia	The Green Building Council of Australia (GBCA)
German Sustainable Building Certificate (GeSBC)	2007	Germany	The German Sustainable Building Council (DGNB)
Pearl Rating System for Estidama	2008	UAE	The Abu Dhabi Urban Planning Council
Green Rating for Integrated Habitat Assessment (GRIHA)	2007	India	Centre for Research on Sustainable Building Science, TERI

Planning of a New Library Building at SVNIT Surat

Despite the fact that the new library building is being planned for SVNIT, Surat began many years ago; it was accelerated in 2013 following an extraordinary meeting convened for the future library building on October 10, 2013. Several presentations and discussions were held consecutively to provide a decent and sustainable library building.

Figures 1 and 2 depict the conceptual model of SVNIT, Surat's new library building.

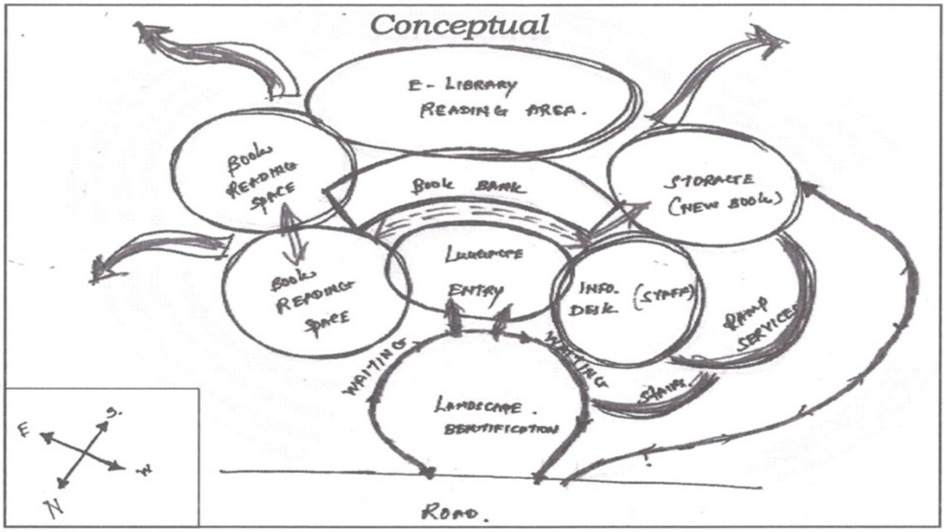

Fig. 1: Conceptual Plan of New Library Building at SVNIT Surat

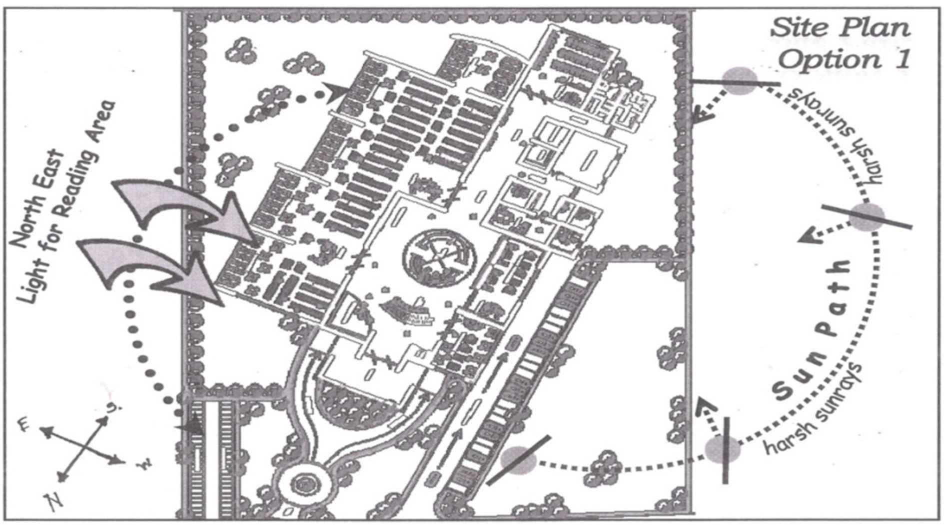

Fig. 2: Site Plan of New Library Building at SVNIT Surat

Figure 1 depicts the conceptual design of the library building. The comprehensive notion of numerous library parts was taken here and attempted to be represented in a conceptual framework. In Figure 2, the direction of sunlight and the availability of natural light were studied and planned to maximise the use of sunlight and natural cooling.

Adopted Sustainability Concept in the SVNIT, Surat Library Building

The new SVNIT Surat library building is built in accordance with the numerous provisions and concepts necessary for sustainable building. Several notions that are essential for sustainable building were adopted in the construction of the new library building.

Sustainability in Library Site Planning

The land used for the central library building is part of the SVNIT campus's approved master plan. It has a small ground coverage of 3100 sqm. Furthermore, the building is not located in an eco-sensitive zone, a coastal zone, a heritage region, a water body zone, or a hazard-prone area. The site planning and construction were completed with minimal damage to ecosystems.

Materials Used for the Construction

The library's building procedure attempted to optimise the usage of environmentally friendly components. The proposal paper discussed for replacing 15% of OPC by weight with fly ash in structural concrete. Provision has also been made to use fly ash bricks as construction blocks.

Resourceful Energy

The energy efficiency of a building determines its sustainability. The advancement of energy efficiency leads to green and cost-effective construction. This is one of the mandatory green building measures that should be required to qualify for green/sustainable building.

Photovoltaic solar panels are mounted on the roof of the central library building to improve energy efficiency. The provision has been made to generate 20% or more of yearly power demand through the use of renewable energy systems.

Solar light poles were used in the garden area/landscape of the new library building for energy efficiency. It will turn on automatically when it detects darkness or at night and switch off automatically when it detects daylight or bright light.

Fig. 3: Solar Energy Generation and Utilization

Light and Lighting

The library building is designed such that more than half of the living space is exposed to natural light. Natural illumination has been well-maintained in the internal areas of the building, and artificial lighting has been avoided in the building's design.

There is provision for the semi-transparent doom in the middle of the new library building, allowing the central hall to receive enough natural light during the day.

The unique feature of the central library building is the installation of louvres. It has louvres installed on three sides, allowing for the control of natural light entering the building. Every area of the library building receives enough natural light during the day to minimise dependency on artificial lighting.

Fig. 4: Louvers to Manage Sunlight

Indoor Environmental Quality

The sustainability of a building greatly depends on the indoor environmental quality. The term "indoor environmental quality" refers to the inside conditions of a building, including the lighting, ventilation, temperature, ergonomics, air quality, and its impact on the occupants. Improved indoor environmental quality is also necessary to provide consumers with a comfortable reading location.

The new library building of the SVNIT Surat made the most of the following features to improve interior environmental quality:

- Optimal utilisation of natural light
- Use of operatable louvers and windows
- Provision for controlling ventilation and temperature
- Provision for Controllable natural lighting inside the library building
- Provision is made for smoke detector alarms
- Furnish with ergonomic furniture
- Enhanced acoustic architecture with the installation of wooden wall panelling and carpeting

CONCLUSION

As we can see, our needs are expanding multi-fold as time passes, and it is challenging to meet our needs with limited resources. Sustainability is required in many aspects of our lives. Libraries are no exception; for the system to survive, numerous procedures for sustainability must be included. One of the primary variables that can help libraries reduce their reliance on limited conventional resources and boost their use of renewable resources is library building design. The link between the buildings' economic and environmental performances must be considered for the new library building. The design guidelines assessment indicators used should be compliant with all applicable standards.

The libraries are changing due to societal changes brought about by environmental degradation, energy depletion, and economic instability. The need of the time is sustainable library building structures which are eco-friendly, environmentally responsible, resource-efficient, and energy-efficient throughout their life cycle.

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RESEARCH PATTERNS IN GREEN ENERGY RESEARCH: A SCIENTOMETRIC ANALYSIS

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ABSTRACT

The primary aim of the present study is to analyse the publications' productivity of Green Energy Research at the global level. The publication records (1367) were extracted from the Web of Science database for thirty years from 1993 to 2022. The parameters used for the present study are publications and citations trends, most profilic authors, organizations, countries, journals, research areas and funding agencies. The results of the study reveals that China and India were highly productive countries; the Chinese Academy of Sciences, Beijing was the most prodtuctive organization; *Energies* was the most preferred journals by the authors. The authors conclude that Green Energy Research has gained momentum due to its ability to reduce environmental damage due to non-renewal energy sources and effectiveness of green energy implementation for human development.

Keywords: *Green Energy, Renewal energy, Clean energy, Scientometrics, VOSviewer, Web of Science*

INTRODUCTION

'Green Energy' is often called renewal energy or clean energy, usually generated by naturally replenishable sources such as sunlight, wind, rain, tides, waves, and geothermal heat. Unlike conventional energy sources such as fossil fuels, which contribute to environmental degradation, the 'Green Energy' resources have no or less negative impact on the environment, and sources of these energies are renewable (Sharma & Dubey, 2023). Hence, 'Green Energy' research is significant for society and human development. Increased research on 'Green Energy' has the potential to protect the globe and reduce the global dependency on 'non-renewal' energy sources.

Hence, around the world, 'Green Energy' research has become a rapidly growing research area to identify the new renewable energy sources and technological developments to obtain the best utilisation of 'Green Energy'. Hence, remarkable growth in research publications on 'Green Energy' illustrates the need for sound evaluation of the scientific research output. Scientometric is used to measure the quantity of research carried out in a particular field,

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and its indicators are helpful in assessing the quantity and quality of research publications. Thus, the current study adopted scientometrics analysis to comprehend the research focuses and patterns in the 'Green Energy' research to help researchers and scientists in the field along with the policymakers in the Government.

LITERATURE REVIEW

The scientific research trends diverge for geographical and research areas (Ellegaard & Wallin, 2015; Martínez-Bueno et al., 2000; Shettar & Hadagali, 2023). Green energy research is diverse, and according to the Scopus database, the first research on Green energy was traced back to 1986. However, research publications on 'Green Energy' found momentum only in the first decade of the 21st century.

Very few evidence of scientometric / bibliometric studies on the 'Green Energy' research was observed. Rosokhata et al. (2021) conducted a bibliometric study to analyse the research trends on renewal energy, identifying the most influential research publications, authors and organisations. Qin et al. (2022) conducted a bibliometric analysis on green energy adoption and its determinants, which attempted to adopt various indicators to identify active authors, organisations and journals and presented a thematic evolution and citation structure of research publications. Rahimi et al. (2019) conducted a scientometric study using research publications on "scheduling in renewable energy", adopting keywords analysis and citation analysis methods. Córdova and Abreu (2023) undertook a bibliometric study using research publications indexed in the Scopus database on renewable energy and energy production. The study identified research leaders by country, institutes and predominant research topics. Kemeç and Altınay (2023) conducted a scientometric study to analyse the research on sustainable energy research trends using various science mapping tools such as VOSviewer, RStudio, Bibliometrix, and CiteSpace.

Some of the bibliometric studies were restricted towards one particular source of green energy, such as solar cell research (Dutta & Nikam, 2016); biomass energy (Yu & Meng, 2018); wind energy (Lagos et al., 2022); geothermal energy (Yáñez-Dávila et al., 2023) and so on. However, not many metric studies on green energy research literature were found. Since the beginning of the 21st century, the world has started looking for sustainable energy sources to avoid dependence on fossil energy sources for the availability of reliable, affordable, clean, and green energy sources, and the last two decades have been evident for the growth in green energy research. Thus, this study has been conducted to find the research trends and patterns of 'green energy' research for the period of thirty years and between 1993 and 2022.

OBJECTIVES OF THE STUDY

The main objective of the study is to analyse the research productivity of 'Green Energy' indexed in the Web of Science database between 1993 and 2023. The other specific objectives are:

1. To study the distribution of publications and citations trends at the global level;
2. To identify the most prolific authors, productive organisations and countries;
3. To determine the most preferred journals and research areas to publish in Green Energy Research; and
4. To list the most supportive funding agencies and highly preferred keywords by the researchers in the 'Green Energy' research.

MATERIALS AND METHODS

The publication records of the published research papers on 'Green Energy' during the period 1993 – 2022 were extracted from the Web of Science database. A total of 1367 publication records were found where 'Green Energy' is part of the title or author keywords were extracted in the CSV file format. The publication records were further analyzed using Excel Spreadsheet, VoSViewer, and the mathematical and statistical formulae for various indicators used.

RESULTS AND DISCUSSIONS

Year-wise Distribution of Publications

According to the Web of Science Core Collection database, 1,367 publications were indexed on 'Green Energy' for thirty years, i.e., between 1993 and 2022. These 1,367 publications have received 31,943 citations at the rate of 23.37 average citations per paper. Although the highest number of publications were recorded in the year 2022 (340), 2021 (232) and 2020 (146), the highest number of citations were received for the publications in the years 2020 (3411), 2014 (3035) and 2016 (3024). The highest average citations per paper were recorded in the year 2014, i.e. 89.26 ACPP, followed by 2008 (68.00) and 2006 (64.00). According to the h-index, the highest h-index was recorded in the years 2020 and 2017, with 30 h-index each, followed by 2019 (28), and the overall h-index for the study period was 82. The study observed a 10.01 % annual growth rate and showed a fluctuating trend in the yearly research publications on 'Green Energy'.

Table 1: Year-Wise Distribution of Publications

Year	TP	TC	ACPP	h-index
1993	2	7	3.50	1
1994	1	33	33.00	1
1995	0	0	0.00	0
1996	0	0	0.00	0
1997	1	0	0.00	0
1998	4	9	2.25	2
1999	4	8	2.00	1
2000	3	1	0.33	1

Year	TP	TC	ACPP	h-index
2001	6	3	0.50	1
2002	3	0	0.00	0
2003	7	0	0.00	0
2004	8	206	25.75	2
2005	7	163	23.29	3
2006	8	512	64.00	4
2007	17	646	38.00	9
2008	16	1088	68.00	9
2009	20	1069	53.45	7
2010	18	280	15.56	9
2011	30	732	24.40	13
2012	34	1441	42.38	15
2013	36	1670	46.39	17
2014	34	3035	89.26	21
2015	48	2054	42.79	26
2016	77	3024	39.27	25
2017	83	2618	31.54	30
2018	79	2139	27.08	27
2019	103	2236	21.71	28
2020	146	3411	23.36	30
2021	232	2848	12.28	27
2022	340	2710	7.97	23
Total	***1367***	***31943***	***23.37***	***82***

TP=Total Publications; TC=Total Citations; ACPP=Average Citations per Paper

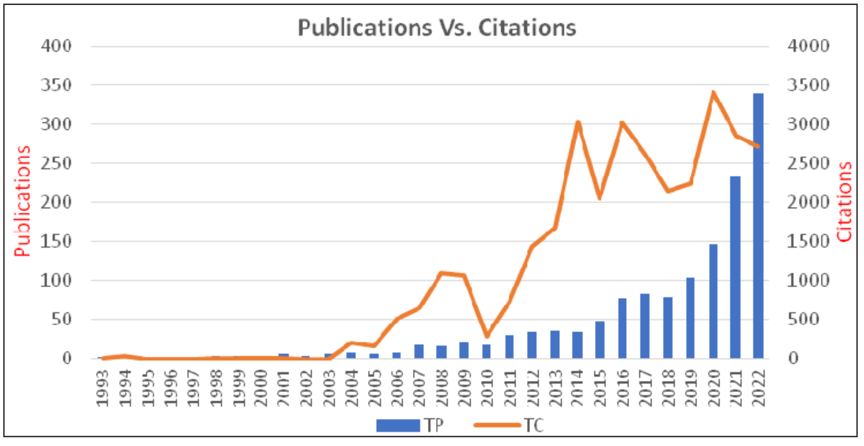

Fig. 1: Year-wise Publications Vs. Citations

Top 10 Most Prolific Authors

Overall, 3,978 authors were associated with publishing 1367 research publications on "Green Energy", at the rate of 2.91 co-authors per paper, and 38 papers were anonymous publications. Among these authors, 3,489 have contributed a single paper, 309 have contributed two papers, 91 have contributed three papers, 38 have contributed four papers, 17 have contributed five papers, and 34 have contributed six or more papers.

The top 10 authors listed in the table have published 75 (5.49%) research papers and received 2,677 (8.38%) citations at the rate of 35.69 citations per paper. Among the top 10 most prolific authors, Nirwan Ansari of New Jersey Institute of Technology, Newark, USA, has contributed the highest, i.e. 13 research papers, followed by Francisco Manuel Baena Moreno of Universidad de Sevilla, Sevilla, Spain and Abdelfatah Abomohra of Universität Hamburg, Hamburg, Germany with nine publications each. Among the top 10 prolific authors, Nirwan Ansari has received the highest number of citations, with 763 citations, followed by Tao Han (570) and Ibrahim Dincer (435). The highest average citations per paper recorded for Tao Han was 95.00 ACPP, followed by Ibrahim Dincer (62.41) and Nirwan Ansari (58.69). Among the top 10 prolific authors, five have international collaborations; three have all their publications with international collaborations. A detailed analysis is provided in Table 3, including international collaborations and their impact.

Figure 2 presents the co-authorship map of authors involved in the "Green Energy" research publications; out of 3,978 authors, only 33 collaborated.

Table 2: Top 10 Most Prolific Authors

Name of Researcher	Affiliation	TP	TC	ACPP	HI	ICP	TC-ICP	ACPP	HI-ICP
Nirwan Ansari	New Jersey Institute of Technology, Newark, USA	13	763	58.69	11	0	0	0.00	0
Francisco Manuel Baena Moreno	Universidad de Sevilla, Sevilla, Spain	9	158	17.56	9	9	158	17.56	9
Abdelfatah Abomohra	Universität Hamburg, Hamburg, Germany	9	40	4.44	4	6	27	4.50	3
Ravinder Kumar Kotnala	CSIR- National Physical Laboratory of India, New Delhi, India	7	96	13.71	6	0	0	0.00	0
Ibrahim Dincer	University of Ontario Institute of Technology, Oshawa, Canada	7	435	62.14	6	4	400	100.00	4
Tomas Ramirez Reina	University of Surrey, Guildford, England	6	103	17.17	6	6	103	17.17	6

Name of Researcher	Affiliation	TP	TC	ACPP	HI	ICP	TC-ICP	ACPP	HI-ICP
Amitava Ray	Jalpaiguri Government Engineering College, Jalpaiguri, India	6	158	26.33	5	0	0	0.00	0
Georgepeter Gnana Kumar	Madurai Kamaraj University, Madurai, India	6	222	37.00	4	6	222	37.00	4
Sumit Bhowmik	National Institute of Technology, Silchar, India	6	132	22.00	4	0	0	0.00	0
Tao Han	Capital Medical University, Beijing, Peoples R China	6	570	95.00	6	0	0	0.00	0

TP = Total Publications; TC = Total Citations; ACPP = Average Citations per Paper; HI = h-Index; ICP = International Collaborated Publications; TC-ICP = Total Citations for International Collaborated Publications; HI-ICP = h-Index for International Collaborated Publications.

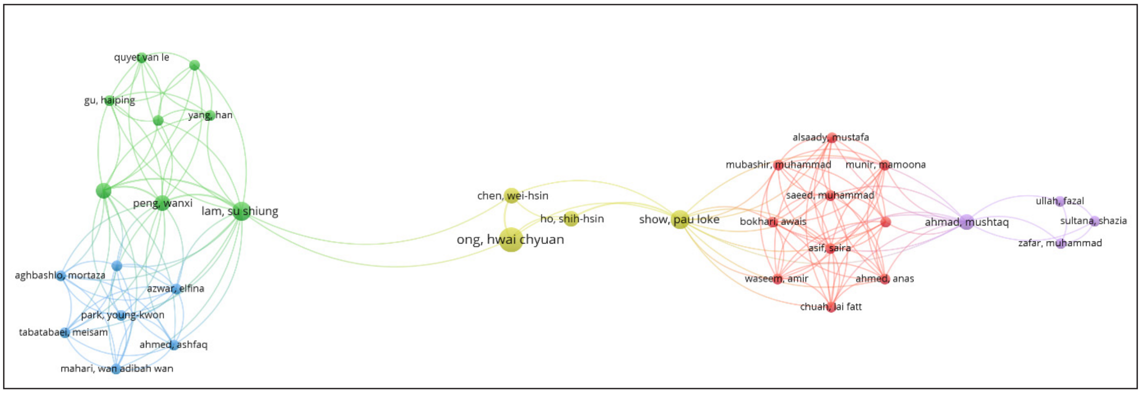

Fig. 2: Co-Authorship Map of Authors Under Study

Top 10 Most Productive Organizations

Authors from 1,851 different organizations have been involved in the research publications on 'Green Energy', and out of them, 747 organizations contributed one paper, 573 organizations contributed two papers, 170 organizations contributed three papers, 119 organizations contributed four papers, 56 organizations contributed five papers, and 186 organizations contributed six or more papers. The table 4 presents the top ten most productive organizations, which together have 148 (10.83%) publications with 6157 (19.27%) citations at the rate of 41.6 citations per paper. Among the top ten most productive organizations, the Chinese Academy of Sciences has contributed the maximum 31 publications, followed by Universiti Malaya (16) and New Jersey Institute of Technology

(15). It is evident from the citations data that the Universiti Teknologi Malaysia has achieved the highest, i.e. 2022 citations, followed by the Chinese Academy of Sciences (1455) and New Jersey Institute of Technology (767). The Universiti Teknologi Malaysia has achieved the highest, i.e. 155.54 citations per paper, followed by New Jersey Institute of Technology (51.13) and the Chinese Academy of Sciences (46.94); ranking according to the h-index, the Chinese Academy of Sciences achieved the highest (14) h-index, followed by New Jersey Institute of Technology and the Universiti Teknologi Malaysia with 11 h-index each. Among the top 10 most productive organizations, the University of Seville has all its publications through international collaboration, and the remaining organizations have partial international collaborations.

Figure 3 presents the co-authorship map of the most productive organization involved in the "Green Energy" research publications; out of 1,851 organizations, 766 organizations collaborated.

Table 3: Top 10 Most Productive Organizations

Affiliations	City, Country	TP	TC	ACPP	HI	ICP	TC-ICP	ACPP	HI-ICP
Chinese Academy of Sciences	Beijing, Peoples R China	31	1455	46.94	14	13	288	22.15	19
Universiti Malaya	Kuala Lumpur, Malaysia	16	503	31.44	8	9	95	10.56	5
New Jersey Institute of Technology	Newark, USA	15	767	51.13	11	2	4	2.00	1
Universiti Teknologi Malaysia	Johor, Malaysia	13	2022	155.54	11	10	480	48.00	8
University of Seville	Seville, Spain	13	444	34.15	10	13	444	34.15	10
University of Surrey	Guildford, England	13	181	13.92	8	12	174	14.50	8
Beijing Institute of Technology	Beijing, Peoples R China	12	297	24.75	10	8	259	32.38	8
King AbdulAziz University	Jeddah, Saudi Arabia	12	169	14.08	7	9	151	16.78	7
King Saud University	Riyadh, Saudi Arabia	12	89	7.42	5	7	87	1.13	5
North China Electric Power University	Beijing, Peoples R China	11	230	20.91	7	2	68	34.00	2

TP=Total Publications; TC=Total Citations; ACPP=Average Citations per Paper; HI=h-Index; ICP=International Collaborated Publications; TC-ICP=Total Citations for International Collaborated Publications; HI-ICP=h-Index for International Collaborated Publications.

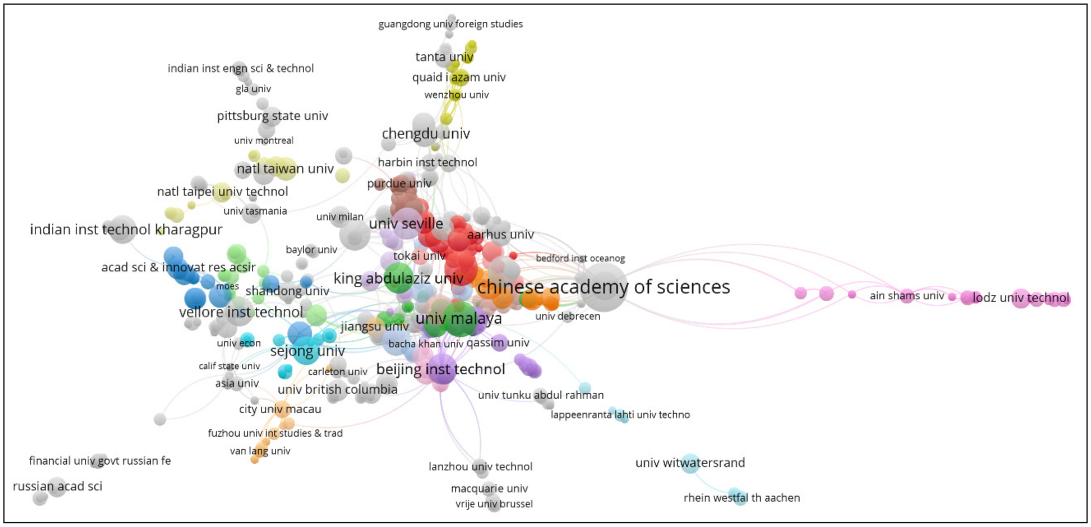

Fig. 3: Co-Authorship Map of Most Productive Organisations

Top 10 Most Productive Countries

Authors from 91 countries participated in research publications on 'Green Energy' between 1993 and 2022. Among 91 countries, 25 countries have contributed one article, 24 countries have contributed two to five articles, seventeen countries have contributed six to ten articles, eleven countries have contributed eleven to twenty articles, ten countries have contributed twenty-one to fifty articles, eleven countries have contributed fifty-one to hundred articles, and three countries have contributed more than hundred research papers in the research publications on 'Green Energy' during the study period.

Peoples R China has contributed the highest number of (302) research publications among the 91 countries, followed by India (170) and the USA (163). Similarly, research papers by Peoples R China have received the highest, i.e. 7,890 citations, followed by USA (4654) and Malaysia (3452). According to the average citations per paper, Malaysia leads the table with 61.64 ACPP, followed by South Korea (39.84) and Canada (29.90). Ranking of countries according to h-index, Peoples R China has achieved the highest (42) h-index, followed by the USA (34) and India (32).

Figure 4 presents the country collaboration map on "Green Energy" research publications.

Table 4: Top 10 Most Productive Countries

Name of Country	TP	TC	ACPP	h-Index
Peoples R China	302	7,890	26.13	42
India	170	3,390	19.94	32
USA	163	4,654	28.55	34

Name of Country	TP	TC	ACPP	h-Index
Pakistan	78	1,563	20.04	20
Canada	73	2,183	29.90	25
Taiwan	71	873	12.30	13
England	65	1,402	21.57	21
Germany	61	1,417	23.23	19
South Korea	61	2,430	39.84	21
Spain	59	1,241	21.03	20
Malaysia	56	3,452	61.64	26
Saudi Arabia	56	884	15.79	15
Turkey	55	1,211	22.02	19
Italy	52	1,328	25.54	19
Poland	47	495	10.53	13

TP = Total Publications; TC = Total Citations; ACPP = Average Citations per Paper

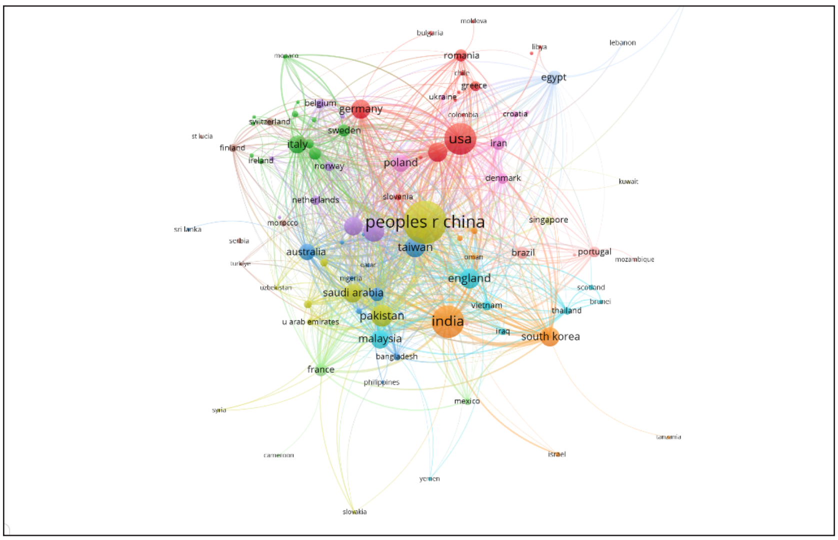

Fig. 4: Co-authorship map of countries

Top 10 Highly Preferred Journals

Overall, 1,367 research publications on 'Green Energy' were published in 525 different journals, of which 340 journals have published only one paper each, 85 journals have published two papers each, 24 journals have published three papers each, 19 journals have published four papers each, 11 journals have published five papers each, 12 journals have published six papers each, 12 journals have published between 7-10 papers, 15 journals have published between 11-20 papers, six journals have published between 21-50 papers and only journal has published more than 50 research publications on 'Green Energy' between 1993-2022.

The table 5 presents the top ten most highly preferred journals by researchers to research 'Green Energy' publications between 1993 and 2022. These top ten journals have published 328 research papers, 23.99% of overall publications under study. These top teen journals have received 10,571 citations, which is 33.09% of the overall citations received. '*Energies*' journal published by MDPI has published the highest, i.e. 84 research papers, followed by *Renewable and Sustainable Energy Reviews* (41) and *Sustainability* (39). However, *Renewable and Sustainable Energy Reviews* published by Elsevier has received the highest number of citations, 4,196, followed by Energy Policy (1,479) and Applied Energy (1,057). *Renewable and Sustainable Energy Reviews* journal has achieved the highest h-index (32) and average citations per paper (102.34). Of the top ten journals, six were published by Elsevier alone, followed by MDPI (2), Springer (1) and Taylor & Francis (1). *Renewable and Sustainable Energy Reviews* has the highest 15.9 impact factored journal among the top ten highly preferred journals.

Figure 5 presents the bibliographic coupling map of the top 50 highly productive journals on "Green Energy" research publications.

Table 5: Top 10 Highly Preferred Journals

Name of Journal	Publisher	IF (2022)	TP	TC	ACPP	h-Index
Energies	MDPI	3.2	84	760	9.05	16
Renewable and Sustainable Energy Reviews	Elsevier	15.9	41	4,196	102.34	32
Sustainability	MDPI	3.9	39	637	16.33	15
Environmental Science and Pollution Research	Springer	5.8	31	485	15.65	13
Energy Policy	Elsevier	9	29	1,479	51.00	19
Renewable Energy	Elsevier	8.7	25	626	25.04	13
Journal of Cleaner Production	Elsevier	11.1	23	566	24.61	12
Applied Energy	Elsevier	11.2	19	1,057	55.63	15
International Journal of Green Energy	Taylor & Francis	3.3	19	179	9.42	8
Energy	Elsevier	9	18	586	32.56	14

IF(2022)=Impact Factor for the year 2022; TP=Total Publications; TC=Total Citations; ACPP=Average Citations per Paper

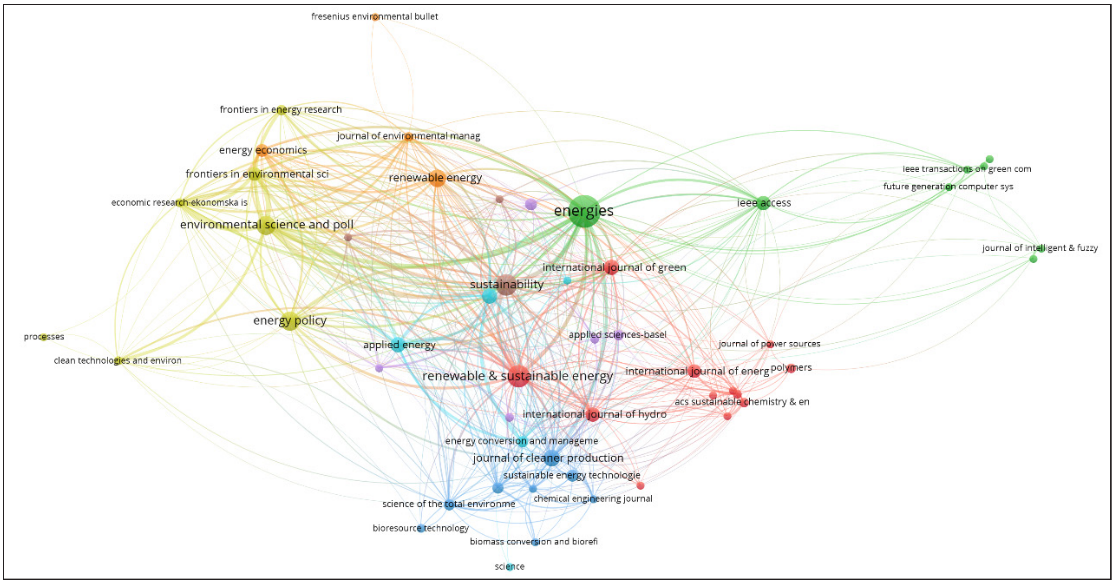

Fig. 5: Bibliographic Coupling of top 50 highly productive journals

Top 10 Distributions of Publications According to Research Area

The research publications on 'Green Energy' were scattered across 77 different research areas; however, a single research paper has been assigned with one or more research areas by Web of Science. The highest number of research papers, i.e. 33.94%, are indexed in the 'Energy Fuels' research area, followed by Engineering (25.53%) and Environmental Sciences Ecology (22.53%). The research area 'Energy Fuels' has received the highest 14,309 citations, followed by 'Science Technology-Other Topics' (10,821) and Engineering (7,294). Among the top 10 research areas, 'Chemistry' has achieved the highest 36.75 average citations per paper, followed by 'Science Technology-Other Topics' (36.31) and 'Materials Science' (35.78).

