

Transforming **LIBRARIES THROUGH RESEARCH DATA MANAGEMENT**



Policies



Practices



Innovations



Foreword By :
Prof. (Dr.) S. D. Vyas

Editors

Praveen Babel

Manish Sharma

Pawan Tripathi

TRANSFORMING LIBRARIES THROUGH RESEARCH DATA MANAGEMENT

POLICIES, PRACTICES, AND INNOVATIONS

TRANSFORMING LIBRARIES THROUGH RESEARCH DATA MANAGEMENT

POLICIES, PRACTICES, AND INNOVATIONS

Edited by

Dr. Praveen Babel

Faculty & Librarian

Faculty of Management Studies (WISDOM Library)
Banasthali Vidyapith, Rajasthan, India

Manish Sharma

Assistant Librarian

Govt Dental College & Hospital, Patiala
DRME, Punjab, India

Pawan Tripathi

Librarian

Daulat Ram College, University of Delhi
India



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DEDICATION

Dedicated to
BHARAT MATA

The eternal mother of knowledge, wisdom, and inspiration

May her spirit of learning, truth, and service continue to
guide every scholar in the pursuit of knowledge and the
progress of our nation.

FOREWORD

I am pleased to write a foreword for the following book, Transforming Libraries Through Research Data Management: Policies, Practices and Innovations. Edited by Dr. Praveen Babel, Mr. Manish Sharma and Mr. Pawan Tripathi. Government of India introduced New Education Policy in 2020, and since then our higher education libraries have been playing an important role in transforming libraries. Information and knowledge should be available free to present generation who are engaged in education, research and development. It has always been a dream of free library service since the days of Dr. S. R. Ranganathan. We appreciate that the international agencies are engaged in preventing wastage of research data, and have given the idea of Research Data Management (RDM). India is contributing to the international storage of RDM. Moreover, all our academic libraries have almost reached to the stage of hybrid libraries. There is now proper balance of print resources and electronic databases. According to the Registry of Research Data Repositories worldwide till August 2022, out of 2938, India had 50 research data repositories in the Registry which accounts to 5.8 per cent of India's contribution. We need to contribute more in this area of research.

The Chapters of the book are well written and conclusions drawn with full bibliographical references of journals, books, and conference proceedings.

All chapters are grouped in the following sections:

1. Foundations and Framework of Research Data Management (RDM)
– Three Chapters
2. Policies, Ethics and Legal Dimensions – Three Chapters
3. Data Management, Planning, and Implementation – Five Chapters
4. Technology, Tools and Innovations – Three Chapters

5. Specialized Applications and Case Studies – Two Chapters

6. Data Visualization and Analytics – Two Chapters

I appreciate and compliment the efforts of the editors: Dr. Praveen Babel, Mr. Manish Sharma and Pawan Tripathi. Dr. Praveen Babel did his research under my guidance more than a decade back. I have been watching his career with interest since 2000 when he joined Banasthali University. With his hard work and dedication, he has taken up the responsibility of teaching Library and Information Science, and guiding research in the University besides supervising the library of WISDOM Institute of Management. I congratulate him for taking up more professional responsibilities. I wish him all success.

I am confident that readers will find the book useful on the subject of transforming libraries through Research Data Management which covers the other aspects as mentioned in the above group of the chapters.



Prof. (Dr.) S. D. Vyas

Former University Librarian
Banasthali Vidyapith

446, I7E Sector Chopsani Housing Board,
Jodhpur



PREFACE

The book *“Transforming Libraries Through Research Data Management: Policies, Practices, and Innovations”* brings together diverse perspectives on how libraries are evolving and adapting to the rapidly changing research environment shaped by data-intensive and digital technologies.

Research Data Management (RDM) has over the past years been seen as an essential part of academic and scientific investigation. Libraries have become central in supporting the work of the researchers by providing careful data planning, systematic arrangement, long-term maintenance, facilitation of access, and sharing ethically.

This edited book compiles thought-provoking works by scholars, researchers, and practitioners, thus providing a conceptualisation of the topic and practical information about how RDM services can be implemented in various library settings. The chapters in totality highlight novel practices, technological interventions, and policy frames that support the role of the library in the wider research ecosystem.

We are thankful to **Prof. (Dr.) S. D. Vyas Sir** for his gracious contribution in writing the Foreword to this book and for his kind encouragement during its preparation.

