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Research Data Management Practices, Benefits and Challenges of Researchers: A Systematic Literature Review

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Abstract
Research data management and sharing have grown increasingly important because of their important role in advancing science by building on prior work and utilizing data created by other researchers, which has become increasingly important. Therefore, the study aimed to systematically review the literature focusing on RDM practices, benefits and challenges faced by the researchers. To collect the relevant evidence, published literature was systematically reviewed by following the Preferred Reporting Items for Systematic Literature Reviews and Meta-Analyses (PRISMA) guidelines. The pertinent literature was obtained from four main scholarly databases and finally, 20 papers that met the inclusion criteria were included in this study. Researchers are beginning to recognize the value of RDM, but few use it. Researchers in rich nations are more likely to use RDM procedures than those in underdeveloped countries. The finding revealed that researchers from diverse disciplines are practicing RDM to preserve and store their research data. The key benefits include data sharing, data reusing, collaboration between researchers, data preservation, data storage and backup facility. However, the key challenges include lack of time, finding appropriate resources, lack of awareness about the usage and copyright, quality assurance, technological limitations and lack of organizational support. The practical and policy implications highlight the joint venture of academia and library professionals to help the researchers to manage their research data effectively and overcome the challenges faced by the scholars in quality assurance and copyright issues.
Keywords: Research data management; RDM; RDM challenges; RDM Benefits; systematic review; RDM practices

Introduction

Advances in information and communication technology (ICT) have occurred in recent years. ICTs have culminated in explosive growth in research data, which is predominantly stored in digital format. All disciplines generate and gather a considerable amount of research data in digital formats as the digital age and infrastructures promote data storage, sharing and re-use(Rafiq & Ameen, 2021).

The necessity of familiarizing all researchers, including academics, research scholars, research associates and other personnel involved in research, with the necessity and process involved in appropriate research data administration is a critical aspect in developing a solid data management culture(Majid et al., 2018).

Research data management and sharing have grown increasingly important because of their important role in advancing science by building on prior work and utilizing data created by other researchers, which has become increasingly important(Borghi et al., 2018). As a result of the rising digitization of academic work processes, researchers are being

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compelled to cope with an overwhelming amount of data across a wide range of subjects (Wilms et al., 2018). Researchers, academic institutions and governments are all eager to harvest available research data as it brings speedier advancement in many fields of study.

The term "research data management" refers to the process of organizing, storing and preserving data generated during a research endeavor. It encompasses early planning, daily operations, as well as long-term archiving and sharing. Globally, research data management (RDM) is viewed as a necessary component of excellent research practice. It is concerned with the planning, creation, preservation, organization, retrieval, sharing, describing and publication of research data. Thorough research data management enables the researcher to comprehend the data processing and documenting lifecycle. For example, as illustrated by visualizations such as the research data lifecycle (Carlson 2014; Cox and Ting Tam 2018), research data management is a constant and iterative process that is integrated into every phase and phase of a research project. RDM procedures that have been carefully considered improve the efficiency of the research process, enhance cooperation and assist in minimizing data loss. Research data management saves time and resources for researchers and enables the reuse of research data through disparate data repositories. Numerous scholars have defined RDM as a procedure for archiving data generated during the research life cycle.

Research on RDM is few and those that do exist are of a restricted nature. Some systematic reviewed and literature-based studies on RDM were conducted; however, they have limited scope and based on few keywords.(Ashiq et al., 2020) provide a systematic literature review about the practices and services of RDM by the library professionals. They reported that RDM is progressively gaining attention of many researchers and libraries; yet, it is still underutilized by both groups. Although it is more prevalent in developed countries than in poor countries, there are numerous obstacles related with RDM activities by researchers and library services. These difficulties necessitate the development of certain specific skills in order to improve practices and services. To address the challenges and issues, stakeholder and university service departments must work together actively. Another systematic literature review was conducted by Cherry et al. (2021) to enlighten the features of RDM training. The researchers found that all of the publications included in this review referenced features of user-centrality in RDM training, which was extensively explored as part of the first primary subject and may indicate to the necessity of addressing user-centrality in RDM (or any) training. However, this systematic review study examined the literature on RDM focusing on practices, benefits, challenges and needed skills and services from the perspective of researchers.

Research Questions

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The study specially answers the following research questions;

1. What are practices used by the researchers to manage their research data?
2. What type of challenges or issues are faced by the researchers while managing their research data?
3. What kind of benefits were received by the researchers from research data management?
4. What are the needed skills or services required by the researchers to manage their research data?

Methodology

To answer the research questions a systematic literature review was carried out by following the Moher et al., (2009) guidelines for preferred reporting items for systematic reviews and meta-analyses (PRISMA). These guidelines enable researchers to conduct a systematic examination of the published literature and to present a holistic understanding of a topic.

Search Strategy

The following keywords were used in the title, abstract and keywords filters to extract the relevant data. This search strategy was run on July 19, 2021, to extract the data from Scopus, Web of Science, Google Scholar and the Higher Education Commission (HEC) Pakistan digital library summon discovery tool.

TITLE-ABS-KEY("Research Data Management") AND TITLE-ABS-KEY(Researcher*)

All the relevant data was downloaded and imported into Endnote Software. In order to assure the accuracy and reliability of the data, the author critically examined the screening, eligibility and included studies. The researcher again went through the entire process of downloading and extracting the data to confirm the accuracy and reliability of the results.