Table 6: Top 10 Distributions of Publications According to Research Area

Research Areas	TP	%TP	TC	ACPP	h-Index
Energy Fuels	464	33.94	14,309	30.84	58
Engineering	349	25.53	7,294	20.9	42
Environmental Sciences Ecology	308	22.53	7,056	22.91	42
Science Technology Other Topics	298	21.80	10,821	36.31	55
Chemistry	197	14.41	7,239	36.75	39
Materials Science	131	9.58	4,687	35.78	29
Business Economics	91	6.66	2,726	29.96	27

Research Areas	TP	%TP	TC	ACPP	h-Index
Computer Science	90	6.58	1,756	19.51	22
Physics	80	5.85	2,471	30.89	21
Telecommunications	78	5.71	1,707	21.88	21

TP=Total Publications; %TP= Per Cent of Total Publications; TC=Total Citations; ACPP=Average Citations per Paper

Top 10 Highly Sponsored Funding Agency

Out of 1367 research publications on 'Green Energy' under study, 711 were funded by one or more funding agencies. Nine hundred seventy four different funding agencies supported these 711 funded research works. The table 6 presents the top ten highly sponsored funding agencies, where the National Natural Science Foundation of China (NSFC) funded the highest (109) research publications on 'Green Energy', followed by the National Science Foundation (29) and the Spanish Government (24). Research publications funded by NSFC have received a maximum of 3,968 citations, followed by the National Research Foundation of Korea (1,489) and the National Science Foundation (1,293). National Research Foundation of Korea achieved the highest 74.45 average citations per paper.

Table 7: Top-10 Highly Sponsored Funding Agency

Funding Agencies	TP	TC	ACPP	h-Index
National Natural Science Foundation of China	109	3,968	36.40	29
National Science Foundation	29	1,293	44.59	19
Spanish Government	24	556	23.17	11
European Union	23	488	21.22	10
Ministry of Science and Technology Taiwan	20	290	14.50	8
National Research Foundation of Korea	20	1,489	74.45	12
Conselho Nacional De Desenvolvimento Cientifico E Tecnologico	17	303	17.82	8
UK Research Innovation	17	390	22.94	10
Department of Science Technology India	16	433	27.06	10
Fundamental Research Funds for The Central Universities	16	388	24.25	10

TP=Total Publications; TC=Total Citations; ACPP=Average Citations per Paper

Top 50 Significant Keywords

The authors who worked on Green Energy Research have provided 3,966 different keywords, and the WoS editors have also assigned 3,082 additional keywords for the indexed papers.

The table 8 presents analyses of 3,966 'Author Keywords' used in the research publications under study. The researcher identified highly preferred top 50 keywords used by the authors of research publications on 'Green Energy'. According to the analysis, the most significant keywords used were Green Energy (591), Renewable Energy (114), Solar Energy (41), and Sustainable Development (40).

Figure 6 presents the keyword co-occurrence map of the highly used top 50 keywords used by the authors of research papers on 'Green Energy'.

Table 8: Top 50 Significant Keywords

Rank	Keyword	Frequency		Rank	Keyword	Frequency
1	green energy	591		26	green products	11
2	renewable energy	114		27	green energy efficiency	11
3	solar energy	41		28	environmental sustainability	11
4	sustainable development	40		29	energy policy	11
5	sustainability	39		30	energy	11
6	energy efficiency	34		31	co2 emissions	11
7	renewable energy sources	25		32	bioenergy	11
8	energy harvesting	23		33	water splitting	10
9	hydrogen	22		34	supercapacitor	10
10	biomass	22		35	photocatalysis	10
11	biofuel	20		36	green energy harvesting	10
12	energy storage	18		37	energy consumption	10
13	climate change	18		38	microbial fuel cell	9
14	internet of things	15		39	green energy production	9
15	economic growth	15		40	energy management	9
16	hydrogen production	14		41	biomethane production	9
17	green energy technologies	14		42	biogas upgrading	9
18	environment	14		43	anaerobic digestion	9
19	biodiesel	14		44	smart grid	8
20	green finance	13		45	power generation	8
21	wind energy	12		46	photovoltaics	8
22	biogas	12		47	global warming	8
23	waste valorization	11		48	fossil fuels	8
24	sustainable energy	11		49	electric vehicles	8
25	microalgae	11		50	clean energy	8

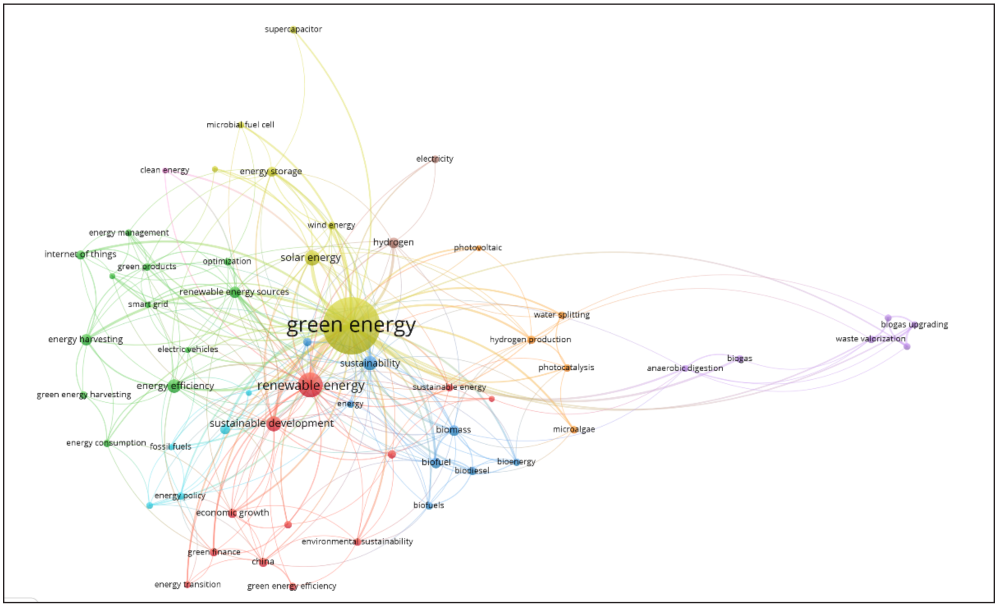

Fig. 6: Keywords Co-Occurrence Map

CONCLUSION

The study analyses the convergence of research publications towards green energy research publications to find alternative energy sources for fossil energy and avoid global warming. The study presents the systematic approach towards green energy research publications indexed in the WoS databases between 1993 and 2022. The authors analysed 1,367 research publications by 3,978 authors from 1,851 organisations and 91 countries.

Unlike most of the research areas, the developed nations like the USA, England and Germany were not highly productive; however, the third world countries like China, India, Pakistan, Taiwan and Malaysia were keen towards green energy research. China and India were highly productive among the 91 countries, and the academic impact of Malaysian research publications was higher among the top ten most productive countries. This clearly indicates that developing countries are enthusiastic about green energy research. The study observed that Nirwan Ansari was the most productive author, and the Chinese Academy of Sciences, Beijing, was the most productive organisation with regard to green energy research. *Energies* was the most preferred journal, and Elsevier was the highly productive publisher among the top ten most preferred journals. It is also observed from the study that a sharp increase in the number of research publications since 2018 with 79 research papers published and reached 340 by 2022. This indicates that green energy research has recently gained extensive global attention.

Green Energy Research has gained momentum due to its ability to reduce environmental damage due to non-renewal energy sources and the effectiveness of green energy implementation for human development. Based on the analysis of this study, academic and research organisations across the world explore the research focus and trends in green energy research publications.

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EXPLORING RESEARCH SUPPORT, RESEARCH DATA MANAGEMENT SERVICES, AND LIBRARIANS' PERSPECTIVES IN CSIR LIBRARIES

Alovi Zhimomi[1] and Durga Sankar Rath[2]

ABSTRACT

Research data as a by-product of research has a value-added potential beyond the lifecycle of research projects. Therefore, the sustainable handling, sharing, discoverability and reusability of research data becomes paramount. The Council of Scientific and Industrial Research (CSIR) is a pioneer in science and technology research and development (R&D) in India. The CSIR is a cluster of research centres and is an academic campus of the Academy of Scientific and Innovative Research (AcSIR), wherein high-quality teaching and research are undertaken. Hence, the research data generated by the scientific community has immense prospects at the national and international levels. This study explores how the CSIR Knowledge Resource Centres (KRC)/libraries support research, particularly the extent to which the libraries have adopted Research Data Management (RDM) services and the librarians' perspectives towards Research Data Services (RDS). Interviews were conducted, and an online survey was administered using a questionnaire for data collection. The findings indicate a growing trend of RDS in some of the CSIR libraries in a segregated state and identified a need for cohesive effort. It is observed that the RDM literacy of librarians/library heads is adequate, and concerning their perspective on various areas of RDS, the majority is of the opinion that top priority should be given to advisory RDS, while there is an indication of scepticism towards technical RDS. The challenges in effective RDS implementation in CSIR libraries are observed as researchers' readiness, lack of skilled manpower, dedicated fund allocation, and more conscious effort from CSIR management.

Keywords: *Research Data Management, Research Data Service, Research support service, CSIR, AcSIR, Knowledge Resource Centres.*

1. INTRODUCTION

The Council of Scientific & Industrial Research (CSIR) is an autonomous body of the Department of Scientific & Industrial Research (DSIR) under the Ministry of Science and Technology, Government of India (GoI). CSIR also acts as an academic campus of the

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Academy of Scientific and Innovative Research (AcSIR), which was established as an Institute of National Importance by an Act of the Indian parliament in 2010. CSIR laboratories conduct research in a wide area of science and technology domain and conduct multimillion projects in the laboratories annually with scientific productivity excellence in terms of soaring research publications along with excellence in intellectual properties in the filing of patents/copyrights in India and abroad. As research projects heighten, the research data from the projects undertaken continues to grow exponentially in terms of volume, velocity and variety. These data are of immense value, and without their management, they will get lost, become inaccessible due to technological obsolescence or remain as dark data (Schembera & Durán, 2020). The CSIR libraries named 'Knowledge Resource Centres' (KRC) is the unit in the CSIR laboratories that acquires information resources, both archival and digital and performs information management to facilitate information dissemination by providing reference and information services to the scientific community (Verma & Kalra, 2015). To standardise terminology, 'Library' shall be used instead of KRC throughout this article. In the research ecosystem of CSIR, the library plays a central role in the information transfer and communication of scientific research. In the present time of data-driven research environment, the Research Data Management Services (RDMS) or Research Data Services (RDS) in compliance with the FAIR (Findable, Accessible, Interoperable, Reusable) use of research data is even more exigent (Wilkinson et al., 2016). As information service providers, libraries are best situated to initiate RDM and facilitate RDS as it is identified as a key component in the open science landscape (League of European Research, 2013). An exploratory study is undertaken to investigate the research support provided by CSIR libraries to the scientific community, RDM initiatives, and librarians' perceptions of RDM. It is of significance to study CSIR as it is a publicly funded organisation, and the accountability of the research undertaken with the taxpayers' money should be substantiated by the reusability and sustainability of data.

1.1 Review of Literature

The library has been established as a key unit, and librarians have been identified as stakeholders in the research process (Lyon, 2012). RDM and RDS activities are considered as an extension of the existing library services (Auckland, 2012), with studies indicating libraries initiating formal RDM policy and providing RDS, including organisations being receptive to the idea of RDM (Cox & Pinfield, 2014). The RDM skills in librarians' professional roles have been discussed as evolving and also identified as diverse (Bradley-Ridout, 2018). Although RDM is a defacto requirement by the exigencies of open science and e-science, it is daunting with challenging factors faced by librarians (Faniel & Connaway, 2018). One of the factors is the management issues, and there is a lag from the institutional administration in making data-informed decisions (Borgman & Brand, 2022). Other challenges include researchers' readiness, stakeholders' involvement (research unit, IT, etc.), technical infrastructures, the fund for RDS, and lack of skill, including data librarian role identification (Chigwada, 2021;

Cox et al., 2016; Verbaan & Cox, 2014). Studies have indicated that RDM developments, specifically RDS, are highest in research-intensive institutions (Cox & Pinfield, 2014; Kennan et al., 2014; Tenopir et al., 2012). Lately, the RDM in libraries discourse focus on the domain-specific institution for providing RDS in libraries (Bishop et al., 2021; Barfi & Sackey, 2021; Chen, 2022; Hansen et al., 2021; Kerby, 2016; Znamirowski, 2021), tools or technological applications in libraries (De Sarkar, 2021; Nie et al., 2021; Nitecki & Alter, 2021; Omame & Alex-Nmecha, 2021; Trippel & Zinn, 2021) including workflow and training (Ashiq & Warraich, 2022; Biernacka et al., 2021; Borycz, 2021; Rantasaari, 2022; Tayler & Jafary, 2021; Wheeler et al., 2022). CSIR is a research-intensive organisation, and servicing RDS is expected. A number of studies have surveyed RDM in multiple institutions and examined the development of RDS in libraries besides designing a set of survey questionnaires that can be used as a benchmark to indicate areas in RDM initiatives in organisations (Corrall et al., 2013; Cox & Pinfield, 2014; Cox et al., 2017; Cox et al., 2019; Higman & Pinfield, 2015; Kennan et al., 2014; Tenopir et al., 2012; Tenopir et al., 2014). Discussion on positioning libraries with research excellence by making visible RDS efforts (Walker, 2020; Wildemuth, 2021) and supporting compliance with funding program policies are also recent trends in RDM discourse (Austin et al., 2021; Madeyski et al., 2021; Spichtinger, 2022; Von Spichtinger & Blumesberger, 2020). This study has been conducted to understand the involvement of CSIR libraries in the RDM conversation based on the mentioned empirical studies. The interview and online survey questions were adopted from these studies, including generic questionnaires from the Canadian Research Data Management Survey Consortium published as a dataset in the Borealis data repository.

1.2 Statements of the Problem

CSIR libraries are responsible for supporting the research community to cope with the requirements of advancement in scholarly communications. Which, of late, is the sharing of not only the research finding publications but also the research data and for the reuse of research data. These requirements are right from the beginning of any research project and beyond the publication of the research output for the perpetuity of the data access to enable other researchers to find the final piece of their puzzle. There is a need to study CSIR libraries to know the research support, RDM policy or RDS initiatives, and the perspectives of librarians, which have been found missing in the literature.

1.3 Objectives

To shed light on the specified problem this study has been conducted:-

1.3.1 To investigate how the CSIR KRC/libraries support research,

1.3.2 The extent to which the libraries have adapted RDM services in CSIR libraries and

1.3.3 To know the librarians'/library heads' perspectives towards RDS.

2. RESEARCH DESIGN AND METHODS

The study is exploratory in design. The purpose of adopting this design is to identify the nature of research support in science and technology research in CSIR and examine the status of RDS in the libraries. The initial web content analysis study of the CSIR libraries' websites indicates that RDM services are rare. However, it might be possible that the websites might not be projecting what the libraries perform, and therefore, an interview or a self-reporting survey was required (Yoon & Schultz, 2017). Hence, this study conducted an online survey and unstructured interviews to understand the status of RDM in CSIR libraries. The data was collected using a questionnaire. Four face-to-face interviews and four telephonic interviews were conducted to understand the system in their respective laboratory and the library's function in the research ecosystem. The interviews also set the stage for the preparation of the questionnaire. The questionnaire was designed into six sections, one of which is on demographic information, and the other sections describe aspects reflected in the study's objectives, which was pilot-studied by two librarians from the target group. The interviews and the pilot study confirmed the initial findings of the website survey that RDS needs to be more present or has minimal service in libraries that initiated RDM. Based on these observations, the questions were focused on opinion based rather than the actual RDS appraisal. The questions were both close-ended and open-ended questions. The questionnaire was administered through an online instrument, i.e., Google Form, so as to cover CSIR libraries across the country. The data collection was completed between March to June 2023.

The CSIR has a pan-India presence with a dynamic network of 38 national laboratories that also support 39 outreach centres, 3 Innovation Complexes, and five units. The 38 CSIR laboratories are also AcSIR academic campuses and have students enrolled in science and technology academic programs, including PhD, Masters and PG Diploma. This study considered all the libraries of the 38 main laboratories, as all research work is carried out under the aegis of the laboratories. 20 CSIR librarians/library heads out of 38 responded to the survey with a response rate of 67%.

3. FINDINGS

The survey results are a projected section which has been designed as per the research objectives.

3.1 General Information about Services Provided by the Library to Support Research

Libraries in academic and research organisations provide a set of services, both primary and secondary Research Support Services (RSS), intended to support the researchers in their research pursuits (Vaering Larsen et al., 2010). The advanced RSS per se RDM services (Evidence, 2021) are not included within the purview of this question, as the objective was to find what traditional or core RSS and facilities exist in the library before we delve into

RDM specifically. Twelve services and infrastructure were given as options (Table 1), and an open-ended option to include others.

Table 1: Traditional Services and Infrastructure List

1. Reading space, conference room, and digital space for researchers with ICT infrastructure	2. Assistance with research grants
3. Access to high-quality content, both physical and e-resource	4. Training programmes to develop research skills
5. Reference service	6. SDI (Selective Dissemination of Information)
7. CAS (Current Awareness Service)	8. Providing information and training on publication, copyright, plagiarism, open access
9. Citation training	10. Hosting repository and assistance with submission
11. Assistance with research visibility	12. Reference management tools support

The CSIR libraries provide multiple services to support research, as indicated in Figure 1. Nevertheless, there seem to be some services that the libraries can provide and enhance, for instance, providing assistance for research grants, research visibility, support for reference management, and citation training. Some libraries stated that they provide additional services like citation analysis and managing the publications of their laboratory, remote login, APC charges, and e-consortium. The library, as such, does not grant the APCs but provides information about the organisational schemes. E-consortium basically is not a service, but the library plays a significant role through the e-consortium for access to resources and services such as seamless search and authentication.

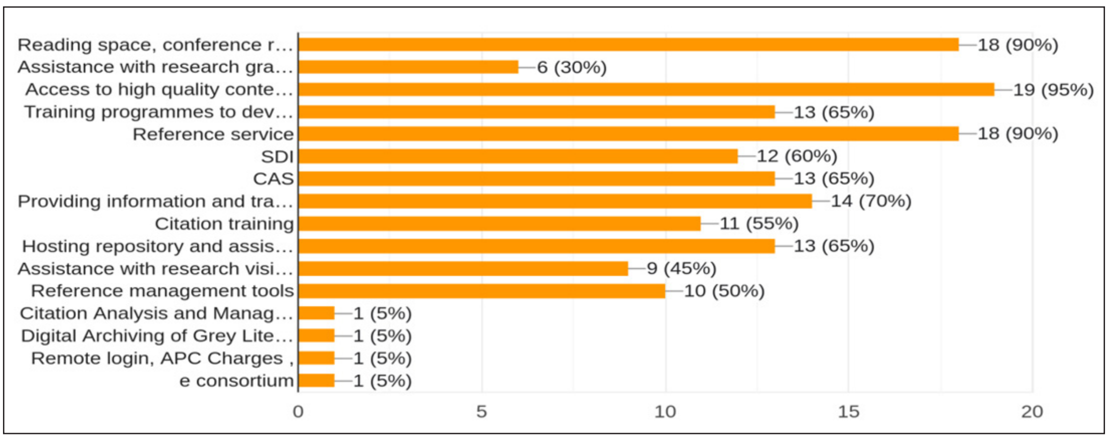

Fig. 1: Traditional research support service offered by the library (n=20)

An institutional repository(IR), being an important part of the research visibility, shows the scientific productivity of the organisation; it enables researchers to self-archive their research output and make an impact through the usage of their work. Being a predominant RSS, the libraries were asked about the repository service. It is found that the majority of 70% of the libraries are already hosting IR, and 20% plan to start. Of the 14 libraries hosting IR, seven use DSPACE and seven use EPrints software, which indicates the adoption of FOSS (Free and Open Source Software). This can support long-term preservation of digital resources (Rosa et al., 2017). The possibility of the use of IR for research data archiving can be further explored.

The need for research data by the patrons is undoubtedly indicated by the survey, whereby research data, independent of research publication, is sought by the patrons. This can be further explored by surveying the researchers. Textual data appears to be the most sought type of research data by the patrons, followed by numerical, multimedia and software. This needs to be substantiated through a survey from the researchers to find what type of data they need in their research domain, what kind of data is generated and in what file format it is stored. Information about projects like project investigators, duration, funders, etc., are also sought by the patrons. On the status of the library to facilitate patron needs, 50% of the libraries have the resources, and the facilities to support the researchers on the information sought about research data independently, data in varied forms or even research project details, while 40% of the libraries are not able to deliver the need and 10%opted others. There was an option given to indicate other response(s). Interestingly, a librarian stated that there is a separate data section for such information. The question arises whether the library can liaise with the data section to incorporate with the library service. Another response was the use of e-consortium to facilitate such information needs. This is open to wide speculation, which is beyond the scope of this study. The majority of the libraries, 50%, stated they use several resources both in-house as well as subscribed to commercial systems or databases and open resources on the internet to support researchers in their information needs. 95% of the libraries responded to ensuring the research articles and related data files in their IR were made available independently of publication. Various ways adopted by the libraries are indicated in Figure 2, with uploading datasets as separate files as common practice. Few libraries practice data citation and DOIs (Digital Object Identifiers).

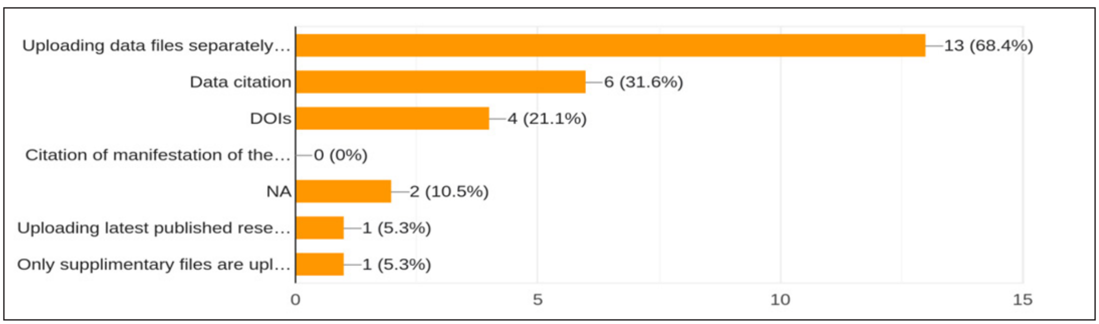

Fig. 2: Ensure research article and research data files in IR independently (n = 19)

3.2 Research Data Management Awareness and RDM Policy

This section seeks to find awareness about RDM and obtain information about RDM policy. The survey finds that 90% of the respondents were aware of RDM, and only 10% were unaware of RDM. Out of the 90%, only 20% were well versed with RDM and current development, 55% had basic ideas about RDM, and 15% had heard of RDM but were still not clear about the concept. There is a need for RDM policy formulation as the survey finds that only 25% have a policy in place, 5% intend to roll it out within a year, which is promising, 40% do not have a policy and are not planning while 30% are not aware of the policy as depicted in Figure 3.

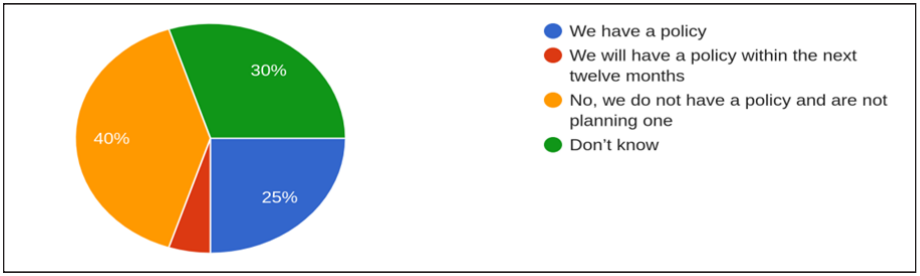

Fig. 3: RDM policy in place (n = 20)

For those libraries that state that they do not have a policy or do not know the existence of a policy, 70% (n=14) of the respondents were mostly of the opinion that a policy is essential (35%), while 25% are unable to determine whether it is essential to have a policy.

The survey finds that the library and research unit preferred to take a lead role in RDM policy development, while some respondents opined that all the units should take a participative role (Figure 4). The respondents were divided in their opinion about the library taking the lead role (50%) and the library taking a participative role (50%) in policy development. However, all the respondents feel that library involvement is essential in RDM policymaking.

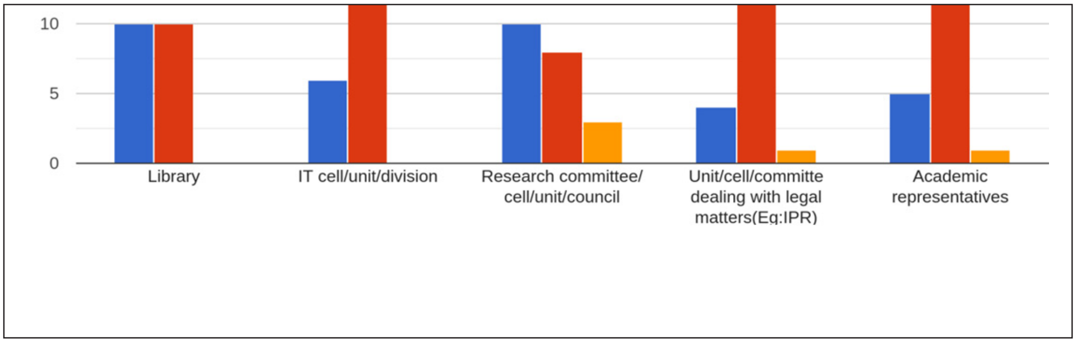

Fig. 4: Opinion on which cell/unit/divisions/committee should be involved in developing RDM policy and their appropriate role (n = 20)

An organisation's research data audit is foremost and integral in the RDM process, which brings several benefits to an organisation (Jones et al., 2008). It is urgently required in

CSIR as 45% of the libraries have not taken an audit/survey/evaluation of the institution's research data, while only 10% have done so with the library as lead, 20% with the library as a participant and 25% not planned on taking one as shown in Figure 5.

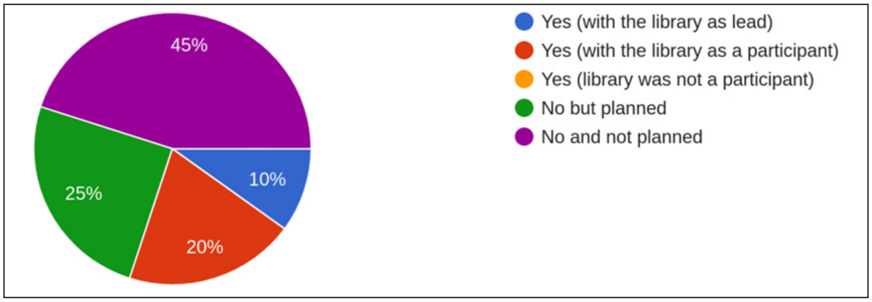

Fig. 5: Audit/survey/evaluation of institute's research data by library (n=20)

An open-ended question on how data audit informed RDM policymaking prompted a response from a librarian that there is a Scientific Ethics Committee (SEC) that regularly audits research data. This is also a welcomed approach of research data being audited on a regular basis by a dedicated committee, which entails accountability, and the librarian as chairperson/member entails data expertise input (data librarian). However, the context of the data audit in this question was on the holdings of the institutional research data, which is slightly different in the context of data auditing in the research process, although both data audits deal with the same research data.

Only 5% have taken a survey of staff attitudes to RDM, which includes RDM knowledge of the staff, skill to implement RDS, and whether they have any inhibition or opinion towards RDM. This indicates that there is a need to conduct the library staff survey.

The majority of the respondents, i.e., 55%, were aware of NDSAP while 45 were unaware. While 80% feel it is sufficient to cover the ambit of research data, the remaining 29% of respondents state that a separate policy on RDM is essential. The National Data Sharing and Accessing Policy was introduced in 2012 by the government of India as a mandate for sharing non-sensitive data generated by public money on a digital platform data.gov.in. The policy document states:

"NDSAP is designed so as to apply to all sharable non-sensitive data available either in digital or analog forms but generated using public funds by various Ministries / Departments /Subordinate offices / organisations / agencies of Government of India. The NDSAP policy is designed to promote data sharing and enable access to Government of India owned data for national planning and development".(National Data Sharing and Accessibility Policy, 2012). The need of a national policy on RDM is conveyed since NDSAP is not specific to research data but covers all ambit of non-sensitive data generated out of public funding, with 80% of respondents affirming it. According to the respondents, the policy-making body for the National RDM policy, in the highest order of preference, should include the following:

- Ministry of Science and Technology (MoS&T), GoI
- University Grants Commission (UGC), GoI

- Ministry of Education (MoE), GoI
- Ministry of Law & Justice (MoL&J), GoI;
- Statutory Professional Councils
- Ministry of Communications (MoC), GoI
- Ministry of Information and Broadcasting (MoI&B), GoI;
- Ministry of Statistics and Programme Implementation (MoSPI), GoI

Respondents were all in agreement on the mandates to be made in the National policy for RDM for making research data available for reuse, open standard data file formats for output of research data, standardisation of metadata and for RDM budget allocation(Figure 6). Few were uncertain about compliance with interoperability standards and compliance with FAIR principles, of which one respondent felt that there was no need for a mandate to comply with FAIR. Certainly, awareness of such areas can garner knowledge on the significance of such mandates.

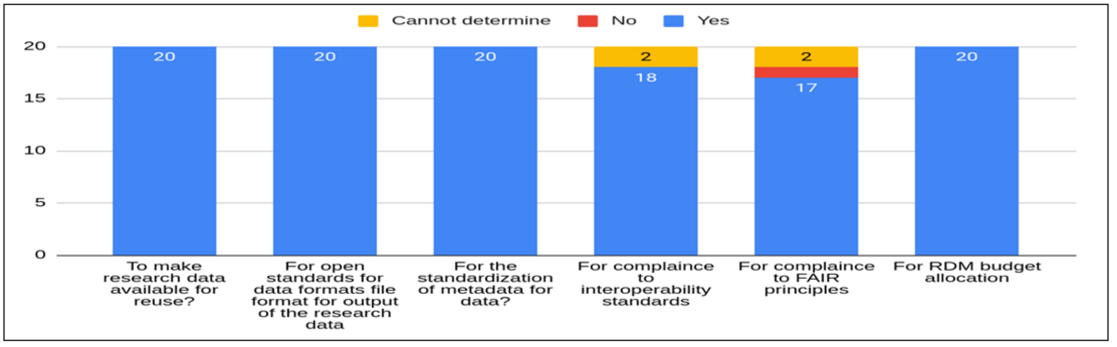

Fig. 6: Opinion on what mandate should be included in national policy on RDM (n = 20)

Respondents consider that certain mandates at the governmental level can enforce the implementation of research data sharing, as indicated in Figure 7. A respondent stated that there should be a periodical career assessment of the scientific community; this certainly is with respect to those under the payroll, which can be a good measure.

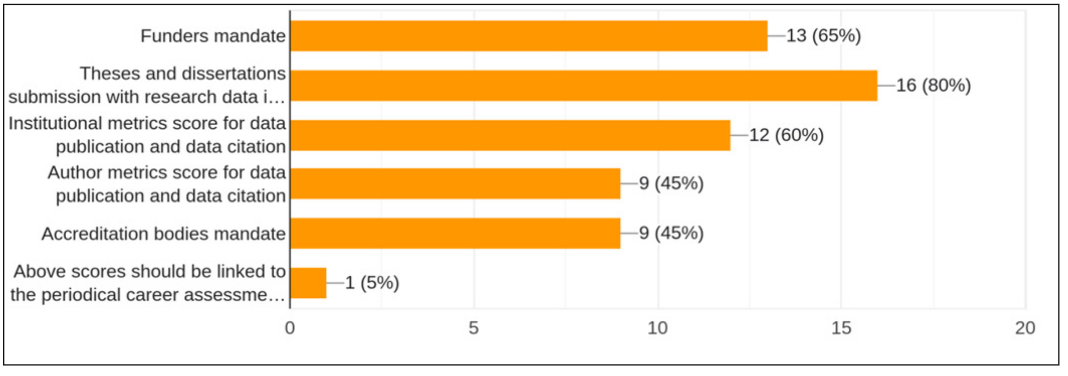

Fig. 7: Opinion on how mandates can enforce implementation of research sharing by researchers (n = 20)

Publishers' mandate and standards/guidelines by international agencies seem to be the best approach according to 60% (n=20) of respondents in international communities' efforts towards implementation of RDM and sharing research data. Funders mandate (45%), and data literacy programs by standard bodies (40%) are also taken into cognisance, as stated in Figure 8.