We are deeply grateful to the contribution of all contributors to this valuable chapter and their unyielding commitment to this scholarly project. We also expect the volume to be a useful resource to library practitioners, research scholars and students, and to encourage further research, collaboration and innovation in the Library and Information Science community.

— **Editors**

Praveen Babel
Pawan Tripathi
Manish Sharma

ACKNOWLEDGEMENT

The editors would like to express their heartfelt gratitude to all chapter contributors whose comprehensive and punctual contributions made this edited volume possible. Their expertise and experiences in their respective fields of work, as well as their innovative ideas, have greatly contributed to the depth of intellectual and general quality of this book.

We express our heartfelt gratitude to the Almighty **God** for His divine blessings and guidance throughout this academic journey. We also wish to sincerely thank the institutional authorities, colleagues and reviewers who supported and provided constructive criticism during the editorial and review process.

Special thanks to **PDP Beacon Publications** for their valuable support in bringing this book to publication. We also express our heartfelt gratitude to **Late Pandit Pawan Dadhich (Pilibanga)**, whose blessings and inspiration continue to guide our academic path. We are deeply thankful to **Prof. (Dr.) S. D. Vyas Sir**, who graciously spared his valuable time to write the **Foreword** for this book.

We would like to thank our families, friends and professional people who have always provided us with the support, of which we have been constantly in need in this academic experience.

The book is a collective work by all professionals, researchers and scholars in libraries to further the Research Data Management (RDM) and to also revolutionize the future landscape of libraries.

— **Editors**

Praveen Babel
Pawan Tripathi
Manish Sharma

LIST OF CONTRIBUTORS

Sr No	Name of Contributor	Designation	Affiliation
1	Mr. A. Muthuraj	Assistant Librarian	Veterinary College and Research Institute, Theni, Tamil Nadu, India
2	Mr. Angshuman Thakuria	Student	Department of Library and Information Science, Gauhati University, Assam, India
3	Mr. Anil Rathod	Librarian	Malwa Institute of Science & Technology, Indore, Madhya Pradesh, India
4	Mr. A. Srikanth H. G.	Librarian; Ph.D. Research Scholar	Soundarya Institute of Management & Science, Bengaluru; CMR University, Karnataka, India
5	Mr. Chintam Sarma	Student	Department of Library and Information Science, Gauhati University, Assam, India
6	Mr. Istayaque Ahmad	Ph.D. Research Scholar	Department of Library and Information Science, Banasthali Vidyapith, Tonk, Rajasthan, India
7	Ms. Jaya Singh	Ph.D. Research Scholar	Department of Library and Information Science, Banasthali Vidyapith, Tonk, Rajasthan, India
8	Mr. Karrin Satija	B. Tech (CSE) Student	Thapar University, Patiala, Punjab, India

9	Ms. Manmeet Kaur	Assistant Librarian	Uttarakhand Sanskrit University, Haridwar, Uttarakhand, India
10	Ms. Mansi Chaudhary	Librarian	Maxfort School Rohini, Delhi, India
11	Mr. Megh Raj Meena	Library Assistant	Central Library, MPUAT, Udaipur, Rajasthan, India
12	Mr. Nandan Singh	Assistant Librarian	IIHMR University, Jaipur, India
13	Ms. Pratibha Kathait	Library Clerk	Shahid Jagdish Purohit Degree College, Nandanagar, Chamoli, Uttarakhand, India
14	Dr. Praveen Babel	Faculty & Librarian	Faculty of Library and Information Science, Banasthali Vidyapith, Rajasthan, India
15	Ms. Priyanka Tripathi	Ph.D. Research Scholar; Assistant Librarian	Banasthali Vidyapith, Rajasthan, India; Integral University, Lucknow, Uttar Pradesh, India
16	Mr. Rajesh N. Bhatt	Librarian	GIDC RAJJU Shroff ROFEL Institute of Management Studies, Vapi, Gujarat, India
17	Dr. Rajkumar Bhakar	Professor	JJT University, Churela, Jhunjhunu, Rajasthan India
18	Dr. Sarita Ola	Associate Professor	JJT University, Churela, Jhunjhunu, Rajasthan India