Inclusion and Exclusion Criteria

This systematic review included the studies that investigated the RDM practices, benefits and challenges/hindrances/issues and needed skills/services faced by the researchers. Since it is relatively a new concept and emerged in first decade of 21st century so no chronological filter / year of publication filter was applied. Only English language studies and research articles were included. The studies on RDM but dealing with other aspects such RDM models, movements and teaching practices were excluded. Further, the literature review, bibliometric, books, book chapters and conference proceedings were also excluded.

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Quality Assessment of Selected Studies

An important component of any systematic literature review is determining the overall quality of the papers that are being reviewed and selected. Several quality assessment checklists (QACs) have been developed over time. The checklist created by Boynton and Greenhalgh (2004) was chosen by the researchers because it was deemed relevant for this review. Several information management researchers have used this checklist to assess the quality of their systematic review studies(Ashiq et al., 2021).Boynton and Greenhalgh (2004)Checklist contains items consisting on six separate aspects of a study: the questions and design, sampling, instrumentation, response rate, coding and analysis and the presentation of the findings and conclusions. Based on these six points of view, the maximum possible score for a study is 13. According to Table 1, the category 'instrument score' received the lowest score of all categories (61 out of 84), while the category 'question and design' received the highest score (42 out of 42). In the category 'instrument,' some studies missed information about the instrument's reliability, validity, or pilot testing, resulting in a poor instrument score. In total, these 20 studies received 235 out of a maximum 273 scores.Table 1: Evaluation of the quality of chosen studies

Studies	Score for the question and design (total 2)	Score for sampling (total 2)	score for Instrument (total 4)	score for Response (total 1)	Score for coding and analysis (total 2)	score for Presentation of result (total 2)	Total score (out of 13)
(Abduldayan et al., 2021)	2	2	2	1	2	2	11
(Milewska et al., 2021)	2	2	2	1	2	1	10
(Bunkar & Bhatt, 2020)	2	2	3	1	2	2	12
(Chawinga & Zinn, 2020)	2	2	3	1	2	2	12
(Unal et al., 2019)	2	2	3	1	2	2	12
(Chigwada, 2021)	2	2	3	1	2	2	12
(Berman, 2017)	2	2	4	1	2	2	13
(Borghi & Van Gulick, 2018)	2	1	2	1	1	1	8
(Burgi et al., 2017)	2	1	3	1	2	2	11
(Chen & Wu, 2017)	2	2	3	1	2	2	12
(Elsayed & Saleh, 2018)	2	2	4	1	2	2	13

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(Joo & Peters, 2020)	2	1	2	1	1	2	9
(Mohammed & Ibrahim, 2019)	2	2	3	1	2	2	12
(Pasek & Mayer, 2019)	2	2	4	1	2	2	13
(Perrier & Barnes, 2018)	2	2	2	1	2	2	11
(Renwick et al., 2017)	2	2	4	1	2	2	13
(Tang & Hu, 2019)	2	1	3	1	2	2	6
(Tripathi et al., 2017)	2	1	3	1	2	2	7
(Vela & Shin, 2019)	2	2	4	1	2	2	13
(Vilar & Zabukovec, 2019)	2	2	4	1	2	2	13
Category score (Quality obtained)	40	35	61	20	38	38	223
Max score of categories (Quality expected)	42	42	84	21	42	42	273

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Results

Bibliographic information of the studies

A detailed search query was formulated in order to find the maximum number of appropriate studies. Overall, there were 8602 records that were identified (Figure 1). The bibliographical information from the identified studies was bring in into the endnote software. In compliance with PRISMA recommendations, identical and inappropriate records (5169)were deleted and potential records (n = 136) were assessed after reading the title and abstract. Furthermore, 13 records were eliminated because the full-text was not found. Finally, 20 studies were selected fulfilling the inclusion criteria.