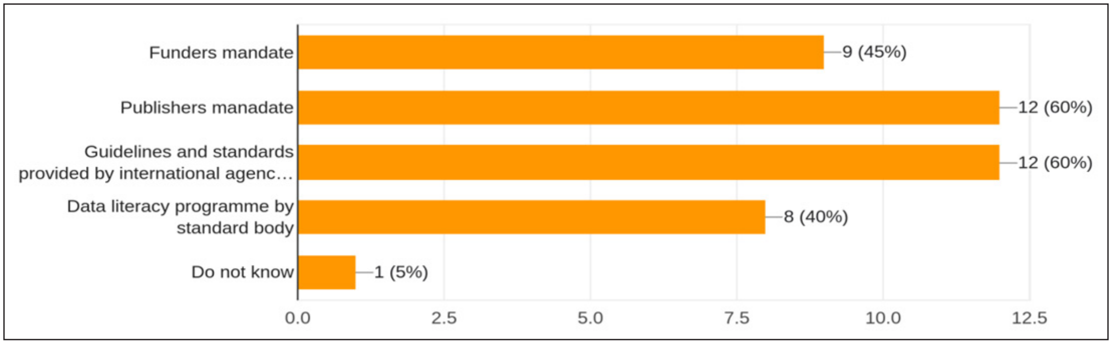

Fig. 8: Opinion on the international community's role in the implementation of research data management and sharing policy (n=20)

3.3 Research Data Services

Only 30% of the libraries are providing RDS, as per the survey, with 5% planning, 60% not in the pipeline and 5% unspecified. Some of the reasons specified, which could be viewed with utmost gravity to mitigate the issue of RDM in libraries, are stated:

"Management's decision/option" and "Policy matter" are managerial issues that project the bottleneck to the library's enthusiastic and expanding capacity in the RDM arena. "Shortage of staff" and "lack of knowledge and resources" are library-specific issues which is reflected in other studies, too (Cox et al., 2012; Chiware, 2020; Chiware & Mathe, 2016; Cox & Pinfield, 2014; Pinfield et al., 2014). A respondent stated that there is no demand for such a service. This is a matter of awareness. Data literacy program initiatives can drive researchers' awareness and need assessment, including the delivery of RDS (Carlson et al., 2013). In terms of collaboration with other internal and external units, there seems to be less collaboration, which indicates CSIR libraries working in isolation. Four libraries collaborate with another unit to provide RDS, while four are planning. The collaborating unit includes a research unit, planning division, scientific works division, digital archiving, management and administration, and IT unit. The digital archiving in a laboratory seems to be a separate division from the library. The majority of the libraries (12) do not intend to collaborate with external organisations for RDS. Few libraries (3) are planning, and only one library is collaborating currently.

There is no specific fund allocation for RDS in libraries, and the majority of the library managers state that the existing fund is insufficient to provide RDS, except for one librarian who states that the existing fund is sufficient. CSIR libraries are not granted uniform funds. As per the data collected, the library's annual budget ranges from 50 lakh (5 million) to 2.5 crores (25 million). On seeking suggestions for standard measures to fund RDM in libraries, library heads are of the opinion that the managerial interest is the first step besides government and publishers' policy. At the national level, the NDSAP 2012 states in section 13, "Budgetary provisions and appropriate support for data management for each department/organisation by Government of India would be necessary". Although the NDSAP does not specifically mention *research data*, the provision of the policy entails the specific budget requirements of RDM in CSIR libraries as the policy covers all amounts of data generated out of public funds.

3.4 Priority of Providing Research Data Services

RDS is basically categorised into '*Advisory and Support Research Data Services*' and *'Technical Research Data Services' (Cox et al., 2017)*. Instead of rating the existing RDS services, the survey seeks to get the opinion of the library managers on which services should be given priority, as shown in Figure 9. Top priority is considered in most of the *Advisory and support RDS* except for some services which were considered as mid priority, particularly *Data citation advisory services, Data publication advisory services, Data analysis/mining/visualisation support* and p*articipating as a team member in a research project.* There were fewer opinions (5% to 10%) from the respondents who considered these services as primarily the responsibility of other units. This also signifies the level of awareness about RDS in libraries.

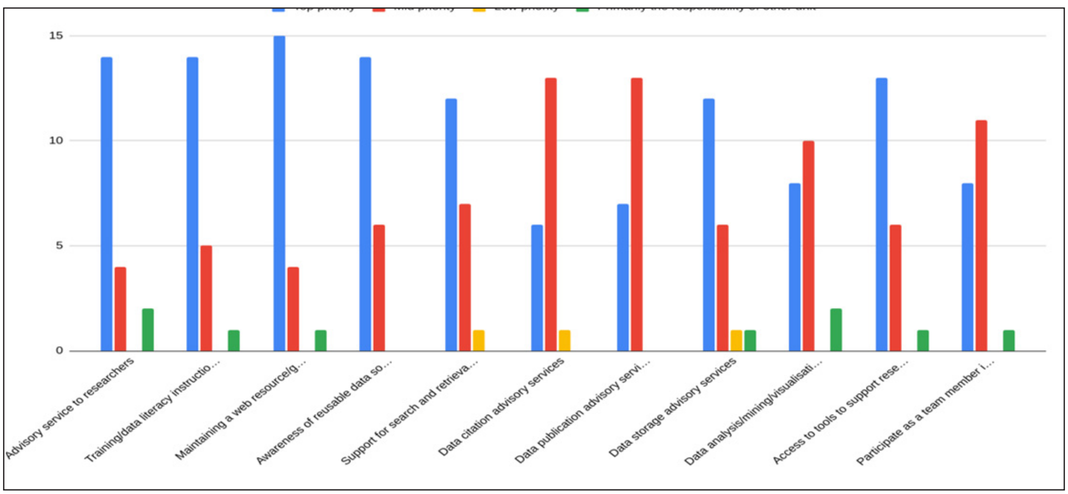

Fig. 9: Opinion on what should be the library's priority to offer Advisory and Support RDS

The *Technical RDS* is seen as intimidating as library managers consider these services as mid-priority of the library, low priority, and even primarily the responsibility of other units, which is higher (as shown in Figure 10) in comparison to *Advisory and support RDS.*

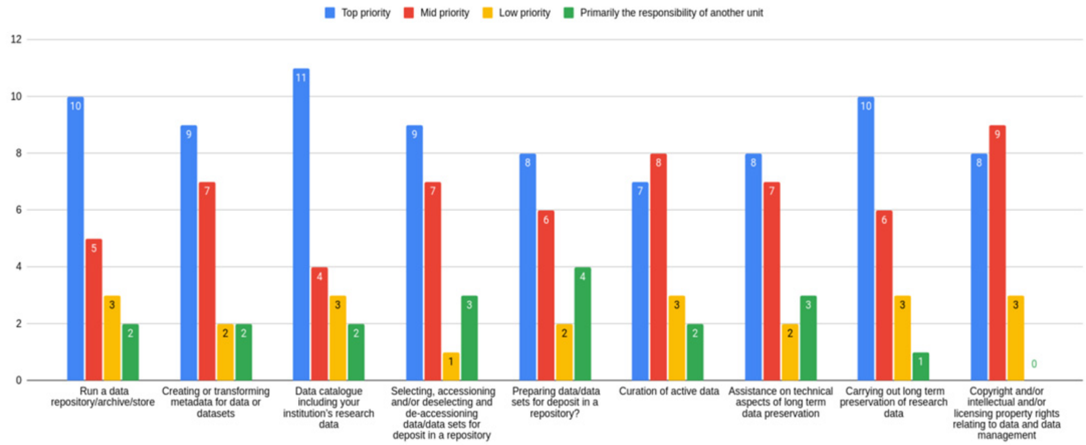

Fig. 10: Opinion on what should be the library's priority to offer Technical Research Data Services (n = 20)

3.5 Library Staff and Their Skills in RDM

The establishment of a Library as a central role in the RDM process warrants librarians' footing in the RDM ecosystem. CSIR library managers were asked about the staffing and skills for RDS. Almost all the libraries are functioning with limited staff of up to 5 staff (65%) except a few libraries which have more than five staff with 12 as the highest (35%). The majority (85% of the respondents) were of the opinion that a team is required for the deployment of RDS. Staff training for RDM is highly felt as 100% responded to the need to be trained. The areas of skill training needs were consistent across the libraries, as indicated in Figure 11.

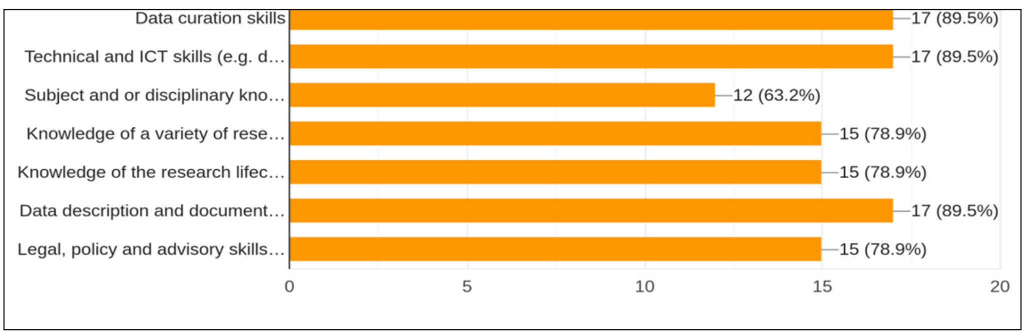

Fig. 11: Staff requirement of additional knowledge or skills to offer RDS (n-=19)

There is an indication of the skill gap realisation and proactive measures being implemented in the libraries, with 40% of the respondents stating that the staff has been given an opportunity to develop skills related to RDS. These skill development programs are highlighted in Figure 12. Nevertheless, the majority of the libraries have yet to initiate such activity.

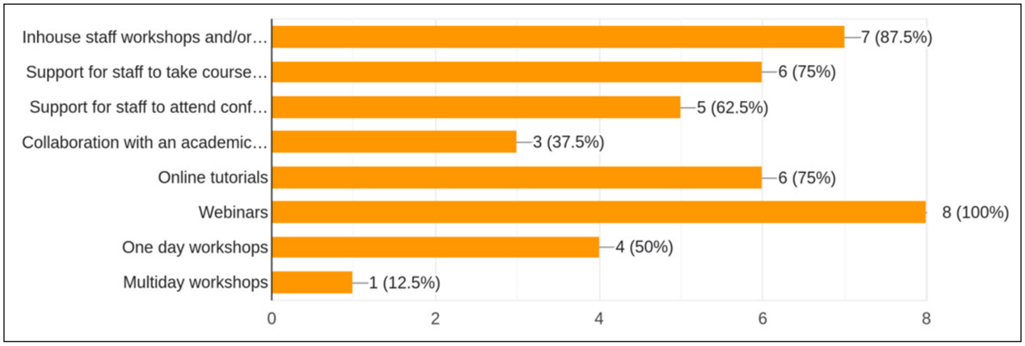

Fig. 12: Delivery of staff development opportunities related to RDS (n=8)

3.6 Other Aspect of RDM

The usage of data search engines in the libraries is very low, although a few respondents stated that it is already in place in their libraries. Responses were Scifinder(https://sso.cas.org/), Elsevier Data search (https://datasearch.elsevier.com/), Google dataset search (https://datasetsearch.research.google.com/), Global plants (https://plants.jstor.org/), WoS (https://www.webofscience.com/), Google Scholar (https://scholar.google.com/). On analysis of each of their response, it is found that there is a misconception about data search and literature search platforms as WoS and Google Scholar have been named, which do not qualify as dataset databases or data search engines. Use of Re3data (https://www.re3data.org/), which is a global registry for research data repositories, is not found in any of the libraries. It is of interest to understand the use of data search engines and data registries as these are the enablers of RDM, a point of contact to the researcher's dataset in the sphere of RDS that provides a place to store, manage and share their research data; search and access other researcher's dataset (Atkinson et al., 2008). NDSAP states that all Ministries/Departments are to upload non-sensitive data regularly every quarter on the portal https://data.gov.in/. The respondents were asked whether the library had uploaded any data; the majority, 85%, had never uploaded any data, and only 15% had uploaded data. The study did not explore the reasons as the scope of the work does not include exploring beyond the library. It might be possible that such roles are entrusted to other units. A respondent also expressed that there is a data unit in their laboratory that handles research data. The librarians feel that challenges in providing RDS in libraries will be foremost from the researcher who either has hesitation to coordinate with the library for their research data or lacks technical skill and knowledge. This is a major roadblock; however, awareness drives, data literacy programs, and workshops have been proven as effective measures (Wang, 2013; Read, 2019; Carlson et al., 2013). Understanding the needs of a researcher/organisation seems to be another issue. A possible solution is to conduct a need assessment survey and data audit. From the librarians' perspective, RDM is a new domain for librarians, and there is a vast area to be learned and mastered, be it the concept or the technical skills in servicing RDS. The lack of staff, infrastructure and funds seems to be a major challenge that library managers consider a stumbling block. Other issues seem to be data-specific challenges like ownership/copyright and data standardisation.

4. DISCUSSION AND CONCLUSION

This survey reveals that the traditional and core RSS in CSIR libraries are commendable. However, in terms of the advanced RSS per se RDM services, CSIR libraries are yet to catch up on the RDM movement. This study shows that few CSIR libraries have initiated an RDM policy, offering RDS and even providing staff development opportunities on RDM. Further work in the analysis of the extent of the RDS and ratings of these services can determine the impact of the RDS in the libraries. Most of the CSIR libraries have yet to take up the RDM initiative, but the higher level of awareness about RDM among library managers is a positive indication. Their acceptance of involving other units in the RDM stewardship shows their acknowledgement of the significance of other units in RDM. Their perception of the priorities to be given to areas of RDS is positive and promising. There is a higher preference for advisory RDS as a top priority for the libraries than the technical RDS. There is an indication from the study that some library managers consider technical RDS as a low priority for the library and even consider these services as primarily the responsibility of another unit. It is, however, already established that the library is the focal point of data stewardship, where the entire infrastructure is in place and services are assembled to support research (Yu, 2017; Koltay, 2019; Cox et al., 2019). These services are tested and successfully implemented across libraries, and librarians are best suited to liaison RDS services. Almost all the libraries run IR, and all existing repositories are open-source software. There is the use of repository software for research data storage, making it findable and enabling the reuse of research data, and the common practice is uploading data files separately. The manipulation and visualisation of research data from these platforms are not feasible as per existing software capabilities. It is apparent from the study that there are challenges in CSIR libraries in initiating RDM services, namely researchers' readiness, limited funds, shortage of manpower, skill gap, and management reluctance. Although there is a national policy on data with a mandate for making non-sensitive data generated out of public funds available in an open platform, budget allocation and compliance with other mandates are very negligible. The library managers have specified a need for research data policy at the national level. It will be soon that the driving forces of RDM compel CSIR libraries to take research data stewardship.

To conclude, it is understated that research data and its management have gained significant utility in the data-driven e-science digital scholarship because of the value data brings to the table. The RDS in CSIR libraries can expound the worth of research data by providing various advisory/informational and technical RDS. The study has found that CSIR libraries have lower engagement in RDM. A considerable amount of effort has to be given both from the CSIR management and the libraries' end. Further work can be carried out on the researcher's data generation and management challenges to align with the need for RDS from the library. Subsequently, the longitudinal study of data stewardship in CSIR libraries over some time can indicate evolution over time. This study has put the CSIR libraries in conversation with the libraries in RDM.

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RESEARCH PRODUCTIVITY OF SRELS JOURNAL OF INFORMATION AND KNOWLEDGE DURING 2018-2022: A BIBLIOMETRIC STUDY

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ABSTRACT

Journal of Information and Knowledge, formerly known as SRELS Journal of Information Management (between 2018 to 2022), is a bi-monthly journal published by Sarada Ranganathan Endowment for Library Science. The current study examines the articles published in the Journal of Information and Knowledge. The authors examine the number of articles published between 2018 and 2022, authorship patterns, year-wise distribution of articles, and author collaboration. Total 228 It has author collaboration from single to four authors. The article has a single author 52 (22.1). More than 50% of the total article 134 (58.77) has a collaboration between two authors. The study also described a maximum of 90.35% of research publications from India, while only 9.65 from foreign countries.

Keywords: *Bibliometric analysis, Authorship Pattern, Degree of Collaboration, SRELS Journal.*

INTRODUCTION

As a source of reliable information, research is crucial to the educational process. Finding the truth is the primary goal of research. The analysis of books, book chapters, journals, theses, and other forms of media using mathematical and statistical techniques is known as bibliometrics. Research output, individual productivity, and inter-person collaboration are all measured using Bibliometric techniques. Library academicians and LIS professionals publish their research articles in this peer-reviewed journal.

The Sarada Ranganathan Endowment for Library Science has been publishing Library Science with a Slant to Documentation, a quarterly publication, since 1964. It was founded by Dr. S. R. Ranganathan. The journal was started with the name “Library Science with a Slant to Documentation and Information Studies” til Vol. 25 in 1988. From 1988 onwards, it was renamed “SRELS Journal of Information Management” in Vol.37(2000). From 2023 onwards, the publication again changed its name to “Journal of Information and Knowledge”.

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REVIEW OF LITERATURE

Maurya et al. (2021) analysed Google Scholar data on the faculty members of library and information science for research output. From 17 Central Universities' permanent faculty, a total of 79 LIS faculties were considered. Data from 1980 to 2018 were used in this analysis, with the most publications occurring in 2017. Between 2011 and 2017, Segado-Boj, F. (2019)& Prieto-Gutierrez, J.J. explored the paper provides a comprehensive bibliometric analysis of research published in the Indian journal Annals of Library and Information Studies (ALIS). It explicitly compares this journal's patterns with those of other library and information science (LIS) journals from the top 10 LIS journals worldwide, as well as those from other regions of Asia, including India. Rahul Pandey and Shikha Awasthi (2019). This investigation explores bibliometric characteristics like article dispersal, year-wise magnification of publications, composition design of the publication, degree of participation, and the typical pace of publishing for each author. The Journal of the Indian Library Association (JILA) published 107 research articles from contributors nationwide between 2015 and 2019. In 2019, individual writers contributed to 47.67% of scholarly articles, which was the year with an extreme growth rate of 21.73%. The study's results show the strength of the journal, which is important for its future growth. Verma and Brahma (2018).A study conducted between 2007 and 2016 in the Malaysian Journal of Library and Information Science revealed that the year 2011 had the highest number of published articles (28), with an average of 9.33 per issue. Additional research reveals the two authors contributed 40.09% of the total papers, adhere to three authors (25.24%). Findings indicated that India came in second with a contribution of 8.50%, and Malaysia came in first with a contribution of 31.17% to the total quantity of papers that have been published. While studying, there were 31.11 references per article on average, and the level of collaboration was 0.76.

OBJECTIVES

1. Determine the quantity of contributions and year-wise distribution during 2018-2022.
2. To find out authorship patterns and authors' productivity.
3. Analysis of the degree of collaboration.
4. To know the year-wise authorship pattern of publication.

METHODOLOGY

The articles published form the basis of the present study between 2018 and 2022 in the Journal of Information and Knowledge. The official journal website (accessible at https://www.srels.org/index.php/sjim) provided the data, which were examined in more detail and tallied for analysis.

DATA ANALYSIS AND INTERPRETATIONS

Data was collected from the Journal of Information and Knowledge website. A year-wise publication chart was prepared using MS Excel. Further, they were categorised according to the number of articles published in a year, authorship pattern, etc., and analysed accordingly.

YEAR-WISE DISTRIBUTION OF ARTICLES

The below Table 1 and Figure 1 show the number of articles published in five years. A total of 228 articles were published during the said period. In 2018 and 2021, the same number of articles, 48. In 2020 and 2022, the same number of articles was published, 43. In 2019, a total of 46 articles were published. The years 2019 and 2021 accounted for 21.05% of all papers published, while 2022 had the lowest publications (18.86%).

Table 1: Year-wise Distribution of Articles

Year	Number of articles	Percentage (%)	Cumulative	%
2018	48	21.05	48	21.05
2019	46	20.18	94	41.23
2020	43	18.86	137	60.09
2021	48	21.05	185	81.14
2022	43	18.86	228	100
	228	100		

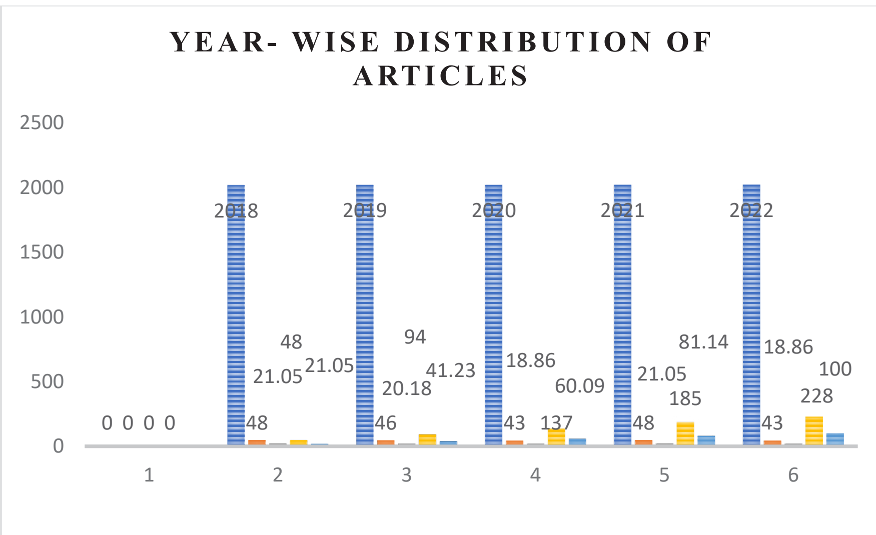

Fig. 1: Year-Wise distribution of articles

AUTHORSHIP PATTERN

Table 1 and Figure 1 below show the authorship patterns of the published. Between 2019 and 2022, a total of 228 articles were published, and these articles have collaboration from single to four authors. 52 (22.81%) articles were written by a single authorship, whereas 134 (58.77%) articles have two-author collaborations, and it is the highest among all. 27 (11.84%) articles were written in collaboration with three authors. 15 (6.58%) articles were written by four authors in collaboration. It is also observed that two authorships (134 (58.77%) have the majority. Authors prefer to write papers in collaboration.

Table 2: Authorship Pattern

Author Collaboration	Total no. of Articles	% of Articles	Total no. of Authors	% of Authors
Single	52	22.81	52	11.28
Two	134	58.77	268	58.13
Three	27	11.84	81	17.57
Four	15	6.58	60	13.02
	228	**100**	**461**	**100**

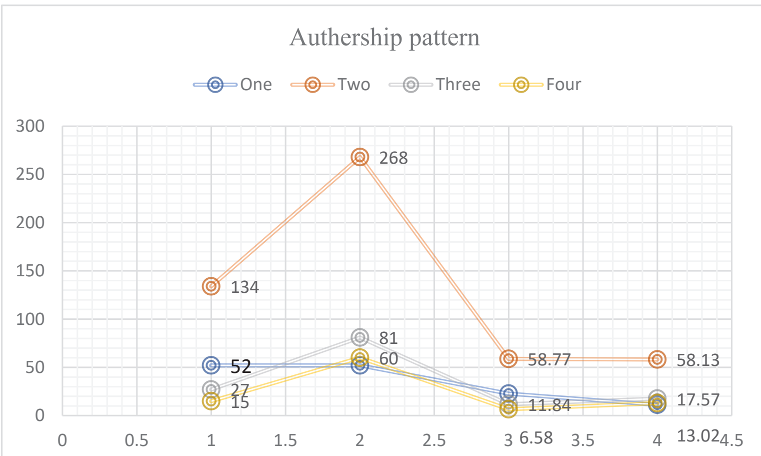

Fig. 2: Authorship Pattern

AUTHORSHIP PATTERN – YEAR WISE

Table 3 and Figure 3 show the year-wise authorship pattern of articles published in the Journal of Information and Knowledge during 2018-2022. It shows that in 2018, a total of 48 articles were published. Out of this, 24 articles were written by a two-author collaboration, followed by 13 articles by a single author, and the lowest was three articles written by a four-author collaboration. In 2019, 22 articles were written by two authors in collaboration, whereas 14 articles were by single authors. In 2020, it has the same tendency of a two-author majority. Twenty-eight articles were written by two -authors collaboration. 2021 and 2022 show no exception. They also have two author collaborations, with a majority of 26 and 19, respectively. Over all, in 5 years, 119 articles have joint authorship followed by 63 Single authorship.

Table 3: Authorship Pattern – Year Wise

Year	Single Author	Two Author	Three Author	Four Author	Total
2018	13	24	8	3	48
2019	14	22	7	3	46
2020	9	28	4	2	43
2021	13	26	7	2	48
2022	14	19	4	6	43
TOTAL	**63**	**119**	**30**	**16**	**228**

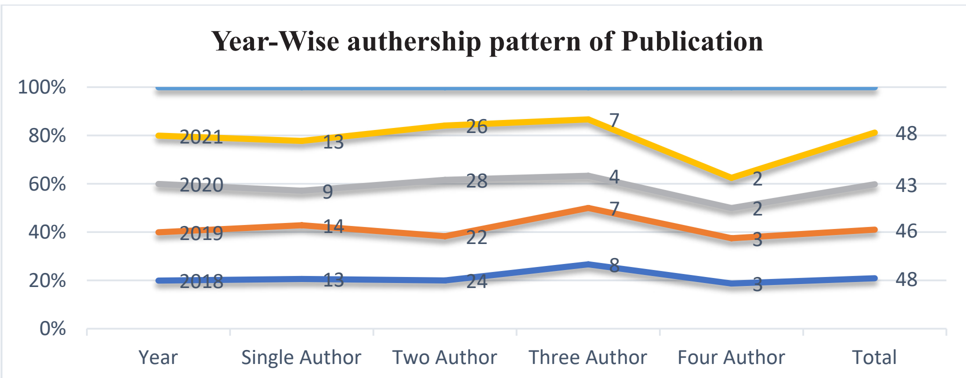

Fig. 3: Authorship Pattern

DEGREE OF COLLABORATION

The ratio of collaborative research papers to all publications during a given period is used to measure the degree of collaboration. The Subramanyam (1983) formula has been applied. It appears as:

Nm = Number of multi-authored papers

Ns = Number of single-authored papers

DC = Nm/Nm + Ns

DC = Degree of Collaboration

Here, DC = 165/63 + 165 = 0.72

Table 4: Degree of Collaboration

Year	Single Authored (Ns)	Multiple Authored (Nm)	Dc / Nm (Nm + Ns)	DC
2018	14	34	48	0.21
2019	12	34	46	0.20
2020	13	30	43	0.19
2021	13	35	48	0.21
2022	11	32	43	0.19
	63	**165**	**228**	**0.72**

PRODUCTIVITY OF THE PUBLICATIONS

The author's productivity in their publications in the Journal of Information and Knowledge from 2018 to 2022 is shown in Table 5 and Figure 5. It is observed that 461 authors wrote 228 articles, and the average contribution of each author is 0.23. 2018 saw the highest number of publications per author (0.23), while 2022 saw the lowest number (0.16).

Table 5: Author Productivity of Publication

Year of Publication	No. of Publication	No. of Authors	Average Publication Per Author
2018	48	105	0.23
2019	46	99	0.21
2020	43	89	0.19
2021	48	93	0.20
2022	43	75	0.16
Total	**228**	**461**	**0.49**

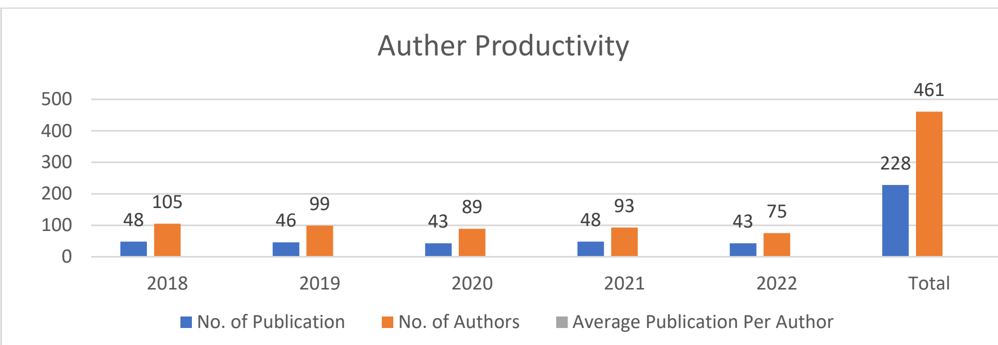

Fig. 4: Author Productivity of Publication

GEOGRAPHICAL DISTRIBUTION

Table 6 below shows the country-wise distribution of authors. The distribution of Articles is divided into two categories: Indian and others., It is found that India has the maximum contribution of 206 (90.355) articles, whereas foreign authors contributed 22 (9.655) articles.

Table 6: Country-wise Distribution of Articles

Country	2018	2019	2020	2021	2022	Total	%
India	44	42	38	46	36	206	90.35
Foreign	4	4	5	2	7	22	9.65

STATE-WISE DISTRIBUTION

Table 7 shows that in five years, West Bengal has the highest contribution of articles, at 44 (19.30%). Followed by Karnataka at 36 (15.79%). Uttar Pradesh and Delhi have the same number of contributions of 16 (7.02%), respectively. Maharashtra has the lowest contribution to 4(1.75&) in five years. Other states have 68 (29.82%) of articles altogether. Other countries have been considered here as a state and have made 22 (9.65%) contributions in five years.

Table 7: State-wise Distribution of Articles During 2018-2022

S.No.	Name of State	2018	2019	2020	2021	2022	Total	%
1	West Bengal	9	15	7	4	9	44	19.30
2	Karnataka	9	6	5	8	8	36	15.79
3	Uttar Pradesh	3	4	3	3	3	16	7.02
4	Delhi	5	4	2	4	1	16	7.02
5	Tamil Nadu	1	2	1	3	2	9	3.95
6	Panjab	6	0	1	0	0	7	3.07
7	Haryana	1	2	1	1	1	6	2.63
8	Maharastra	1	2	1	0	0	4	1.75
9	Others State	18	22	18	8	2	68	29.82
10	Foreign	6	5	4	4	3	22	9.65
	Total	**59**	**62**	**43**	**35**	**29**	**228**	**100**

FINDINGS AND CONCLUSION

Present study research analyses of the Journal of Information and Knowledge during 2018-2022. The investigation based on bibliometric tools is one of the relevant areas in library and information science for evaluating the year-wise contributions, research assessment, and analysis of the degree of collaboration among the authors. This research shows that the maximum number of papers published is 21.05%, and the lowest is 18.86%, while the degree of collaboration was 0.72. The highest number of publications per author was found in the year 2018 (0.23), while the lowest was recorded in the year 2022 (0.16).

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LINKED OPEN DATA IN THE DOMAIN OF LIBRARY & INFORMATION SCIENCE: BEYOND DISCOVERY AND FEDERATED SEARCH

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ABSTRACT

Library and information centres are the storehouse of knowledge. Of late, these are dealing with numerous types of databases like bibliographic databases, full-text book databases, archival databases, statistical databases, CD/ DVD ROM databases, etc., to fulfil the users' demand. Web technology quickly changes services' storage, recycling, processing, and dissemination. Semantic web technology is such an advanced technology of web platform which provides structured data on the web for describing and retrieving data by the library and information centres. It provides users with more suitable information from other external sources, which isn't impossible by the discovery, federated, OPAC, or allied tools. In this paper, the authors described, in short, the present scenario of linked open data, its use in various academic libraries and information centres, and its services and resources.

Keywords: *Linked Data (LD), Linked Open Data (LOD), Discovery search, Federated search, RDF, XML, JSON, Bibliographic data, OpenRefine, MARC-2, URI, Datasets, MarcEdit.*

1. INTRODUCTION

Because the vast majority of data sets are available in open formats, with no access limitations, linked open data for academic libraries are gaining popularity worldwide. This helps librarians create new, efficient, smooth services for all libraries regardless of type or size. Most academic libraries can provide information about their resources through web-based OPAC or Discovery searches. This means that users can only access the information that is available in the library's databases. If a library's bibliographic data can be linked with external datasets and provided service at a semantic level, it would increase library data's visibility and interoperability. The user will get a wide range of related data to their subject of interest.

2. OBJECTIVES

The main objective of this article is to aware LIS professionals about the linked open data (LOD) and how LOD could help immensely the domain of LIS. It provides more relevant information

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from other external resources to the users, which is impossible by the discovery and federated search techniques. This paper also discusses a few methods to implement LOD in the LIS domain.

