

# THE ROLE OF DATA SCIENCE IN LIBRARY AND INFORMATION SCIENCE EDUCATION

**Harihararao Mojjada**

*Assistant Librarian, MVGR College of Engineering (A), Vizianagaram, Andhra Pradesh, India.  
Email: harimojjada@mvgrce.edu.in*

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**Abstract** *This article explores the evolution of Library and Information Science (LIS) education in relation to data science, examining how curriculum frameworks have adapted to incorporate data-driven methodologies and tools. It delves into the symbiotic relationship between data science and LIS education, highlighting core competencies required for effective data analysis, including statistical methods, data visualisation and machine learning techniques. The study assesses the role of technological tools, such as advanced analytics platforms and programming languages, in enhancing data analysis capabilities within LIS programs. Information management skills are emphasised, focusing on how data science methodologies improve user behaviour studies and research methodologies. This article reviews the development of data science within LIS education, identifying intersecting competencies that bridge the gap between data science and traditional LIS roles. Opportunities for leveraging data science in LIS education are discussed alongside the challenges, including curriculum development, faculty expertise and resource constraints. Future directions are proposed, emphasising the need for continuous adaptation and interdisciplinary collaboration. This study addresses the critical role of LIS professionals in the effective implementation of data science within LIS education, advocating for professional development and strategic partnerships to bridge the skills gap. The study provides a comprehensive overview of how data science can transform LIS education, offering insights into overcoming challenges and seizing emerging opportunities to enhance the relevance and impact of LIS programs in the modern era.*

**Keywords:** *Data Science, LIS Education, LIS Profession, Data Management, Information Technology, Data Analytics*

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## INTRODUCTION

Still programme is relatively young; Library and Information Science (LIS) education has traditionally been aimed at the organisation, management and distribution of information. There were common courses that fell under the traditional LIS curriculum including cataloguing, classification, reference services and archiving. But, the change has occurred lately due to the emergence of the digital revolution making; information work differs fundamentally. These diverse focuses combined with an unprecedented increase in available digital content, the emergence of big data and the shifting focus to data analysis has posed new challenges to the field of LIS education that cannot be ignored.

In earlier days, the major challenge of LIS professionals was primarily about acquisition of physical resources, and the major service offered to users was giving references. Today, it is inconvenient to work with extensive digital collections, to create and implement plans for the storage and use of information, and to apply large datasets to enhance services and choices. They have all told me that this shift calls for a new set of knowledge and skills, and it is thus not just advantageous but necessary to introduce data science into LIS education.

## The Evolution of LIS Education Relations with Data Science

Growth in education in Library and Information Science has been closely related to advances in data science, especially in this modern digital era. Conventionally, the field of LIS was associated with cataloguing, indexing, archival storage and the like, with an emphasis on easy location and retrieval. However, the sudden proliferation of digital data supported by rapid technological advancements has made a change in this very education of LIS necessary, to incorporate use of data science. Once information management changed character from physical libraries to digital repositories, the principles of data science like data curation, mining, analytics and big data management found a place within the curricula of LIS so that these professionals could manage complex datasets. This is important, considering that libraries and information centres are supposed to deal in managing digital knowledge and provide access to research data. With the growing importance of open access, digital libraries and institutional repositories, today the practitioners in the LIS field are also expected to be conversant with key data science techniques in order to offer necessary support in the data-driven decision-making

processes of information management. Also, the alignment of the LIS education to data science enhances not only the role of a librarian to be a data curator but extends their scope to such areas as digital humanities, e-science and research data management. Courses in data science, data visualisation and programming were introduced by the offering institutions as important disciplines in the modern information professional. The latter makes one believe that the development of data science-influenced LIS education reflects the shift in the world at large towards managing information in a digital, data-driven world. In fact, a small yet growing number of works have engaged with the emergence of data science in LIS scholarship in the work of *Cooke (2020) and Joo and Wolfram (2019)*, among others, which underlined the need for data science competencies to become an integral part of the curricula of LIS schools. By transitioning to this, the LIS professionals may meet the ever-evolving environment where data management and big data analytics are vital in shaping the future of research toward supporting academic and organisational agendas.