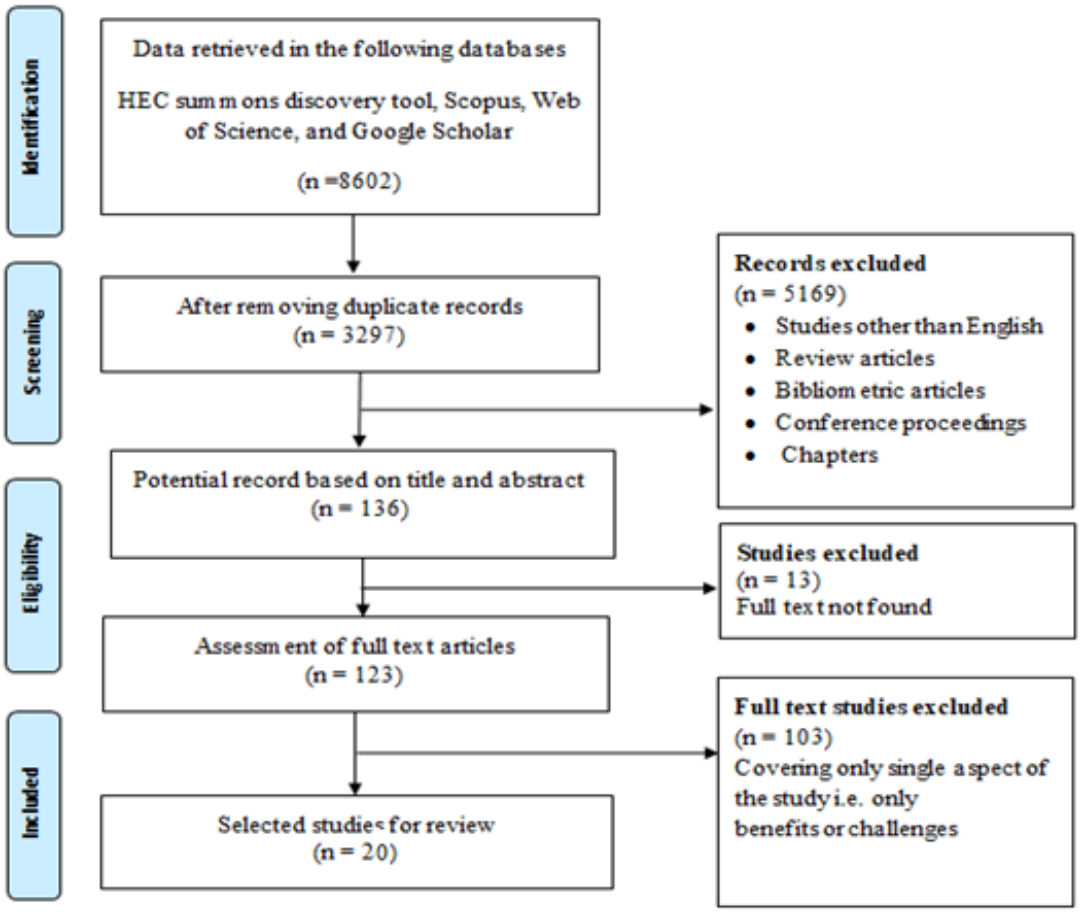

Fig1: PRISMA flow diagram of selection procedure of the studies

Table 2 indicates that most of the articles (n=5) were published by the USA, followed by India (n=2) and by Nigeria,Poland,SouthAfrica,Turkey, France, Zimbabwe, Switzerland,China,Egypt and Saudi Arabia,Iraq,Canada,WestIndies, SloveniaandUK (n=1). The publication year of these articles was ranged between 2012 to 2021 and most

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of the articles (n=6) were published between 2020-2021, which shows that RDM is relatively a progressing concept. The authorship pattern of these articles ranged between 1 author to 8 authors, while, the most common authorship pattern of these articles was 2 authors (n=12). Table 1 also revealed that most of the articles were published in reputed journals. Overall, it shows that RDM is emerging in both developed and developing countries.

The methodological detail disclosed that most of the studies (n=13) were quantitative in their nature, whereas, the most used method (n=13) for conducting these studies was a survey questionnaire. Four studies were qualitative in their nature, whereas a small number of studies (n=2) applied a mixed-method approach to conducting the study. It indicates that RDM applied quantitative, qualitative and mixed method approaches. The selected studies targeted researchers or research students from various discipline assess the practices, benefits and challenges of RDM. The minimum number of respondents of these studies was 28, whereas, the maximum number of respondents was 1098 among the included studies.

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Table 2: Overview of the selected studies

Sr. No	Studies	Country	Type of study	Method	Target population	Sample size
1	(Abduldayan et al., 2021)	Nigeria	Qualitative	exploratory research method	Chemistry researchers	N=40
2	(Milewska et al., 2021)	Poland	Quantitative	Online survey	Medical Researchers	N=603
3	(Bunkar & Bhatt, 2020)	India	Quantitative	Online survey Questionnaire	research scholars /academicians	N=88 (Professor=13 Reader=1 Associate Professor=16 Assistant Professor=43 Researcher=15)
4	(Chawinga & Zinn, 2020)	South Africa	mixed method Design	Questionnaire and in-depth interviews	Researchers	N=130
5	(Unal et al., 2019)	Turkey; France ;United Kingdom	Quantitative	online questionnaire	Academic Researchers	n=1098
6	(Chigwada, 2021)	Zimbabwe	mixed method Design	online questionnaire	Researchers	N=100

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7	(Berman, 2017)	United States	exploratory sequential mixed method research	Survey questionnaire and Semi Structures interviews	Researchers/Faculty	Interviewed=6 Survey questionnaire=319 textual analysis of DMPS=35
8	(Borghi & Van Gulick, 2018)	United States	Quantitative	Survey Questionnaire	Neuroimaging researchers	n=144
9	(Burgi et al., 2017)	Switzerland	Qualitative	Interviews and document analysis	Researchers	n=49
10	(Chen & Wu, 2017)	China	Quantitative	Survey Questionnaire	Chemistry Researchers	n=129
11	(Elsayed & Saleh, 2018)	Egypt and Saudi Arabia	Quantitative	Questionnaire	Researchers	n=337
12	(Joo & Peters, 2020)	United States	Quantitative	Online survey	Researchers	n=186
13	(Mohammed & Ibrahim, 2019)	Iraq	Quantitative	Survey Questionnaire	Researcher students	n=155
14	(Pasek & Mayer, 2019)	United States	Quantitative	Survey questionnaire	Research students and faculty researchers	n=210

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15	(Perrier & Barnes, 2018)	Canada	Qualitative	Interviews/ Focus Group	IT professionals, Librarians andResearchers	n=28
16	(Renwick et al., 2017)	West Indies	Quantitative	Survey Questionnaire	Researcher	n= 65
17	(Tang & Hu, 2019)	United States	Quantitative	Online Survey	Researchers	n=241
18	(Tripathi et al., 2017)	India	Qualitative	Interview	Research students & faculty members	n= 40
19	(Vela & Shin, 2019)	United States	Quantitative	survey questionnaire	Researchers	n=52
20	(Vilar & Zabukovec, 2019)	Slovenia	Quantitative	Online survey	Researchers	n=317