3. LINKED DATA VS OPEN DATA

Linked data is the basics and foundations of the Semantic Web, also called the Web of Data. The purpose of the Semantic Web is to create relationships between datasets that are understandable to humans and machines, and Linked Data offers the finest methods for doing so. A set of design guidelines known as "Linked Data" is used to share machine-readable, interconnected data over the web. Making web-based data machine-readable and establishing connections and links to other data sets are vital objectives. Data can be connected to different external data sets, such as a worldwide dataset, by publishing it in this fashion (Ontotext, 2017). Open-Data and Linked-Data are not the same concept. Open data refers to the data that can be used, manipulated free of cost and distributed freely by the people. Open Data is accessible to everyone without links to other data. Side-by-side data, which are not available free of cost for reuse and distribution, can also be linked.

4. LOD: FIVE STAR SCHEMA

Tim Berners-Lee, the father of WWW, recommended the five-star data as below:

- Data should be available with an open licence
- Data should be machine-readable structured data (e.g. excel, not image)
- Data should be structured, machine-readable and in CSV instead of Excel
- Data should have all the above characteristics with **open standards** from the World Wide Consortium (W3C) (i.e. RDF and SPARQL) to detect things so that other people could see the data.
- All, as mentioned aforesaid, **data should be linked** to others' data to give context

5. COMPONENTS OF LINKED DATA

From the above thumb rules of LD provided by Berners-Lee, we can derive the following as the main components of LD:

- URIs, as the basis of linking data on the web;
- HTTP, as the protocol for locating and accessing related data resources;
- Structured data in RDF triple format, created using controlled vocabulary terms and
- made available using different RDF serialization formats such as RDFa, RDF/XML,
- N3, Turtle, or JSON-LD; and
- Linked Data Platform (LDP), a specification that allows the use of RESTful HTTP to consume, produce and manipulate RDF resources.

6. LINKED OPEN DATA AND LIBRARIES

- Linked open data can be shared, extended, modified, and reused.
- A collaborative online sharing platform for the production and dissemination of structured data.
- RDF, Ontology, URIs, HTTP, SPARQL and Machine-Readable Bibliographic Data and Full-text Contents with Semantic Relationships/Contexts (SPARQL Protocol and RDF Query Language).
- Web-based data that incorporate external data sources or conventionally linked datasets, publishing the augmented dataset as LOD
- They are connecting and sharing LOD as a dataset or SPARQL service so that other libraries and information centres can use it.

7. ROLL OF LIBRARIANS IN THE TRANSFORMATION OF DATA

Extracting bibliographic and authority data (both personal and subject) in MARC format from KOHA ILMS,

(i) Transforming or converting those data into an RDF triple model with different formats like RDF/XML, JSON, Turtle, etc.

(ii) The transformed RDF triple data will be enriched with other externally linked open data by manual insertion or using automatic tools like Open Refine (http://openrefine.org/).

(iii) Linked open data is the advent of the semantic web. So, searching linked data would be made a semantic search using tools and techniques like SPARQL endpoint and open semantic search (http://www.opensemanticsearch.com).

(iv) A web-scale discovery system plays a significant role in discovering the data among large volumes of collection in different structures and ontologies. It is a big challenge how it is possible to find the linked open data among the big data by applying free & open-source software and tools and technologies to design a framework to access LOD in the management science domain.

8. METHODOLOGY

- Reorganizing validating MARC data using the MarcEdit tool
- Converting MARC records into CSV formats
- Cleaning messy, unorganized data using the OpenRefine tool
- Reconciliation of Data with external resources like VIAF, LCSH, LCNAF, Wikidata, Geonames, OpenLibrary
- Filtering URIs with GREL Language
- Assign RDF Schema

- Mapping between MARC Tags and RDF Schema Ontology
- Linked Open Data transformation with link generation and so on.

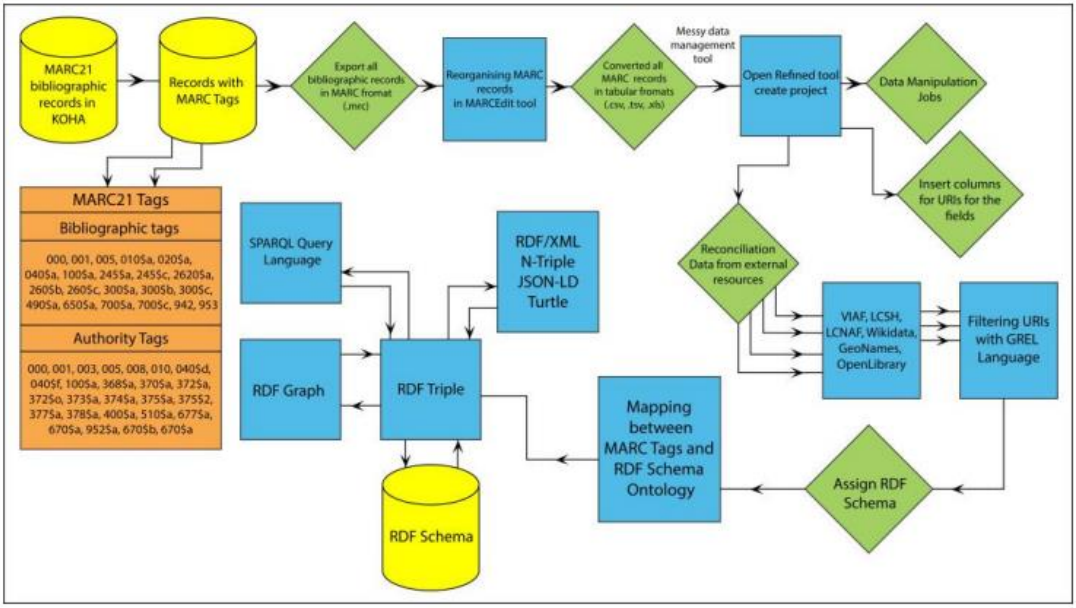

Fig. 1: Workflow of producing LOD dataset from bibliographic data

9. LINKED OPEN DATA: RESOURCES (KNOWLEDGE-BASE AND DATA SETS)

(a) General Purpose Datasets:

(a) DBpedia, (b) WikiData, (c) GeoNames, (d) FreeBase & (e) Google Knowledge Graph

(b) Open Data Portals:

(a) LOD Cloud

(b) DataPortals.org

(c) Linked Open Data: Resources

- LOC Linked Data Service; Europeana; British National Bibliography
- BIBFRAME: SHARE VDE; DPLA; USA
- WorldCat (OCLC) linked data; OpenLibrary; LIBRIS
- Library-Link Network; Data Cite; GOKb.org; WordNet

10. LOD CLOUD

The LOD Cloud is a Knowledge Graph that aids in the graphical visualization of linked datasets on the Semantic Web. It essentially follows the principles of LOD for the publication of the linked dataset. LOD cloud helps to understand the growth and development in the publication of LOD and establishes the relationships between the available linked open datasets. It collects and joins the related LO datasets and allows single-point access to the datasets. It will enable basic and sophisticated lookup-oriented browsing using the SPARQL query expressions or SQL syntax. The cloud also allows the downloading of datasets in different serialization formats.

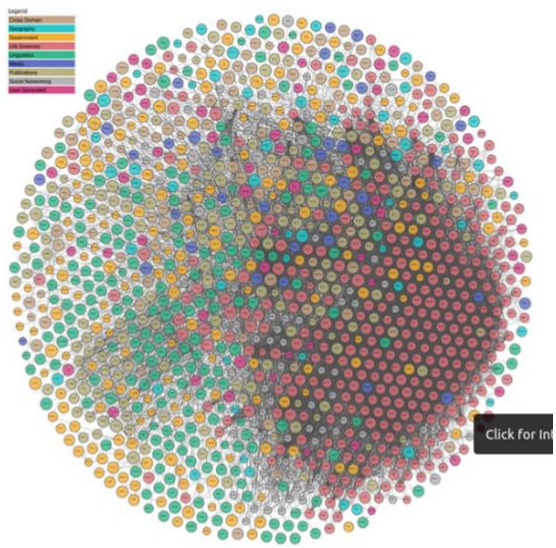

Fig. 2: An example of cross-domain LOD Cloud.
Source: (The Linked Open Data Cloud, n.d.)

- This LOD cloud diagram/ image shows the datasets published in LOD format.
- LOD Cloud is a diagram that depicts publicly available linked datasets.
- Maintained by the ICDA (Insight Centre for Data Analytics).
- The dataset currently contains more than 1260 datasets with 16187 links.
- Anyone may reuse the diagram and add LO Data sets to this cloud under the Creative Commons Attribution License.

11. LOC LINKED DATA SERVICE (HTTPS://ID.LOC.GOV/)

The Library of Congress' 'Linked Data Service' started in 2009 and now has access to over 260,000 authority records. It also provides access to Library of Congress standards and vocabularies, like classifications, themes, geographies, languages, event types, and software. The Library of Congress started to change in 2011, introducing a new "bibliographic environment" that makes it easier to connect network resources. This was then used as the starting point for integrating Linked Data into the Web of Data.

- Datasets available under LOC-LD
- LCSH
- LCNAF
- LC Classification to MADS/RDF
- LC Thesaurus for Graphic Materials
- MARC codes
- Preservation vocabularies
- Each vocabulary is also freely downloadable.

12. OCLC LINKED DATA SERVICES

- OCLC WorldCat (https://www.worldcat.org)
- Bibliographic metadata in WorldCat includes a rich collection of objects, which can be represented as linked data. Extracted entities such as works, people, and locations from this metadata will form the basis of WorldCat's linked data, supporting the deployment of Web services that provide a variety of features and data access.
- Provide linked open data from OPAC in various formats, like RDF/XML, Turtle, JSON-LD, N-triples
- OCLC identifiers and Linked Data URIs (e.g. OCLC Numbers, VIAF IDs, WorldCat Work URIs) are available in the public domain.

13. CONCLUSION

Many of the issues currently associated with federated search engines include lack of granularity, inability to support sophisticated queries, poor relevancy ranking, inaccurate de-duplication, and slowness. These issues could be resolved if all electronic resource providers exposed their data in RDF and used linking hubs to apply a common controlled vocabulary. People can access the data of other users that are spread around the web and kept in various locations through linked data. A complete "integrated library system" covering selection, sorting, cataloguing, authorization management, taxonomy creation, and search operations might be offered by linked data.

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HOW THE INTERNET OF THINGS TRANSFORMING SOCIETY THROUGH CONNECTED DEVICES

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ABSTRACT

This paper examines how the Internet of Things (IoT) is transforming the daily lives of people as well as industries with linked gad gates. It is also telling regarding how the Internet of Things facilitates items for better communication and increases the capacity for productivity. Various applications of IoT are covered in this paper. They are the development of communities and smart homes as well as the manufacturing process. The study reveals the challenges accompanying security and privacy in the age of the Internet of Things (IoT). It studies future innovations and technical advancements and the prospects of IoT development worldwide. Altogether, the study provides an extensive summing up of the simple Integration of the Internet of Things (IoT).

Keywords: *IoT, Smart Cities, Sustainable Development, IoT in Health care*

INTRODUCTION

The revolutionary thinking of the Internet of Things is changing the nature of work and people's lifestyles. It describes the network of material objects such as cars, appliances and other equipment. These materials are linked together with software and network connectivity via sensors and built-in to allow them to communicate the gathered data. IoT Internet of Things has a strong footprint and influence on people and businesses as it continues to evolve.

CONNECTING THE UNCONNECTED

A very important objective of the Internet of Things is to connect early independent devices mixing to form an ecosystem in which they interact and communicate together. A large number of applications for this connection are industrial gear, medical equipment, smart household appliances, lights and thermostats. The possible exchange of information on this networked web generates new opportunities regarding creativity and productivity.

Highlighting the basic concepts of IoT, it brings together previously stand-alone devices and objects into a balanced, interconnected network. It shows a strong impact on the process

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of far-reaching implications across the different types of industries and the daily lives of the people. Assisting in a new era of capability, collaboration and innovation provided to the nation.

SMOOTH INTEGRATION OF THE DEVICES

The need for "Connecting the unconnected" depends upon the smooth integration of devices that are independently operated in a conventional manner. In the picture of the smart home situation, for illustration, appliances regarding household lighting materials, security cameras, and thermostats should communicate with each other at present, associating an intelligent ecosystem promptly responding to user selection and adapting to changing situations.

INCREASED OPERATIONS FOR INDUSTRIAL APPLIANCES

Connecting industrial settings, machinery and equipment through IoT provides excellent coordination and communication that was not previously attainable. Machines can share real-time data, allowing anticipated maintenance, optimising production, and decreasing downtime. This 4.0 revolution is a key driver for the interconnectedness industry. IoT has influenced smart factories to leverage unprecedented levels of automation and capability.

BETTER DECISION-MAKING

A wealth of data can be provided by connecting the unconnected through harnessed for informed decision-making. It can collect and transmit data related to usage patterns, metrics of performance and environmental situations via sensors embedded in devices. This data has been analysed intelligently, empowering businesses to make individual decisions data-driven, leading to the utilisation of resources with more capability and enhanced outcomes.

INTER-INDUSTRY COLLABORATION

IoT encourages cross-industry synergy by attaching disparate sectors and systems. For example, data collected from agricultural sensors can be made available with contributed linked systems, providing a continuous flow of information from the farm to the customer. This kind of interconnectedness generates opportunities for collaboration and innovation, breaking down soils and promoting a more integrated and capable global ecosystem.

PROVIDING NOVEL OPPORTUNITIES

Opening the doors to connecting the unconnected for novel opportunities and use cases. The following items can become part of IoT such as everyday objects, household commodities and personal accessories. This exploration of IoT ecosystems morsel creativity in developing innovative solutions, bringing to advancements that were once the line of thinking can be the realm of science fiction.

CONSIDERATIONS AND CHALLENGES

The idea of connecting the unconnected holds immense promise regarding the challenges, especially in terms of Security, privacy and interoperability. A large number of devices become a part of the IoT, ensuring they can communicate very carefully and harmoniously, which becomes controlling, necessitating current efforts in the recommendation of standardisation and security protocols.

IMPROVING PRODUCTIVITY AND EFFICIENCY

IoT has the capacity to increase productivity significantly across the industry. In the manufacturing sector, connected devices predict each one another regarding optimising production processes, reducing downtime and other maintenance activities. In the agriculture sector, IoT triggers can promote soil conditions, Atmospheric conditions, and crop health, delivering to farmers at the right time with real-time data regarding informed decisions and optimising yields.

SUSTAINABLE LIVING AND SMART CITIES

The role of smart cities in the age of the Internet of Things (IoT) has got name and fame because of sustainable living and quality of life for people in urban areas. It plays a crucial role in monitoring and managing traffic flow, better consumption of energy and brushing up on waste management. Sustainable living and Smart Cities concepts raise urban living standards and assist sustainable efforts by decreasing materials waste and improving environmental safety.

REVOLUTION IN HEALTHCARE

IoT is playing a game-changing role in the healthcare sector; accessible gatekeepers, like fitness trackers and smartwatches, can promote high-spirited signs and contribute important health insights. IoT is providing medical equipment for the sake of remote patient care and timely intervention, especially for beneficiaries of chronic conditions. This not only upholds patient outcomes but also decreases the risk & burden on the health care system.

IoT is guiding us in a transformative era regarding health care, increasing patient care, optimising operational processes, and accommodating innovative approaches to treatment. The following issues are concerned.

PATIENT MONITORING VIA REMOTE

One of the important features of IoT is patient care. A number of devices equipped with sensors, such as smartwatches and fitness trackers, would continuously gather and transmit wide signs and health data to healthcare providers. It can be proactive and personalised care, particularly for individuals with chronic situations, no doubt, as doctors can remotely monitor their patient's health condition. As needed, the doctor will intervene.

PATIENT OUTCOMES IMPROVED

IoT devices grant improved patient outcomes by enabling healthcare professionals to have an elaborative and real-time view of patients' health metrics. This regular follow-up of data allows for early prevention of health issues, providing time-to-time observation and reducing the likelihood of complications. They benefit the patients with more personalised and effective plans for preparing their specific health needs and deeds.

MEDICAL DEVICES PROVIDING IOT

In the medical field, IoT has brought radical changes that are diagnostics and treatment. Connected devices, such as smart insulin pumps, face makers, and infusion pumps, allow for precise monitoring and control of various medical conditions. These devices provide the utmost care to patients with higher levels of autonomy and health care professionals with more accurate insights, and the devices can automatically adjust settings based on real-time data.

HEALTHCARE DECISIONS WITH DATA-DRIVEN

IoT devices create a wealth of data which contributes to data-driven decision-making in the health care system. Latest analytics and machine learning algorithms can be processed and interpret this data, giving valuable insights into population health trends, treatment efficacy and predictive modelling for disease outbreaks. The eminent healthcare professionals prepared informed decisions regarding improving public health outcomes and allocation of resources at the optimum level.

PRIVACY CHALLENGES AND SECURITY

Privacy and Security are very important due to the large number of devices connected to the internet, which requires utmost care about data theft and malware viruses trying to spoil the network and damage the devices. In this connection, it enhances the capability of the IoT. Moreover, it can prevent unauthorised access and potential data breaches. Software developers and manufacturing industries are continuously working on improving security protocols and encryption methods of safeguarding relating to the integrity of the IoT ecosystem.

INTERNET OF THINGS (IOT) FUTURE

The future of IoT has exciting possibilities, and it is a more dynamic field than other fields in the world. The latest developments have been taking place in the field of artificial intelligence and machine learning, which will certainly enhance the capabilities of IoT devices, providing them with the ability to interpret and analyse data more effectively. The advancement of 5 G technology has brought radical changes and will further accelerate the high speed with better communication reliability between devices, releasing a fresh possibility for instantaneous uses.

CONCLUSION

The Internet of Things (IoT) is definitely rebuilding the way we interact with the rapidly growing world from our doors to workplaces and across the globe. It has brought radical changes relating to information and communication technology and other fields, overcoming barriers in industries and improving the quality of life and standard of living worldwide. Continuously evolving with it is essential to meet the challenges relating to security and privacy by embracing the present opportunities. That's why these are interconnected for coming updates. The Internet of Things is not only a technological evolution but also a paradigm shift that is rebuilding the bright future of an interconnected world.

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INFRASTRUCTURE FACILITIES OF RURAL LIBRARIES IN ANDHRA PRADESH

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ABSTRACT

This paper examines the physical geographical conditions of the Rural Libraries and their facilities and their key role in the country's development. The Rural Libraries function like an educational institution and act as a preservation hub of the Nation's cultural, geographical and historical heritage, enlightening the rural people against blind faiths. Rural libraries build the national spirit and try to stop the religious crises spoiling the Nation. Rural libraries reduce their expenditure through the digital divide and solve that problem; hence, it highlights the issues relating to infrastructure and technology in libraries. Even though rural libraries face several obstacles, they still work as information resource centres in rural areas. This paper provides several ways to strengthen rural libraries. This positively influences Andhra Pradesh's lives and enhances their living standards. This is the effort of the Government as well as community involvement programs.

Keywords: Rural Libraries, Digital Libraries, Libraries in Andhra Pradesh, Library Movement in Andhra Pradesh.

INTRODUCTION

The cultural diversity and historical significance of the state of Andhra Pradesh have reached challenges in the development of its rural districts. The development of rural libraries has been taken through the information revolution in order to support education, information exchange and community empowerment. This paper explains the status of rural libraries in Andhra Pradesh in addition to their resources, challenges, and potential impact on people's lives.

DEFINITION OF THE RURAL LIBRARIES

Law Insider states, "Rural libraries means a public library in a Municipality or unincorporated village a tribe an Indian Nation, a pueblo or a community with a population less than fifteen thousand as determined by the latest Federal decennial Census".

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Oxford Advanced Learners' Dictionary defines it as "A building which collections of books, newspapers, etc. sometimes films recorded music are kept for people to read, study or borrow".

RURAL LIBRARY

The Rural Library is a public library established by the Government located in a rural area that enables service to the needs of the local people.

Akanwa (2013) even mentioned that rural libraries have all the characteristics of public libraries, but they are smaller, with fewer visitors than those in urban areas (Ruslan, 2020)

The mindset of an open society can be reshaped with the correct information; it is accompanied by a critical attitude as long as. An era of competitive information has started. Information is at the heart of human society in triggering the competitiveness of people and institutions. This kind of rural library is essential to achieving public welfare. The latest updates are spread through social media and other means of information gateways. Prompt and emergency information in society requires people to manage information wisely and well.

HISTORICAL BACKGROUND OF ANDHRA PRADESH RURAL LIBRARIES

Information is an important and essential resource for the development of people. Information becomes a fifth element after fulfilling the four elements: air, water, food, dressing and information. The need and necessity of information to enlighten the rural people can be noticed by great personalities such as Ayyanki Venkataramana, Gadicherla Hari Sarvottama Rao, and Paturi Nagabhushanam. They started a library movement in Andhra Pradesh.

A Unique struggle of Andhra Pradesh is the library movement. It is self-generating and swayambhvu. This is purely a people's movement; libraries were established with the active support of the British Government, as were the other parts of the country, apart from the A.P. Hence, the library movement was led by social reformists and selfless persons. The library workers strongly spread this movement to villages.

Ayyanki Venkataramanaiah rightly pointed out that the objective of the library movement in other countries has targeted to enhance the intelligence of the people, but in Andhra Pradesh, this movement also focused on improving people's personalities and directing them in the right way for the sake of country development. The Andhra Pradesh library movement became a springboard for all other movements in Andhra Pradesh, including social, political and literary ones. This A.P. library movement encouraged others like the Home Rule movement, Quit India, etc. This A.P. library movement strongly supported the Indian freedom movement.

The Renaissance movement of the Andhra region's political, social, and cultural struggle started at the end of the 19th century and the beginning of the 20^{th} century. Library movement is a part and parcel of that movement. Library movement also participated in Indian National Congress programs and other literal reform movements.

In the reconstruction of the Nation, the active participation of the library movement was a landmark in the Indian freedom fight. This kind of spirit gradually reached the village people through the rural libraries. The rural library became an information centre and pivot of the social and cultural life of the villages. In this connection, a greater number of libraries have been established in towns and villages. Meanwhile, the library movement became a people's movement and contributed a lot to eradicating illiteracy and disseminating world wisdom among people.

CAUSES FOR LIBRARY MOVEMENT

- In 1806, encouragement for the spread of publication activity printing in Telugu. Gradually, many books were printed in Telugu, which caused the establishment of public libraries, reading clubs, and school and college libraries to increase steadily.
- The dissemination of English education promoted the growth of literacy among the population. The number of educated employees increased steadily due to the industrial units and government offices.

Andhra Pradesh Rural libraries were the brainchild of Ayyanki Venkataramana, Gadicherla Hari Sarvottama Rao, and Pauri Nagabhushanam, who led the library movement in A.P. The role of information in socio-economic development is crucial because people need different types of information in their daily lives, and their information-seeking behaviour also differs from person to person.

Today, information has become an essential commodity like bread and butter; it is a fundamental right of people because of the right to information. It is people's primary right to access the right information at the right time without wasting time. In this connection, the Government is responsible for providing appropriate information at the proper time.

Today, the impact of the Information Revolution on rural people also needs technological advancements for the sake of their needs and deeds. Hence, to reshape the rural library with ICT and renovate the rural libraries instead of poor infrastructure facilities.

The Government of Andhra Pradesh has taken an initiative to establish rural digital libraries. This project is almost all completed and ready to inaugurate in this way, bringing education and information to the heart of rural communities. These rural libraries promote intellectual growth, preserving a wealth of Nation, culture and heritage and empowering rural communities irrespective of caste, colour, creed, race, sex, language, region and religion. In this connection, rural libraries delve into their dynamism and uniqueness in Andhra Pradesh. They are focusing on the light of their achievements, challenges, and the revolutionary influence on the lives of the native people through rural libraries.

IMPORTANCE OF THE RURAL LIBRARIES

Knowledge Resource Centers

Rural Libraries act as Knowledge resource centres in remote areas, enabling an oasis for learning where native people, irrespective of age, caste, colour, creed, religion, race, language, sex, or region, can give access to a diverse array of books, journals, periodicals, competitive examination books and other educational materials which pertain to needs of the rural people.

Treasury of Cultural Heritage

Rural libraries serve as custodians of Cultural Heritage. Andhra has a great heritage regarding tapestry skills and a small women's saree, which was kept in a matchbox and manufactured by a weaver from Pocham Pally during the British period. Rural libraries preserve ancient literature, folklore, the history of freedom fighters, social reformists, and fathers of the Renaissance movement, and records that connect the younger generations to their roots at the optimal level.

Public Meeting Place

Not only books but also Rural libraries providing access to public meetings, which is trying to fulfil the objective of community involvement for the sake of village development activities like seminars, exhibitions, blood & eye donation camps, Medical services through Anganvadies, and Agricultural activities for cultivators. Young people development programs. Rural libraries are instrumental in promoting a sense of brother/sisterhood and solidarity among the villagers.

Legal Aids

A rural library provides legal knowledge to readers by organizing legal aid programs with eminent personalities in the legal field. It is a kind of service for the sake of the rural population.

INFRASTRUCTURE FACILITIES

Real Spaces

The blueprint of rural libraries in Andhra Pradesh is frequently designed to blend with local needs. The rural library buildings are constructed according to government-approved standards within the community centres. This space in all rooms of the library is tailored to accommodate irrespective of readers' age.

Diversity of Resources

A diverse range of resources curated by rural libraries serve the specific needs and interests of rural people, in addition to literature in all regional languages, textbooks, and material on agriculture, a sector integral to many rural livelihoods.

Integration of Digital

Rural libraries are transforming through a blend of technology. The challenges have been met with the efforts made to introduce computers, internet connectivity and digital materials, fill the gaps via the digital divide and start new ways to access information. The Andhra Pradesh government recently established digital libraries at the village secretariat to improve digital literacy.

RURAL LIBRARIES – CHALLENGES

Paucity of Funds

Rural libraries are suffering a lot due to a paucity of funds because the Cess collected by the Panchayat is not paid to the libraries; meanwhile, the state government did not take any initiation about this problem. The rural libraries hinder their ability to expand infrastructure and update collections, and the rural libraries can implement technological advancements.

Technology Access

The digital revolution has not reached every corner of Andhra Pradesh till today. Insufficient access to solid internet services in remote areas obstructs the integration of technology into rural libraries.

Knowledge and Involvement

Educating the people about using rural libraries and motivating them regarding community participation remains an ongoing Challenge. Most people may not be updating their knowledge of the transformative potential use of these libraries. Lack of digital literacy is the barrier.

UPCOMING OPPORTUNITIES

Initiatives by the Government

The need and necessity of sustainable growth of rural libraries depend upon state government initiation for continuous support in digital growth. There should be an excellent need for sufficient funding, policy frameworks, and capacity building to strengthen these libraries against the present challenges.

Programs for Community Engagement

The development of rural libraries depends upon the involvement of local communities, NGOs, Philanthropists, Scholars, professionals and Educational institutions. These items can play a crucial role in driving awareness, promoting literacy and highlighting the impact of rural libraries.

Community group's empowerment depends upon many aspects, and community development requires a comprehensive process between motivators and facilitators, for example, in knowledge, skills and various other fields to improve society (Wrihatnolo & Dwidjowijoto,2007).

The State Library of Victoria (2005) library report explains the four ways to identify libraries that can contribute to community empowerment, such as enabling free access to computers and information resources, assisting, running lifelong learning programs, providing community literacy programs and able to maintain good relations with individuals, groups and Government.

Maani, KD (2011) further explains three things that need to be done in community empowerment through the ACTORS theory, which includes the following:

- Development needs to be directed at structural changes
- Development is directed at community empowerment as an effort to eradicate poverty, unemployment, and inequality by providing possible space and opportunity for the community to participate in development.
- Development must be oriented to cross-sectoral coordination, including programs between particular sectors and regions. The framework can be seen through the acronym of "ACTORS" namely

  A: Authority

  C: Confidence & Competence

  T: Trust

  O: Opportunities

  R: Responsibilities

  S: Support (endorsement)

By applying ACTORS' theoretical framework, community empowerment may grow well. This refers to empowerment from within and outside the community, where the government and non-government sectors play significant roles in human resource development.

CONCLUSION

The duty and beauty of rural libraries in Andhra Pradesh stand at the intersection of tradition and modernity, acting as a stimulus for change in the lives of rural people. This can be possible through strategic infrastructure development, community involvement, and continuous efforts these libraries can ride to be transformative agents and bring up the intellectual.

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TRANSFORMATIONS OF THE LIBRARIES INTO GREEN LIBRARIES: AN ANALYSIS FROM THE PERSPECTIVE OF INDIAN LIBRARIES

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ABSTRACT

Purpose: The necessity of environmental preservation and energy conservation through green practices is covered in this paper. The preservation of the environment, social and economic well-being, physical and mental health, and a sustainable future for humanity are all prioritized by green practices. The library is the only option available, as it is considered a social institution that disseminates information about environmentally friendly behaviours. For this to function, the library needs to turn green. The green library uses natural building materials and biodegradable products, recycles waste materials responsibly, conserves energy, water, and paper, and carefully selects sites to minimize negative environmental impact and maximize indoor environmental quality. It also emphasizes the library's moral obligation to promote environmental sustainability. Building green libraries is essential in a country like India, where the fast population growth has a detrimental effect on the environment and natural resources.

Value: This study demonstrates that a big budget is not necessary for the establishment of a green library. To make the library green, all that is needed is knowledge of green practices and efforts, along with the assistance of capable stakeholders. LIS specialists will thus benefit from this study's planning assistance for green libraries.

Keywords: Energy Conservation, Green Building, Green Codes, Green Library, Green Practice, Green Services, IGBC, Sustainable Library.

1. INTRODUCTION

Due to factors like climate change, poor global air quality, and general environmental degradation, it is becoming increasingly difficult for our lovely planet to maintain its natural beauty. These are, without a doubt, some of the most horrific problems the world is now dealing with. In addition to rising average temperatures, these terrifying problems include extreme weather, increasing sea levels, shifting wildlife populations and habitats, and other effects. The impact of humans on the environment is exacerbating all these changes. The

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quality of surface water pollution, greenhouse gas emissions, resource consumption, and climate change are typical consequences of human environmental activity. Humans can sometimes directly or indirectly cause these impacts. The utilization of technology to enhance and simplify human life is a contemporary phenomenon that warrants discussion in this context. It is a serious environmental hazard. Pollution, radiation risks, resource exploitation, etc., are the origins of the threat. All these problems seriously threaten the earth's ability to sustain its life. Global organizations are, therefore, making an attempt to become more environmentally friendly as they become aware of the harmful repercussions of their operations. The preservation of the environment, social and economic well-being, physical and mental health, and a sustainable future for humanity are all prioritized by green practices. The library is the only option available, as it is considered a social institution that disseminates information about environmentally friendly behaviours. To be done correctly, the library must first change into a green library. Green libraries are "designed to minimize the negative impact on the natural environment and maximize indoor environmental quality through careful site selection, use of natural construction materials and biodegradable products, conservation of resources (water, energy, paper), and responsible waste disposal (recycling, etc.)," according to the Online Dictionary for Library and Information Science (ODLIS). They also emphasize libraries' civic duty as pioneers in environmental sustainability. The creation of green libraries is crucial in a nation like India, where the population's rapid increase is negatively impacting the environment and natural resources.

2. OBJECTIVES OF THE STUDY

- To explore how libraries can be transformed into green libraries in India.
- To discuss standards for green libraries, highlighting the Indian Green Building Council (IGBC).
- To inform about green library initiatives in India.

3. REVIEW OF RELATED LITERATURE

Bhattacharyya1 (2017) discussed that green libraries, which stand for libraries, built with the intent to protect the environment and safeguard the community, can again prove their social responsibilities by creating awareness about green practices.

Rabidas2 (2016) dealt with what green library buildings are, how they are accredited, what the things required are, and what the future of green library buildings is in modern India.

Sarswat and Kamal3 (2015) discussed the applicability of passive and low-energy cooling technologies and ventilation techniques inspired by India's past to make green libraries in the context of composite climate.

Kurbanoglu and Boustany4 (2014) proposed how information literacy and its instruction can be transformed into green and contribute to the green library movement.

4. METHODOLOGY

This study focuses on the seven green features- sustainable architecture and design, energy efficiency, water conservation, indoor environmental quality, building materials and resources, and innovation and development- as defined by the Indian Green Building Council (IGBC). It describes how Indian libraries might transform into green libraries. Certain traits of green buildings have been taken into consideration in order to handle the library's transformation into a green library from an Indian perspective.

The focus of this study is on how libraries in India can become green libraries by implementing the seven green features identified by the Indian Green Building Council (IGBC):

(*i*) Eco-Friendly Architectural & Design,
(*ii*) Site Selection and Planning,
(*iii*) Water Conservation,
(*iv*) Efficiency in Energy Use,
(*v*) Resources and Building Materials,
(*vi*) The quality of the indoor environment and
(*vii*) Innovation and Development. For green libraries, specific characteristics of green buildings have been considered.