## OBJECTIVES OF THE STUDY

- To interpret chronological development of LIS education in different phases.
- To explain the relation between data science and LIS education in general.
- To identify out the heterogeneous development of LIS education through data science.
- To discuss challenges and future recommendations while integration of DS and LIS Education.
- The role of LIS professionals in implementing data science involvement in LIS education.

## Need and Scope of the Study

The need and scope of the study on “The Role of Data Science in LIS Education in the Modern Era” stem from the increasing integration of data science into various fields, including LIS. As libraries and information centres are transformed by digital technologies and big data, understanding the impact of data science on LIS education becomes crucial. This study aims to explore how data science principles and techniques can enhance LIS curricula, improve data management practices and support decision-making processes within libraries. It will examine the current state of LIS education in relation to data science, identify gaps and propose strategies to incorporate data science skills into LIS programs. The scope encompasses an analysis of existing educational frameworks, a review of data science applications in libraries and the development of recommendations for curriculum development. By addressing these areas, the study seeks to provide insights

into how LIS professionals can leverage data science to meet the evolving demands of the information landscape and contribute to more efficient and innovative library services.

## EARLIER STUDY

Martin and Evans (2021) concluded their research with a view to the future of data science for the LIS curricula. According to them, in the following decade, AI and machine learning would be leading roles in the curricula of the LIS programs. Their results showed that the ability to change fast and make students lead to an increasingly data-driven future was to be called from the LIS programs. Anderson and Green (2021) reviewed the complementary roles that data science and the digital humanities are playing within LIS programs. From the curricula review, there is a growing trend for text mining, digital curation and data visualisation courses. They suggested better collaboration between LIS and humanities faculties to further enhance the learning of data science. Bergquist and Tuomi (2021) focused on data literacy alone and surmised that data literacy is a core skill for which LIS graduates should be educated. The authors reasoned that students in this course of study should learn about processing and ethical issues regarding data use. This underpins the core ethics of using data and data governance in the education curriculum for LSS. Walters and Leonard (2021) polled LIS faculty about their perceptions related to the teaching of data science. Although the study showed that most faculties perceive data science as being important, only 40% feel confident in teaching it. This awareness-ability gap was a primary reason cited for the slow integration of courses in data science. Ahmad and Han (2021) adopt an international comparison in order to discuss the status of the inclusion of data science into the programs of LIS education in Europe, North America and Asia. The study showed there was regional difference; the North American programs were deeper technically, while the European ones focused more on ethical and legal issues concerning data science. Perez and Liu (2020) made a comment concerning the place of open data in the curriculum of studies in the field of LIS. Their empirical investigation showed that open data, data sharing and data ethics were getting quite common in the curricula of LIS. They said that open data initiatives are part of the core of the education in library and information science because they are in full agreement with the emphasis of the profession on access to information. Garcia and Roberts (2020) investigated how data science can be utilised for decision-making in libraries, such as analysing how library usage is carried out. The study postulates that the analytics tools, such as Tableau and R, in the LIS programs need to be more focused on making their students better prepared when faced with real-world applications. Shao et al. (2020) identified the key competencies which future librarians will

need in the age of data science. Their empirical study listed data mining, machine learning and advanced statistics as very critical skills that a modern graduate of LIS needs. They concluded with how profound this understanding of competencies should be within the framework of the curricula of LIS. Kim and Jeong (2020) presented an empirical analysis of how data science competencies are infused into the curricula of LIS. The authors investigated course offerings in 50 LIS programs around the world, noticing that an increasing concentration on data science is present, although most programs do not have real depth in data science training. To this end, they recommended partnerships with computer science departments for more holistic education. Smith and Kautz (2020) also indicated the need for continuing education in the field of data science for currently working professionals within the field of LIS. Their research on mid-career librarians demonstrated many returning to academic programs or attending workshops with the intent of learning about the subject area of data science—a need that highlights lifelong learning opportunities in this area. Cox et al. (2020) investigated changing skills in the LIS regarding the ever-growing relevance of data science. According to them, most programs of the LIS are undergoing transitions and now place new curricula on data analytics, programming and database management. This study concluded that there is an urgent need for the alignment of the LIS education in regard to technological changes coupled with job market demands. Singh and Khan (2020) explored some barriers to the integration of data science faced for its implementation within the curricula of the library and information science programs. By surveying program directors, they identified a lack of faculty expertise, resource constraints and institutional inertia as key barriers. They suggested targeted professional development for the educators of LIS and more strategic partnerships with the departments of data science. Johnson et al. (2020) describe some pedagogical strategies that should be adopted to integrate data science into the curriculum of the LIS. Their study noted problem-based learning, project-based assignments and real-world data projects to be most effective in letting the students of the LIS learn about complex ideas in the field of data science. Their recommendation suggested the heavy use of hands-on teaching methods for the courses in data science in the curriculum of library and information science programs. Zhou and Li (2019) have carried out a comparative study in universities in North America by comparing how far LIS programs have gone in terms of the integration of data science. They found out that 70% of the LIS schools have incorporated into the curriculum courses that range from data mining to information visualisation. The authors have noticed an imbalance in the programs: the pace of curriculum modernisation in some institutions