19	Mr. Satvik Arora	BDS Student	Government Dental College and Hospital, Patiala, Punjab, India
20	Ms. Seema Kumari	Assistant Librarian	IIHMR University, Jaipur, India
21	Dr. Seema Sharma	Chief Librarian & Head	NC Medical College & Hospital, Panipat, Haryana, India
22	Dr. Shraddha Kalla	Librarian	IIHMR University, Jaipur, India
23	Dr. Shinder Pal Kaur	Library Assistant	Baba Farid University of Health Sciences, Faridkot, Punjab, India
24	Mr. Snehasish Paul	Ph.D. Research Scholar	Department of Library and Information Science, University of Delhi, India
25	Ms. Sonal Rawat	Ph.D. Research Scholar	Department of Library and Information Science, Banasthali Vidyapith, Rajasthan, India
26	Ms. Urvashi Banodha	Librarian	Elite Public School, Indore (M.P.), India



ABBREVIATIONS

Abbreviation	Full Form
AI	Artificial Intelligence
ALA	American Library Association
AMU	Aligarh Muslim University
ANRF	Anusandhan National Research Foundation
APA	American Psychological Association
API	Application Programming Interface
AR	Augmented Reality
ARGOS	OpenAIRE ARGOS DMP Tool
ARL	Association of Research Libraries
ASSAf	Academy of Science of South Africa
AWS	Amazon Web Services
BHU	Banaras Hindu University
CC	Creative Commons
CDL	California Digital Library
CKAN	Comprehensive Knowledge Archive Network
CPD	Continuing Professional Development
CSIR	Council of Scientific and Industrial Research
DCC	Digital Curation Centre
DIAMANT	Designing and Information Architecture for Data Management Technology
DLRB	Data Librarian Role Blueprint
DMP	Data Management Plan
DMPRoadmap	Data Management Planning Roadmap
DMPTool	Data Management Plan Tool
DOI	Digital Object Identifier
DRM	Digital Rights Management
DSW	Data Stewardship Wizard
EBP	Evidence-Based Practice
EEC	Education–Expertise–Curation Framework
EHR	Electronic Health Record
ELIXIR	European Life-Science Infrastructure for Biological Information

EOSC	European Open Science Cloud
FAIR	Findable, Accessible, Interoperable, and Reusable
GDPR	General Data Protection Regulation
GPL	General Public License
HEI	Higher Education Institution
ICSSR	Indian Council of Social Science Research
ICT	Information and Communication Technology
IFLA	International Federation of Library Associations and Institutions
IISc	Indian Institute of Science
IIT	Indian Institute of Technology
INFLIBNET	Information and Library Network
IPR	Intellectual Property Rights
IoT	Internet of Things
JMI	Jamia Millia Islamia
JNU	Jawaharlal Nehru University
LIS	Library and Information Science
MA-DMP	Machine-Actionable Data Management Plan
MIT	Massachusetts Institute of Technology
ML	Machine Learning
MLA	Medical Library Association
MLIS	Master of Library and Information Science
MMER	Management Monitoring Evaluation and Research
NCBS	National Centre for Biological Sciences
NDA	Non-Disclosure Agreement
NDSAP	National Data Sharing and Accessibility Policy
NFDI	National Research Data Infrastructure (Germany)
NIH	National Institutes of Health
NIRF	National Institutional Ranking Framework
NMEICT	National Mission on Education through ICT
NSF	National Science Foundation
OA	Open Access
OAIS	Open Archival Information System
OGD	Open Government Data

PAIR	Partnerships for Accelerating Institutional Research
PLA	Public Library Association
RDA	Research Data Alliance
RDM	Research Data Management
RDMO	Research Data Management Organizer
RISE	Research Infrastructure Self-Assessment System
RUSA	Rashtriya Uchchatar Shiksha Abhiyan
STI	Science and Technology Innovation Hub
U.S. NSTC	U.S. National Science and Technology Council
UC3	University of California Curation Center
UGC	University Grants Commission
UK	United Kingdom
UKDS	UK Data Service
UNESCO	United Nations Educational, Scientific and Cultural Organization
URL	Uniform Resource Locator
USA	United States of America
VR	Virtual Reality
WWW	World Wide Web



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Data Visualization in Academic Libraries: Tools and Applications