5. TRANSFORMATION OF LIBRARY INTO GREEN LIBRARY

5.1 Sustainable Architecture and Design

When preparing the library building, care should be given to protect the site features to minimize damage and the associated adverse effects on the environment. IGBC states that the following must be maintained: 50% of the site's contour, 100% of the water bodies and channels, 50% of natural rocks, 10% of the current topography and scenery, and 75% of the trees (with integration). Library buildings should also incorporate passive architectural design elements to reduce adverse environmental effects. These can be achieved by using climate-responsive concepts and design elements like skylights, shading from surrounding trees and buildings, punched windows, extended louvres, and passive cooling/heating technologies like wind towers, earth tunnels, and geothermal technologies.

5.2 Site Selection and Planning

People will use the library more frequently if certain basic amenities are located adjacent to it or at least one kilometre away. Some amenities include a grocery store, pharmacy, post office, courier service, restaurant, cafeteria, ATM/bank, clinic/hospital, and utility bill payment centre. Administrators of libraries should encourage their clients to take public transit in order to lessen the negative consequences of driving. A bus stop, an intra-city rail station, or other public transportation hubs should, therefore, be 800 meters away by foot from the library. Library users should be encouraged to utilize non-fossil fuel vehicles, such as electric or compressed natural gas (CNG)-powered automobiles, to reduce the negative consequences of fossil fuel-powered autos. Within five kilometres of the library, CNG filling stations and electric charging stations must be set up with the assistance of the relevant authorities. In order to minimize long-term detrimental effects on the ecosystem, an effort should be made to restore the land while the library building is being prepared. For this reason, it is important to protect already-existing mature trees and to plant new tree saplings in order to enhance habitat and biodiversity. The library building will receive plenty of shade from the existing trees on its west and south faces, which will help to lower the building's temperature. High solar reflectance index (SRI) materials, such as white or light-coloured China mosaic tiles, white cement tiles, or other highly reflective materials/ coatings, should be used to cover library roofs to limit the heat island effect and lessen its detrimental effects on the microclimate. Another way to lower heat is by using vegetation on the roof. Senior folks and people with disabilities should also have easy access to library buildings through design. To raise awareness among library patrons, a few fundamental rules of green building ought to be posted at the entrance, on a notice board, beside the circulation desk, and in the reading area.

5.3 Water Conservation

"Groundwater levels in various parts of the country are declining because of continuous withdrawal due to increased demand for freshwater for various uses, vagaries of rainfall, increased population, industrialization, and urbanization," according to the Jal Shakti Ministry, Government of India. Water usage must be used correctly from the beginning. In this regard, the library needs to lead by example as well. Libraries can save water in so many different ways. Water can be saved significantly by using toilets and sinks appropriately. For that, water-efficient plumbing fixtures (as applicable) whose flow rates meet the baseline criteria in aggregate can be used. Rainwater also has to be preserved from library roof catchment, gutters, down pipes in filter chambers, storage tanks/pits/sumps, and groundwater recharge structures like pits, trenches, tube wells, or a combination of the above structures for storage of rainwater on the surface for future use and recharge to groundwater. This way, we can collect a good amount of water, which can be used for washroom, cleaning, and gardening purposes in the library. Collected rainwater can be cleaned following a simple sedimentation process, which is a process of suspending the insoluble/heavy particles from the water. Once the insoluble material settles down at the bottom, we can separate the pure water. Simple chemical treatment involves the use of chlorine, which is commonly used to kill bacteria, which 5 decomposes water by adding contaminants to it. Another oxidizing agent used for purifying the water is ozone. This cleaned water can be used in basins along with toilets and gardening. Besides this, plantation in library surroundings area or landscape area should be done with drought tolerant or native or adaptive species like Palash or dhak (Buteamonosperma), Amaltash (Cassia fistula), Amla (Emblicaofficinalis) Neem (Azadirachtaindica), Jarul (Lagerstroemia flos-reginae), Siris (Albizialebbeck), Imli(Tamarindusindicus), Peepal (Ficusreligiosa), etc. so that they do not require supplemental irrigation or very less water is required.

5.4 Energy Efficiency

In the library, we have to try to use eco-friendly heating, ventilation, and air-conditioning (HVAC) equipment which are CFC (Chloro Fluoro Carbon) free, thereby minimizing the negative impact on the ozone layer. The fire extinguisher installed in the library should be free from Halons or any other ozone-depleting substances. The lights, air-conditioning systems, heating system, fans, pump and motors and other electrical gadgets used in the library should be of a standard which consumes less energy. The library should also install solar panels on the library rooftop to produce electricity. Libraries belonging to hill areas can install wind turbines to produce electricity. Both renewable sources are clean and cost-effective. Another source of renewable energy, i.e., biomass, can be installed in rural libraries to produce energy. It is also clean and carbon-free. All these renewable sources of energy help to minimize the environmental impacts associated with the use of fossil fuel energy. A library can feel less institutional and more personal by making good use of daylight, which can also save energy consumption. Uncontrolled daylighting, however, has the potential to cause glare and harm delicate materials. Windows or clerestories that face northward let in light but block out direct sunshine. Adequate overhangs and south-facing glazing can also work well. Adjustable window coverings should be available when natural sunlight is permitted in reading spaces. As a result, using as much daylight as possible to improve the library's visibility lowers expenses and energy consumption.

5.5 Building Materials and Resources

5.5.1 Sustainable Building Materials

The Indian central government founded the Building Materials and Technology Promotion Council (BMTPC) in 1990 to advance building materials and technologies that are reasonably priced, ecologically benign, and energy efficient. Among the natural elements that BMTPC deemed potentially acceptable building materials were agro-industrial wastes, by-products, residues, natural fibres, and plantation timbers, such as rice and wheat husk, bagasse from sugarcane, coir, hemp, etc., that are cultivated extensively in Indian farms. Because of their durability, accessibility, and affordability, a few of these state-of-the-art green building materials stand out in particular. These include bamboo as a building material, bagasse particle board, and concrete made of rice husk ash. When developing a new library structure in India, these eco-friendly building elements must be taken into account.

5.5.2 Green Library Furniture

For library furniture, a large range of environmentally friendly furnishing materials are available. The robustness, durability, and elegance of the ecological library furniture are guaranteed. The following well-liked environmentally friendly building materials can be utilized to create library furniture: Six Bamboo furniture is as strong as furniture made of any other wood. Bamboo is useful for building ladders, bookcases in the library, tables, seats, and sofa sets. There are many different sources of reclaimed wood, such as lumber that washes up from rivers, imperfect wood, and insect-infested trees that had to be chopped down. Reclaimed wood enhances the library's visual appeal while contributing to its feeling of a deep, mysterious past, thanks to the antique treatment. Now, lantana wood closely resembles cane and bamboo in quality, so it's a less expensive option. Lantana is a non-edible decorative weed plant that was introduced to India and has now become an invasive species, strangling native plants throughout forests. Its tough stem can withstand termites and, with varnish treatment, maintain its glossy, smooth appearance. Bookcases, trays for library cards, couches, and chairs could all be made with it.

5.5.3 Green Collections and Collection Development

Three approaches can be used to discuss green collections and collection development: choosing materials that promote environmentally friendly behaviours, de-selection procedures that emphasize the value and technique of material reuse and recycling and choosing information sources (print or electronic) that emit fewer greenhouse gases. Selection: Its main objective is to gather data from sources that address environmental issues, pollution prevention, water and energy conservation, etc. Books, journals, reference tools, and e-resources are some of the information sources. The proliferation of information literacy on the green movement is aided by all those information sources. De-selection: This method stresses reusing books, journals, and periodicals that have been weeded out in good physical condition. It can be distributed to poor neo-literates and semi-literates in rural or slum areas instead of just throwing away. The damaged paper-based materials should be recycled to enhance the green practice. However, recycling e-waste is really a problematic issue. Format of Information Sources: It indicates the two formats, i.e., print and electronic, of information sources found in the library. Which one is a more suitable format for the green library is to be looked into. Print and electronic media both have positive and negative impacts on the environment. Both can be sustainable, but both will need to become far more eco-efficient over the next years.

5.5.4 Green Services

Quality service makes a library effective to its users and attracts the user community to be involved with the library. The green library movement is influencing libraries to offer services in an eco-friendly mode. They are:

- The library should provide clean printed information sources that are not hazardous to the health of its users.

- At the time of providing information for stereotyped reference queries, the librarian should not unnecessarily use the internet; rather, s/he would use his/her own memory to provide prompt service.
- In addition to the green environment in the library, the services are tried to offer less energy. Users are motivated to use computers and the internet judiciously. Unnecessary printouts and photocopies should be avoided. They should be done using both sides of the paper. The font size of the printout matter should not exceed 12. In this regard, it is to be mentioned here that a growing number of companies like Apple, Facebook, and Google have begun to produce green internet and browsers based on renewable energy. Green Library has to incorporate all those green internet and browsers to enhance the green practice.
- To help staff and users have a clear understanding of green practices and to encourage them to adopt green practices in order to assist others in greening their own lives, facilities, and operations, libraries should organize orientation programs, seminars, conferences, library talks, and workshops on green practices in addition to disseminating information about these practices through a variety of information sources.

5.5.5 Waste Management

In the library, three types of solid waste or garbage are generated. They are organic waste, toxic waste, and recyclable waste. Organic waste includes residual parts of foods, vegetables, flowers, leaves, and fruits. Toxic waste covers old medicines, paints, chemicals, bulbs, spray cans, pesticide containers, batteries, and e-waste, including computers, UPS, printers, scanners, photocopiers, etc. Recyclable waste includes paper, glass, metals, and plastics. These three types of waste should be kept in separate baskets in the library. For that, instructions should be given very clearly at the place where the baskets would be placed. The instructions should also be written on the baskets so that library staff and users can easily understand the type of waste and its disposal in the right basket. The baskets of organic and toxic waste, excluding e-waste, should be handed over to the garbage-carrying car of the municipality/corporation. The e-waste has to be managed following the rules of E-Waste (Management) Amendment Rules, 2018, in India. The recyclable waste has to be handed over to the proper agencies that deal with all kinds and grades of recyclable waste and facilitate recycling and reuse. Landfill facilities, at least for organic waste, can be arranged in library premises in rural areas, which can be recycled by the method of composting, one of the oldest forms of disposal. It is the natural process of decomposition of organic waste that yields manure or compost, which is very rich in nutrients.

5.6 Indoor Environmental Quality

The quality of the air we breathe indoors is crucial to our health. Unfortunately, materials that may be harmful to our health can be found in modern libraries. These can be anything from harmless dust to dangerous substances. Indoor air in libraries is essentially tainted by chemical and biological pollutants. Dust mites, pollen, animal dander, bacteria, and melds are the biological pollutants. In the printed materials of the library, Molds emit both fumes and spores. Employees and patrons at libraries may inhale mould spores, which can lead to infections, irritation of the skin and eyes, and respiratory issues. Particulates and gases are among the chemical pollutants. One of the main chemical contaminants in the library is formaldehyde, which can be harmful to health and may be a carcinogen. It enters the building through an adhesive called urea-formaldehyde, which is found in pressed wood products, including particleboard, cabinetry, and trim. Volatile Organic Compounds (VOCs) are also harmful to health and can be found in libraries, particularly in particleboard, wood panelling, carpets, paints, glues, varnishes, and solvents. An imbalance in the proper balance of gases and the production of carbon dioxide within the library is caused by the HVAC system's existence and improper/regular maintenance. Lack of maintenance on the HVAC system also negatively affects humidity regulation, creating an ideal environment for the growth of bacteria, mould, and mildew. The routine pest control with strong chemicals like toxic organo-phosphate and carbamate insecticides in the library also contaminates the indoor air quality of the library.

The environment of the library can be healthy by following some simple and careful steps. First of all, regular cleaning of the library floor, furniture, and resources should be done to make it dust and moisture-free, along with the provision of adequate sunlight. The green movement has prompted the development of long-lasting, reasonably priced, and less hazardous paints and finishes with low or zero volatile organic compounds (VOCs) for the environment and human health. The library should employ these common- and zero-VOC paints and finishes. Our native cooling and ventilation method, which was widely used in the palaces of Rajasthan, Gujarat, and the Mughals, can replace the HVAC systems in the library. The orientation of the structure, thermal mass, water feature, open courtyard, several types of shading devices, flora, lattice screens, domes, charkhas, wind towers, air vents, and other magnificent design elements were all employed in those palaces to provide thermal comfort.

5.7 Innovation and Development

The library needs to incorporate more cutting-edge features that aren't adequately outlined in green building standards, such as energy efficiency, waste management, novel structural design, and library services. This will improve the library's sustainability initiatives. Green Building Council-accredited professionals must be involved to make the library green. Additionally, a "green budget" should be created for the library. The green budget is one area where promoting constructive behaviour and discouraging environmental harm affects how humans interact with the environment.

6. GREEN CODES

To promote the design, development, construction, and maintenance of green buildings, the US Green Building Council established the LEED rating system in 1993.

To further the nation's green building movement, the Indian Green Building Code collaborates closely with several Central and State Government agencies. It is an amalgam of the Energy Conservation Building Code (ECBC), the National Building Code, State bylaws, the Indian Green Building Council (IGBC) standards and guidelines for the residential sector, TERI-GRIHA, and other comparable certifications, the protocols developed by rating programs such as Leadership in Energy and Environmental Design India (LEED-India), and other sources. A few Central and State Government entities have acknowledged the IGBCs' Green Rating Systems.

7. GREEN LIBRARY INITIATIVES IN INDIA

Anna Centenary Library (ACL), Chennai: It is a state-of-the-art library that was opened to the public on 20 September 2010. The positive aspect of ACL indicates that in terms of occupant comfort, the library performs well in its design. The library has achieved a gold rating from LEED.

Karnataka University Library, Dharwad: Karnataka University has incorporated the Gurukul system to provide library services. The university has arranged the reading space in a natural green environment with sitting, drinking, and WiFi facilities.

NIT Library, Silchar: The Library of NIT, Silchar, is the first green initiative in northeast India. It was built following the LEED, USA, green certification system. It is really a role model for green library initiatives in India.

PermaKarpo Library, Ladahk: It is truly an amazing piece of work and the ideal illustration of how science, smart design, and local expertise came together to produce a library building that is both beautiful and sustainable. On-site, technological and design choices include timber panelling, wool insulation, vented Trombe walls, mud roofs, and even solar panels mounted on the roof. To guarantee that the knowledge is retained, the materials are sourced locally, and the design solutions and experience are developed in collaboration with the individuals present.

8. FINDINGS

It has been mentioned that creating green libraries requires meticulous design in accordance with green building standards. Buildings used by libraries must be equipped with features for waste management, energy and water saving, and good indoor air quality. In contrast, there are three ways that collections and collection development in green libraries have been discussed: selecting print or electronic information sources that use less energy and produce less carbon dioxide; de-selection procedures that emphasize the necessity and means of material reuse and recycling; and selecting materials that support the spread of awareness about green practices. Conversely, research indicates that green services consume less paper and energy. Furthermore, studies have shown that the transformation of Indian libraries into "green" libraries will be financially advantageous due to the application of specific local techniques for ensuring the sustainability of libraries. The use of easily obtained agricultural products for construction and furnishings, natural pesticides, recycling techniques, and other notable ventilation and cooling techniques used in Indian palaces are all worthy of attention. The IGBC and Indian green library projects have also been discussed, along with a few other green codes.

9. CONCLUSION

In India, regarding her present condition in terms of the environment and conservation of natural resources, green practices have become very crucial for sustainability. The library, which is considered a social institution, has to take the leading role in spreading awareness about green practices. For that, libraries have to be transformed into green libraries. This transformation should be enhanced with the help of central and state governments, NGOs, library associations, and, obviously, Library and Information Science professionals.

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OPENING MINDS, OPENING DOORS: MEASURING OPEN ACCESS FRIENDLINESS OF THE TOP FIVE PHARMACY INSTITUTES (NIRF - 2023)

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ABSTRACT

This study aims to devise the Open Access Friendliness Indicator (OAFI), a ranking framework to evaluate how Indian institutes embrace Open Access (OA). To gather and extract OA data, we employ open-access Data Carpentry tools and software, giving particular attention to determining OdbL license values. The ranking framework encompasses four primary areas: OA publications share, OA license share, OA citations share, and OA altmetric share.

By conducting a SWOC analysis of India's open access landscape, we assign weightage to ten factors within these areas, resulting in a 100-point scale that quantifies an institute's OA friendliness. We validate the framework by applying it to the publications, citations, and altmetric data of the top five Indian Pharmacy Institutes featured in the National Institutional Ranking Framework (NIRF) 2023 Pharmacy category.

Keywords: Data carpentry, Open access, Open access friendliness, OAFI ranking framework, Pharmacy Institutes. NIRF ranking

1. INTRODUCTION

The rise of Open Access (OA) has significantly influenced scholarly communication globally, including in India. Despite the increasing acceptance of OA in India since the late 2000s, there is no ranking framework to assess OA support in Indian institutes. Previous studies evaluated OA friendliness on regional or global scales, considering factors like OA publication share, repository presence, OA journal adoption, and Creative Commons licenses. Our research builds on these efforts, proposing a weightage-based ranking framework for five Pharmacy Institutes in the NIRF 2023 category, considering OA publication, license, citation, and altmetric scores. Robinson-Garcia's study, encompassing 963 universities worldwide, inspired our approach,

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incorporating Gold, Green, Bronze, and Hybrid OA models (Robinson-Garcia et al., 2020). Our framework delves into specific aspects within each primary area for nuanced weightage distribution. The study samples five Pharmacy Institutes from the latest NIRF ranking (2023)

Table 1: Pharmacy Institutes in NIRF (2018-2022) – arranged by Ranks in NIRF, 2023

S.No.	Name	NIRF 2023 Ranking
1	National Institute of Pharmaceutical Education and Research, Hyderabad (1998)	1
2	Jamia Hamdard, Delhi (1989)	2
3	Birla Institute of Technology & Science, Palani (1964)	3
4	JSS College of Pharmacy. Ooty(1980)	4
5	Institute of Chemical Technology, Mumbai (1933)	5

2. DATA CARPENTRY: TOOLS AND TECHNIQUES

Early open-access researchers faced data challenges (Bar-Ilan, 2008; Hajjem et al., 2005; Harnad, 2008). Recent tech advancements, like API manipulation and sources (Unpaywall, Dimension), improved data availability. This study uses Openrefine, following methods by experts (Robinson-Garcia et al., 2020) for API calls, JSON extraction, and advanced techniques ((Mukhopadhyay et al., 2021); (Mukhopadhyay & Mukhopadhyay, 2021)).

3. OBJECTIVES AND RESEARCH QUESTIONS

This research aims to create a ranking system that can assess how supportive an institute is of Open Access (OA). Unlike previous approaches that primarily focused on measuring the share of OA publications, this framework aims to consider a wide range of data to provide a more comprehensive evaluation. The research questions that guide this study are interconnected and designed to ensure the research progresses in the right direction.

RQ 1: Can we create a ranking system (OAFI) for Indian institutes based on their Open Access (OA) support? We'll consider factors like OA publications, licenses, citations, and altmetric scores. How do we assign importance, gather data, and set up a scale for each factor?

4. METHODOLOGY

The present research study aims to build an indicator to measure the Open Access (OA) friendliness of an institution of Indian origin. The sample includes all Indian Institutes of Technology (Pharmacy Institutes) that are included in the top 100 institutions of the Pharmacy category of NIRF 2023 (the dataset was released on 05th June 2023, and so far, the latest available ranked list of Indian institutions by NIRF). The 'Pharmacy' category is a sort of single-rank list of all the participating institutions in Pharmacy categories. As a result, the 'Pharmacy' category represents the top brass of the Indian institutions. The 'Pharmacy' category of NIRF 2023 includes a total of 115 institutions.

4.1 Selection of Institutions

There is a total of 100 Indian Pharmacy Institutes. Still, we selected only 5, included in the elite group of NIRF 2023 (top 100 of the 'Pharmacy' category), with the rank ranges from 1 to 5. These 5 Pharmacy Institutes (listed according to their ranks in the top 100 of NIRF, 2023 in the 'Pharmacy' category) are -

National Institute of Pharmaceutical Education and Research Hyderabad (1); Jamia Hamdard (2); IBirla Institute of Technology & Science -Pilani (3); JSS College of Pharmacy (4); Institute of Chemical Technology (5).

4.2 Development of Primary Dataset

The primary dataset of publications by these 5 Pharmacy Institutes has been created by searching in the Scopus database with a suitable query that includes the affiliation ID [AF-ID (eight-digit ID number)] of the institution, all document types and time range from 2018 to 2022 (5 years). Scopus allows downloading only 2000 retrieved records in 'csv' format; therefore, we needed to export each Pharmacy institute on an email option and finally merge them into a single 'CSV' file. The final primary dataset includes 5 'CSV' files for 5 Pharmacy Institutes listed in the top 100 of the 'Pharmacy' categories of NIRF, 2023. A summary table (table 2) gives a panoramic view of the primary dataset.

Table 2: Primary Dataset (Arranged by the Total Number of Publications According to NIRF 2023 Ranked Order)

S.No.	Name of Pharmacy Institutes	Total Publications (2018-2022)	Publications with DOI	Rank in NIRF 2023
1.	National Institute of Pharmaceutical Education and Research Hyderabad(1998)	1372	1330	1
2.	Jamia Hamdard(1989)	3265	3135	2
3.	Birla Institute of Technology & Science -Pilani	9475	9052	3
4.	JSS College of Pharmacy	731	671	4
5.	Institute of Chemical Technology	2737	2682	5
	Grand Total of Publications	17580	16870	

The publications with DOI in the primary dataset have a significant role to play in developing the secondary dataset as the entire data wrangling process stands on DOI-based data fetching to collect OA related data, citations data and altmetrics data from data sources available through Open Data Commons Open Database License (OdbL).

4.3 Development of Secondary Dataset

As prepared by merging publication datasets of all 5 Pharmacy Institutes, the primary dataset is now ready for enrichment with data elements related to OA status, citations and altmetrics data; surprisingly, almost 1.5 thousand papers (4.01%) do not have DOI published by Pharmacy Institutes. The data sources available against ODbL for achieving the stated purposes are as follows:

Open Access Data: Unpaywall (*Unpaywall: An Open Database of 20 Million Free Scholarly Articles*, n.d.) is presently the largest bibliographic storehouse for open contents (2,97,12,856+ records as of 31st July 2021 and counting). It harvests open contents from 50,000+ publishers and allows free access to the dataset on the top of REST/API call (version 2 with DOI endpoint - GET /v2/:doi) against a generous call limit of 1,00,000 calls per day. The API call structure with the valid responses received is arranged in Table 3.

Table 3: Unpaywall – API Calls and Result

API call structure for Unpaywall	No. of queries sent	Responses received
"https://api.unpaywall.org/v2/" + value + "email=mdmiansari1@gmail.com" value is DOI	16,870 publications with DOI	15,747 93.34% of publications with DOI

Citations Data: The open data revolution facilitates obtaining citation data under ODbL, with three prominent products: i) Open Citation Corpus (opencitations.net); ii) Dimensions (app.dimensions.ai); iii) sCite (scite.ai). OpenCitations, a non-profit by JISC, UK, provides open bibliographic and citation data using LOD. Gathering citation counts through DOI-based API calls is straightforward. Citations play a crucial role in scientific publishing, representing the knowledge-building mechanism. They quantify a publication's impact, though not all citations are equal. The textual context surrounding a citation, found in the citing paper's section, provides insight into why the citation was made. The API call structures for both services are given in Table 4.

Table 4: Citation Data Sources

Service name	API call structure	No. of queries sent	Responses received
OpenCitations	"https://opencitations.net/index/api/v1/citation-count/" + value Value is DOI	16,870 publications with DOI	16,845 99.85% publications
Dimensions	"https://metrics-api.dimensions.ai/doi/" + value value is DOI	16,870 Publications with DOI	16,691 98.94% publications
sCite	"https://api.scite.ai/tallies/" + value value is DOI	16,870 Publications with DOI	16,731 99.21% publications

Altmetric Data: The only altmetrics data source that provides free API call to gather altmetric data

is altmetric.com (api.altmetric.com). A researcher can typically make 1200 API calls per day without a license key or 86400 daily calls against a license key (which can be obtained free of cost against the application). It delivers a rich dataset in JSON format that includes many socio-academic web spaces like Twitter, Facebook, blogs, Wikipedia, Mendeley, CiteULike, Connotea and Altmetric attention score. The API call structure and the coverage are included in Table 5.

Table 5: Altmetric data – API calls and result

Table 5: Citation Data Sources

API call structure for Almetric	No. of queries sent	Responses received
"https://api.altmetric.com/v1/doi/" + value value is DOI	16,870 publications with DOI	4601 27.27% publications

4.4 Data Extraction

The dataset's value is unlocked through extraction. After gathering data in JSON format from specified sources (Section 4.3), the open-source data wrangling tool, Openrefine, utilizes GREL (General Refine Expression Language) for thorough parsing of JSON data. GREL employs syntaxes to selectively retrieve information from the JSON-formatted dataset, aligning with the researcher's requirements and dataset structure. Offering support for various functions such as string parsing & splitting, mathematical operations, format-based functions (JSON, XML, HTML), array operations, date functions, Boolean operations, string functions, and more, GREL is a versatile tool. Table 6 provides a set of simple examples.

Table 6: GREL – an Example of Extracting Data from the Unpaywall Dataset

Response from Unpaywall in JSON	GREL for data extraction	Extracted data

{
"best_oa_location": {
"host_type": "publisher",
"is_best": true,
"license": "cc-by",
},
"doi": "10.4018/978-1-6684-4755-0.ch013",
"has_repository_copy": true,
"is_oa": true,
"is_paratext": false,
"journal_is_in_doaj": true,
"journal_is_oa": true,
	value.parseJson().best_oa_location.host_type	publisher

	value.parseJson().best_oa_location.license	cc-by
	value.parseJson(). has_repository_copy	true
	value.parseJson().is_oa	true
	value.parseJson(). journal_is_in_doaj	true
	value.parseJson().journal_is_oa	true
	value.parseJson().oa_status	true

Response from Unpaywall in JSON	GREL for data extraction	Extracted data
……………………… ……………………… "oa_status": "gold", "published_date": "2011-09-05", "publisher": "Springer Science and Business Media LLC", ………………………..		

In the same way, GREL syntaxes for data extraction are applied in Openrefine to pull out required data values from JSON responses received from Dimensions.ai and Altmetric.com. For example, value.parseJson().times cited extracts the number of citations for a publication from Dimensions.ai and value.parseJson().score retrieves altmetric attention score from Altmetric. com.

5. DISCUSSION AND FINDINGS

This section of the research study starts with the larger picture of the OA contributions by all 5 Pharmacy Institutes ranked in the top 5 of NIRF, 2023 (Pharmacy category) under the generic scenarios section, followed by the institute-specific scenarios.

5.1 Generic Scenarios

Analysis of the merged dataset, comprising 15,747 Unpaywall responses for 16,870 publications with DOIs, indicates that 71.50% (11,248) are 'closed access,' while only 28.54% (4,493) are Open Access (OA) publications. The 4,493 OA publications are distributed across four routes: green OA (21.23%), gold OA (58.96%), bronze OA (13.75%), and hybrid OA (6.06%). The trend among 5 Pharmacy Institutes from 2018 to 2022 shows a consistent increase in gold and green OA publications, contrasting with slower growth in bronze and hybrid routes, as illustrated in Figure 1 and detailed in Table 7. The tabulated data also show a steady but gradual rise in the percentage of OA in total publications over the five years, ranging from 25.35% in 2018 to 30.16% in 2022 for these top 5 Pharmacy Institutes.

Table 7: Growth of OA in Pharmacy Institutes (for publications with open/close status from Unpaywall)

Year	Total publi-cations by 5 Pharmacy Institutes	Close Access Publications	Open Access Publicat-ions	Open Access Categories				% OA in Total publica-ti-ons
				Green	Gold	Bronze	Hybrid	
2018	2272	1696	576	104	340	110	22	25.35
2019	2705	1967	738	152	437	100	49	27.28
2020	3255	2319	936	204	505	158	69	28.76

Year	Total publi-cations by 5 Pharmacy Institutes	Close Access Publications	Open Access Publicat-ions	Open Access Categories				% OA in Total publica-ti-ons
				Green	Gold	Bronze	Hybrid	
2021	3709	2612	1097	243	630	154	70	29.57
2022	3800	2654	1146	251	737	96	62	30.16
	15741	11248	4493	954	2649	618	272	141.12

Among contributors at these 5 Pharmacy Institutes, there is a growing awareness of open access licensing systems. The number of OA resources with formal licenses has increased from 132 in 2010 to 278 in 2022, with half of the OA resources now having some kind of license (63.32% of 4,493 publications). Notably, contributors favour licensing agreements such as CC-BY (37.86%), CC-BY-NC-ND (15.05%), and CC-BY-NC (5.07%), as indicated by the positive trend from 2010 to 2022.

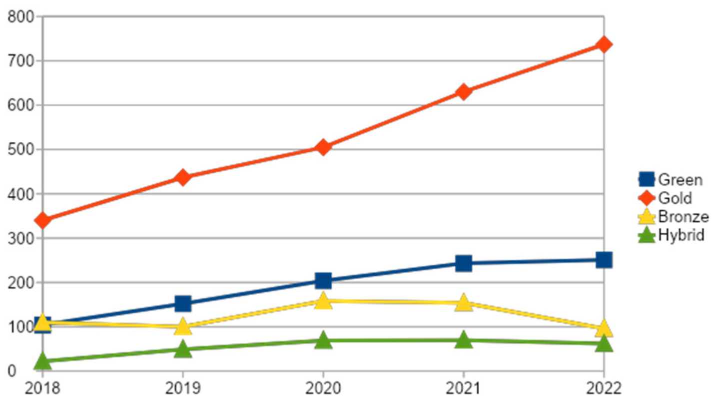

Fig. 1: SEQ Figure * ARABIC 1: Growth of four OA types in Top 5 Institutes over the years (2018-2022)

"The gold OA route leads among the top 5 Pharmacy Institutes with 2,649 contributions, including articles (99.56%), book chapters (7), proceedings-articles (3), journal-issues (1), and others (1). Green OA presents 954 journal papers, with 93.19% lacking formal OA licenses. Among the 7.14% licensed, CC-BY is most common. Birla Institute of Technology and Science, Pilani, contributes the most (670 papers, 82.31%). Altmetric scores are available for 51.57% of green OA publications, with the highest (AAA score of 1032.94) from the Birla Institute of Technology and Science Pilani. The top citation (995) is from a bronze OA publication. In green OA, 35.94% of 2,649 publications are in 759 repositories globally. Leading five repositories include Cornell University - arXiv (428), PubMed Central - Europe PMC (54), University of Illinois at Chicago - INDIGO (39), Le Centre pour la Communication Scientifique Directe - HAL - Diderot (12), and La Trobe University - OPAL (Open@LaTrobe) (11). Only 9.74% of green OA publications have licenses, with CC-BY being the most popular (13 out of 19).

The 2649 gold OA publications are distributed across 2649 Open Access journals from 239 publishers. Top 5 favourite OA journals for all 5 Pharmacy Institutes include RSC Advances (94 publications), Scientific Reports (88 publications), ACS Omega (88 publications), IOP Conference Series: Materials Science and Engineering (66 publications), and Journal of Physics: Conference Series (57 publications). Leading publishing agencies are Elsevier BV (482 publications), MDPI AG (392 publications), Springer Science and Business Media LLC (203 publications), Frontiers Media SA (153 publications), and IOP Publishing (145 publications). In gold OA, 2365 contributions (78.98%) have formal OA licenses, distributed in 9 categories, with CC-BY (1461 contributions) being the most common. Birla Institute of Technology and Science Pilani leads in gold OA contributions (1230 publications). Among these, 1924 publications (72.83%) are listed in DOAJ. A total of 961 gold OA publications from 5 Pharmacy Institutes have received altmetric scores (36.27% of 2649 publications in the gold OA category). The highest altmetric score (AAA score 479.809) is obtained by a gold OA publication from Jamia Hamdard, with the highest number of citations (92) received by a paper from Jamia Hamdard published in AIP Advances.

The bronze OA category (618 publications) constitutes 13.75% of total OA contributions, distributed across 800 sources from 239 agencies. The top five publishing agencies are Springer Science and Business Media LLC (162 publications), Elsevier BV (147 publications), Wiley (40 publications), Oxford University Press (OUP) (21 publications), and the Institution of Engineering and Technology (IET) (17 publications). Leading destinations for bronze OA include the Journal of Chemical Sciences, SN Applied Sciences, AIP Conference Proceedings, Journal of Clinical Orthopaedics and Trauma, and Artificial Cells. Only 47 out of 618 contributions in bronze OA have open licenses. The highest number of citations (995) in the bronze OA category is received by a paper from Birla Institute of Technology and Science Pilani in the close access journal Nature Sustainability. A total of 228 bronze OA publications from 5 Pharmacy Institutes have received altmetric scores (36.89% of 618 publications in the bronze OA category). The highest altmetric score (AAA score 1932.652) was obtained by a journal article from the Birla Institute of Technology and Science Pilani in Nature Sustainability in 2019.