is well behind. Rehman and Al-Abdulla (2019) explored employers' expectations about data science skills in graduates from the LIS domain. The authors surveyed 150 professionals and employers in the LIS domain; they reported an increased demand for data management and programming skills in Python and R. However, in a related vein, they indicated that there was a gap in that very skill set, with a number of employers noting that their students were not prepared to work in data science. Vickers and King (2019) investigated some cross-disciplinary efforts involved in the collaboration of the field of LIS with other fields such as computer science and engineering. The result of their empirical investigation indicated that collaborative programs and courses are better equipped to prepare the students of LIS for modern-day job requirements. They concluded that truly interdisciplinary collaboration is critical to effectively teaching data science to students. Brown and Chen (2019) discuss, in a longitudinal study, how the integration of data science into programs in library and information science will work. They concluded that students taking coursework in data science reported a competitive edge in the job market and, more importantly, much higher levels of technical confidence. They also cited significant variation between course content at institutions. Liangan d Tan (2018) discuss how data science influences the research methods in the LIS domain. They recognise some uses of data science tools to analyse large-scale studies related to library services and user behaviour. The research recommends that education in the LIS field should focus on technical skills and how to apply data science in enhancing their research skills. Patel et al. (2018) investigated student perceptions of the inclusion of data science in the curriculum of the programs of study in library and information science. Their qualitative study found that while students generally welcomed the inclusion of data science, most expressed apprehension due to the intensive demands on technicalities. The authors suggested additional scaffolded learning experiences as ways to ease the transition from traditionally lighter LIS courses to more technically demanding courses. Wu and Hou (2018) investigated the intersection of key principles in data science and traditional information management education. They found that data curation and preservation, and metadata management represent priority areas in which the overlap between LIS and data science is coming into focus. The authors then recommend that these areas need stronger emphasis in the curriculum of LIS.

## **METHODOLOGY**

The methodology for this article on “The Role of Data Science in LIS Education in the Modern Era” involved

a comprehensive literature review of scholarly articles, conference papers and reports published in last ten years. The primary databases used for sourcing literature include Scopus, Web of Science and Google Scholar. Keywords such as “Data Science in LIS,” “library and information science education,” and “modern LIS curriculum” guide the search. A systematic selection process is employed to identify relevant studies that discuss the integration of data science into LIS programs, trends, challenges and outcomes.

## **RELATION BETWEEN DATA SCIENCE AND LIS EDUCATION**

### **The Relationship between Data Science and Library and Information Science (LIS) Education**

Data science has rapidly emerged as a powerful discipline that uses statistical, computational and analytical methods to extract meaningful insights from large and complex datasets. It has become essential for decision-making processes in various industries, including healthcare, finance, education, marketing and more. Central to data science is data analysis, which involves breaking down raw data into useful information through a series of steps, including data cleaning, transformation and interpretation. This essay will discuss the core skills required for data analysis, explore the technological tools used in the process and provide examples of how these skills and tools are applied in real-world scenarios.

#### **Data Science and Its Role**

Data science is an interdisciplinary field that combines techniques from computer science, statistics and domain expertise to extract actionable insights from data. It involves various stages, from data collection to data processing, analysis and interpretation, with the goal of answering specific questions or driving decision-making. In today’s data-driven world, data science plays a critical role in identifying patterns, predicting trends, optimising business strategies and improving operational efficiency.