Dr. Shraddha Kalla¹

Librarian

IIHMR University, Jaipur, India

Nandan Singh²

Assistant Librarian

IIHMR University, Jaipur, India

Seema Kumari³

Assistant Librarian

IIHMR University, Jaipur, India

ABSTRACT

In an electronic age, academic libraries are relying more on data to inform decisions, streamline management of resources, and show value to the institution. Data visualization tools also provide robust functionalities for converting complex data sets—such as usage statistics of e-resources, circulations statistics of eBooks, analytics of research repositories, and metrics on user engagement—into interactive and intelligible formats. The following article offers an extensive examination of data visualization tools that are applicable for use in academic libraries, such as card tools (Tableau, Power BI, etc.), open access tools (R, Python), and library integration systems. It investigates real life cases in collection development, research support, and strategic and operational planning, and shows the strategic benefits and practical challenges along the way. The paper ends with recommendations for supporting adoption, developing data literacy in the library, and connecting visualization with institutional needs.

Keywords: Data Visualization; Tableau; Power BI; Google Data Studio; SAS Visual Analytics.

1. Introduction

Academic libraries have come a long way. The days of paper catalogues, dusty shelves, and handwritten notes are over. Now, libraries are becoming data centers, and they use computers to look after information so that more information can be made available and take away when they do not need it anymore. As institutions grow, and as user expectations expand, libraries must be smarter about the resources — be they books, space, budgets, or services they deploy. And one of the best ways to do this? Data visualization.

By converting raw data into easy-to-read graphics, libraries can glean real-time insights about how their operations are functioning, informing the best decisions. Next, in this chapter and in the subsequent chapter, we will focus on how academic libraries can use data visualization tools to improve resource management, book circulation and budget, space utilization, and ushering in an improved user engagement.

2. Data Visualization Tools

2.1 Tableau

- **Overview:** A leading tool in data visualization, Tableau enables users to create interactive and shareable dashboards. It is widely used in academia to represent library data in a visually appealing way.
- **Key Features:**
 - Drag-and-drop interface
 - Real-time data analytics
 - Multiple data source integration

- Strong visualizations (heat maps, bar charts, line graphs, etc.)
 - Web and desktop versions available
- **Use in Libraries:** Reporting on library usage, user engagement, resource distribution, or faculty and student research data.

2.2 Power BI

- **Overview:** Microsoft Power BI is another popular tool used for creating business intelligence (BI) reports and data dashboards. It is like Tableau in terms of visualization capabilities.
- **Key Features:**
 - Integration with Microsoft products
 - Interactive visualizations and reports
 - Cloud and desktop versions
 - Customizable dashboards
 - Supports real-time collaboration
- **Use in Libraries:** Ideal for reporting on circulation statistics, patron demographics, or library spending.

2.3 Google Data Studio

- **Overview:** A free tool that integrates seamlessly with Google's suite of applications (Google Sheets, Google Analytics, etc.). It is user-friendly and ideal for those looking for an easy entry point into data visualization.
- **Key Features:**
 - Free to use

- Simple interface
- Real-time data updates
- Customizable templates
- Easy sharing options
- **Use in Libraries:** Great for visualizing library website traffic, usage statistics, and resource sharing.

2.4 Qlik Sense

- **Overview:** Qlik Sense is a powerful self-service data visualization tool that helps users to create detailed, interactive data visualizations and dashboards.
- **Key Features:**
 - Self-service BI
 - Data association (can automatically detect relationships within data)
 - Collaboration features
 - Web-based or desktop version
- **Use in Libraries:** Analyzing circulation data, academic journal usage, or research citation trends.

2.5 R (with ggplot2)

- **Overview:** R is a programming language for statistical computing and data analysis. It's especially useful for academics due to its strong statistical background.
- **Key Features:**
 - Extensive data manipulation capabilities
 - Advanced statistical analysis
 - ggplot2 package for high-quality visualizations

- Open-source and free
- **Use in Libraries:** Useful for creating customized visualizations and performing complex statistical analyses on library data, such as user demographics or citation analysis.

2.6 D3.js

- **Overview:** D3.js is a JavaScript library for producing dynamic, interactive data visualizations in web browsers. It is ideal for developers with a background in programming.
- **Key Features:**
 - Highly customizable
 - Interactive and dynamic visualizations
 - Works well with large datasets
 - Requires JavaScript knowledge
- **Use in Libraries:** Used for custom, web-based data visualizations like interactive library maps or interactive charts for scholarly articles.