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Table 3:RDM Practices, Benefits, Challenges and Needed Skills/ Services extracted from the selected studies

Sr. No	Study	Practices	Benefits	challenges / issues	Need services / skills
1	(Abduldayan et al., 2021)	Research data understanding; Loss of research data; Preferred data storage media; protection of research data; preservation research data; plan for data management	Data Sharing; Data reusing; Collaboration between researchers; Data preservation; Data storage and backup facility	Hardware and software failures; lack of awareness of DMPs; poor storage device; virus attack and system theft	advocacy and training should be carried; formulate policies; There should be periodic evaluation
2	(Milewska et al., 2021)	Stored research data in university equipment, private computers, external hard drives; Deposit data in repositories; saved data in spreadsheets, text documents and graphic files	opening the research data; cooperation between scientists; facilitating research; Share best practices, Reduce development costs / time, Enhance current practice, Support developing nations,	lack of understanding on how to protect data from unauthorized usage; Copy right issues; People may gain from the outcomes of their efforts; Technical barriers; Time consuming	Provision of technical Support; Legal aid with data deposit in repositories; participation in the archiving process; Educational training should be carried out;
3	(Bunkar & Bhatt, 2020)	Data storage in CD, DVDs, Personal Computers, Flash Drives and in emails; Mostly stored data in PDF format	Freely access of raw data; facility of data sharing; Long term preservation of data	Issues in data ethics; issues of Intellectual property rights and copy right;	hands-on training; creation and developmentof clear RDM policy
4	(Unal et al., 2019)	Save data in open access datasets; Pre-processing of research data gathered from other sources; Research data stored in institutional repository for long term preservation	Easily accessible; Data is reusable; facility of data sharing; social benefits	Concerns about Data ethics; issue in data sharing	Data storage that is appropriate; Data policies are being established; Provision of technical Support; Legal aid with data deposit in repositories

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5	(Chigwada, 2021)	Keeping data on External Hard Disks and Computer machines, Dropbox, google drive etc.	open research material, more education for researchers, Cost-Benefit, Equal to Traditional Resources, collaboration Benefit	lack of research data management skills; lack of familiarity with sources of research data; institutional RDM policies are lacking; insufficient data storing and sharing infrastructure, as well as licensing difficulties related to data rights and variety	In house staff workshops ; Support for staff to attendconferences; Collaboration with academic program; Support for staff to take courses; Online turorials
6	(Chawinga & Zinn, 2020)	Researchers involved in research creation; specimens, digital text, digital images, spreadsheets and audio recordings are the main formats produced by the researchers in research process; Share research data with others; Sharing tools including funders' websites, journals; backup data on personal computers and external drives	Data Sharing; Data reusing; Collaboration between researchers; Data preservation; Data storage and backup facility	Access to reusable data is difficult Inadequate metadata Inadequate standardization of metadata formats Inadequate data may result in misunderstanding. Restriction imposed by law/ethics Inadequate skills for data reuse Not having faith in the collection techniques of others	Provision of data management plans; Disposition of research data; short- and long-term preservation strategies; migration over to the new formats
7	(Burgi et al., 2017)		Better teaching and learning outcomes, improved learners' performance, Access to quality and cheap learning resources	There are no formal DMPs in place; Standards are not being utilized; Problems with coordination; Problems with archiving; Copyright issues are being elevated; Storage devices are expensive, as are their associated costs.	Development of RDM strategies for institutions; Stakeholders working together to achieve common goals; Capacity for storing large amounts of data online; Provision of Research support services
8	(Renwick et al.,	Personal gadgets are used to store	resources are easily	Support for appropriate	Data storage that is

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	2017)	data; Backing up data on a hard disc and storing it on the cloud	accessible, affordable, good quality, creativity and flexibility, cost-effective, customizable, accurate and current, accessibility, adaptability, availability	preservation of information; Problems with copy right and permission; Problems with retrieval; Storage in a secure environment; Backing up data	appropriate; Data policies are being established; Competencies in data analysis; Services in the areas of training and consulting
9	(Tripathi et al., 2017)	Applications of metadata are not being used; Using personal computers and mobile devices that save information; There are no established policies or guidelines followed; Sharing raw data with a small group of people	reduces the financial burden, free and accessible	Organizing, preserving and storing of data are the major issues; Issues of data ownership; Data sharing regulations are only vaguely known	RDM policy at the national level; Services provided by the library for the benefit of its patrons; The necessity of library-researcher cooperation
10	(Berman, 2017)	Sharing of data over publications; Availability of Metadata standards; Extensive archiving through storage media and personal computers; The majority of researchers do not provide data to repositories.	low cost of the materials, portability, Ease of use, more interactive, more additional resources	Infrastructural capacity is limited; Lack of support from the university; Support from libraries is lacking; Misinterpretation of data is a concern; Copyright Issues	Guidance and institutional help with regards to data management plans, issues related to copy rights/ data privacy/ best practices related to standards of metadata and policy formulation and implementation; Provision of ethical standards; Facility of technical assistance with analysis of data, data security, storage of data for long-term, provision of institutional repositories and data set.
11	(Mohammed & Ibrahim, 2019)	There is no RDM strategy or policy in place; Insufficient	increase teaching efficiency, increase the quality of	Inadequate policies and standards; Insufficiency of	Provision of RDM rules and regulations; Staff education and