Hybrid OA resources (272 publications) constitute 06.06% of total OA contributions, available through 168 sources from 62 agencies. The top five hybrid OA publishers are Elsevier BV (59 contributions), Springer Science and Business Media LLC (27 contributions), EManuscript Technologies (20 contributions), Springer International Publishing (19 contributions), and Royal Society of Chemistry (RSC) (15 contributions). The majority (99.26%) of hybrid OA publications have licenses attached, with many available through CC-BY (63.70%) and CC-BY-NC-ND (34.44%). A total of 100 hybrid OA publications from 5 Pharmacy Institutes have received altmetric scores (37.03% of 272 publications in the hybrid OA category). The highest altmetric score (AAA score 876.96) was obtained by a journal article from Birla Institute of Technology and Science Pilani in Nature Methods in 2020, with the highest number of citations (9237) in the hybrid OA category also received by the same paper from Birla Institute of Technology and Science Pilani in 2020.

Of 16,691 publications with DOIs, 87.42% have received at least 1 citation. Publications from the 'close access' group (11,209) have a citation rate of 67.16%, while the 'open access' group (4,491) has a citation rate of 26.90%. Within the 'open access' group, 21.24% are green OA, 58.94% gold OA, 13.76% bronze OA, and 06.06% hybrid OA. The distribution shifts at higher citation cut-off values, indicating a different pattern for highly cited publications. For example, when the cut-off is set at >=100 citations, the ratio becomes 67.36% (close): 27.07% (open). The citation cut-off analysis reveals that no 'close access' publications belong to the >=1000 citations category, and the close-to-open ratio for publications with extremely high citations is 00.00% (close): 100.00% (open), in contrast to the generic citation analysis ratio of 33.33% (close): 66.67% (open) (Table 8).

Table 8: Citations 'Score Range' Blocks and Access Types of Publications

Citation Score range	Close Access publications	Open access publications	Open Access Categories			
			Green	Gold	Bronze	Hybrid
1 to 99	9033	3740	850	2180	509	201
100 to 249	55	33	7	13	8	5
250 to 499	4	5	NILL	4	NILL	1
500 to 749	1	5	1	3	NILL	1
750 to 999	NILL	2	NILL	1	1	NILL
1000 to	2	4	1	NILL	1	1
Total	9095	3789	859	2201	519	209

The citation corpus of Dimensions.ai provides additional measures, including 'recent citations' (citations received in the previous two calendar years) and the Field Citation Ratio (FCR), indicating that OA publications perform progressively better than 'close access' publications with increasing cut-off values. For instance, at the cut-off value >=100 for recent citations, 550 publications qualify, with 310' close access' and 240' open access.' A cut-off mark >=500 retrieves 54 publications, consisting of 8 'close access' and 46' open access' resources. Similarly, an FCR cut-off value >=25 includes 1043 'close access' and 678' open access' publications, while higher values like >=50 lists 211 'close access' and 244' open access' publications, and a cut-off value >=100 shows 34 'close access' and 122' open access' publications.

In the socio-academic webspace, altmetric data reveal that 4601 contributions (27.27% of total publications with DOI) have received altmetric scores ranging from 0.25 to 2000. A total of 4300 publications (93.46%) have recorded access status, with 2,519 contributions in the 'close access' group (58.58%) and 1781 contributions available through OA channels (41.42%). Altmetric attention is distributed among green (492 contributions), gold (961 contributions), hybrid (100 contributions), and bronze (228 contributions) OA routes. The majority of resources with altmetric scores fall within the range of 0.25 to 49.999 (98.69%).

An analysis of contributions with high altmetric scores (>=100) shows that 24 publications out of 4300 (0.05%) have altmetric scores >=100, with the majority available through OA routes (20 in open access vs 4 in close access). Setting a higher scale (altmetric score >=500) identifies only five contributions, all available through OA routes (hybrid – 1; green – 3; and bronze – 1). A detailed breakdown of altmetric score ranges, and OA types are provided in Table 9.

Table 9: Altmetric 'Score Range' Blocks and Access Types of Publications

Altmetric score range	Close Access publications	Open Access publications	Open Access categories			
			Green	Gold	Bronze	Hybrid
0.25 to 49.999	2509	1735	Nill	941	219	95
50 to 74.99	13	6	3	5	3	2
75 to 99.99	8	Nill	2	5	1	Nill
100 to 499	4	20	4	10	4	2
500 to 999	Nill	3	2	Nill	Nill	1
1000 to 2000	Nill	2	1	Nill	1	Nill
Total	2534	1766	12	961	228	100

This section aims to understand the nature and characteristics of open access in India's top educational institutions, focusing on Pharmacy Institutes. The goal is to identify strengths, weaknesses, opportunities, and challenges (SWOC) for establishing an Open Access Friendliness Indicator. A decision table (Table 10) summarizes these observations, providing the basis for a distributed weightage-based formula for the Open Access Friendliness Indicator (OAFI), as discussed in Section 5.2.

Table 10: Decision Table for Identifying Factors Based on SWOC

<table>
<tr><th>Area</th><th>Observations</th><th>Important</th><th>Important factors</th><th>Area weightage</th></tr>
<tr><td rowspan="4">OA publications</td><td>Strength</td><td>Steady and continuous growth of OA over the years, in all PHARMACY INSTITUTES</td><td rowspan="4">1. Overall OA share in total publications;
2. Gold & Green OA share as preferable routes; and
3. Green OA access through open access repositories (as best OA locations)</td><td rowspan="4">50</td></tr>
<tr><td>Weakness</td><td>The highest growth recorded as 20.04%, not even 25% of the total publications</td></tr>
<tr><td>Opportunities</td><td>Availability of OA infrastructure for repository setup in all PHARMACY INSTITUTES</td></tr>
<tr><td>Challenges</td><td>To achieve an OA share at least 50% by 2030</td></tr>
</table>

Area	Observations	Important	Important factors	Area weightage
OA licensing	Strength	Increasing awareness of OA licenses (almost 43% of OA contributions are now available through OA licenses)	1. Share all OA publications with licenses and 2. Availability of gold & green OA publications with licenses	25
	Weakness	Still, more than 50% of resources are made available without OA licenses		
	Opportunities	Almost 63% of licensed OA contributions are made available though liberal OA		
	Challenges	Ideally, all OA resources need to be made available through OA licenses and the target needs to be set as 100% licensed OA by the year 2030		
OA citations	Strength	A significant number of OA resources belong to the group of highly cited publications	1. Overall cita-tions share by OA publications; 2.Citations share by OA resources in moderately cited publication group; 3.Citations share by OA resources in highly cited publication group	15
	Weakness	Overall citation ratio still shows 82% (close) : 18% (open)		
	Opportunities	Increasing number of OA resources are entering to highly cited publications group		
	Challenges	To increase overall citation ratio from 80/20 to 50/50 ratio by the year 2030		
OA socio-academic	Strength	Highly discussed publications in socio-academic webspace are almost all OA	1. Share of OA publications in total altmetric score of a given institution consid-ering all publica-tions; and 2. Share of OA publications in altmetric score of a given institution considering publications more than average altmetric score	10
	Weakness	Around 16.50% of resources have re-ceived altmetric attention, and overall altmetric score ratio still shows 60% (close): 40% (open)		
	Opportunities	Number of OA resources in the group of highly discussed publications in socio-academic webspace are increasing steadily		
	Challenges	To increase overall altmetric score ratio from 60/40 to 25/75 ratio by the year 2030		

The area weightage values in Table 10 outline a priority order for academic institutes in developing countries where the concept of open access is relatively new. The order is determined by the importance of areas for ensuring the success of open access in terms of availability, visibility, and impact, as follows: 1) Ensuring OA availability (to achieve a close-open ratio of at least 50:50 by 2030); 2) Supporting gold and green paths of OA over bronze and hybrid paths; 3) Pledging for proper OA licensing; 4) Making contributors aware of citation advantages for OA resources and encouraging quality publications through OA channels; and 5) Building awareness about new channels for the visibility of scholarly resources in the socio-academic web space.

5.2 Indicator for Open Access Friendliness (OAF)

To measure Open Access Friendliness (OAF), four key areas are considered: i) OA share in publications, ii) compliance of OA publications with licensing, iii) share of citations received by OA publications, and iv) attention received by OA publications in the academic web space. These areas are subdivided, ensuring appropriate weightage distribution, guided by the reasons outlined in Table 10 in Section 5.1. The proposed groupings and weightage distribution on a 100-point scale are detailed in Table 11.

Table 11: Areas, Groups and Factors for Calculating Open Access Friendliness Indicator (OAFI)

<table>
<tr><th>Areas (weightage)</th><th colspan="4">Groups within the areas (with distributed weightage)</th></tr>
<tr><td>OA publications
(Area weightage: 50%)</td><td>OA share
(Group weightage: 25%)</td><td colspan="2">Gold & Green share
(Group weightage: 15%)</td><td>Repository share
(Group weightage: 10%)</td></tr>
<tr><td>OA licensing
(Area weightage: 25%)</td><td colspan="2">OA license share
(Group weightage: 15%)</td><td colspan="2">Gold & Green license share
(Group weightage: 10%)</td></tr>
<tr><td>OA impact: Citations
(Area weightage: 15%)</td><td>OA citation share kind I
(Group weightage: 5%)</td><td colspan="2">OA citation share kind II
(Group weightage: 5%)</td><td>OA citation share kind III
(Group weightage: 5%)</td></tr>
<tr><td>OA impact: Altmetric
(Area weightage: 10%</td><td colspan="2">OA altmetric share kind I
(Group weightage: 5%)</td><td colspan="2">OA altmetric share kind II
(Group weightage: 5%)</td></tr>
</table>

5.3 Institutional Scenarios

This section of the research report demonstrates the application of the OAFI (Open Access Friendliness Indicator) ranking framework with two Pharmacy Institutes. Subsequently, it generates a ranked list encompassing all 5 Pharmacy Institutes. The selection includes the oldest one, the Institute of Chemical Technology (ICT Mumbai, 1933), and the newest one, the National Institute of Pharmaceutical Education and Research Hyderabad (NIPER, Hyderabad, 1998), chosen from the top 5 Pharmacy Institutes based on their year of establishment.

Table 12: Calculation of Scores for Area I & Area II for two Selected Pharmacy Institutes

Area I: OA publications (weightage 50) & Area II: OA licensing (weightage 25)							
Factors		**Values(round)**		**Factors**		**Values(round)**	
SL	**Element**	**ICT, Mumbai**	**NIPER, HBD**	**SL**	**Element**	**ICT, Mumbai**	**NIPER, HBD**
A	Total publications	2,737	1,372	E	Total Gold & Green OA	413	131
B	Total publications with DOI	2,682	1,330	F	Total Green OA	100	27
C	Publications with close/open status from Unpaywall	2,610	753	G	Green OA available via repositories (as the best OA locations)	100	27
D	Total OA publications	548	157	H	Licensed OA resources	376	115
Factor 1: OA share (D/C * 25)		5.25	5.21	K	Licensed Gold & Green OA	413	131
Factor 2: Gold & Green OA share (E/D * 15)		11.30	12.51	Factor 4: OA license share (H/D * 15)		10.29	10.99
Factor 3; Repository share (G/F * 10)		10.00	10.00	Factor 5: Gold & Green license share (K/E * 10)		10.00	10.00
Area I scores		26.55	27.72	**Area II scores**		20.29	20.99

Table 13: Calculation of Scores for Area III & Area IV for two Selected Pharmacy Institutes

Area III: OA impact - citations (weightage 15) & Area II: OA impact - altmetric (weightage 10)							
Factors		**Values**		**Factors**		**Values**	
SL	**Element**	**ICT, Mumbai**	**NIPER, HBD**	**SL**	**Element**	**ICT, Mumbai**	**NIPER, HBD**
A1	Total publication with citation status	2,649	1,325	M	OA Publications with recent citations >Lrc	306	68
A2	Total publications with citation >=1	2,134	1,029				
B	Total citations received by all resources that are having citations status	23,311	20,368	N	Total recent citations received by OA resources with recent citations >Lrc	4,817	1,952

C	Average citations per publication (Avg= B/A1)	8.8	15.40	P	Total publications with altmetric score publications with a score >0	948	574
D	OA publications with citation >=1	419	124	Q	Sum of altmetric scores for all	3,079	1,757
E	Citations received by OA resources with citation >=1	4,285	1,829	R	Average altmetric score publication (AAvg= Q/P)	3.52	3.06
F	All publications with citation >Avg (Avg is the average citation value ‘C’ here)	1,072	492	S	Number of OA publications with altmetric score	84	224
G	Citations received by all resources with citation >Avg	26,801	21,935	T	Sum of altmetric scores for OA publications with a score >0	1,828	444
H	OA Publications with citation >Avg	205	42	U	All publications with altmetric score >AAvg (AAvg is the average altmetric score here)	151	113
J	Citations received by OA resources with citation >Avg	5,201	2,086	V	Sum of altmetric scores for all publications with score >AAvg	2,321	1,294
K	All publications with ‘recent citations’ >Lrc (Lrc is the lowest recent citations in the set of top 1% publications byrecent citations - rounded)	1,547	519	X	Number of OA publications with altmetric score >AAvg	64	25

L	Total recent citations received by all resources with recent citation >Lrc	22,187	11,860	Y	Sum of alt-metric scores for OA publications with a score >AAvg	1,633	374
Factor 6: OA citation share kind I (E/B * 5)		0.91	0.45				
Factor 7: OA citation share kind II (J/G * 5)		0.97	0.47	Factor 9: OA altmetric share kind I (T/Q * 5)		2.97	1.26
Factor 8: OA citation share kind III (N/L * 5)		1.09	0.82	Factor 10: OA alt-metric share kind II (Y/V * 5)		3.52	1.45
Area III scores		2.97	1.97	**Area IV scores**		6.49	2.71

Table 14: Ranked List of 5 Top Pharmacy Institutes by OAFI

Name Of Pharmacy Institutes	Area I (50)	Area II (25)	Area III (15)	Area IV (10)	OAF (100)	Rank
JSS	34.17	20.34	6.05	7.03	67.59	1
Jamia	31.56	18.86	5.85	7.06	63.33	2
Birla	28.75	14.34	9.19	8.31	60.59	3
ICT Mumbai	26.55	20.29	2.97	6.49	56.3	4
NIPER	27.72	20.99	1.97	2.71	53.39	5

CONCLUSION

While recognizing that no ranking list is immune to criticism, including this effort to establish a ranking framework for gauging Open Access (OA) support among Indian institutions, particularly the top 5 Pharmacy Institutes used as samples, this research holds significance for several reasons: i) it utilizes datasets related to OA, citations, and altmetrics available under the ODbL license; ii) it extensively explores OA data through API calls and extraction from JSON formats; iii) it measures previously unreported information, including different levels of OA publications and availability through repositories; iv) it goes beyond OA publication share by incorporating diverse datasets, including OA citations overall and within highly cited articles; v) it incorporates altmetric data to gauge the popularity of an institute's OA publications in the academic and social web space. The methodology and ranking framework developed here can be easily extended to measure and compare OA friendliness scores for other Indian and global institutes using data manipulation software like Openrefine.

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ROLE OF GREEN LIBRARIES IN THE DIGITAL AGE

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ABSTRACT

This paper examines the elaborate role of libraries in the digital age, cultivating the need and importance of "green libraries" as pivotal learning centres in promoting environmental consciousness within their communities. The globe is struggling with several environmental issues, including libraries. In this connection, there is a need for sustainable practices that are expanding in all spheres of society. Green libraries are designed according to their dedication to environmentally friendly formulas, use of resources within budget limitations and use of digital technology to minimise environmental impact. This paper peeps into how green libraries are using digital advancements to hike accessibility, foster green projects, and aid in generating a more sustainable future. Green libraries reconsider their activities to align environmental targets by picturising the case studies and best practices. It enables a criterion for other institutes examining sustainability and offering a blueprint in the digital age. The debate is confined to energy-efficient infrastructure, digital collections, engagement in community activities, and the broader societal impact of green libraries. The ultimate object of this exploration is to encourage an overall conversion about the crucial role of libraries in shaping more environmentally conscious and sustainable.

Keywords: Green Library, Green Rating for Integrated Habitat Assessment, GRIHA, Green Library Standards, Digital Divide, Sustainable Development.

INTRODUCTION

Information and Communication Technology is growing with innovative dimensions, and libraries are transforming to meet the challenges and changing needs of their communities. An essential ingredient of this elaboration is the exposure to accurate information resources provided by green libraries at the right time. These institutions arrange support and keep them in an environmentally friendly environment with the utmost care.

What is Green Library?

According to the **IFLA ENSULIB** section:

Environment means the surroundings and conditions where human beings, organisations, animals, or plants live and operate. Environments can be natural, social or cultural.

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Sustainable development "meets the needs of the present without compromising the ability of future generations to meet their own needs" (Our Common Future, Brundtalnt Report, UN).

Present environments are endangered by climate change and other threats, including social inequalities. All organisations should strive to protect the environment through sustainable development. This includes all kinds of libraries, which can play a significant role in sustainable development.

A green building is a building that is concerned about the inhabitants' well-being, environment, and earth resource protection (U.S. Green Building Council, 2005). Green designs help to :

- Reduce Human exposure.
- Conserve non-renewable power sources and raw materials.
- Protect and restore good air, water, soils, and vegetation.
- Help maintain people on foot, bikes, crowd travel, contrasting options to fossil-filled vehicles.

  (Indian Green Building Council, 2008).

DEFINITION OF GREEN LIBRARY

According to the Oxford English Dictionary

Through this paper, the expressions "green" and "sustainable" are utilised and defined in the Oxford English Dictionary (1989). The word "green" is characterised as "relating to, or supporting environmentalism" (P. 811). The expression "sustainable " identifies with economic activity, action and culture that don't prompt ecological degradation (Oxford English, 2008).

The Concept of Libraries

The concept of a green library has been surviving for 20 years due to climate change, leading people to start a green library movement throughout the globe. The word '**green**' has a great responsibility for global warming and its misuse. Hence, we want to save the planet. In recent years, the interconnected topics of sustainability and green libraries have acquired much coverage in publications targeted at world librarians.

How Libraries Become Green and Why?

Models and systems created by that library facilitate sustainable development. Tremendous opportunities exist for Libraries to improve their customers' environmental awareness through communication and environmental education.

Standards for Green Libraries

A few of the Green Libraries Standards are discussed below

Chicago Illinois Standards

Chicago is the pre-eminent city to amalgamate environmentally friendly practices into public buildings and develop its standards. It is a kind of standard which is strongly influenced by the LEED green building rating system. This type of green building consists of all the necessary design, selection of materials and construction as well as life cycle analysis and energy efficiency.

Brown Green Standard

The Governor of California, Jerry Brown, analysed the emerging trend of green libraries and announced that the libraries were on the cutting edge of green design. Buildings renovated over 10,000 sq feet and reached the U.S. Green Building Council's LEED Silver Certification and clean energy generation.

IGBC Indian Green Building Council Standard

Confederation of Indian Industry (CII) established IGBC in 2001 with a great vision and mission to provide a sustainable building environment for all. IGBC got a license from the U.S. Green Building Council with LEED Green Building Standard and, in collaboration, developed a Gold rating system to poster green buildings in India.

Green Rating for Integrated Habitat Assessment (GRIHA)

The Energy and Resources Institute, New Delhi (TERI) is another organisation coming forward to start a green library movement in India. TERI anticipated the need to develop a domestic tool for rating green buildings in India, which guided the foundation of 'GRIHA'. Later, this rating system was adopted by India's government.

To fulfil these standards for the development of green libraries, institutions are making many contributions to environmental conservation and fostering a culture of sustainability. These instructions are handy for the benefit of the planet and to keep the libraries in the right position as leaders in the movement toward a greener, more environmentally conscious society. Acting as beacons of knowledge and community hubs, green libraries can encourage pragmatic change and render them to serve as models for sustainable practices worldwide.

A green and sustainable library is a library that takes into account environmental, economic, and social sustainability. Green and sustainable libraries may be of a size, but they should have a clear sustainability agenda which includes:

Design of Building with Efficiency

The design of green libraries is constructed with sustainability kept in mind and considers an environmentally friendly approach that reduces the impact of pollution on the environment. Green library building construction engineers and designers emphasise efficient ventilation to all the parts of the library, temperature and calm breezes, as well as renewable energy sources like solar power and wind power. Environmentally friendly materials are used in the construction of green libraries, which promote energy conservation towards reducing the overall carbon footprint of the building.

Digital Resources and Decreased Paper Consumption

In the age of digital technology, traditional libraries are transformed into digital resources. Green libraries are encouraging the quick use of digital resources and reducing paper consumption through investment in digital resources. This type of green library uses e-books, e-journals and online databases, which are designed to protect forests and reduce the impact of pollution from the paper manufacturing industries on the environment.

In addition, green libraries encourage the use of electronic resources instead of printed materials for their readers. This kind of transformation is according to the objectives of environment protection and prioritises the changing needs of library users in the digital world.

Recycling and Waste Reduction

The sustainability of green libraries extends beyond digital collections and energy-efficient buildings. Green libraries are strongly committed to reducing waste and encouraging recycling initiatives. Many recycling activities are implemented within the library premises to educate library users to dispose of materials responsibly and promote a culture of environmental awareness.

Libraries also handle the recycling of projects with creativity and convert the discarded material into new useful things. This kind of attitude minimises wastage and, as an educational tool, upholds awareness about the chances of repurposing materials for sustainable practices.

Outreach and Community Education

Green libraries work as educational hubs for the community. These libraries are more than just physical spaces. Green libraries are diligently participating in outreach activities as well as programs of environmental education. It also organises workshops, seminars, health awareness programs, legal aid programs, and events that promote eco-friendly practices by working together with local organisations, schools, NGOs, and business firms, which can help eradicate environmental crises and overcome all the barriers. Green libraries are granted ecologically conscious with a larger objective for the sake of national interest.

Green libraries work for the communities in sustainable-related activities such as community gardens, composting workshops, and nature-inspired reading programs.

Environmental Impact of Technology Innovation

Green libraries act as the vanguard of technical innovation in the digital age. Advancements have made changes to reduce their environmental impact further. This innovative technology improves operational efficiency for implementing automated resource management systems, smart building systems, and energy efficiency technologies and guarantees that sustainability will always remain a top priority.

CHALLENGES

Green libraries face several challenges as they attempt to balance environmental sustainability with meeting the demands of rapidly growing technology in the digital world. These challenges comprise various operations characteristics, technology integration and community involvement.

Energy Consumption and Digital Infrastructure

Pose challenges are faced due to the shift from conventional to digital collections & services related to the energy consumption of the necessary technological infrastructure. Carbon footprints have increased numerously from data centres and electronic devices, and there is continuous worry about developing sustainability for managing digital resources.

Management of E-Waste

On all occasions, outdated electronic gadgets and equipment are being produced due to the rapid speed at which technology is developing. Effective waste management strategies are badly needed for green libraries with committed disposal or recycling of old equipment to prevent environmental damage.

DIGITAL DIVIDE AND EQUITABLE ACCESS

Accessibility is made better through digitalisation. There is increasing concern about the digital divide. Green libraries can provide equal opportunity without discrimination, irrespective of socio-economic status and technical competence. Still, it is very needed to navigate the challenges in the digital world.

Development of Sustainable Collections

Traditional collection development practices face several challenges due to the digital shift. The struggle of the library issues relating to the environment will be reduced by hosting digital collections, agreement on licensing and stabilising the wish for extensive digital resources, which are helping a lot with sustainability with utmost care.

Engagement and Education in the Community

Green libraries face numerous challenges in promoting environmental awareness and working with their communities. Green libraries take the excellent initiative to educate readers about the environmental impact of digital practices and try to inspire sustainable behaviours among people habitually to fast technical knowledge of consumption, which needs innovative and continuing efforts.

Budgetary Restrictions

Significant and authentic investments are often required for the implementation of green initiatives. Financial problems the libraries face due to adopting energy-efficient technologies, facilities renovating for sustainability, and environmental answerability are purposeful challenges.

Privacy and Data Security

The nature of digital library services raises privacy and data security problems. There is a great need to navigate the complexities of protecting reader information privacy while adopting digital technology. Green libraries must negotiate these problems to maintain their commitment to sustainability without compromising.

REPLACEMENT OF USER EXPECTATIONS

In the digital age, patrons are habituated to prompt access and convenience that prioritise sustainability over speed and may resist changes. It is needed to find better ways to align user calculations with ecologically responsible practices and a balance between comfort and environmental responsibility in green libraries.

Collaborative efforts are required to address these challenges with the support of library professionals, technical experts, policymakers and communities. Green libraries played a prominent in pioneering sustainable practices, motivating the rest of the people to defeat barriers and subscribe to a more environmentally responsive digital future.

CONCLUSION

In the digital age, green libraries are significant in promoting a sustainable future to protect from environmental pollution. Green libraries provide environmentally friendly building design, materials for digital resource collections, campaigns to reduce waste, community empowerment, and educational programs. These organisations inspire readers to use environmentally friendly methods. Green libraries are serving as the bacon of sustainability, which is to meet the challenges of the rapidly growing technology in the 21st century. It shows to be a proper hunt for wisdom and acquisition of environmental stewardship.

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CONTRIBUTION OF LIBRARIES IN SECURING RANKING IN NIRF: AN ANALYSIS OF THE TOP TEN ENGINEERING INSTITUTIONS IN INDIA

Surendar Ratnala*

ABSTRACT

This paper investigates the pivotal role of libraries in influencing the National Institutional Ranking Framework (NIRF) rankings of the top ten engineering institutions in India. Utilising data-driven analysis, we explore the correlation between library resources and NIRF rankings, emphasising the significance of well-equipped libraries in fostering academic excellence. The study compares library expenditures among these top ten institutions, providing insights into the investments in cultivating robust knowledge ecosystems. The calculation of NIRF Rankings takes into account the library expenditure in the categories of Books, Journals, and e-resources exclusively. Additionally, we have analysed the number of publications, e-subscriptions of journals and other resources for the library users of the concerned institutes. Scholarly outputs play an important role in securing good rank in NIRF. IITM has registered the highest number of patents (976), followed by IITB (897). And they secured first and third ranks in NIRF. IITD has (614) patents but has the highest publications among the top 10 ranked Institutes. The top 10 ranked Engineering Institutes spent ₹ 539.74 crore together in the last three Financial Years. IIT Hyderabad has spent a maximum ₹ 37.41 crore on average in an FY.

Keywords: Libraries in NIRF, NIRF Rankings, Library Resources, Library Fund, IITs, CFTIs

INTRODUCTION

Different countries have their set of rules to evaluate the performance of educational and research institutes in the form of rankings such as The Times Higher Education (THE) World University Rankings, QS World University Rankings (Quacquarelli Symonds), etc. India also has its own Higher Education Ranking system known as NIRF. It follows some parameters to evaluate and rank in different categories, such as Engineering Institutions, Universities, Pharmacies, and Medical colleges.

The Education Ministry approved the National Institutional Ranking Framework (NIRF), the then Ministry of Human Resource Development (MHRD), launched by the Honourable Minister of Human Resource Development on 29th September 2015. This framework outlines

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a methodology to rank institutions across the country. The methodology draws from the overall recommendations and broad understanding arrived at by a Core Committee set up by MHRD to identify the broad parameters for ranking various universities and institutions. The parameters broadly cover "Teaching, Learning and Resources," "Research and Professional Practices," "Graduation Outcomes," "Outreach and Inclusivity," and "Perception".

The National Institutional Ranking Framework (NIRF) in India is a comprehensive system that evaluates institutions based on various parameters. This paper focuses on the contribution of libraries to NIRF rankings in the context of the top ten engineering institutions. A thorough analysis of library resources and expenditures aims to underscore the correlation between academic excellence and library infrastructure.

OBJECTIVES

1. Finding the top 10 Ranked Engineering Institutes in India;
2. Comparing scholarly resources of these institutions,
3. Analysing the library expenditure of the top ten engineering institutions in India;

METHODOLOGY

This study employs a quantitative approach, utilising data fetched from the NIRF website maintained by the Education Ministry. The data sheet was downloaded from the top 10 engineering institutes in India and analysed using MS Excel. Library expenditures by these institutions over the past three financial years, i.e., 2021-22, 2021-20 and 2019-20, are evaluated for the study.

TOP 10 NIRF RANKING ENGINEERING INSTITUTES IN 2023

This analysis reveals a positive correlation between library resources and NIRF rankings. Institutions with well-stocked libraries, state-of-the-art technology, and comprehensive digital resources consistently ranked higher. The below table shows that Indian Institute of Technology Madras (IITM) secured the top position in NIRF-2023 with a score of 89.79, Indian Institute of Technology Delhi (IITD) secured second position with a score of 87.07, Indian Institute of Technology Bombay (IITB) is at third position with 80.74 points and Indian Institute of Technology Kanpur (IITK) secured fourth position with 80.65 points. Indian Institute of Technology Roorkee (IITR) and Indian Institute of Technology Hyderabad (IITH) were established in 2001 and 2008, respectively, and secured fifth and eighth positions with 75.64 and 70.28 points, respectively. It is observed that IITH is the youngest IIT and secured its position in 10 Institutes. Indian Institute of Technology Kharagpur (IITKGP) and Indian Institute of Technology Guwahati (IITG) have secured sixth and seventh positions, respectively, with scores of 73.76 and 70.32, respectively. It is found that the National Institute of Technology

Tiruchirappalli (NIT Trichy) and Jadavpur University (JU) are the only non-IITs that secure top 10 ranks in NIRF at ninth and tenth positions with 69.71 and 69.04 scores, respectively. NIT Trichy is the only NIT secured top ten position. On the other hand, JU is the only state institute in India that secured its position among IITs and NITs.

Table 1: Top 10 NIRF Rankings 2023 in Engineering Institutions

Sl.	Name of the Institute	Year of Estd.	State	Score	Rank
1	Indian Institute of Technology Madras	1959	Tamil Nadu	89.79	**1**
2	Indian Institute of Technology Delhi	1961	Delhi	87.09	**2**
3	Indian Institute of Technology Bombay	1958	Maharashtra	80.74	**3**
4	Indian Institute of Technology Kanpur	1959	Uttar Pradesh	80.65	**4**
5	Indian Institute of Technology Roorkee	2001	Uttarakhand	75.64	**5**
6	Indian Institute of Technology Kharagpur	1951	West Bengal	73.76	**6**
7	Indian Institute of Technology Guwahati	1995	Assam	70.32	7
8	Indian Institute of Technology Hyderabad	2008	Telangana	70.28	8
9	National Institute of Technology Tiruchirappalli	1964	Tamil Nadu	69.71	**9**
10	Jadavpur University	1955	West Bengal	67.04	**10**

COMPARATIVE ANALYSIS OF LIBRARY EXPENDITURE

Libraries play a crucial role in providing teaching and research materials to library users. To gain insights into the financial commitment to libraries, top-ranked institutes have spent plenty of money on library resources. It includes print and online materials. Compare annual library expenditures across the top ten ranked NIRF 2023 engineering institutions to analyse the library expenditure. For the smooth analysis points, after digits of decimals are avoided in Table 2 below. Examining budget allocation and resource utilisation provides a comprehensive understanding of institutional priorities. In the last three financial years, libraries utilised the amount under the Capital Expenditure in academic activities, and research resources were taken to analyse library expenditure.

Table 2 shows that the average library expenditure on resources in the last three FYs of IITM is ₹ 20.43 Crore where, whereas IITD spent during this period around 17.30 crores. It is found that IIT Hyderabad has spent more than any top-ranked Institute in India to ₹37.41 crores, followed by IIT Bombay to ₹30.22 crore, and IITM spent ₹ 20.43 crore, the third highest expenditure on library resources.

It is observed NIT Trichy has shown a sudden decrease in library expenditures. FY 2019-20, it spent ₹ 3.32 crores; in FY2020-21, it was reduced to ₹ 0.54 crore, which is more than a 75% deduction.

Jadavpur University is the only University Ranked in the top 10 and stands equivalent to CFTIs in terms of performance.

Table 2: Library Expenditure in three Financial Years in Crores

S.No.	Name of the Institute	2021-22	2020-21	2019-20	Average
1	Indian Institute of Technology Madras	21.95	21.22	18.12	20.43
2	Indian Institute of Technology Delhi	18.33	16.58	17.00	17.30
3	Indian Institute of Technology Bombay	37.54	30.11	23.03	30.22
4	Indian Institute of Technology Kanpur	16.59	16.95	15.30	16.28
5	Indian Institute of Technology Roorkee	24.84	14.50	19.26	19.53
6	Indian Institute of Technology Kharagpur	17.49	20.75	22.73	20.33
7	Indian Institute of Technology Guwahati	11.94	11.28	10.09	11.10
8	Indian Institute of Technology Hyderabad	35.65	36.05	40.54	37.41
9	National Institute of Technology Tiruchirappalli	0.26	0.54	3.32	1.37
10	Jadavpur University	6.04	8.53	3.21	5.92

LIBRARY EXPENDITURES IN THREE FINANCIAL YEARS

We have analysed the total expenditure for the 2019-20, 2020-21 and 2021-2022 Financial Years in Table 4 given below. In terms of library expenditures, IIT Hyderabad has spent a maximum ₹112.24 crore, followed by IIT Bombay ₹90.68 crore. IIT Guwahati has spent the lowest to ₹33.31 crore. The top 10 ranked Engineering Institutes spent ₹ 539.74 crores altogether. This is quite enough compared to the other top 10 ranked Institutes in different categories.