For example, in e-commerce, companies like Amazon use data science to analyse customer purchasing behaviour, enabling them to offer personalised product recommendations, optimise pricing strategies and streamline inventory management. In healthcare, data science is used to analyse patient data and predict disease outbreaks or suggest treatment plans tailored to individual patients.

## **Core Data Analysis Skills**

Successful data analysis requires a combination of technical and analytical skills. The following are some key skills needed for data analysis:

### **Statistical Analysis**

Statistical analysis forms the backbone of data analysis, enabling analysts to summarise and infer relationships from data. Skills in probability theory, hypothesis testing, regression analysis and descriptive statistics are essential for understanding and interpreting data patterns. For example, in finance, analysts use regression analysis to forecast stock prices based on historical data. They can predict how various factors (e.g., interest rates or company performance) influence stock prices.

### **Data Manipulation and Cleaning**

Raw data often contains errors, missing values, or inconsistencies. Data manipulation and cleaning involve preparing data for analysis by removing outliers, dealing with missing data and standardising formats. For example in healthcare, patient records might contain missing fields or contradictory information. Data cleaning techniques are applied to ensure the dataset is accurate, enabling researchers to draw reliable conclusions when conducting clinical trials.

### **Programming Skills**

Programming is critical for automating repetitive tasks, handling large datasets and applying machine learning algorithms. Python and R are the most widely used programming languages for data analysis due to their extensive libraries for data manipulation and statistical modelling. For example Python’s Pandas library allows analysts to quickly manipulate and analyse large datasets, while R’s ggplot2 library is used for creating visualisations. Both are essential for handling complex datasets, such as social media data or financial transactions.

### **Data Visualisation**

Data visualisation involves presenting data insights in a clear and understandable format using charts, graphs, or dashboards. Effective visualisations allow stakeholders to easily interpret complex data and make informed decisions. For example a retail company may use data visualisation to display sales trends over time, helping executives understand which products are performing well and where to focus their

marketing efforts.

## Machine Learning and Predictive Modelling

Machine learning is an advanced technique used in data analysis to create models that can predict outcomes or classify data based on historical data patterns. Predictive modelling helps organisations forecast trends, detect anomalies and automate decision-making processes. For example credit card companies use machine learning algorithms to detect fraudulent transactions by analysing patterns in customer behaviour and flagging deviations as potential fraud.

## Technological Tools for Data Analysis

The technological landscape for data analysis is vast, with numerous tools available for data collection, processing and visualisation. The choice of tools depends on the specific requirements of the analysis and the complexity of the data. Below are some of the most commonly used tools for data analysis.

### Excel

Excel is one of the most basic but widely used tools for data analysis. It provides built-in functions for data manipulation, statistical analysis and data visualization. Although not suitable for large-scale data, Excel is ideal for smaller datasets and quick analysis. For example financial analysts frequently use Excel to create pivot tables that summarise large amount of financial data, making it easier to analyse trends and prepare reports.

### Python

Python has become a go-to tool for data analysts and data scientists due to its versatility and ease of use. With libraries such as Pandas, NumPy, Matplotlib and Scikit-learn, Python offers powerful functionalities for data manipulation, statistical analysis, machine learning and visualisation. For example data analysts use Python's Pandas library to clean and organise data, while Scikit-learn is employed for building machine learning models that predict customer churn in industries like telecommunications.

### R Programming

R is a statistical programming language designed specifically for data analysis. It is widely used in academia and research because of its robust statistical libraries and advanced data

visualisation capabilities. For example researchers in fields like economics and biology use R to run complex statistical tests, such as multivariate regressions, and to visualise their findings in detailed graphs.

### SQL

Structured Query Language (SQL) is essential for querying and managing databases. SQL enables data analysts to retrieve data from relational databases, perform aggregations and join tables to create comprehensive datasets. For example a marketing analyst might use SQL to extract customer data from a relational database and perform queries to identify trends in purchasing behaviour.

