CHAPTER-1

INTERDISCIPLINARY APPROACHES TO RESEARCH DATA MANAGEMENT: BRIDGING THE GAP BETWEEN HUMANITIES, SOCIAL SCIENCES AND STEM FIELDS

Dr. Mariraj Vasudev Sedam[1] and Chaithra A. M[2]

[1]Librarian, Department of Library, Maharani Science College for Women, Palace Road, Bangalore - 560 001, Karnatka, India.
E-mail: smariraj.lis@gmail.com / Mob: + 91 9880308997
[2]Research Scholar, Department of Library and Information Science, Bangalore University, Bengaluru and Librarian, Jyoti Nivas College Autonomous, Bangalore, Karnatka, India.
E-mail: chaithramlisc1993@gmail.com

ABSTRACT

Interdisciplinary approaches to research data management (RDM) are crucial in addressing the growing complexities of modern research across diverse fields. While the demands for managing data in the Humanities, Social Sciences and STEM (Science, Technology, Engineering, and Mathematics) are often distinct, the integration of practices from these disciplines can foster more effective and comprehensive data stewardship. This paper explores the challenges and opportunities in bridging the gap between these fields, emphasizing the need for a unified framework that accommodates the varied nature of data types, methodologies and research outcomes. By examining the unique data practices and workflows within each domain, the paper highlights commonalities and divergences in the handling, sharing and preservation of data. The study suggests that cross-disciplinary collaboration can promote best practices, enhance data interoperability and ensure that research data is accessible and reusable across disciplines. Ultimately, this work advocates for the development of adaptable RDM strategies that support both discipline-

specific needs and the overarching goal of advancing open science and knowledge sharing.

Keywords: STEM Fields, Data Stewardship, Data Integration, Research Data Framework, Data Accessibility, Data Reusability, Unified Data Management, Research Data Management

INTRODUCTION

In today's academic landscape, data management is crucial across all disciplines. The interdisciplinary nature of research often requires blending knowledge from various fields. Humanities, social sciences and STEM (Science, Technology, Engineering, and Mathematics) fields all produce significant volumes of data, yet they manage, analyze and interpret data in fundamentally different ways. The divergence in methodologies, expectations and tools across these fields can lead to barriers in collaboration and communication. Therefore, bridging these gaps requires fostering an environment where best practices in data management can be shared, adapted and improved across these diverse disciplines.

The key to achieving this lies in adopting interdisciplinary approaches to research data management (RDM)-strategies that combine strengths from various fields, address shared challenges and leverage the unique tools and methodologies of each. By acknowledging the value of cross-disciplinary learning, we can build frameworks that enhance the management, sharing, preservation and analysis of data.

Research data management (RDM) has become an increasingly vital aspect of academic work across disciplines. Whether in the humanities, social sciences or STEM (science, technology, engineering, and mathematics) fields, researchers are generating vast amounts of data that must be preserved, curated, shared and analyzed in meaningful ways. However, the nature of research data varies greatly across disciplines, creating unique challenges and opportunities for interdisciplinary collaboration. This chapter explores the importance of interdisciplinary approaches to research data management and discusses strategies for bridging the gap between the diverse ways data is handled in the humanities, social sciences and STEM fields.

THE IMPORTANCE OF DATA MANAGEMENT ACROSS DISCIPLINES

Data management is often perceived as an area of specialized concern-something that is relevant primarily to STEM fields where large-scale

quantitative data is frequently generated and processed. However, the importance of data management in the humanities and social sciences has grown significantly in recent years. These fields are increasingly adopting data-driven approaches to research, with digitized archives, qualitative data and survey results all needing systematic organization and analysis.

In the humanities, research data can include textual data, manuscripts, historical documents and multimedia files. In the social sciences, it may comprise interview transcriptions, survey responses, demographic information and other qualitative or quantitative data sources. In STEM, data may be collected from experiments, simulations or large-scale computational models.