2.7 Vizable (for iOS)

- **Overview:** Vizable is a mobile app designed to help users visualize data easily, offering a simple user interface. It's often used for more basic visualizations.
- **Key Features:**
 - Easy to use
 - Interactive charts
 - Mobile-friendly

- **Use in Libraries:** Ideal for on-the-go visualization of library metrics or project data, suitable for library staff who need quick, basic insights.

2.8 Plotly

- **Overview:** Plotly is both an open-source graphing library and a platform for creating dashboards and visualizations. It is widely used in scientific computing and academia.
- **Key Features:**
 - Interactive visualizations
 - Python and R libraries for more advanced users
 - Can be embedded in websites or applications
- **Use in Libraries:** Perfect for scientific libraries or academic institutions that want to present research data interactively.

2.9 Gephi

- **Overview:** Gephi is a tool specifically for network visualization. It is used to explore and analyze relationships within large data sets.
- **Key Features:**
 - Open-source and free
 - Interactive visualizations
 - Great for network analysis (social network analysis, citation networks)
- **Use in Libraries:** Useful for analyzing citation networks, academic collaboration, or library resource linkages.

2.10 RawGraphs

- **Overview:** RawGraphs is an open-source data visualization framework that helps users to create customizable visualizations directly in the browser.
- **Key Features:**
 - Open-source
 - Simple drag-and-drop interface
 - Variety of charts (Sankey diagrams, hierarchical edge bundling, etc.)
- **Use in Libraries:** Good for creating non-traditional data visualizations for specific types of library data (e.g., citation data or resource use).

2.11 SAS Visual Analytics

- **Overview:** SAS offers a robust suite of analytics tools, including Visual Analytics, which provides powerful data visualization and analysis capabilities.
- **Key Features:**
 - Advanced analytics and predictive modeling
 - Data discovery and reporting
 - Customizable dashboards
 - Real-time data analytics
- **Use in Libraries:** Can be used for more advanced analysis and reporting on library trends, such as user engagement, collection development, and budget analysis.

2.12 Microsoft Excel (with Power Query and PowerPivot)

- **Overview:** Although not traditionally viewed as a data visualization tool, Excel’s Power Query and PowerPivot functionality provide users with strong data analysis and visualization options.
- **Key Features:**
 - Pivot tables and charts
 - Data connection and transformation with Power Query
 - Advanced analysis and reporting with PowerPivot
- **Use in Libraries:** For basic visualizations and analysis of library data, especially when combined with other tools like Power BI.

3. Choosing the Right Tool

The best tool for an academic library depends on factors like:

- **Ease of use:** How intuitive is the interface? Will library staff require training to use the tool?
- **Data complexity:** Is the data simple, or does it require advanced analysis?
- **Budget:** Some tools are expensive (e.g., Tableau, Power BI) while others (e.g., Google Data Studio, R, or Gephi) are free or open-source.
- **Customization needs:** Does the library need highly customizable visualizations or off-the-shelf charts?

4. Strengths of Data Visualization Software

Strength	Explanation
Improved	Visualization makes it easier for library staff,

Decision-Making	administrators, and stakeholders to understand trends, usage patterns, and performance metrics quickly and accurately.
Enhanced Communication	Complex data (e.g., COUNTER reports, circulation stats) can be presented visually for clearer communication with non-technical stakeholders like faculty, students, and funding bodies.
Real-Time Insights	Many tools (e.g., Power BI, Tableau) support real-time dashboards, allowing libraries to monitor e-resource usage or repository engagement as it happens.
Customizable Dashboards	Tools offer customizable visualizations that can reflect specific KPIs such as ebook downloads, database searches, or user demographics.
Integration with Multiple Data Sources	Visualization tools can often integrate with various systems (ILS, LMS, COUNTER reports, Excel, SQL databases), creating unified views of disparate data.
Support for Data-Driven Culture	Encourages academic libraries to adopt evidence-based practices in budgeting, acquisitions, and service design.
User Engagement and Transparency	Visuals can be shared with the public or stakeholders, making library activity more transparent and impactful.