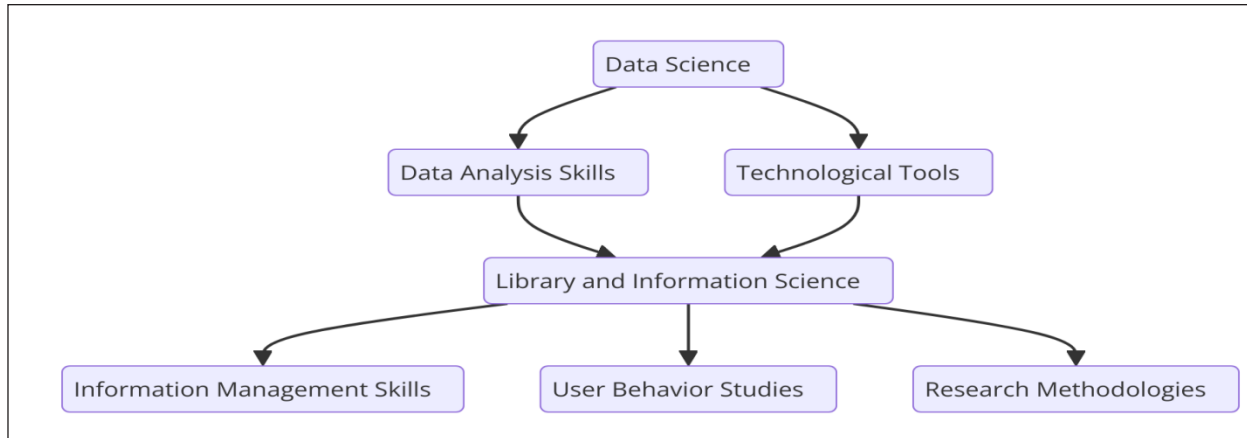
### Tableau

Tableau is a leading data visualisation tool that allows users to create interactive dashboards and reports. It connects to various data sources, including databases, spreadsheets and cloud services, enabling users to visualise and explore data with ease. For example, a sales manager might use Tableau to create a dashboard that shows real-time sales performance, regional comparisons and sales forecasts, allowing for data-driven decision-making.

### Power BI

Power BI is another popular business intelligence tool that provides data visualisation and reporting capabilities. It integrates well with Microsoft products and offers features for real-time data monitoring and sharing of reports. For example in human resources, Power BI is used to track employee performance, retention rates and hiring metrics, providing visual insights that guide workforce planning strategies.

Data science and data analysis are critical in today's data-driven world, enabling organisations to harness the power of data for informed decision-making. The key skills required for data analysis—ranging from statistical analysis and programming to data visualisation and machine learning—are essential for extracting insights from complex datasets. Technological tools such as Excel, Python, R, SQL, Tableau and Power BI facilitates the analysis process by providing powerful functionalities for data manipulation, statistical modelling and visualisation. As organisations continue to generate vast amounts of data, proficiency in these skills and tools will become increasingly important for driving innovation and efficiency across industries.



**Fig. 1: Relation between Data Science and LIS Education**

### Information Management Skills

Information management skills are essential in data science for efficiently organising, storing and retrieving data. These skills involve the systematic handling of data throughout its lifecycle, from collection and storage to processing and analysis. Effective information management ensures that data is accurate, accessible and secure, which is crucial for making informed decisions. In data science, managing large datasets requires proficiency in using databases, cloud storage systems and data governance practices. For instance, data scientists must know how to use tools like SQL for database management and ensure compliance with data privacy regulations like GDPR. Without proper information management, data can become disorganised or vulnerable to breaches, undermining the integrity of data-driven projects.

### User Behaviour Studies

User behaviour studies play a pivotal role in data science by offering insights into how individuals interact with systems, products, or services. These studies help data scientists understand user preferences, engagement patterns and decision-making processes, enabling them to create more personalised experiences. For example, analysing user behaviour on e-commerce platforms can help predict purchasing trends, allowing businesses to offer targeted recommendations and improve customer satisfaction. User behaviour data is often collected through web analytics, transaction logs and social media, providing a rich source of information for developing predictive models. By studying user behaviour, data scientists can help organisations optimise services, enhance user experience and make data-driven decisions.