While each of these disciplines has distinct needs when it comes to data management, they also share many challenges, such as ensuring data accessibility, fostering long-term preservation, maintaining data quality and promoting open science practices. Interdisciplinary approaches to RDM can help to create strategies that benefit all fields by allowing for knowledge transfer, shared best practices and the development of common frameworks for managing data.

THE CHALLENGES IN BRIDGING DATA MANAGEMENT ACROSS DISCIPLINES

Disciplinary Diversity in Data Types and Formats:

Humanities: Humanities researchers typically work with a variety of non-numerical and often unstructured data, such as text, images, audio and video. The data may be historic, literary or cultural artifacts (e.g., manuscripts, maps, oral histories, artworks). This type of data is complex and multifaceted, requiring specialized preservation and metadata systems.

Social Sciences: Social science research often involves both qualitative data (such as interviews, case studies and ethnographies) and quantitative data (e.g., surveys, statistical analyses). The challenge lies in managing both types of data in a way that ensures compatibility and effective cross-analysis, while preserving the richness of qualitative insights.

STEM: In contrast, STEM research commonly produces highly structured, quantitative datasets-ranging from numerical data in fields like physics and biology to large-scale datasets from

experiments and simulations. These datasets are often processed using sophisticated computational tools and need a more rigid, standardized approach to storage and sharing.

The challenge here is to reconcile these differences in data formats and structures. Developing flexible yet standardized systems for managing both qualitative and quantitative data would greatly improve interdisciplinary work.

Differences in Research Methodologies: Research methods in the humanities and social sciences often emphasize interpretive and theoretical frameworks, focusing on deep analysis of texts, concepts or social phenomena. In contrast, STEM fields typically rely on empirical methods and the application of statistical models or algorithms. These divergent methodologies influence not just data collection but how data is understood and used.

As such, RDM systems need to support both interpretative analysis of rich, context-dependent qualitative data and the precise, reproducible analysis required in quantitative experiments. This requires a balance of flexibility and rigor in RDM practices.

Data Sharing and Accessibility: While STEM fields have led the way in terms of open data practices-particularly through initiatives such as FAIR (Findable, Accessible, Interoperable and Reusable) data principles-humanities and social science disciplines have been more cautious. Concerns about privacy, ethical considerations (particularly in qualitative research) and the cultural sensitivity of certain data types make sharing data in these fields more complex.

For example, in the humanities, textual data or digital archives may contain sensitive historical information or proprietary literary works. In social sciences, research might involve private data from human subjects that require strict ethical oversight before they can be shared.

Bridging this gap requires developing common frameworks that respect the unique ethical challenges in each discipline while promoting openness and transparency in research practices.

Silos and Lack of Communication: Many universities and research institutions continue to operate in silos with separate departments for the humanities, social sciences and STEM fields.

This organizational structure can hinder communication and collaboration, limiting the exchange of best practices in data management.

To address this, institutions must foster an interdisciplinary approach to data management that encourages interaction between these fields. For example, research data management services in libraries and research centers should be equipped to assist researchers from diverse disciplines, ensuring that best practices in data management are adaptable and applicable across all research domains.

KEY STRATEGIES FOR BRIDGING THE GAP IN RDM

To overcome the challenges of interdisciplinary data management, a variety of strategies can be employed:

Standardization of Metadata and File Formats: Although different fields use different types of data, metadata standards (which describe the characteristics of the data) and file formats can help to create a common ground. By adopting standardized metadata schemes (such as Dublin Core for humanities or DataCite for STEM), research data can be better indexed, searched and linked across disciplines. Additionally, ensuring compatibility with open, widely accepted file formats such as CSV, XML or JSON for structured data can help bridge the data gap.

An example of this is the development of common metadata frameworks in digital humanities projects. Tools like Omeka and Fedora allow users from various fields to create and manage digital collections with standardized metadata, supporting the sharing of data across domains.

Integration of Data Repositories with Cross-Disciplinary Features: Data repositories are central to RDM, but they often cater to specific disciplines or data types. Creating integrated, cross-disciplinary repositories that support a wide range of data types and metadata standards can encourage data sharing and reuse across fields. Open repositories like Zenodo, which accommodate both qualitative and quantitative data and SHARE, a repository of

research outputs from various disciplines, provide a model for such interdisciplinary platforms.