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		information on RDM may be found; Short-term data storage; Data storage in conventional formats such as papers, worksheets and charts; Data repositories that are no longer operational	teaching, reduce economic and geographic barriers, Time saving, easy to modify and use, easy to find,	social and fiscal resources; Infrastructure is insufficient; Misunderstanding about research data management; Support from the institutions is insufficient.	training; Facility of Inter- and inter-organizational collaborations Availability of institutional repository devoted to a single subject
12	(Borghi & Van Gulick, 2018)	For researchers, there are several funding possibilities; There is a lot of attention paid to data management plans; Facilities for RDM training; Restrictions on the sharing of information	availability of high-quality material, Time saving, Reduced the cost, personalized learning	Data collection, analysis and dissemination are constrained by time; Motivators and rewards are lacking; There are little chances for training; Costs to the economy; The data contains sensitive information; Sharing data might be a challenge due to formatting issues	
13	(Perrier & Barnes, 2018)	Numerous commercial tools, as well as non-proprietary platforms, are used by researchers to organize and store data; Data preserving technologies such as Drop-Box are effective and simple to use	facilitate the collaboration, develop new knowledge and skills, establishment of synergies, low cost, dissemination of knowledge, facilitate the publishing, develop self-regulation skills	Issues relating to technology and obsolescence; Expenses associated with technical tools; Restriction on the use of data; Concerns about data protection; Apprehension about data abuse	Provision of data storage at the Institutional level; Availability of data safety and data backup plans; existence of unambiguous policies and procedures for data management plans
14	(Pasek & Mayer, 2019)	sharing of research data; Data curation and Re-Use; Data preservation; Data plaining and organization; Acquisition and discovery of data	enhance learning outcomes, facilitate knowledge sharing, offers secure and reliable educational resources, lifelong education, enhance	Data management and analysis concerns; Problems with data retention data archiving and redistribution; Defining	The ability to organize data; Availability of data backup and storage; The ability to write DMPs; Sharing research data; The preservation of data across

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			the quality of research data	metadata is a challenge; handling of database and data format; locating and securing data	time; Identifying a dataset that can be repurposed
15	(Vela & Shin, 2019)	Researchers have access to financing; There is a lack of knowledge regarding DMPs; Personal electronic gadgets store and manage data; Institutional and subject-specific repositories facilitate data exchange; Data is preserved from 3 to 10 years	self-paced learning, vocational training facilities, free in flexible formats, increase access to educational content, helping teachers develop practices, develop the necessary knowledge, increase student outcome	Discrepancies between members of a project team; a lack of digital storage capacity; Data protection; Obsoleteness of technology; Due to a lack of available space	
16	(Tang & Hu, 2019)	Services for data planning and management; Disseminating and distributing information; Preserving information; Data exploration and retrieval; Metadata-enabled software Visualization of data; Data archiving and management; availability of digital repositories; Software for data processing is readily available; Manager of data citations	improve student outcome, financial benefits, flexible learning, collaboration	Personnel issues; Collaborative comprehension; Concerns about awareness; The issue of service consistency; Concern about skill sets Infrastructure concerns; Concerns about funding/resources; Insufficient use of services; Administrative support issues; RDM services tailored to certain disciplines	Data archiving and management; Skills in Metadata collection and management; management plans for the use of data; Work that is done together; Preserving information; management of the copyright; A reservoir of information; Reproducibility of data; Understanding of data file format; Knowledge about the different systems, tools and software as well as infrastructure.
17	(Vilar & Zabukovec, 2019)	Information gathered through the use of spreadsheets, documents	Save time and money, facilitate sharing of	Inappropriate use of information; Problems with	Planned procedures for data handling; Those that use

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		and presentations; Data sources are readily available; Facilities for storing data Access to data is restricted; The citation of scientific data in a proper manner	knowledge, provision of capacity building resources for educators, preservation and dissemination of indigenous knowledge, improve educational quality.	misinterpretation; Concerns about the law and morality; There is a lack of policies and adequate security; Anxiety over data loss; The standard naming method for files is rather seldom used.	metadata in their work; File naming conventions; Keeping track of changes to a dataset; Styles of reference for data
18	(Elsayed & Saleh, 2018)	Various types of data are created; A minimum of six years of data storage is required; Metadata is never used in any way; Self-responsibility is required for data preservation; Publishing data allows for the dissemination of such data.	open access, customizable, sharing, free resources, advancement in teaching and learning worldwide, limitless in expanding knowledge, lifelong learning	Sharing information is a problem; Confidentiality and privacy concerns; Tasks need a lot of time and effort; Issues with copyright; Problems with computer hardware and software	
19	(Chen & Wu, 2017)	Data from experiments and observations; Data are stored in a variety of forms; Data storage via personal gadgets and a store of subject data	access to presentations of internationally renowned scholars, enhanced scope of knowledge, remotely access	Problems with data storage; Concerns about data exploitation; Problems with security; difficulties in preserving; Concerns about intellectual property; Problems with data quality; Concerns about data sharing; Academic etiquette concerns	Data processing techniques are required; The use of metadata Adding data to a storehouse of data; Systems for naming and locating data files; Tools for storing and retrieving data in the event; A set of guidelines for the collection of information; According to funding agencies' data policy
20	(Joo & Peters, 2020)	RDM services are available; Availability of data formats; Personal, cloud and repository data storage; Data exchange is	helps in accomplishing the academic challenge, stimulating mental activities, memorizing facts, analyze an	Concerns about privacy; Inadequate data sharing expertise; time and effort required to communicate data;	Data examination; Visual analytics can be beneficial; Help in locating repositories; Assist with DMPs; Assistance with

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		restricted	idea, experience and theory, synthesize and organize ideas, or experience, helps to write clearly and effectively, collaborative learning, work effectively	Concerns about intellectual property Rights; Inadequate data sharing tools; Data misinterpretation	data collecting; Assistance with data cleansing; Documentation of data

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Characteristics of the Studies

The characteristics of the selected studies are presented in Table 3. The aim of the study was to identify the RDM practices,benefits, challenges and required skills/services for researchers. Therefore, the first main column extracted data about the researchers' practices of RDM and the second column identified benefits of RDM. Furthermore, challenges/ issues and needed skills and services are presented in third and fourth column respectively.