### Research Methodologies

Research methodologies in data science involve systematic approaches for collecting, analysing and interpreting data to answer specific questions or solve problems. These methodologies often include qualitative and quantitative techniques, such as surveys, experiments and statistical analysis. In data science, research methods help ensure that findings are valid, reliable and reproducible. For instance, hypothesis testing and A/B testing are commonly used to evaluate the effectiveness of different strategies, such as marketing campaigns or product features. Data scientists also use methodologies like regression analysis and machine learning algorithms to identify trends and predict outcomes. Robust research methodologies are crucial for extracting meaningful insights from data and making evidence-based recommendations in various fields, from healthcare to business analytics.

## DATA SCIENCE DEVELOPMENT IN LIS EDUCATION

In the digital age, data science has become a pivotal tool for managing and enhancing the performance of various sectors, including libraries. Libraries have traditionally been repositories of knowledge, but in recent years, they have transformed into dynamic centres for information access and dissemination. With the growing availability of data, library management and user services can benefit significantly from the application of data science principles. This essay will explore six essential data science development elements—data collection, data cleaning, data analysis, data modelling, data cataloguing and data visualisation—and their application to library management and user services.

Each element plays a crucial role in streamlining library operations and improving user experience.

## Data Collection

Data collection is the foundation of any data science process, involving the systematic gathering of relevant data from diverse sources. In the context of libraries, data collection is essential for understanding user behaviour, tracking circulation patterns and monitoring resource utilisation. Libraries collect data from various touchpoints, including borrowing records, digital resource access logs, user feedback forms and website analytics. This raw data provides crucial insights into how users interact with library resources, enabling administrators to tailor services to meet evolving demands.

For example, through user transaction logs, libraries can gather data on the types of books borrowed the frequency of visits, and user preferences. Additionally, online catalogues and databases track digital resource usage, giving further insight into users' research habits. The key to successful data collection lies in ensuring the data is comprehensive, relevant and gathered in a manner that respects user privacy. A well-designed data collection system is the cornerstone of effective data-driven decision-making.

## Data Cleaning

Data cleaning, also known as data pre-processing, is the process of detecting and correcting errors or inconsistencies in collected data. In library management, raw data is often incomplete, redundant, or inconsistent due to manual entry errors, system glitches, or user-generated content. Unclean data can lead to misleading conclusions and erroneous decision-making, making data cleaning a critical step in the data science workflow.

For instance, library data might contain duplicate user entries or incomplete metadata for books and other resources. These inconsistencies need to be resolved through techniques such as removing duplicates, standardising formats and filling in missing values. This ensures that the dataset is accurate and reliable for analysis. In a library context, clean data enables administrators to manage inventory efficiently, track user preferences more accurately and ultimately improve the quality of services offered.

## Data Analysis

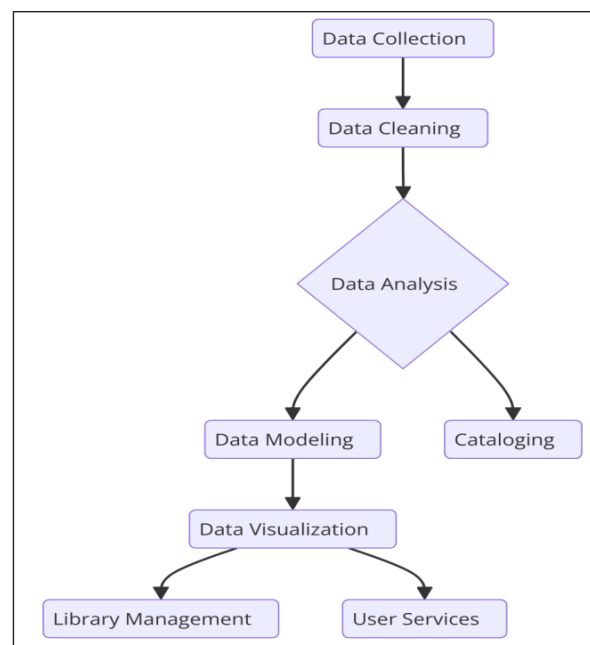
Data analysis involves applying statistical and computational techniques to extract meaningful insights from the cleaned data. For libraries, data analysis can uncover patterns and trends related to user engagement,

resource allocation and operational efficiency. Through data analysis, library administrators can identify which materials are most frequently borrowed the demographic breakdown of users, peak usage times and underutilised resources. For example, an analysis of borrowing patterns could reveal that certain genres or formats (e.g., e-books vs. physical books) are more popular among specific user groups. Libraries can then adjust their collection development strategies to prioritise high-demand materials or formats. Additionally, analysis of user activity can help in optimising staff schedules, improving the organisation of library spaces and enhancing overall service delivery.