These repositories need to support not only the storage and sharing of data but also facilitate collaboration through tools that enable annotation, tagging and version control which are crucial for interdisciplinary research.

Collaborative Data Management Plans: One important tool for interdisciplinary RDM is the development of collaborative data management plans (DMPs). A DMP outlines how data will be collected, stored, shared and preserved over the course of a project. By including representatives from different disciplines during the planning phase, researchers can create data management plans that account for the needs of multiple fields.

In particular, collaborative DMPs can include provisions for making data accessible to both STEM researchers and social scientists or humanities scholars while adhering to discipline-specific ethical standards. For instance, a research project on environmental change might involve qualitative interviews (social sciences) and satellite data (STEM), requiring a DMP that covers both privacy protections and data standardization.

Cross-Disciplinary Data Workshops and Training: Building a shared understanding of data management practices requires ongoing education and training across disciplines. Workshops and training programs that focus on data management and encourage interdisciplinary dialogue can be incredibly effective. These programs can teach researchers the importance of metadata, how to use data repositories and how to incorporate open data practices into their work-while also addressing the ethical concerns and practical considerations specific to each field.

A successful example of this is the training provided by institutions like the Digital Curation Centre (DCC) in the UK, which offers a variety of resources and workshops on best practices for data management across disciplines. Such initiatives can help researchers from different fields adopt similar RDM practices, fostering more effective collaboration.

Use of Collaborative Data Analysis Tools: Many tools and platforms are available that allow for collaborative, cross-disciplinary data analysis. For instance, platforms like GitHub enable version control and collaborative coding, which is useful for both STEM and humanities researchers working on shared data. Collaborative platforms for qualitative research, such as NVivo or ATLAS.ti, can also facilitate interdisciplinary analysis of interview transcripts, ethnographies and texts alongside quantitative datasets. These tools promote not just data sharing but also collaborative problem-solving, allowing for interdisciplinary insights that could enhance the quality and scope of research.

CHARACTERISTICS

Interdisciplinary approaches to research data management (RDM) emphasize collaboration across diverse academic fields, aiming to overcome the barriers between the humanities, social sciences and STEM (Science, Technology, Engineering, and Mathematics) disciplines. This approach incorporates unique characteristics that facilitate effective communication, data sharing and integration of practices from different domains. Below are key characteristics of these interdisciplinary approaches:

1. COLLABORATION AND INTEGRATION

Cross-Disciplinary Collaboration: One of the fundamental characteristics of interdisciplinary RDM is the collaboration between experts from different fields. In this context, researchers from the humanities, social sciences and STEM come together to design and implement effective data management strategies that reflect the needs and nuances of each discipline.

Shared Problem-Solving: Through interdisciplinary teamwork, researchers combine their expertise to solve complex research problems that span multiple domains. This collaborative environment encourages the integration of different methodologies, tools and perspectives to enhance the overall research process.

Community Engagement: Interdisciplinary RDM initiatives often involve engaging with broader research communities, including data scientists, archivists, librarians and information technologists

to ensure that the management systems are flexible, scalable and inclusive.

2. FLEXIBILITY AND ADAPTABILITY

Adaptation to Diverse Data Types: Research across humanities, social sciences and STEM generates different types of data. Humanities research may involve text, images or audio files; social sciences may produce qualitative or mixed-method data (interviews, surveys) and STEM research frequently generates large, structured datasets (numerical or experimental data). An interdisciplinary approach recognizes and accommodates these diverse data formats by ensuring that data management tools and practices are adaptable to each field's needs.

Customizable Frameworks: Interdisciplinary RDM frameworks are designed to be flexible, allowing for the inclusion of field-specific practices while maintaining consistency in core principles such as data preservation, sharing and discoverability. The frameworks should be adjustable to accommodate new research trends or emerging technologies.