Researchers' Practices of Research Data Management

Researchers' practices of research data management are identified in 19 studies out of 20 selected research articles. The majority of the research concentrated on RDM techniques such as data storage, data exchange, save data in open access datasets, pre-processing of research data gathered from other sources, research data stored in institutional repositories(Abduldayan et al., 2021; Chigwada, 2021; Elsayed & Saleh, 2018; Renwick et al., 2017). Most of the researchers practiced to stored research data in university equipment, private computers, external hard drives, deposit data in repositories, saved data in spreadsheets, text documents and graphic files (Abduldayan et al., 2021; Borghi et al., 2018; Borghi & Van Gulick, 2018; Burgi et al., 2017; Chawinga & Zinn, 2020; Perrier & Barnes, 2018). Researchers claimed that applications of metadata are not being used and there are no established policies or guidelines followed (Tripathi et al., 2017). There are two studies claimed that there is no RDM strategy or policy in place, insufficient information on RDM may be found, data is saved for short-term, researchers save data storage in conventional formats such as papers, worksheets and charts and in data repositories that are no longer operational (Vela & Shin, 2019; Vilar & Zabukovec, 2019). Only one study found that data management plans are detected throughout the course of a research endeavor(Borghi & Van Gulick, 2018). Data sharing has been reported to be a difficult issue for academics, particularly the exchange of raw data. While researchers disseminate information via papers and lectures (Elsayed & Saleh, 2018). About half of those who responded claimed they were unwilling to share their study results with others (Joo & Peters, 2020).

Research data management (RDM) is gaining importance among researchers and academic libraries, but it is still poorly practiced, especially in developing countries (Ashiq et al., 2020). The main activities in RDM include data sharing, citation, curation, storage and related concepts such as data governance, quality and literacy (Galih&Barát, 2024). Most studies on RDM rely on self-reports or case studies, with few examining the impact of RDM interventions or early phases of research projects (Perrier et al., 2017).

The features of RDM practices demonstrate that, while RDM is evolving in developed nations and most institutions have RDM policies in place, it is still in its infancy and data management plans are not closely scrutinized by academics and researchers. The position is considerably more precarious in developing nations, where the majority of institutions have not yet developed research data management policies.

Benefits of Research Data Management

The benefits of the usage of RDM are manifold. The benefits of RDM were mainly included sharing of research data, provision of data reusing, collaboration

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between researchers,data preservation and backup facility. Benefits of RDM have been identified by all the selected studies (n=20). Among the 20 studies 6 studies reported that sharing of research data among the researchers is a major benefit of RDM for researchers (Abduldayan et al., 2021; Bunkar & Bhatt, 2020; Chawinga & Zinn, 2020; Chigwada, 2021; Milewska et al., 2021; Unal et al., 2019). Collaboration between researchers is another big benefit of research data management as collaboration may enhanced the research output of the researchers (Mohammed & Ibrahim, 2019; Pasek & Mayer, 2019; Perrier & Barnes, 2018; Unal et al., 2019; Vela & Shin, 2019; Vilar & Zabukovec, 2019). Research data management opening the research data and enhancing the cooperation between scientists(Berman, 2017; Unal et al., 2019). Financial burden could be reduced, by freely accessible of raw data which is possible only due to the management of research data (Burgi et al., 2017; Chigwada, 2021). Facility of data sharing,long term preservation of data reduce the development costs / time and support developing nations (Abduldayan et al., 2021). Data management practices significantly contribute to the effectiveness of educational research in terms of proper citations, problem-solving, knowledge creation and generation of testable data (Odigwe et al., 2020).

Challenges of Research Data Management Faced by the Researchers

As documented in all chosen research, the problems and concerns are the most prominent characteristics of RDM. Challenges of RDM have been identified in all 20 selected studies. The primary problems include storage of research data, issues about copyright, lack of organizational support, a shortage of skilled data workers, financial limits, complex coordination with many campus units, data exchange risks, data misinterpret and loss of research data. All of these obstacles are mostly related to limited financing, personnel and policy concerns and they demand management, as well as a proactive role on the part of funders to improve research data management(Abduldayan et al., 2021; Chigwada, 2021). The three primary problems are storage of research data, copyright concerns and a lack of or limited organizational support (Abduldayan et al., 2021; Berman, 2017; Tang & Hu, 2019; Tripathi et al., 2017). Another big challenge is the lack of research data management skills and lack of familiarity with sources of research data (Chawinga & Zinn, 2020). Researchers perceived that access to reusable data is difficult and inadequate metadata, inadequate standardization of metadata formats may result in misunderstanding. Inadequate skills for data reuse and not having faith in the collection techniques of others are the main challenges in RDM (Chawinga & Zinn, 2020; Chigwada, 2021; Elsayed & Saleh, 2018; Perrier & Barnes, 2018; Vela & Shin, 2019; Vilar & Zabukovec, 2019). Another major issue found in the research was financial restrictions. Rapid change in technology and its implications on associated hardware, software and other technology difficulties have been connected to financial challenges, while others have viewed financial issues as a barrier to RDM services development (Chen & Wu, 2017).One study (Chen & Wu, 2017) found that data sharing is difficult because of a lack of data-sharing solutions (Joo & Peters, 2020). Sharing data is seen as a time and effort-consuming process as reported by Elsayed and Saleh (2018). Researchers feared data loss, abuse and misunderstanding as a result of these substantial obstacles and restricted capabilities (Berman, 2017; Joo & Peters, 2020; Perrier & Barnes, 2018; Vilar & Zabukovec, 2019).Moreover,