5. Limitations of Data Visualization Software

Limitation	Explanation
Steep Learning Curve	Advanced tools (e.g., Tableau, D3.js, R) may require technical skills or training, especially for customization and data integration.
Data Preparation Required	Raw data often needs cleaning and formatting before it can be visualized properly. Inaccurate or poorly structured data can lead to misleading visuals.
Cost and Licensing	Tools like Tableau and Power BI (Pro version) may involve significant costs, which can be a barrier for libraries with limited budgets.
Over-Simplification of Data	Visualizations can oversimplify complex issues or hide important context if not carefully designed.
Data Security Concerns	Sharing dashboards online or integrating with cloud services may raise concerns about data privacy, especially with user data or research outputs.
Dependence on Data Availability	The usefulness of visualizations depends entirely on the quality and completeness of the underlying data; missing or outdated data can compromise insights.
Compatibility and Integration Challenges	Some tools may not integrate easily with legacy systems or institutional repositories, requiring custom development.

6. Conclusion

The current digital transformation and data-focused institutional priorities have put a high gloss on the importance of interpreting data for the purpose. Nowadays, if you are not good in language with graphs like that which show data visualization information then please do not imagine that it is available. They also offer libraries an opportunity to review how they conduct business. Data visualization tools are unfinished software products (or services) that can be integrated into existing systems or custom-designed on their own. Combined with static reports, they give libraries a kind of flickering image statement; a constantly updating picture showing library use, user behavior, service performance, and scholarly activity in action.

The paper investigated the abundant visualization tools. Some of them are easily operated commercial that Tableau and Power BI powerful open-source solutions on the other hand include R and Python -- at the same time exploring the uses for these visual products in e-resource tracking, institutional repository analysis, service optimization, and strategic planning. Which tool is superior? This is in the final analysis dependent on the needs of a specific library, how its data stack is structured, and which technology personnel it employs. adoption will also require addressing challenges in data literacy gaps, system integration, and ethical concerns on data privacy. The future as we look to the future, the role of data visualization in academic libraries will only continue to expand – especially as artificial intelligence (AI) and predictive analytics take on new forms of automated decision support. Embracing a visualization core service

can allow academic libraries to be more than service providers and become critical partners in institutional planning and research advancement.

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About the Editors



Dr. Praveen Babel

Dr. Praveen Babel Working as an Faculty and Librarian at the Faculty of Management Studies (WISDOM Library) and as a Research Supervisor in the Department of Library and Information Science, Banasthali Vidyapith, Rajasthan. With over 13 years of teaching and research experience, he is known for his thoughtful mentorship, academic rigor, and commitment to advancing the field of Library and Information Science.

A passionate educator and lifelong learner, Dr. Babel Awarded his Ph.D. from Banasthali University. He has guided 14 Ph.D. scholars, with several others currently working under his supervision. His research and writing contributions include more than 50 papers published in national and international journals and conferences, along with two books that reflect his deep engagement with contemporary information practices.

Dr. Babel was conferred the "Best Teacher Award – 2023" by the Society for Library Professionals (SLP) and the Special Library Association – Asia Community, a testament to his excellence as an educator and researcher.



Pawan Tripathi

Pawan Tripathi is a Librarian at Daulat Ram College, University of Delhi. He has 14 years of experience in the field of librarianship and is pursuing a Ph.D. in Library and Information Science from Banasthali Vidyapith.

He is the author of the books "Foundations of Library and Information Science" and "Vivekanand: Life Sketch and His Philosophy." He has penned numerous articles for newspapers and magazines. Demonstrating a strong commitment to inclusive library services, he has developed an innovative library system, "सुश्रव्य पुस्तकालय (Sushravay Pustakalaya)", designed specifically for the deaf community. This system helps library professionals better understand and address the unique needs of deaf individuals.



Manish Sharma

Manish Sharma, born in Pilibanga, Hanumangarh (Rajasthan), is working as an Assistant Librarian at Government Dental College & Hospital, Patiala, under the Directorate of Research and Medical Education (Govt. of Punjab), India. He has qualified UGC-NET and Rajasthan-SET, and is presently pursuing a Ph.D. in Library and Information Science from Banasthali Vidyapith.

He has actively participated in various workshops, seminars, conferences, and training programs. He has published and presented several research papers and book chapters, and authored six Library Professional Competitive Books. He also continues to guide students through the LIS Learning Academy platform, promoting academic growth and professional learning in the field of Library and Information Science.



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