3. STANDARDIZATION AND HARMONIZATION

Unified Metadata Standards: One key aspect of interdisciplinary RDM is the development and use of standardized metadata schemas. These common frameworks help ensure that data from different disciplines can be easily discovered, linked and understood by researchers across fields. For instance, metadata standards like Dublin Core (for humanities) or DataCite (for STEM) facilitate the integration of data from various domains.

Common Terminology: Interdisciplinary approaches often work towards harmonizing the language used to describe data management concepts. This helps bridge gaps between disciplines that may use different terminologies to describe similar processes or concepts. Clear and common terminology enables better communication and reduces misunderstandings when researchers from different fields collaborate.

4. EMPHASIS ON OPEN ACCESS AND DATA SHARING

Promoting Open Data: Interdisciplinary RDM supports the principles of open access, making data available for public use, reuse and analysis. By fostering a culture of transparency and accessibility, researchers across different fields can benefit from shared datasets. This is particularly important in facilitating replication studies, new discoveries and interdisciplinary research.

Cross-Disciplinary Data Reuse: Open access initiatives make it easier for researchers to reuse data across disciplines, encouraging innovation. For example, qualitative data from social sciences might be useful in developing algorithms for computational models in STEM, while humanities data could contribute to social science research on historical contexts.

5. ETHICAL CONSIDERATIONS AND PRIVACY CONCERNS

Respect for Discipline-Specific Ethical Norms: An interdisciplinary approach to RDM must respect the ethical standards and privacy concerns of each field. For instance, research in the humanities or social sciences may involve sensitive or personal data, such as interviews or cultural artifacts, which require special handling. In contrast, STEM research might be more focused on anonymizing data for reproducibility while ensuring compliance with regulatory standards (e.g., HIPAA in healthcare-related research).

Balanced Risk Management: An interdisciplinary approach takes into account ethical risks in each field, promoting responsible data sharing and storage practices. It ensures that sensitive data is properly protected while allowing for data reuse and collaboration where ethically and legally permissible.

6. SCALABILITY AND SUSTAINABILITY

Long-Term Data Preservation: Ensuring the sustainability of research data over time is crucial in an interdisciplinary RDM approach. It emphasizes the need for reliable data preservation strategies that can accommodate diverse data types, whether these

are digital archives in the humanities, longitudinal surveys in social sciences or experimental datasets in STEM fields.

Scalable Infrastructure: Interdisciplinary RDM promotes the creation of scalable infrastructure that can handle the growing volumes of data across disciplines. This could include cloud storage solutions, interoperable repositories or distributed systems that allow for future expansion without significant overhaul.

7. HOLISTIC DATA MANAGEMENT LIFECYCLE

Comprehensive Data Planning: Interdisciplinary RDM takes into account the entire data lifecycle, from initial data collection, processing and analysis, to sharing, preservation and eventual archiving. It ensures that data management is integrated into each stage of the research process from inception to long-term access.

Collaborative Data Management Plans: Data management plans (DMPs) that span multiple disciplines are essential to ensuring data is well-organized, accessible and reusable. These plans must address the unique needs of each field while maintaining a coherent overall structure, ensuring that the data remains useful and relevant to all stakeholders.

8. USE OF ADVANCED TECHNOLOGIES

Data Analytics and Machine Learning: Interdisciplinary RDM increasingly incorporates advanced technologies like data analytics and machine learning to improve data processing and management. For example, machine learning algorithms can be used to automate the categorization and classification of unstructured data in the humanities or to analyze large datasets from STEM experiments.

Interoperability of Tools: The use of tools that facilitate cross-discipline interoperability, such as application programming interfaces (APIs) and linked data technologies, is a key characteristic. These tools allow researchers from different fields to connect their data management systems, ensuring that data can be shared and used seamlessly across disciplines.

9. EDUCATIONAL AND TRAINING INITIATIVES

Cross-Disciplinary Training Programs: Interdisciplinary RDM necessitates a training model that prepares researchers in multiple fields to manage their data in ways that are compatible with other disciplines. This includes providing skills in areas like metadata creation, ethical data sharing and the use of common tools or platforms.