## Data Modelling

Data modelling refers to the creation of a conceptual framework that represents relationships between different data elements. In the context of libraries, data modelling helps in developing predictive models that can anticipate user needs and improve resource management. Libraries can use data modelling to predict future trends in resource demand, plan collection development and optimise space utilisation based on historical data patterns.

One application of data modelling in library management is the development of recommendation systems. By analysing past borrowing behaviour, a library can model user preferences and suggest books or resources that align with their interests, much like how commercial platforms such as Amazon and Netflix provide personalised recommendations. This predictive capability enhances user satisfaction by offering more relevant materials and services.



**Fig. 2: Data Science Development in LIS Education**

## Data Cataloguing

Data cataloguing involves organising and indexing data to make it easily discoverable and accessible. In libraries, data cataloguing has traditionally been done for books and resources, but with the increasing digitisation of content and services, data cataloguing now includes a broader range of assets such as e-books, digital archives and multimedia resources. Cataloguing also extends to user data, making it easier to track user engagement, monitor circulation and manage library operations efficiently.

A well-structured data catalogue not only simplifies resource retrieval for users but also facilitates library staff in managing and updating inventory. Advanced cataloguing systems allow for keyword searching, tagging and metadata management, making it easier to link related materials and track the availability of resources. Furthermore, integrating user data into cataloguing systems enables personalised services, such as recommending resources based on individual borrowing histories.

## Data Visualisation

Data visualisation refers to the use of graphical representations such as charts, graphs and dashboards to present data insights in an intuitive and accessible manner. In library management, data visualisation is invaluable for communicating complex data trends to stakeholders, including library staff, users and funding bodies. By visualising data on resource usage, user demographics and service efficiency, libraries can make informed decisions and improve their services.

For instance, a library might use heat maps to illustrate peak traffic times, helping administrators allocate resources and staff accordingly. Bar charts and pie charts can showcase the distribution of borrowed materials across different categories or formats, providing a clear view of user preferences. Dashboards summarising key performance indicators allow libraries to track their progress toward strategic goals, such as increasing user engagement or improving resource accessibility.

## Intersecting Competencies - Data Science and LIS

At the core of the intersection between DS and LIS are shared competencies. Both fields require strong skills in data organisation, curation and retrieval. Additionally, both fields emphasise metadata creation and management—an essential part of ensuring that information is accessible and usable over time. LIS professionals, especially librarians and archivists, have historically been experts in organising

information, which aligns with the role of data scientists in structuring and preparing data for analysis.

Data science techniques such as data mining, predictive analytics and machine learning are becoming valuable tools for LIS professionals. The ability to process and analyse large datasets has become essential for everything from resource management in libraries to developing new models of user engagement in archives or information services. Data science tools also enhance the ability of LIS professionals to provide more personalised services, optimise information retrieval and improve knowledge discovery through recommendations and automated indexing.

## Data Science in LIS Curricula

In response to this convergence, many LIS programs have begun integrating data science courses into their curricula. This integration is seen in the addition of courses such as data analytics, machine learning, database management and programming. By incorporating these elements, LIS programs aim to prepare graduates for a data-driven job market that increasingly demands expertise in both traditional information science and modern data science techniques.

For instance, skills in Python programming, SQL and data visualisation have become desirable additions to the skill set of LIS graduates. Furthermore, LIS programs are emphasising data ethics and privacy—a critical intersection of both fields. As information professionals, librarians have long held roles as stewards of privacy and intellectual freedom. These principles carry over into data science, where ethical considerations are crucial in handling sensitive or personal data, preventing biases in algorithms and ensuring transparent data usage.