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studies reported that Lack of awareness is the biggest challenge of RDM most of the users are unaware of RDM, which could be another contributing factor to the non-adoption of RDM in higher education settings, Moreover, most of the Academics were mostly unaware of the license that underpins copyright exploitation(Borghi et al., 2018; Borghi & Van Gulick, 2018; Elsayed & Saleh, 2018; Perrier & Barnes, 2018). Whereas, lack of support from organization in terms of lack of policies at institutional level, lack of incentives and lack of support and education in the creating, using and sharing of research data(Abduldayan et al., 2021; Berman, 2017; Borghi et al., 2018; Borghi & Van Gulick, 2018; Burgi et al., 2017; Elsayed & Saleh, 2018; Milewska et al., 2021; Mohammed & Ibrahim, 2019; Perrier & Barnes, 2018; Tripathi et al., 2017; Vela & Shin, 2019; Vilar & Zabukovec, 2019). However, there are challenges in implementing RDM services, including creating awareness among researchers, institutional commitment, collaboration and developing necessary skills and competencies for librarians (Sheikh et al., 2023).

Skills and Services Needed for Research Data Management

A total of 20 studies identified the necessary resources for research data management, including personnel, tools and training. Developing an RDM policy is the first and most important step (Abduldayan et al., 2021; Mohammed & Ibrahim, 2019; Renwick et al., 2017). The developed nations have emphasized the necessity of clear data management policies and guidelines(Perrier & Barnes, 2018). The necessity for adequate storage facilities was highlighted in certain research (Burgi et al., 2017; Renwick et al., 2017) while Perrier and Barnes (2018) provided a detailed description of the demand for data storage capacity at the institutional level. Researchers, according to Burgi et al. (2017), are in desperate need of consultation, training and educational services. It's not uncommon for researchers to get educated in data management, as Renwick et al. (2017) reported. Researchers demand provision of data storage at the institutional level, availability of data safety and data backup plans, existence of unambiguous policies and procedures for data management plans (Abduldayan et al., 2021; Milewska et al., 2021; Perrier & Barnes, 2018). Researchers perceived that the service of legal aid with data deposit in repositories , participation in the archiving process, backup of research data should be provided (Burgi et al., 2017; Milewska et al., 2021; Pasek & Mayer, 2019).

Discussion

This systematic literature review examined the data on research data management practices, benefits, challenges and needed skills and services specifically in the perspective of researchers. There are 20 relevant studies were identified following the PRISMA guidelines and fulfilling the inclusion criteria. According to the literature study, RDM is still in its infancy stage. RDM is more commonly found in developed nations than in developing nations, when compared to one another. The majority of the research concentrated on RDM techniques such as data storage, data exchange, save data in open access datasets, pre-processing of research data gathered from other sources, research data stored in institutional repositories(Abduldayan et al., 2021; Cherry et al., 2021; Chigwada, 2021; Elsayed & Saleh, 2018; Renwick et al., 2017). Research on RDM practices has mostly focused on storage of data, preserve and share of research data procedures. Only two research articles comprehensively examined RDM practices, including data sharing and preserving policies, the amount of the

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data, data organization, processing of research data, storage of data, sharing of data and security of research data, which are all important aspects of RDM (Berman, 2017; Burgi et al., 2017; Perrier & Barnes, 2018). Generally, RDM programs are not closely monitored and the researchers kept data on personal management gadgets. Additionally, data-sharing procedures are limited, with the majority of studies indicating that researchers released their data via publications; nevertheless, raw data has been controlled and shared with a specific audience, team members and those in direct touch with the researchers (Joo & Peters, 2020; Tripathi et al., 2017). By and large, RDM procedures are not outstanding and provide several difficulties for researchers.

The studies reported that due to RDM the research data are free and easily accessible for all. RDM are academic contents towards knowledge of social and scientific information, considered as public commodities(Abduldayan et al., 2021; Berman, 2017; Burgi et al., 2017; Chawinga & Zinn, 2020; Chigwada, 2021). The RDM promote the culture of participation, collaboration and sharing of research data in academic institutes. RDM enhances the individual's knowledge of the subject and the reputation of the universities, Open access of research data contents supports the researchers in terms of accessibility, cost and time. Developing nations gain access to the quality of the best research resources providing their institutes (Milewska et al., 2021; Mohammed & Ibrahim, 2019; Perrier & Barnes, 2018; Renwick et al., 2017). The reason associated with these benefits is that most of the studies pointed out that research data management opens the research data and enhances the cooperation between scientists(Berman, 2017; Unal et al., 2019). Financial burden could be reduced, by freely accessible of raw data which is possible only due to the management of research data (Burgi et al., 2017; Chigwada, 2021). RDM provides academia free access to open-licensed research resources that they can retain, reuse, alter, remix and redistribute for personalized instruction. Some studies reported that the using of researchers can access high-quality educational resources freely without any cost, copy right restriction, enhance the academic performance and save the time, money and ease of use. It enhances the researchers' engagement and learning outcomes or performances. RDM enhance the advancement in teaching and learning at national and international level(Abduldayan et al., 2021; Berman, 2017; Elsayed & Saleh, 2018; Tripathi et al., 2017; Unal et al., 2019; Vela & Shin, 2019; Vilar & Zabukovec, 2019).