Capacity Building: Interdisciplinary data management approaches promote building the capacity of researchers to engage with the evolving landscape of data management. By teaching methods and tools applicable across disciplines, researchers can adapt to the changing data landscape and contribute to cross-disciplinary projects more effectively.

10. FOCUS ON USER NEEDS AND EXPERIENCE

User-Centered Design: Interdisciplinary RDM focuses on designing data management systems and platforms that meet the needs of diverse user groups. Whether those users are researchers, archivists, librarians or data analysts, the systems are designed to provide user-friendly interfaces and functionalities that suit the different workflows and requirements of each discipline.

Inclusive Practices: An interdisciplinary approach ensures that diverse communities, such as marginalized or underrepresented groups, can participate in and benefit from research data management practices. It supports equal access to data and promotes the inclusion of diverse perspectives in research outputs.

ADVANTAGES

Enhanced Collaboration and Knowledge Sharing

Cross-disciplinary learning: An interdisciplinary approach fosters collaboration between researchers from different fields, allowing them to share expertise, tools and methodologies. This exchange of ideas can help researchers in the humanities, social sciences and STEM fields understand each other's approaches to data management, leading to richer, more informed research practices.

Holistic problem-solving: By bringing together diverse perspectives, interdisciplinary collaboration can provide more holistic insights into complex research questions. For example, in health studies, integrating social sciences and STEM can lead to a more comprehensive understanding of public health issues by considering both the biological and sociocultural factors at play.

STANDARDIZATION OF BEST PRACTICES

Improved data management consistency: Interdisciplinary RDM initiatives can help establish standardized practices for data collection, preservation, sharing and analysis that can be adapted across fields. This consistency makes it easier to share data between disciplines and ensures that data is accessible, reusable and compliant with established norms (e.g., FAIR principles).

Unified metadata standards: Standardizing metadata across disciplines ensures that data is organized, indexed and described in a consistent manner, which increases its findability and interoperability. This is particularly important for large-scale collaborative research projects involving multiple disciplines.

INCREASED DATA ACCESSIBILITY AND REUSE

Encouraging open science: A common RDM approach that embraces openness and data sharing can increase the visibility of research outputs and encourage reuse of data across disciplines. Data that is well-organized, properly documented, and stored in shared repositories can be easily accessed by researchers in multiple fields, reducing the need for redundant data collection and analysis.

Cross-disciplinary applications: Data collected in one discipline can often have valuable applications in another. For example, social science survey data may be useful for STEM researchers studying behavioral patterns, while humanities data could inform social science studies on cultural context.

BROADER FUNDING OPPORTUNITIES

Interdisciplinary funding prospects: As funding bodies increasingly prioritize collaborative, cross-disciplinary research,

developing strong interdisciplinary RDM practices positions researchers to attract a wider range of funding. Many grants now encourage or even require cross-disciplinary collaborations, recognizing the value of research that bridges gaps between fields.

Efficiency in resource use: Pooling data and resources across disciplines can lead to more efficient use of funding, as researchers may avoid duplicating efforts by sharing data, tools and methodologies.

SUPPORT FOR COMPLEX, REAL-WORLD PROBLEMS

Tackling complex societal issues: Many contemporary research challenges-such as climate change, public health or social inequality-require interdisciplinary approaches to fully understand and address the complexity of these issues. Combining data management practices across the humanities, social sciences and STEM fields allows researchers to analyze multifaceted problems from various angles, leading to more nuanced and effective solutions.

DISADVANTAGES

Challenges in Data Integration and Compatibility

Incompatible data types: The data produced in the humanities (e.g., textual or visual data) differs significantly from that generated in STEM (e.g., quantitative datasets), making it difficult to integrate across fields. The lack of common data structures or formats can create barriers to sharing, analyzing and interpreting data across disciplines.

Complex Data Curation: Humanities data, which may be less structured and more interpretive, can be challenging to manage using traditional RDM tools that are designed for quantitative or experimental data in STEM fields. Conversely, social science and STEM data that require rigorous standards for replication and statistical analysis may not easily align with the more narrative or descriptive data from the humanities.