Table 4: Overall Annual Expenditure

S.No.	Name of the Institute	Total in crores	Overall expenditure in percentage
1	Indian Institute of Technology Hyderabad	112.24	21 %
2	Indian Institute of Technology Bombay	90.68	17 %
3	Indian Institute of Technology Madras	61.29	11 %
4	Indian Institute of Technology Kharagpur	60.97	11 %
5	Indian Institute of Technology Roorkee	58.60	11 %

S.No.	Name of the Institute	Total in crores	Overall expenditure in percentage
6	Indian Institute of Technology Delhi	51.91	10 %
7	Indian Institute of Technology Kanpur	48.84	09 %
8	Indian Institute of Technology Guwahati	33.31	06 %
9	Jadavpur University	17.78	03 %
10	National Institute of Technology Tiruchirappalli	04.12	01 %
	All Together	**₹ 539.74**	100%

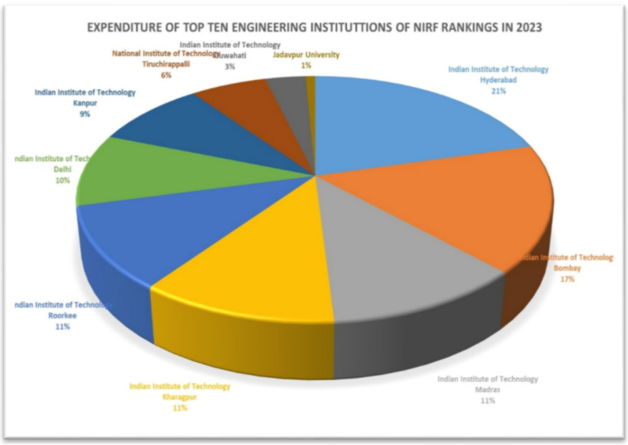

Fig. 1: Overall Expenditure in Percentage

SCHOLARLY COMMUNICATIONS

Scholarly publications are the indicator of the research output of any institute. Data was collected from the Indian Research Information Network System (IRINS) library portals of the concerned institutions and analysed the scholarly resources**,** i.e., publications, patents, journal articles, conference proceedings, and book chapters, among others. The data is shown in Table 3 below. It was found that IITM has the second highest publications (36057) and highest patent registration, and it secured first position in NITF, whereas IITD has the highest number of publications but third highest in patent registrations and secured second position in NIRF. IITB has the third lowest publication but the second highest patent registration and secured third rank. It is also observed that IIT Roorkee has the lowest patents (65) and publications (21571) among IITs and NIT Trichy. NIT Trichy has more patents (68) than IIT Roorkee, whereas Jadavpur University has only one patent among the top-ranked Institutes.

Table 3: Scholarly Communications

S.No.	Name of the Institute	Publications	Patents	Journal Articles	Conference/ Proceedings	Books/ Chapters
1	Indian Institute of Technology Madras	36057	976	25311	8554	849
2	Indian Institute of Technology Delhi	41773	614	27474	10469	1286
3	Indian Institute of Technology Bombay	34512	897	22860	9368	857
4	Indian Institute of Technology Kanpur	23763	438	16444	5168	820
5	Indian Institute of Technology Roorkee	21571	65	15420	4533	507
6	Indian Institute of Technology Kharagpur	33902	270	24757	6676	876
7	Indian Institute of Technology Guwahati	22844	239	15463	5171	1021
8	Indian Institute of Technology Hyderabad	9894	112	6668	2317	265
9	National Institute of Technology Tiruchirappalli	9848	68	6568	2326	389
10	Jadavpur University	19696	1	13641	4497	651

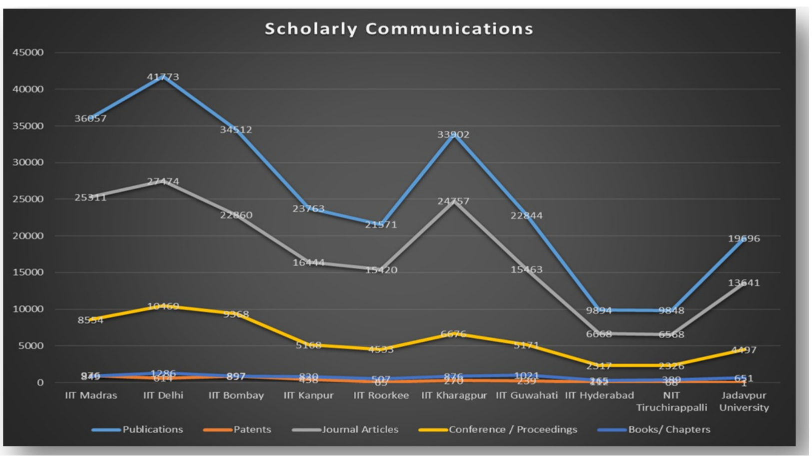

Fig. 2: Scholarly Communications

CHALLENGES AND OPPORTUNITIES

The challenges faced by institutions in improving library contributions include budget constraints, and changing user expectations, technological advancements, changes in scholarly communication practices. The comparative studies of institutions like top-ranked institutions in various categories offer qualitative opportunities in library initiatives and their impact on NIRF rankings. The comparative study shows the best practices and innovative approaches institutions adopt to improve library contributions.

CONCLUSION

This analysis evaluates the expenditure incurred in the library in books, journals, and e-resources in the last three FYs of the top ten NIRF 2023-ranked engineering institutions in India. This study provides an important role of the library in securing NIRF rankings, and it reveals valuable insights into the scholarly resources of the institutions. It compared the scholarly communications among the intuitions. It is mainly focused on the comparison of a number of publications/journal articles/conference proceedings and the registrations of patents since the establishment of the institution.

Findings of the study: The NIRF Rankings in India provide a platform to prioritise their academic and research requirements, focus on framing the strategies, and plan appropriately for investments made in various activities. Competing for each institution in India can strengthen its position in national rankings. The library also plays a vital role in securing the NIRF Rankings.

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NAME AUTHORITY CONTROL IN SHODHGANGA: ISSUES AND CHALLENGES

Sourav Debnath*

ABSTRACT

Shodhganga repository has achieved a milestone of 5 lakhs theses uploaded by Indian Universities and Institutes. While uploading the metadata for this amount of theses a gamut number of new research scholar names have been entered for the first time. However, the guide's or supervisor's name is repeated in many cases where multiple PhDs are completed under the same guide. Although there is a common guideline and template provided by the Shodhganga manual to the University or Institute coordinator to follow up while entering metadata, different stakeholders are entering the guide's name and researcher's name in different formats. This study suggests a pragmatic approach for the name authority control in institutional repositories in process of developing the national thesis collection like Shodhganga which facilitates speedy information retrieval in perspective of theses search. This work further investigates the reasons for different name formats and how to enhance the retrieval of all theses completed under the same guide/ supervisor.

Keywords: Name Authority Control, Shodhganga, Information Retrieval, Thesis

1. INTRODUCTION

Theses by doctoral scholars are one of the intellectual outputs of an academic institution. National repositories like Shodhganga are collecting, organizing, managing, preserving, and providing seamless access to these intellectual contents hosting in universities' and institutions' own repositories as well as depositing at the central place (Park & Richard 2011). Due to author ambiguity, difficulty arises in associating a scholarly work with the person who wrote it, thereby introducing inaccuracy in credit attribution (Sanyal et al., 2021). In an ideal situation, the PhD theses which were supervised by the same guide should be listed under the same guide's name but different name rendering of the same guide is posing a real hurdle to retrieve the requisite information from the system. In this work author proposes to maintain a name authority file in the university or institute level to enhance Shodhganga search and retrieval mechanism which will reduce the metadata entry fault by different persons deputed by university coordinator for theses upload mandated by

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the Ministry of Education, Government of India to every University and Higher Education Institute within India.

2. OBJECTIVES

The main objective of this study is to perceive reasons for inconsistency in researchers' and guides' name entry while developing collections of national thesis repository. The study also explores the name authority search facilities from the institutional repository interface.

3. METHOD

This study was conducted using a mixed method with an inclination to case study on Shodhganga. Description method is used to describe the observations by the author while searching Shodhganga and uploading theses.

4. DISCUSSION

Electronic objects are collected in a digital repository and information retrieval is a sub-process of that digital repository system. Metadata is one of the important concepts in the field of digital technology throughout the higher education as well as research environment. Its primary purpose is to assist users in locating resources specific to their subject areas, staying updated on new resources, and connecting them to relevant, easily understandable information (McCutcheon et al., 2008).

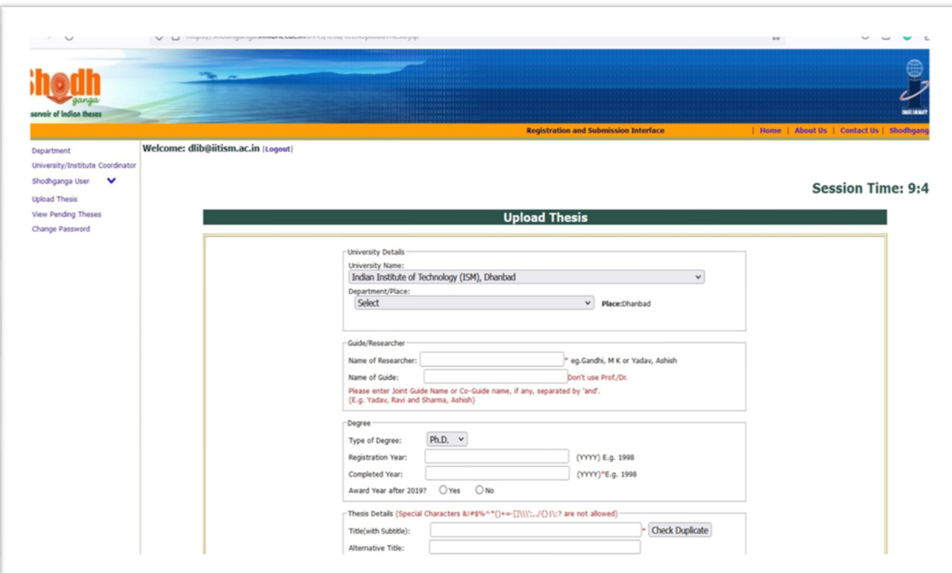


Fig. 1: Thesis Details Entry Page in Shodhganga

A university coordinator or deputed cataloger who uploads theses in Shodhganga has to keep certain points in mind before starting the process. The entire data entry, file selection, uploading session has to be completed within 10 minutes. A thesis has to be splitted in different chapters (title, preliminary pages, abstract, table of contents, introduction, chapters 1, 2, 3, - - - etc., conclusion / summary, annexures and recommendations) not more than 30 MB in size each. This time limit puts a cataloger on edge to make any mistake while typing the thesis details.

The Shodhganga homepage search box performs keyword search while three other options namely "Advance Search", "Subject Search" and "Google Search" are available. The initial level search option, Subject Search (https://sgsubjects.inflibnet.ac.in/) was not responding. Author also explored the "Search & Browse" dropdown six options: University & Departments, Upload Date, Researcher/Guide, Title, Keyword and Handle no. For a first-time user, the handle no search option does not really help much. The researcher whose thesis has been uploaded in Shodhganga might remember his/her thesis number or a user who wants to consult a particular thesis multiple times might keep the thesis number for quick reference.

If a user wants to search a researcher/guide name, the search process can start with the first few letters of the researcher or guide name; however, the precision of this method is very low as shown in Fig 2. Author entered the full name of a guide "Sanjit Kumar Pal".

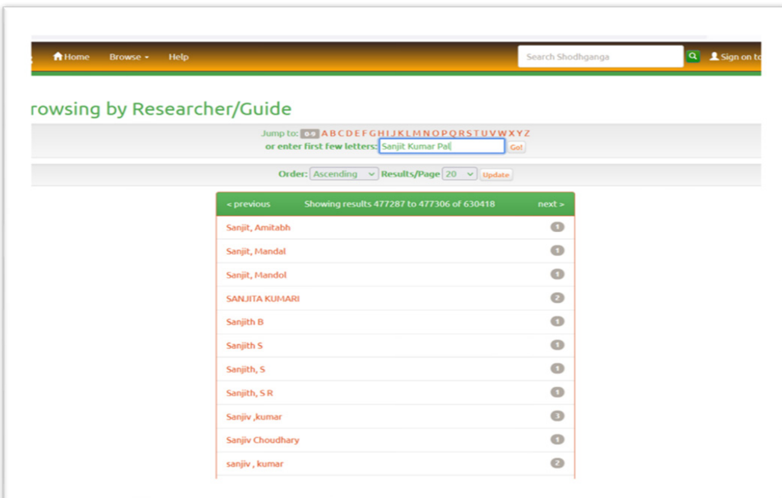


Fig. 2: Browsing Guide's Name in Firstname Surname Format

The returned result nowhere comes to the intended guide, Sanjit Kumar Pal or a researcher's name matching with "Sanjit Kumar Pal" in the first few pages of the list. The "Results/Page" gives options from 5 to 100 results per page with a drop-down option to select the range with intervals of 5 numbers increase or decrease per page. A user needs to click the "next" to find the exact name if it does not come in the first 100 itself. To explore the Surname, Firstname method, the author entered "Pal, Sanjit Kumar" but the result was not satisfactory either.

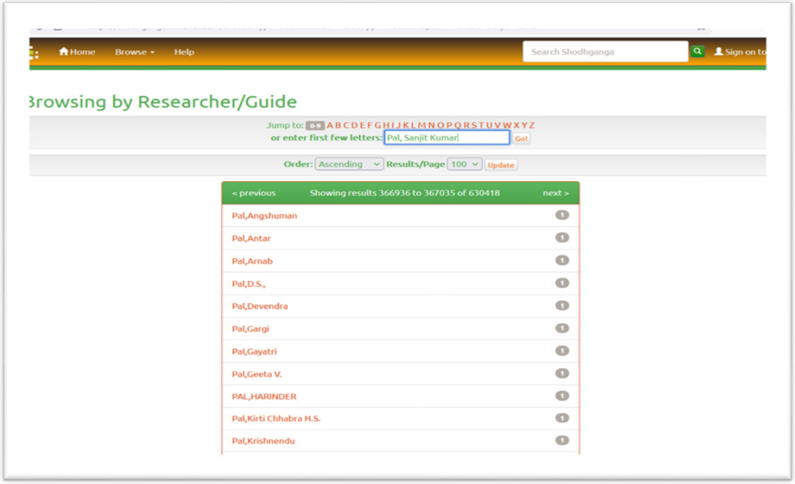
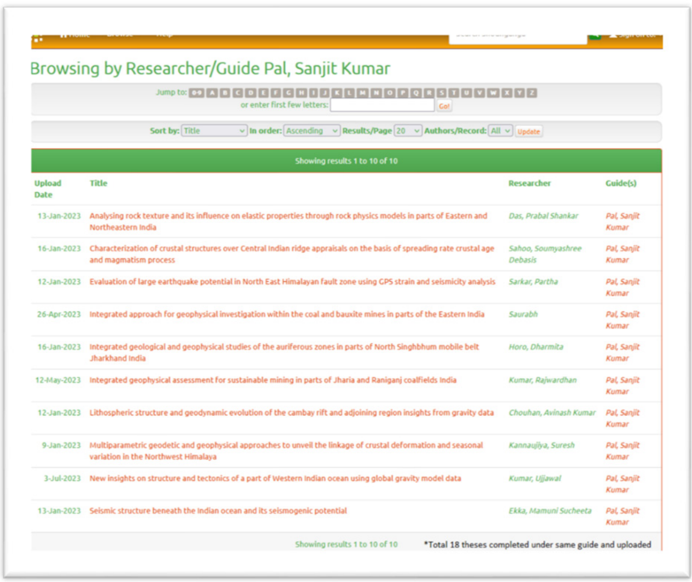


Fig. 3: Browsing Guide's Name in Surname, Firstname Format

Author randomly picked the guide's name, Prof Sanjit Kumar Pal from the Department of Applied Geophysics of the Indian Institute of Technology (Indian School of Mines) Dhanbad while browsing "Browsing by Researcher/Guide" option. The initial click on the guide name displayed ten theses completed by different research scholars under the same guide as depicted in Fig 4. Till date total count of uploaded theses under the guidance of Prof Sanjit Kumar Pal is eighteen. But any user has to count it manually going through the list searched under the department which is comparatively easier than directly searching a guide's name in the search box.


Browsing by Researcher/Guide Pal, Sanjit Kumar

Jump to: 0-9 A B C D E F G H I J K L M N O P Q R S T U V W X Y Z
or enter first few letters: Go!

Sort by: Title In order: Ascending Results/Page 20 Authors/Record: All Update

Showing results 1 to 10 of 10

Upload Date	Title	Researcher	Guide(s)
13-Jan-2023	Analysing rock texture and its influence on elastic properties through rock physics models in parts of Eastern and Northeastern India	Das, Prabal Shankar	Pal, Sanjit Kumar
16-Jan-2023	Characterization of crustal structures over Central Indian ridge appraisals on the basis of spreading rate crustal age and magmatism process	Sahoo, Soumyashree Debasis	Pal, Sanjit Kumar
12-Jan-2023	Evaluation of large earthquake potential in North East Himalayan fault zone using GPS strain and seismicity analysis	Sarkar, Partha	Pal, Sanjit Kumar
26-Apr-2023	Integrated approach for geophysical investigation within the coal and bauxite mines in parts of the Eastern India	Saurabh	Pal, Sanjit Kumar
16-Jan-2023	Integrated geological and geophysical studies of the auriferous zones in parts of North Singhbhum mobile belt Jharkhand India	Horo, Dharmita	Pal, Sanjit Kumar
12-May-2023	Integrated geophysical assessment for sustainable mining in parts of Jharia and Raniganj coalfields India	Kumar, Rajwardhan	Pal, Sanjit Kumar
12-Jan-2023	Lithospheric structure and geodynamic evolution of the cambay rift and adjoining region insights from gravity data	Chouhan, Avinash Kumar	Pal, Sanjit Kumar
9-Jan-2023	Multiparametric geodetic and geophysical approaches to unveil the linkage of crustal deformation and seasonal variation in the Northwest Himalaya	Kannaujiya, Suresh	Pal, Sanjit Kumar
3-Jul-2023	New insights on structure and tectonics of a part of Western Indian ocean using global gravity model data	Kumar, Ujjawal	Pal, Sanjit Kumar
13-Jan-2023	Seismic structure beneath the Indian ocean and its seismogenic potential	Ekka, Mamuni Sucheeta	Pal, Sanjit Kumar

Showing results 1 to 10 of 10 *Total 18 theses completed under same guide and uploaded

Fig. 4: List of Theses Completed Under a Guide

Fig. 5: Description Page of a Thesis with Researcher, Guide, Bibliographic Details and Link

However, when a user clicks on the department level search to see how many theses are submitted in the same department, he/she finds different name formats of the same guide. As pointed out in Fig 6, Prof Sanjit Kumar Pal's name has been entered in two formats "Pal, Sanjit Kumar" and "Pal, Sanjit K". The issue might not be created by the cataloger but by the PhD researchers while writing their guide's name in the thesis's certificate and declaration page. Even the guide might have overlooked his/her name format in hurry and signed on the documents.

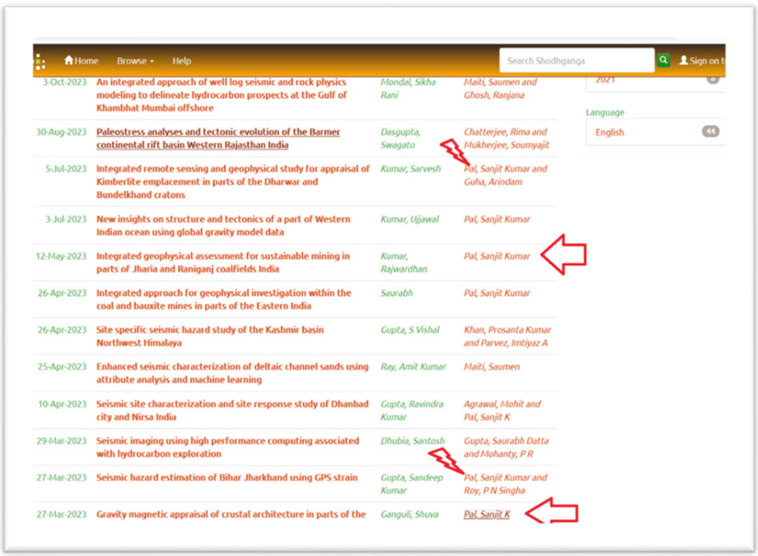


Fig. 6: List of Theses with Different Name Formats of the Same Guide Listed Under the Same Department.

Fig. 7: Guide's Name in Surname, Firstname Short Middle Name Format

If the guide co-supervised with another supervisor, the data entry method enlists his/her name with other guide/s and makes a single entity of all guides under whom the thesis was completed. The thesis will not be displayed under the single guide's name whenever a user tries to find all theses completed under the same guide name.

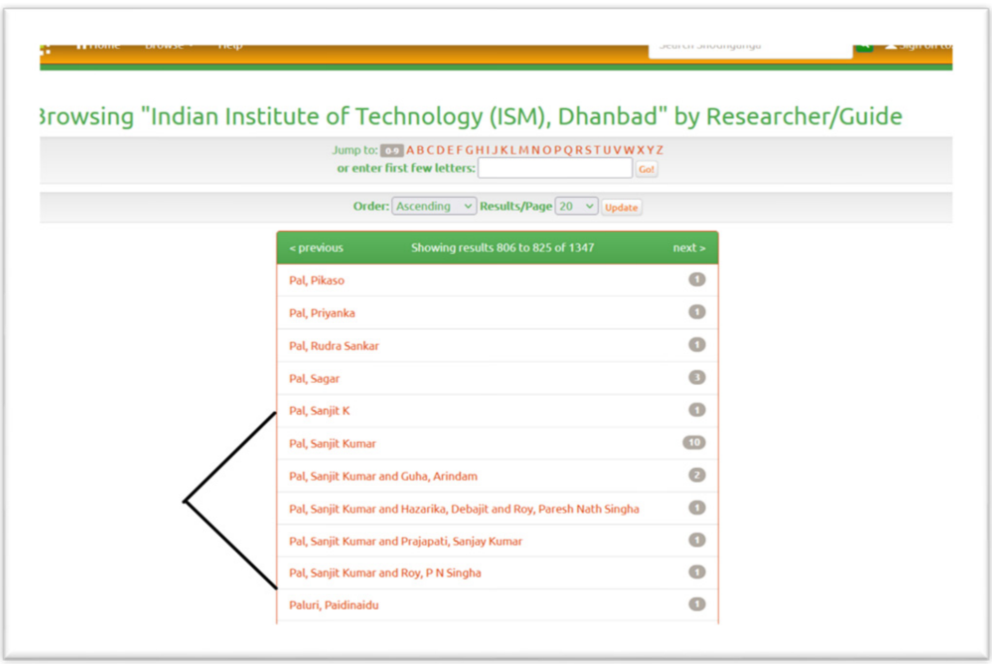


Fig. 8: Guide's Name in Different Formats with Co-Guides' Names

5. FUTURE WORK

The observations drawn from this study are limited to Indian case only. However, the result provides insights into maintaining uniformity in name element for other institutional repositories. Author checked Networked Digital Library of Theses and Dissertations (NDLTD). NDLTD displayed the guide's name in the contributors' field with (Internal/ Supervisor / Supervisor, Supervisor2) annotation. There is no consistency of name format either. It displayed like {J Andrew Large (Internal/Supervisor)}, {Beheshti, Jamshid (Supervisor)}, {France Bouthillier (Supervisor1), Pierre Pluye (Supervisor2)}, {Catherine Guastavino (Supervisor)}, {John E Leide (Internal/Supervisor)}, {Catherine Guastavino (Internal/Supervisor), John E Leide (Internal/Cosupervisor2)} etc. There is also no uniformity of name rendering. If any faculty member is a fellow of a reputed body, he/she inserts that in the surname field instead of name suffix because that facility is not available. Analysis of the name authority file of multiple national repositories would add more perspective.

6. CONCLUSION

Theses uploading in a centralized repository like Shodhganga enhances the reputation or goodwill of a particular institution for the better retrieving of resources as well as global visibility (Mandal 2019). However, metadata element, namely researcher's and guide's name in Shodhganga have a significant level of inconsistency and variation. The outcome of this study provides a comprehensive view of theses collection development process in a country like India where more than a thousand universities, near about hundred and fifty centrally funded technical institutes and research bodies are running PhD programs as a result publishing theses out of these processes. Different test cases and in-depth analyses show that it is not an easy task for a single organization like INFLIBNET to maintain the name authority file because faculty members and scientists change their organizations for various reasons. University or institute coordinators need to be more cautious and should make sure skilled catalogers are deputed while uploading thesis details in Shodhganga; it is comparatively easier from their end to maintain the name authority file for faculty members, industry experts and scientists as guides.

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डिजिटल पुस्तकालयः भारतीय राष्ट्रीय डिजिटल पुस्तकालय (एन.डी.एल.आई.) का अवलोकन

रीतेश कुमार साहू[1] और अजय कुमार शर्मा[2]

1.0 परिचय

डिजिटल युग ने सूचना संग्रहीत करने के तरीके में जबरदस्त बदलाव लाया है| इससे पुस्तकालयों की अवधारणा, उनका संग्रह और सेवाएँ में बदलाव आया है, यह तीन विशिष्ट विशेषताओं द्वारा चिह्नित है: प्रचुरता, नवीनता और आसान सूचना तक पहुंच। सूचना प्रौद्योगिकी में विकास ने पुस्तकालय की अवधारणा को प्रिंट और पेपर मीडिया से डिजिटल मीडिया में बदल दिया है। डिजिटल पुस्तकालयों की सफलता लाइब्रेरियन और सूचना अधिकारी के आधुनिक तकनीक के संबंध में कंप्यूटर, संचार कौशल के ज्ञान पर निर्भर करती है। वर्तमान परिदृश्य में, हम पारंपरिक पुस्तकालयों से वैश्विक डिजिटल पुस्तकालयों में परिवर्तन के दौर पर खड़े हैं। डिजिटल लाइब्रेरी की स्थिति में लाइब्रेरियन और सूचना अधिकारी की भूमिका बदल रही है। बदलते परिदृश्य के साथ लाइब्रेरियन और सूचना अधिकारी को डिजिटल लाइब्रेरी के विकास और प्रबंधन के लिए नए कौशल हासिल करने की आवश्यकता है।

1.1 डिजिटल लाइब्रेरी क्या है?

'डिजिटल लाइब्रेरी' एक विशेष लाइब्रेरी है जो मुख्य रूप से पुस्तकों का संग्रह डिजिटल या इलेक्ट्रॉनिक प्रारूप में करता है और पुनर्प्राप्ति पर केंद्रित रहता है| डिजिटल लाइब्रेरी, पुस्तकों तथा अन्य पठन सामग्री का इलेक्ट्रॉनिक संग्रह हैं | डिजिटल संग्रह विभिन्न प्रारूप का हो सकता है, उदाहरण के लिए, किताबें, टेक्स्ट, ऑडियो-वीडियो सामग्री, फोटोग्राफ वगैरह। डिजिटल लाइब्रेरी तक इंटरनेट या अन्य डिजिटल माध्यमों से पहुँचा जा सकता है तथा इलेक्ट्रॉनिक उपकरणों एवं कंप्यूटर के माध्यम से इसका उपयोग किया जा सकता है। डिजिटल लाइब्रेरी को ऑनलाइन लाइब्रेरी, इंटरनेट लाइब्रेरी, डिजिटल रिपॉजिटरी, या डिजिटल संग्रह के रूप में भी जाना जाता है। यह डिजिटल वस्तुओं का एक ऑनलाइन डेटाबेस है।

1.2 डिजिटल लाइब्रेरी की विशेषताएं

डिजिटल लाइब्रेरी इंटरनेट पर बहुत बड़ी बुकशेल्फ़ की तरह है। उनमें ढेर सारी किताबें, तस्वीरें और अन्य पठन सामग्री रखी जा सकती है। पारंपरिक पुस्तकालय केवल एक निश्चित मात्रा में ही पठन सामग्री रख सकते हैं क्योंकि उनमें जगह

[1] उप पुस्तकालयाध्य, मोतीलाल नेहरू राष्ट्रीय प्रौधोगिकी संस्थान इलाहाबाद, प्रयागराज ई-मेल:ritesh@mnnit.ac.in

[2] उप पुस्तकालयाध्य, मोतीलाल नेहरू राष्ट्रीय प्रौधोगिकी संस्थान इलाहाबाद, प्रयागराज ई-मेल:aksharma@mnnit.ac.in

ख़त्म हो जाती है। लेकिन डिजिटल लाइब्रेरी के साथ पठन सामग्री के लिए पर्याप्त जगह है। साथ ही, पारंपरिक लाइब्रेरी की तुलना में डिजिटल लाइब्रेरी की देखभाल करना सस्ता है क्योंकि डिजिटल जानकारी को रखने के लिए बहुत कम भौतिक स्थान की आवश्यकता होती है।

डिजिटल लाइब्रेरी की कुछ प्रमुख विशेषताएं हैं

- किताबें, टेक्स्ट, फोटोग्राफ, ऑडियो-वीडियो सामग्री, मल्टीमीडिया वगैरह और अन्य प्रकार के संसाधनों का डिजिटल रूप मे संगठित संग्रह है ।
- अधिग्रहण, भंडारण, संरक्षण, पुनर्प्राप्ति का कार्य डिजिटल प्रौद्योगिकी के उपयोग के माध्यम से किया जाता है।
- पूरे संग्रह तक पहुंच विश्व स्तर पर एक नेटवर्क में प्रत्यक्ष या अप्रत्यक्ष रूप से होता है।
- इलेक्ट्रॉनिक/डिजिटल साधनों आदि के माध्यम से किताबें, टेक्स्ट, ऑडियो-वीडियो सामग्री, फोटोग्राफ वगैरह के संगठन और प्रस्तुति में मदद करता है।

1.3 एक डिजिटल पुस्तकालय प्रणाली के लाभ

आधुनिक युग में डिजिटल पुस्तकालयों के फायदे विशाल और परिवर्तनकारी हैं । जिस तरह से हम जानकारी तक पहुंचते हैं और संलग्न होते हैं, उसमें क्रांतिकारी परिवर्तन लाते हैं। उपयोगकर्ता भौतिक सीमाओं और समय की बाधाओं को पार करते हुए दुनिया में कहीं से भी पठन सामग्रियों का पता लगा सकते हैं। डिजिटल पुस्तकालयों द्वारा नियोजित शक्तिशाली खोज क्षमताओं और उन्नत प्रौद्योगिकियां तेजी से और लक्षित सूचना पुनर्प्राप्ति को सक्षम करती हैं, जिससे मूल्यवान समय और प्रयास की बचत होती है।

डिजिटल लाइब्रेरी के कुछ प्रमुख लाभ

- **स्थान:** पारंपरिक पुस्तकालयों में भंडारण स्थान सीमित होती हैं जबकि डिजिटल पुस्तकालयों में बहुत अधिक जानकारी संग्रहीत करने की क्षमता है, क्योंकि डिजिटल जानकारी को उन्हें शामिल करने के लिए बहुत कम भौतिक स्थान की आवश्यकता होती है।
- **कोई भौतिक सीमा नहीं:** एक डिजिटल लाइब्रेरी के उपयोगकर्ता को भौतिक रूप से पुस्तकालय में जाने की आवश्यकता नहीं है। जब तक इंटरनेट कनेक्शन उपलब्ध है, तब तक दुनिया भर के लोग एक ही जानकारी तक पहुंच प्राप्त कर सकते हैं।
- **चौबीसों घंटे उपलब्धता:** डिजिटल पुस्तकालयों को किसी भी समय, 24 ×7 एक्सेस किया जा सकता है।
- **एकाधिक अभिगम:** एक ही समय में एक ही संसाधन का उपयोग कई उपयोगकर्ताओं द्वारा किया जा सकता है।
- **सूचना पुनर्प्राप्ति:** डिजिटल लाइब्रेरी उपयोगकर्ता के अनुकूल इंटरफेस प्रदान कराती है, जिससे अपने संसाधनों तक एक क्लिक करके पहुंच सकते हैं। उपयोगकर्ता पूरे संग्रह के शब्द या वाक्यांश के लिए किसी भी खोज शब्द का उपयोग करने में सक्षम है।

- **काम की पुनरावृत्ति को कम करता है:** डिजिटल लाइब्रेरी सॉफ्टवेयर की मदद से डुप्लिकेट प्रविष्टियों से बचाता है। जैसा कि सिस्टम प्रविष्टि का पता लगाता है और उपयोगकर्ता को दोहराव के बारे में सूचित करता है।

1.4 भारत के लिए डिजिटल पुस्तकालय नीति

सूचना प्रौद्योगिकी और सॉफ्टवेयर विकास संबंधी राष्ट्रीय कार्य बल (2003) ने देश में डिजिटल पुस्तकालयों के विकास के लिए कुछ बहुमूल्य सिफारिशें की हैं। इन सिफारिशों को सामग्री निर्माण और सामग्री उद्योग के लिए आई.टी. एक्शन प्लान (भाग III) के तहत रिपोर्ट में शामिल किया गया है।

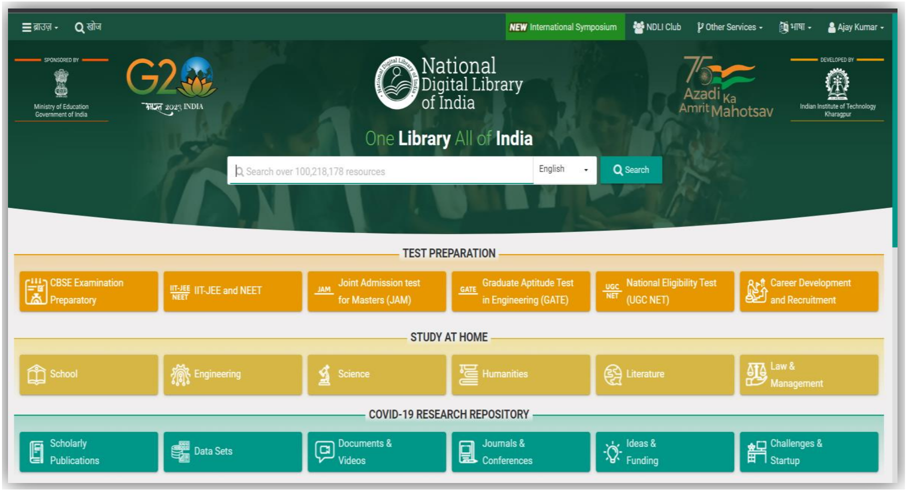
1.5 देश की प्रमुख डिजिटल लाइब्रेरी

- भारतीय राष्ट्रीय डिजिटल पुस्तकालय, आई.आई.टी. खड़गपुर।
- भारत का डिजिटल पुस्तकालय, भारतीय विज्ञान संस्थान, बैंगलोर, सी.डी.ए.सी. नोएडा, आई.आई.आई.टी. हैदराबाद।
- पारंपरिक ज्ञान डिजिटल लाइब्रेरी स्वास्थ्य और परिवार कल्याण मंत्रालय, भारत सरकार।
- इंदिरा गांधी राष्ट्रीय कला केंद्र, डिजिटल लाइब्रेरी, नई दिल्ली।
- विद्यानिधि मैसूर, मैसूर के सूचना विज्ञान विभाग का पुस्तकालय और डिजिटल पुस्तकालय।
- संसद डिजिटल पुस्तकालय, लोक सभा डिजिटल पुस्तकालय, भारत की संसद।
- शोधगंगा, इनफ्लिबनेट, भारत।
- भारतीय राष्ट्रीय विज्ञान अकादमी डिजिटल पुस्तकालय, आईएनएसए, भारत।

1.6 भारतीय राष्ट्रीय डिजिटल पुस्तकालय (एन. डी. एल. आई.)