The application of data science in library management and user services is transformative. The six key elements of data science—data collection, data cleaning, data analysis, data modelling, data cataloguing and data visualisation—each plays a vital role in enhancing the efficiency and effectiveness of library operations. By leveraging these data science processes, libraries can offer personalised services, optimise resource management and ultimately provide a more engaging and user-centred experience. As libraries continue to evolve in the digital era, the integration of data science will be crucial for staying relevant and meeting the diverse needs of users.

## OPPORTUNITIES, CHALLENGES AND FUTURE DIRECTIONS

The fusion of data science with LIS education also opens new doors for interdisciplinary collaboration. Libraries,

archives and information centres are increasingly becoming hubs for digital scholarship, offering data services and research support. LIS professionals, equipped with data science skills, are better positioned to support researchers in fields like digital humanities, social sciences and the sciences, where large datasets are critical.

Additionally, opportunities for innovation abound, especially in the development of digital repositories, open data initiatives and scholarly communication platforms. The role of data librarians, for example, is becoming more prominent as academic institutions recognise the need for professionals who can both manage research data and assist scholars with data analysis.

Despite these advancements, there are challenges in fully integrating data science into LIS education. One key obstacle is the need for faculty expertise in data science within LIS schools, as not all programs have the resources or faculty trained in these new areas. Furthermore, some traditional LIS professionals may resist the shift towards a more data-centric model, viewing it as a departure from the field's historical focus on information services and user needs. To overcome these challenges, many LIS programs are collaborating with computer science departments, hiring data science experts and offering joint degrees or certifications that bridge both fields. The future of LIS education likely involves a blended curriculum that balances traditional library science with cutting-edge data science training.

The relationship between data science and LIS education is one of growing synergy. As the digital age continues to expand the scope of information management, LIS programs are evolving to meet the demand for data-literate professionals. This convergence enables LIS professionals to harness the power of data analytics while upholding the ethical and organisational principles that have long defined their field. Ultimately, the integration of data science into LIS education offers exciting opportunities for innovation, collaboration and more effective information management in a data-driven world.

### **The Role of LIS Professionals in Implementing Data Science in LIS Education**

The role of LIS professionals in implementing data science within LIS education is crucial for bridging the gap between traditional library practices and modern data-driven methodologies. As data science becomes increasingly integral to the LIS field, professionals are key to integrating these skills into educational frameworks effectively. LIS professionals must champion the inclusion of data science in LIS curricula. They need to advocate for curriculum updates that reflect the evolving landscape of information management and data analysis. This involves collaborating

with academic institutions to develop course content that includes data science fundamentals such as statistical analysis, data visualisation and machine learning. By pushing for these updates, LIS professionals ensure that students gain relevant skills that are essential for modern information management roles. LIS professionals play a vital role in professional development and training. Many current LIS educators may not have extensive backgrounds in data science, so LIS professionals can facilitate workshops, webinars and training programs to up-skill faculty members. This continuous education is necessary to keep instructors abreast of new technologies and methods, enabling them to teach data science concepts effectively. Another critical aspect is fostering interdisciplinary collaborations. LIS professionals should work closely with experts from computer science, data science and other related fields to create comprehensive and integrative educational experiences. Such partnerships can help design interdisciplinary courses and research projects that enrich the learning environment and offer students a broader perspective on data science applications.

As well, LIS professionals are instrumental in identifying and addressing resource constraints. They can advocate for investments in technology and tools required for data science education, such as software for data analysis and programming languages. They should also seek funding opportunities to support the integration of data science into LIS programs. LIS professionals are essential in guiding the transformation of LIS education to include data science. Their responsibilities encompass curriculum development, faculty training, fostering interdisciplinary collaborations and addressing resource needs. Through these efforts, they ensure that LIS education remains relevant and equips students with the skills needed to excel in a data-driven world.

### **CONCLUSION**

The role of data science in LIS education is both transformative and indispensable. As the volume of digital information continues to grow, the need for professionals who can effectively manage, analyse and interpret this data becomes increasingly critical. Integrating data science into LIS education equips students with the skills and knowledge needed to thrive in the modern information landscape.

By embracing data science, LIS programs can prepare graduates to meet the challenges of the digital age, improve library and information services and contribute to the advancement of knowledge in diverse fields. The on-going evolution of LIS education, driven by the convergence with data science, promises to create a new generation of information professionals capable of harnessing the power of data to make informed decisions and drive innovation.

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