CONFLICTING METHODOLOGIES AND TERMINOLOGIES

Differences in research methodology: The underlying research methods used in different disciplines can complicate the sharing and management of data. Humanities scholars often engage in interpretative analysis of qualitative data, while STEM researchers may focus on empirical, hypothesis-driven experiments. These methodological differences can affect how data is collected, analyzed and presented, creating challenges in aligning approaches to data management.

Terminology and jargon: Different fields use unique terminology, making communication about data management more difficult. This can lead to misunderstandings, inefficiencies or reluctance to adopt interdisciplinary best practices. For instance, terms like "metadata," "variables" or "standardization" may have different meanings or applications depending on the discipline, leading to confusion when collaborating across fields.

INCREASED COMPLEXITY IN TRAINING AND SKILL DEVELOPMENT

Diverse training needs: Interdisciplinary RDM requires researchers from different fields to gain skills outside their comfort zones. Humanities researchers may need to learn technical skills related to database management, while STEM researchers may need to familiarize themselves with qualitative data analysis tools. This could result in a steep learning curve, especially for researchers not traditionally exposed to certain types of data management practices.

Resource-intensive training: Training programs that address the needs of multiple disciplines can be resource-intensive, requiring substantial investment in developing educational materials and support systems. Additionally, researchers may need to dedicate time away from their own projects to participate in these training programs.

ETHICAL AND LEGAL CONCERNS

Conflicting ethical standards: Different disciplines may have varying ethical standards when it comes to data collection, privacy and sharing. For example, social science research often involves sensitive data (e.g., interviews or surveys with human participants) that requires specific ethical guidelines, while STEM data may be less ethically sensitive but governed by stricter privacy laws related to health, genetics or environmental data. Aligning ethical standards across disciplines can be complex and may require significant negotiation.

Informed consent and privacy: Humanities and social science research often involves sensitive human subjects data, which may involve privacy concerns, especially regarding anonymity and confidentiality. Bridging the gap between disciplines requires ensuring that the data management plan respects the ethical considerations inherent in both qualitative and quantitative research, which can be difficult to harmonize.

RESOURCE ALLOCATION AND MANAGEMENT CHALLENGES

Competing priorities: Different research fields may prioritize different aspects of data management. For example, STEM researchers may prioritize the automation of data analysis and reproducibility, while humanities scholars may place more emphasis on preserving the interpretive nuances of their datasets. Balancing these competing priorities within a shared data management infrastructure can be a challenge.

Lack of dedicated resources: Interdisciplinary approaches to RDM may require the development of specialized tools and infrastructures that are not readily available. This might lead to a lack of dedicated resources (funding, expertise, software) for managing the diverse data needs across fields, resulting in difficulties in implementing effective, cross-disciplinary RDM strategies.

RESISTANCE TO CHANGE

Disciplinary inertia: Many researchers in traditional disciplines may be resistant to adopting new data management practices, especially if they feel that their established methods work well for their particular field. Shifting to an interdisciplinary RDM model may be seen as unnecessary or burdensome, especially if researchers do not fully understand the potential benefits of cross-disciplinary collaboration.

Institutional barriers: Many academic institutions have discipline-specific structures, resources and support systems for RDM, which may discourage interdisciplinary collaboration. Institutional inertia can be a significant barrier to implementing broader more integrated RDM strategies.

CONCLUSION

As research becomes more interdisciplinary, effective data management strategies that bridge the gap between the humanities, social sciences and STEM fields are increasingly essential. By fostering a collaborative environment that embraces the diversity of data types, methodologies and ethical considerations across disciplines, we can improve the accessibility, interoperability and preservation of research data. Through shared standards, integrated repositories and cross-disciplinary training, researchers can maximize the value of their data and enhance the potential for groundbreaking discoveries across all fields of study. Ultimately, interdisciplinary approaches to RDM will support a more inclusive, open and sustainable research ecosystem.

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