भारत की राष्ट्रीय डिजिटल पुस्तकालय (एन. डी. एल. आई.) सभी उम्र और क्षमताओं के शिक्षार्थियों को सीखने में मदद करने के लिए शिक्षा मंत्रालय तब मानव संसाधन विकास मंत्रालय (एम. एच. आर. डी.) द्वारा शुरू की गई एक राष्ट्रीय मिशन परियोजना है।भारत का राष्ट्रीय डिजिटल पुस्तकालय ज्ञान और जानकारी का एक मिश्रण है जिसमें देश के सर्वश्रेष्ठ संस्थानों द्वारा क्यूरेट, संग्रहित और बनाए गए विभिन्न मीडिया रूपों में विभिन्न प्रकार के व्याख्यान, पाठ्यक्रम, अभिलेखागार हैं। यह सीखने को प्रेरित करने, सशक्त बनाने और प्रोत्साहित करने के लिए देश के सभी नागरिकों के लिए डिजिटल शैक्षिक संसाधनों को सुलभ बनाने के लिए बनाया गया एक मंच है।

भारत की राष्ट्रीय डिजिटल लाइब्रेरी सीखने के संसाधनों का एक आभासी भंडार है जो न केवल खोज/ब्राउज़ सुविधाओं वाला एक भंडार है बल्कि पाठ्यपुस्तकें, लेख, वीडियो, ऑडियो पुस्तकें, व्याख्यान, सिमुलेशन, कथा और अन्य सभी सेवाएं भी प्रदान करता है। शिक्षार्थियों/उपयोगकर्ता समुदाय के लिए अन्य प्रकार के शिक्षण मीडिया।



चित्र 1: एन.डी.एल.आई का वेब पेज।

- एन.डी.एल.आई. शिक्षा मंत्रालय तब मानव संसाधन विकास मंत्रालय (एम. एच. आर. डी.) द्वारा मई 2016 में शुरू की गई थी और जून 2018 में राष्ट्र को समर्पित की गई थी।
- यह परियोजना सूचना और संचार प्रौद्योगिकी के माध्यम से शिक्षा पर राष्ट्रीय मिशन (एन.एम.ई.आई.सी.टी.) के तत्वावधान में है।
- इसका विकास और रखरखाव आई.आई.टी. खड़गपुर द्वारा किया जा रहा है।
- उपयोगकर्ता राष्ट्रीय डिजिटल पुस्तकालय का उपयोग weblink- https://ndl.iitkgp.ac.in/ कर सकते हैं।
- प्राथमिक से स्नातकोत्तर तक के उपयोगकर्ताओं के विभिन्न स्तरों के लिए प्रासंगिक सामग्री एनडीएलआई पर उपलब्ध है।
- एन. डी. एल. को छात्रों (सभी स्तरों के) शिक्षकों, शोधकर्ताओं, लाइब्रेरियन, पुस्तकालय उपयोगकर्ताओं, पेशेवरों, अलग-अलग सक्षम उपयोगकर्ताओं और अन्य सभी आजीवन शिक्षार्थियों जैसे सभी प्रकार के उपयोगकर्ताओं को लाभान्वित करने के लिए डिज़ाइन किया गया है।
- 60 से अधिक प्रकार के शिक्षण संसाधन उपलब्ध हैं। जैसे पुस्तकें, लेख, पांडुलिपियाँ, वीडियो व्याख्यान, ऑडियो व्याख्यान, थीसिस, प्रस्तुति आदि।
- 100 से अधिक भाषाओं में सामग्री उपलब्ध हैं।
- रिपॉजिटरी प्रौद्योगिकी, विज्ञान, मानविकी, कृषि और अन्य जैसे कई विषय डोमेन से सामग्री होस्ट करता है।
- विभिन्न विषय क्षेत्रों के लिए सामग्री उपलब्ध हैं। जैसे प्रौद्योगिकी, कला और मानविकी, सामाजिक विज्ञान, प्राकृतिक विज्ञान आदि।
- रिपॉजिटरी विभिन्न भारतीय और अंतर्राष्ट्रीय संस्थागत रिपॉजिटरी से सामग्री को एकीकृत करता है।

- निरंतर बढ़ते डिजिटल सामग्री भंडार के लिए एकल खिड़की खोज सुविधा।
- उपयोगकर्ताओं को लॉगिन के लिए उपयोगकर्ता आईडी और पासवर्ड के साथ पंजीकरण करने की आवश्यकता है।

1.7 एन.डी.आई.एल. में संसाधनों के प्रकार

अधिकांश डिजिटल पुस्तकालयों में ई-पुस्तकें, इलेक्ट्रॉनिक पत्रिकाएं, इलेक्ट्रॉनिक पत्रिकाएं और अन्य पारंपरिक सामग्री डिजिटल रूप में होती है। हालांकि, एन.डी.एल.आई. में पारंपरिक वस्तुओं के साथ-साथ विभिन्न प्रकार की अन्य डिजिटल सामग्री जैसे एप्लिकेशन, सिमुलेशन, एनिमेशन, डेटासेट और अन्य प्रकार की डिजिटल सामग्री के लिए डिजिटल सामग्री शामिल है जो पहले एकल डिजिटल लाइब्रेरी द्वारा कवर नहीं की गई थी।

1.8 एन.डी.आई.एल. में विभिन्न संगठनात्मक स्रोत

एन.डी.एल.आई. में एन.पी.टी.ई.एल., एन.सी.ई.आर.टी., साउथ एशिया आर्काइव, ओ.ई.सी.डी. लाइब्रेरी, लिब्रीवॉक्स, कृषिकोश - भारतीय राष्ट्रीय कृषि अनुसंधान, इनफ्लिबनेट - एन-लिस्ट-ऑफोर्ड स्कॉलरशिप ऑनलाइन, सत्यजीत रे सोसाइटी, वर्ल्ड ई-बुक लाइब्रेरी, आई.आई.टी. के संयुक्त प्रवेश बोर्ड और इंजीनियरिंग में ग्रेजुएट एप्टीट्यूड टेस्ट जैसे संगठनात्मक संसाधन शामिल हैं। विश्व ई-बुक लाइब्रेरी में बड़ी संख्या में आइटम हैं और पहले स्थान पर हैं।

टेबल 1: एनडीएलआई में दस्तावेजों के स्रोत।

स्रोत	**दस्तावेजों की संख्या**
एन.पी.टी. ई. एल. (NPTEL)	223503
एन.सी.ई.आर.टी. (NCERT)	5806
साउथ एशिया आर्काइव (South Asia Archive)	29969
ओ.ई.सी.डी. आई-लाइब्रेरी (OECD iLibrary)	102017
लिबरी वोक्स (LibriVox)	206672
कृषि कोष (Krishi Kosh)	138322
शोधगंगा (Shodhganga)	390295
शोध-गंगोत्री (Shodhgangotri)	1930
वर्ल्ड ई-बुक लाइब्रेरी (World eBook Library)	7526581
ब्रिटिश कॉउन्सिल (British Council)	656861
	अन्य और..

(स्रोत: 10/11/2023 को एनडीएलआई वेबसाइट से लिया गया)

1.9 भारतीय राष्ट्रीय डिजिटल पुस्तकालय लाइब्रेरी तक कैसे पहुंचें

- उपयोगकर्ता वेबसाइट के माध्यम से राष्ट्रीय डिजिटल लाइब्रेरी तक पहुंच सकते हैं- https://ndl.iitkgp.ac.in/
- एंड्रॉइड फोन के लिए एन.डी.एल.आई. मोबाइल ऐप से पहुंचा जा सकता है। https://play.google.com/store/apps/details?id=com.mhrd.ndl&hl=en/
- एन.डी.एल. प्रणाली सामान्य ब्राउज़िंग के लिए सभी उपयोगकर्ताओं के लिए सुलभ है। हालाँकि, कुछ वर्गीकृत सामग्रियों तक पहुँचने के लिए किसी को उपयोगकर्ता आई.डी. और पासवर्ड के साथ पंजीकरण करना होगा और उनका उपयोग करके लॉगिन करना होगा।

संदर्भ

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4. **दास, पी.पी., भौमिक, पी.के., सरकार, एस., गुप्ता, ए., चक्रवर्ती, एस., सूत्रधार, बी., चट्टोपाध्याय, एस., चट्टोपाध्याय, एन.जी. (2016)। राष्ट्रीय डिजिटल पुस्तकालय: भारत में शिक्षा और अनुसंधान में प्रतिमान बदलाव के लिए एक मंच। विज्ञान और संस्कृति, 82, 4-11।**

SUBJECT AND RESEARCH SUPPORT SERVICE USING SUBJECTSPLUS: WITH SPECIAL REFERENCE TO TEESTA-INDUS CENTRAL LIBRARY, SIKKIM UNIVERSITY

Dr. Sujit Kujur[1] and Ajay Kumar Sharma[2]

ABSTRACT

The visibility of library collections, especially e-resources, is an essential feature of library websites for the proper utilization of available resources. Subject guides or research guides are essential in ensuring such visibility and usability. They bridged the gap between library resources and users in finding the recorded information resources on a topic/subject of interest. SubjectPlus is an open-access software that is a tailor-made platform for library resources. The present paper highlights the salient features of SubjectPlus, its implementation in the library website in the context of Teesta-Indus Central Library, Sikkim University (SU) and the different services provided among the various user groups.

Keywords: *SubjectPlus; Open-Source Software; Subject Guide; Information Management Tool; Subject Support; Research Support; Teesta-Indus Central Library; Sikkim University*

1. INTRODUCTION

The mission of the Testa-Indus Central Library is *"To provide quality resources and services which facilitate lifelong learning"*. To achieve the mission of Central Library, Sikkim University introduced SubjectPlus, a tailor-made platform for library resources that is the most convenient for users. The university offers 33 courses at different levels, such as UG / PG / PhD (*Prospectus 2022-23 for Certificate, UG & PG*, n.d.). All the resources are divided into three main divisions considering the types of users, i.e. students (UG / PG), researchers (MPhil / PhD) and Faculty and Staff. It is user-friendly, and most of the relevant resources and information related to the course are arranged from the available resources as well as resources from different sources such as library catalogues, e-resources, documentaries, lectures, etc.

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In the later part, these will be discussed in brief. All the efforts are to facilitate the users of the library services in the best possible way in no time.

2. OBJECTIVES OF THE STUDY

The present paper concentrates on the subject and research support services by Teesta Indus Central Library, Sikkim University, via the SubjectPlus platform (Open-Source Tool). The main objective is as follows:

2.1 Advocating to introduce SubjectPlus as a CMS for the library website.

2.2 Identify the benefits of the tool.

2.3 How does Teesta-Indus Central Library, Sikkim University implement the tool, and what are the different subjects and research support services covered?

3. ABOUT TEESTA-INDUS CENTRAL LIBRARY, SIKKIM UNIVERSITY

The Teesta-Indus Central Library, the heart of the university, is dedicated to providing materials to supplement teaching and learning. The Central Library has a floor area of about 1000 sq. ft and can accommodate about 80,000 plus books. University, right from its inception, has a priority to build up a sound university library equipped with adequate resources and services that take care of any academic and research work. The central library has met the vision of the university and presently provides all the resources and services that are essential for any teaching, learning, and research process (Central Library, n.d.).

The library is fully automated and equipped with the latest IT Infrastructure such as an Integrated Library Automation System (KOHA), Radio Frequency Identification (RFID) for material management and movement, an Institutional Repository (DSpace) for management of in-house publications, theses, and dissertations, Faculty Publication Profile (IRINS) for showcasing the research strength, Remote Access for accessing resources off-campus, and Plagiarism Detection System and so on. The library is comparable to any other old university library in the country so far as modernization and infrastructure facilities are concerned. The library is quite active in extending research support services through adopting web-based services and systems.

Up-to-date Online Public Catalogue is web-enabled with the facilities of online reservation, renewal of issued books, recommendations for purchase of books, and daily notification of new arrival of books. All collections are RFID tagged to facilitate users' independence in returning and issuing books. The whole library premises are Wi-Fi enabled with excellent connectivity speeds. For security purposes, all the floors of the library are fitted with CCTV with an electronic exit (Central Library, n.d.).

4. WHAT IS SUBJECTPLUS?

The SubjectPlus is a free and Open Source tool to manage several interrelated parts of a library website (Andrew, 2011) by creating subject guides developed by Ithaca College Library, USA, but currently, the University of Miami Libraries continue it. Basically, it is a content management tool like Drupal, Joomla, etc. SubjectPlus allows compiling library resources on a specific topic from the subscribed and open-access collection. The subject guide maps to the library resources; at the same time, it helps the users find the recorded information resources on a topic/subject of interest (Pandurangaswamy, 2019). SubjectsPlus is designed to manage three aspects of a library Web site dynamically. It allows librarians to maintain subject guides, A-Z database lists, and a staff list that is sortable by department and subject specialist. It is possible for librarians to easily add resources of all kinds (even including subject specialists) to subject guides. It is built using PHP and a MySQL backend (Corrado & Frederick, 2008).

In India (Rahaman et al., 2017), very few institutions have implemented SubjectPlus, such as IIT Gandhinagar, ISI Delhi, Pondicheery University, NIT Rourkela, etc.

5. FEATURES OF SUBJECTPLUS

There are lots of advantages of using the Subject Plus or Subject Guide, some of which are as follows (Pandurangaswamy, 2019) **:**

5.1 The subject guide maps to the library resources; at the same time, it helps the users to find the recorded information resources on a topic/subject of interest. The main idea for this is to provide a starting view to the library patrons.

5.2 When the research topic is chosen, for further in-depth information purposes, users can visit the library via personal, telephone, live chat, e-mail or social media sites and library resources are compiled by library staff on a specific topic from the subscribed and open access collection in a library.

5.3 Using subject guides, library staff can answer frequently asked questions (FAQ) on a popular subject or topic.

5.4 Patrons can find various formatting information through the subject guide, i.e., numerical, graphs, videos, text, etc., at one point on a specific topic/subject.

5.5 Subject guides offer a unique tool for the user seeking information, as well as offering the creator of the subject guide the opportunity to become more familiar with the subject area.

5.6 SubjectsPlus has a community (the SubjectsPlus wiki) of users and developers actively improving and extending the application (Moses & Richard, 2008).

6. ADVANTAGES OF IMPLEMENTING SUBJECTPLUS

SubjectsPlus allows the management of many types of library website content, including subject guides, staff and database lists, FAQs, suggestion boxes, and video lists ("SubjectsPlus," n.d.). SubjectPlus can be justified with its advantages by certain issues, which makes it unique from other similar kind of platforms such as:

6.1 SubjectsPlus is a user-friendly, open-source content management system for information sharing.

6.2 It provides tools to create information-rich subject guides, organize curated content for specific audiences in or around a research topic, and develop and manage library websites.

6.3 Offers a robust toolbox: Use it as your library's home page, create a quick reference FAQ list, maintain dynamic staff and database lists, add suggestions or catalogue search boxes, and much more.

6.4 Gives library staff an easy-to-use interface for creating web content without web design experience.

6.5 It also offers flexible options for advanced users to include theming and functionality via SubjectPlus' add-on widgets.

6.6 As an open-source product, it is flexible, customizable, and more affordable than proprietary alternatives.

6.7 SubjectsPlus is purely web-based - no client is required.

6.8 There is never a licensing fee to use the software. The code is open and distributed under the General Public License (GPL) version 2 or later.

6.9 There is an option to use SubectsPlus and to choose a vendor or no vendor at all. Because there is no need for a license to use SubjectsPlus, one can install and host it on one's own or contract with any vendor for the services in need.

6.10 There is the SubjectsPlus Community, which is backed by a global community of librarians and developers.

7. SYSTEM REQUIREMENTS IN INSTALLATION

SubjectPlus is licensed under the GNU General Public Licence. SubjectPlus supports Windows as well as the Linux Operating System platform. The server package XAMPP (Windows) / WAMPP (Linux) may install or applications may install separately as follow (Kujenga, 2012):

- Web Server (Apache- recommended) or Internet Information Services (IIS)
- MySQL
- PHP
- JavaScript for administration backend
- Permission to create a new MySQL database

After the setup of the server, the steps to be followed (*SubjectsPlus: Take Control of Your Library Data*, n.d.)

- Download SubjectPlus from the website https://www.subjectsplus.com/ and put it on the webserver.
- Create a new empty MySQL database and user with Select, Insert, Update, Alert and Delete privileges.
- Visit the control/folder with the browser.
- Follow the simple instructions.
- For more detailed instructions, read me and the SubjectPlus wiki.

8. IMPLEMENTATION OF SUBJECTPLUS IN TESTA-INDUS CENTRAL LIBRARY, SU

Teesta-Indus Central Library, Sikkim University, has good resources in its collection, both in print and electronic form. In present technological advancement, information is vital for everyone, especially for students, researchers, and faculty. Due to the time constraints and the stress of completing them

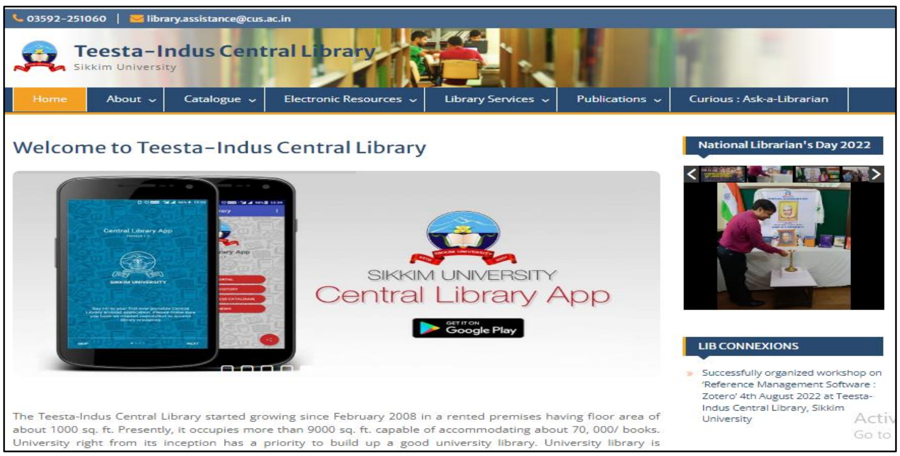

Fig. 1: Homepage of Testa-Indus Central Library

research on time, they want pinpoint information on clicks. The library, as an information provider, plays a vital role in anticipating users' needs and designing tailor-made information to satisfy user requirements and deliver them on time. To meet all the user's requirements Teesta-Indus Central Library introduced the SubjectPlus platform to manage and integrate all the possible resources, such as the Library catalogue, subscribed e-resources, academic video lectures, tutorials, open source e-resources, web links, etc., in a most convenient way.

On the landing webpage of the Testa-Indus Central Library (https://library.cus.ac.in/), the SubjectPlus service is under the menu Library Services. The entire library resources and services are tailored according to the user's group and divided into three parts as follows:

a. Library Services for Study: Targeted for UG / PG Students/ Faculties
b. Library Services for Research: Targeted for MPHIL / Ph.D. Scholars/ Faculties
c. Library Services for Teaching: Targeted for Faculties

9. SUBJECT SERVICES FOR STUDY (UG/PG STUDENTS) / FACULTIES

The Library Services for Study includes six tabs to provide users with Subject / Research Support Services. The six tabs are as follows:

Fig. 2: Subject Guide for UG / PG Students

9.1 Library Catalogue

This helps users to become aware and guide how to use Library Catalogue (http://opac.cus.ac.in), search facility by different approaches (Title / Author / Subject / ISBN, etc.), how to borrow a book, and how to bring the books on loan from any libraries in India through DELNET, etc.

9.2 Library Services

This tab guides the users on how to avail of all the services of the library, like recommendations of books from students or faculty, floor guides, shelve guides, FAQs, access resources, Digital Resources Repositories, etc. and many others.

9.3 Competitive Examination Resources

Teesta-Indus Central Library has a good collection of the different competitive examinations so that the students may get benefits if they wish to appear in the competitive exams such as UPSC, GATE, Banking, NET, PCS, GRE, GMAT, ICAR, and other examinations. The list of Competitive Books is arranged under the different types of examination.

9.4 Remote Access

Under the Remote Access tab, it is guided on how to access the library's electronic journals, e-books, databases, etc., from outside of the Sikkim University Campus Network. A video guide to use remote access and a common user manual help users get the steps to follow for remote access. Also mentioned are the e-resource-wise steps for institutional IDP login.

9.5 Subject Guides

This tab is the most important and anticipated page where resources are tailored as the Library's Subject Guides for each department (32) of the Sikkim University (*Sikkim University*, n.d.). It is designed to help in finding information and accessing relevant materials for the departments. All the 32 departments are listed according to alphabetical order; once you click on any department from the list, all the relevant information and resources will open to explore in one place under five tabs: a) About; b) Database; c) Electronic Journals; d) Video Lectures; e) Encyclopaedias.

Library resources are compiled subject-wise from a library's subscribed and open-access collection. It is designed to answer Frequently Asked Questions (FAQs)

Fig. 3: Department-wise Subject Guide

on a popular subject or topic. Subject guides offer a unique tool for the user seeking information, as well as offering the creator of the subject guide the opportunity to become more familiar with the subject area (Pandurangaswamy, 2019).

9.6 Need Assistance

Any assistance relating to the use of library resources and any query relating to the library can be asked by any user. For the different types of queries, different library staff are devoted to taking the query and response in the minimum time.

10. LIBRARY SERVICES FOR RESEARCH (MPHIL / PHD SCHOLARS) / FACULTIES

In this group, all the possible resources relevant to researchers are clubbed into different tabs, such as research-oriented databases, resources, applications tools and guides, which are very useful for research scholars.

The Library Services for Research (for MPhil / PhD scholars) includes twelve tabs to provide Subject / Research Support Services, and the tabs are as follows:

10.1 Research Database

A list of databases is sorted according to the subjects. These databases are subscribed (like Web of Science, MathSciNet, JSTOR, etc) and unsubscribed (like PubMed, AnthroSource, etc.) for open access etc. The databases are further expanded with their basic description. It is also categorized according to alphabetical order and can be further filtered.

10.2 Reference Management

It explains the importance of reference management, citation guides, and the guide to using the two worldwide reference management software/tools: ZOTERO and MENDELEY. Many researchers benefit from the service.

10.3 Copyright & Patents

To make aware and fair use of the academic resources and proper understanding of the copyright, patents, and the creative commons, the section is very useful. It is well defined with the explanation and possibly all the relevant information such as concept, patent office, how to apply for IPR, etc.

10.4 Research Consultation

In this section, the role of a librarian is highlighted by helping researchers in finding different resources relating to their research. For the said purpose, the researcher may fix a meeting with a librarian, and the librarian provides the consultation in searching the resources in all the possible ways to resolve the actual problem faced by a scholar. For instance, the librarian may provide recommended databases and grey literature sources, teach strategies for identifying searches, if necessary, invite external experts to take a session, Organize Author Workshops, Writing Workshops, Training on the use of different tools such as reference management software and many similar consultations.

10.5 Library Catalogue

It is a similar service as mentioned in “Service for Study”, applicable for all kinds of users.

10.6 Thesis and Dissertation Digital Repository

In this section, the entire awarded Thesis (PhD) and Dissertation (MPhil) (access through LAN only) from Sikkim University and the digital collection are showcased and parallelly linked for the Shodhganga (A reservoir of Indian Theses) are also provided.

10.7 Plagiarism Detection

The Central Library has access to DrillBit plagiarism checker through the INFLIBNET Centre, Ahmedabad. The software is available for use by all the faculty of Sikkim University (*Plagiarism Detection Software*, n.d.). This section briefly mentions all the information related to the concept of plagiarism, the kinds of plagiarism, how to avoid it, and UGC guidelines regarding plagiarism.

10.8 Remote Access

Sikkim University provides its users with the ability to access the e-resources subscribed, such as e-books, e-journals, e-databases, etc., while accessing from a campus network. This is the extended facility for users to be connected with the library wherever they go and do their research work uninterruptedly. The library provides login credentials for remote access only to university users. Sikkim University provides access to electronic resources off campus through the Indian Access Management Federation (INFED) and INFLIBNET.

10.9 Literature Review

For the researcher, a very important portion is writing a good literature review. This section is designed to offer guidance for completing a literature review by linking with resources, techniques, and advanced approaches to conducting and writing a literature review.

10.10 Academic Visibility & Research Network

This page is meant to provide information about promoting the research activities so that the research becomes visible to peers. In other words, it can be said that researcher are involved in publishing their academic works, and those are to be visible properly. They must be known by the other subject expert groups. This page provides guidelines on how a researcher can use different platforms where he may be academically visible and connect with research groups such as Google Scholar, ORCID iD and IRINS (*Academic Visibility and Research Network*, n.d.).

10.11 Writing a Research Paper

It is observed that researchers always need guidance and suggestions for writing their research papers at every stage of their research work. In this section, various principles and steps are discussed to help researchers write a good research paper.

10.12 Fellowships, Scholarship & Funding

There are various agencies, government bodies, societies, etc., that offer funding and scholarships for conducting research work, which the researchers should know. This page provides various scholarships, fellowships and fund provisions offered by the UGC, ICSSR, DST/DBT, DAAD (*Scholarships, Fellowships & Funding*, n.d.).

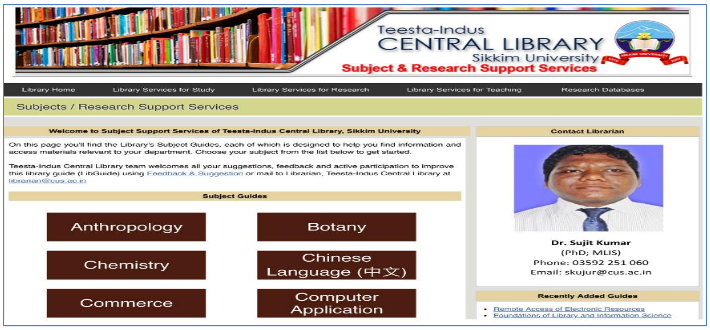

Figure 4: Subject Guide for Researchers

This section is very informative for the researcher, and the effort is to help researchers not only by providing links or referring resources but also by helping scholars complete their research work in the most suitable way, self-directed and within the targeted time frame. Every researcher must need assistance in writing their thesis, dissertation, article, and others for the purpose. Some suitable suggestions and software are mentioned under 'Reference Management', 'Research Consultation' and 'Writing a Research Papers'. Likewise, many resources and guides are covered in this section.

11. LIBRARY SERVICE FOR TEACHING (FACULTIES)

This category is devoted for the teaching and learning group. In this group, different platforms are linked where the academic digital content is available and also downloadable, such as NPTEL, ePGPathshal, SwayamPrabha, Diksha, etc.

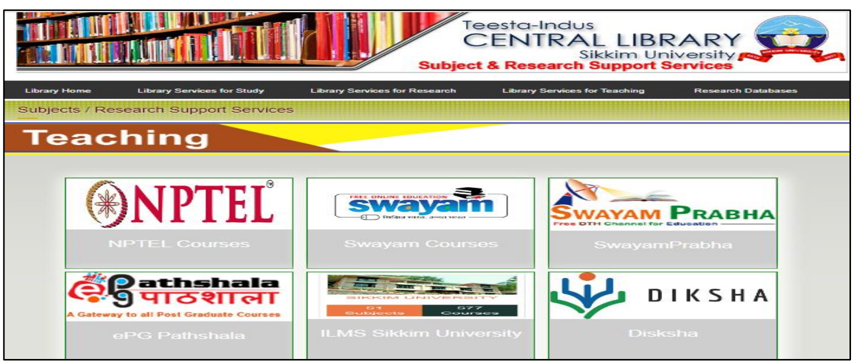

Figure 5: Subject Guide for Teachers

Not only this but various platforms are linked where online courses can be done, such as Swayam courses. Sikkim University is also developing its own ILMS.

12. CONCLUSION

Teesta Indus Central Library, Sikkim University, holds a good number of e-resources in its collection, and through its website, the entire collection can be accessed, even by the library apps. The library service on the library website incorporated the entire e-resource of the university. Though SubjectPlus was implemented very recently and is still in the developing stage, very positive responses were received by the users. As encouraged by the government, open access software SubjectPlus can be an option for developing the content management system (CMS). The installation and designing of websites is simple, and for any problems, a global community of Librarians and Developers, blogs, wikis, etc., are there to provide solutions.

SubjectPlus has very dynamic features and support systems; it is also open source and does not require any web designing language. Librarians may opt for it as a choice to develop user-friendly websites for the greater visibility of their collections.

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EBLT – 2024

EVIDENCE BASED LIBRARY TRANSFORMATIONS

QUALITY SERVICES FOR NEXTGEN USERS

ABOUT THE BOOK

Libraries play a crucial role in higher education, serving as essential hubs for learning, research, and academic development. They provide access to information, cultivate critical thinking, offer quiet study spaces, and serve as community hubs. The roots of the Library practice go up to the 7th Century BC and are considered the warehouse of knowledge. Before the invention of printing technology, books were chained to shelves to preserve information as books were produced by hand. Printing technology brought the first revolution in the Libraries to adopt open access systems and book lending services in the Libraries. However, with the advent of ITC, libraries have witnessed tremendous change over the past few decades in the number of forms of information publishing and ever-changing users' expectations, especially by Gen Z members. Thus, with every passing year, libraries started adopting new technologies or tools for smooth and improvised library services. Libraries are the very first to open up to adopt new technological developments to provide innovative services. This book is the academic outcome of the conference with an emphasis on evidence-based services to adapt to ever-changing user expectations and demands. The published papers have a different approach to recording the various developments, best practices and potential of innovative library services with contemporary issues and services.

ABOUT EDITORS

Dr. Jitendra Kumar has a PhD in Library and Information Science from the University of Burdwan, West Bengal. He has done his MLISc from the University of Delhi and BLISc from the Jamia Millia Islamia, New Delhi. His Graduation is from the Banaras Hindu University. He is currently a Deputy Librarian at the Indian Institute of Petroleum and Energy, Visakhapatnam. He has more than 14 years of experience in the library profession.

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