This study identified five significant problems and hurdles based on the number of times they appeared in chosen studies with the highest frequency. Storage of data problems, issues of intellectual property, limited organizational resources, a lack of qualified and experienced research support employees and researchers' fears of data loss and misinterpretation were among the difficulties faced. Data storage and related concerns are largely associated with archiving issues, long-term challenges related to preservation, backup of data, the growing cost of storage devices, restricted equipment, insufficient infrastructure and a lack of available digital storage space. The intellectual property of the data continues to be a major source of worry among participants, particularly when the data was developed via the collaborative efforts of a financed project (Abduldayan et al., 2021; Chawinga & Zinn, 2020; Chigwada, 2021; Milewska et al., 2021; Unal et al., 2019). Other major difficulties were technological obstacles, particularly those relating to hardware and software, hardware and the fast development in

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information technology, as well as the growing cost of tools. It has been observed that the majority of organizations have not yet developed RDM guidelines (Elsayed & Saleh, 2018; Milewska et al., 2021; Mohammed & Ibrahim, 2019; Vilar & Zabukovec, 2019).

The five most often mentioned primary skills/services in the examined studies included policy for research data, research support services, technical assistance, data processing support and construction of data repositories. These five abilities are inextricably related to the proactive involvement of research support workers and leadership in the research process (Abduldayan et al., 2021; Chawinga & Zinn, 2020; Chigwada, 2021; Milewska et al., 2021; Unal et al., 2019).

The discussion identified the dire need to define the technical and legal frameworks as well as business models to sustain in RDM initiatives in terms of their purpose, content and funding to start with it. The accessible, appropriate, accredited, affordable educational contents are the dire need of the researchers and teachers in this era of information technology. Educational institutes are suggested to make the necessary arrangements to solve the issues in the way of RDM researches. The culture of sharing educational resources is the utmost need of the present era.

Implications of the Study

Practical implications

This systematic review offers insights RDM practices, benefits, challenges and required skills/services. Library professionals can greatly contribute enhancing student's information literacy instructions particularly for RDM and help the students how to manage research data, usage and evaluate the relevant and required procedures. The library professionals can contribute up skilling the students particularly for quality assurance, copy right issues and lifelong learning. Such organizational cooperation and support from the academia as well as libraries certainly enhance the usage of RDM among the students and researchers.

Policy implications

Undoubtedly, the role of academia is very important to promote the RDM; however, the library professionals are already offering information literacy instructions and promoting open access. A joint venture of academia and library leadership (library directors) can certainly create awareness, enhance learning and usage, pedagogical benefits and promote the RDM which ultimately support the open access and increase students learning. Such policy guidelines (containing joint venture by the academia and library leadership to promote RDM) particularly help the libraries and save their huge budgets on purchasing and subscribing educational resources from the private vendors and publishers.

Limitations of the Study

The limitations of this study include the databases used, the language filtration, the search strategy and the quality assessment of the 20 studies chosen. Four databases were consulted for data extraction (Scopus, Web of Science, HEC summon discovery tool and Google Scholar). Even though a comprehensive search strategy was devised, some research may have been overlooked due to non-matching terms. The findings were limited to 20 studies examining the

practices, benefits, challenges and required skills and services of research data management. Additionally, the study was confined to publications in the English language. While the researchers used a reputable quality assessment tool to determine the quality of each evaluated paper, there is still the possibility of overlooking critical information.

Conclusion

The purpose of this systematic review was to investigate the research data management practices, benefits, challenges and required skills by the researchers of various disciplines using the PRISMA guidelines. A comprehensive search query was developed to find the maximum number of relevant studies. Finally, 20 studies were selected fulfilling the inclusion criteria. A quality assessment checklist (QACs) indicated that the selected 20 studies received 223 out of a maximum of 273 scores, which indicated that these selected studies were published in a good journal. The primary RDM benefits include increased access to research data, support for lifelong learning, educational benefits and an improvement in researcher's collaboration and learning outcomes, saving time and money, facilitating sharing of knowledge, provision of capacity-building resources for educators, preservation and dissemination of Indigenous knowledge, improve educational quality. The major obstacles include concerns about data exploitation, problems with data storage, problems with data security, difficulties in preserving, concerns about intellectual property,a lack of time for resource identification, lack of information regarding usage and copyrights, lack of quality assurance, technological restrictions and lack of organizational support.

The review recognized a need to define technical and legal frameworks, as well as suitable models, for the purpose, content and funding of research data management (RDM) initiatives. The researchers and faculty in this information technology era require readily accessible, suitable, accredited and affordable instructional content. Educational institutions are encouraged to establish the required structures for resolving challenges through research data management. The culture of sharing research data is the utmost need of the present era. Additionally, the cooperation and support of academic library personnel in promoting research data management among faculty and researchers and in particular in training them on how to preserve, store, evaluate and apply research data, will increase their awareness and use. Employees who are dynamically involved in RDM, such as consultation in developing DMPs, data collection and examination and data explanation counseling, should be provided with training incentives by donor organizations and higher education institutions.

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